Sec 4G3 / 5G2 Sci (Physics)

Compilation of Exam Papers

2026

IN^{3}guing Science – Inquire · Inspire · Innovate

NAME: _____( )

CLASS: _____

SCHOOL: St Patrick's School

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SUBJECT CONTENT

SECTION 1: MEASUREMENT

Overview

Physics is an experimental science and precise measurements enable the collection of useful experimental data which can be tested against hypothesis for the development of physical theories. With the development of better measurement tools and techniques, the data available is improved and scientific knowledge continue to evolve in light of new information.

There is a variety of instruments available and our choice of instrument should take into consideration the precision, and feasibility of the choice of instrument when making measurements. We need to be cognisant of the limitations associated with the measurement process which can arise from the precision of the instrument chosen, the mechanics of the measuring instrument and the design of the experiment.

Apart from the need of accurate measurements, interactions between objects in systems should also be described with precisely defined quantities and units and as these interactions could range from celestial objects to sub-atomic particles, prefixes in order-of-ten are necessary to depict such diversity in range of magnitude.

1 Physical Quantities, Units and Measurement

Content

- Physical quantities and SI units
- Measurement
- Scalars and vectors

Learning Outcomes

Candidates should be able to:

(a) show an understanding that physical quantities typically consist of a numerical magnitude and a unit

(b) recall the following base quantities and their units: mass (kg), length (m), time (s), current (A), temperature (K), amount of substance (mol)

(c) use the following prefixes and their symbols to indicate decimal sub-multiples and multiples of the SI units: nano (n), micro (μ), milli (m), centi (c), deci (d), kilo (k), mega (M), giga (G), tera (T)

(d) show an understanding of the orders of magnitude of the sizes of common objects ranging from a typical atom to the Earth

(e) select and explain the use of appropriate measuring instruments to measure or determine physical quantities listed in "Summary of key quantities, symbols and units" taking into consideration the range and precision of the instrument

(f) state what is meant by *scalar* and *vector* quantities and give common examples of each

SECTION II: NEWTONIAN MECHANICS

Overview

Mechanics is the branch of physics that deals with the study of motion and its causes. Through a careful process of observation and experimentation, Galileo Galilei used experiments to overturn Aristotle's ideas of the motion of objects, for example the flawed idea that heavy objects fall faster than lighter ones, which dominated physics for about 2,000 years.

The greatest contribution to the development of mechanics is by one of the greatest physicists of all time, Isaac Newton. By extending Galileo's methods and understanding of motion and gravitation, Newton developed the three laws of motion and his law of universal gravitation, and successfully applied them to both terrestrial and celestial systems to predict and explain phenomena. He showed that nature is governed by a few special rules or laws that can be expressed in mathematical formulae. Newton's combination of logical experimentation and mathematical analysis shaped the way science has been done ever since.

2 Kinematics

Content

- Speed, velocity and acceleration
- Graphical analysis of motion
- Free-fall

Learning Outcomes

Candidates should be able to:

(a) state what is meant by speed and velocity

(b) calculate *average speed = distance travelled / time taken*

(c) state what is meant by uniform acceleration and calculate the value of acceleration using *change in velocity / time taken*

(d) interpret given examples of non-uniform acceleration

(e) plot and interpret a distance-time graph and a speed-time graph for motion in one direction.

(f) deduce from the shape of a distance-time graph when a body travelling in one direction is:
(i) at rest
(ii) moving with uniform speed
(iii) moving with non-uniform speed

(g) deduce from the shape of a speed-time graph when a body travelling in one direction is:
(i) at rest
(ii) moving with uniform speed
(iii) moving with uniform acceleration
(iv) moving with non-uniform acceleration

(h) calculate the area under a speed-time graph to determine the distance travelled for motion in one direction with uniform speed or uniform acceleration

(i) state that the acceleration of free fall for a body near to the Earth is constant and is approximately $10\,m/s^2$

3 Force and Pressure

Content

- Types of forces
- Mass, weight and gravitational field
- Density
- Pressure

Learning Outcomes

Candidates should be able to:

(a) identify and distinguish between contact forces (e.g. friction, air resistance, tension and normal force) and non-contact forces (e.g. gravitational, electrostatic and magnetic forces)

(b) state that mass is a measure of the amount of matter in a body

(c) state that a gravitational field is a region in which a mass experiences a force due to gravitational attraction

(d) define gravitational field strength, *g*, as *gravitational force per unit mass placed at that point*

(e) recall and apply the relationship *weight = mass × gravitational field strength* to new situations or to solve related problems

(f) distinguish between mass and weight

(g) recall and apply the relationship *density = mass / volume* to new situations or to solve related problems

(h) define pressure in terms of force and area

(i) recall and apply the relationship *pressure = force / area* to new situations or to solve related problems

4 Dynamics

Content

- Newton's laws of motion
- Effects of resistive forces on motion

Learning Outcomes

Candidates should be able to:

(a) apply Newton's Laws to:
  (i) describe the effect of balanced and unbalanced forces on a body
  (ii) describe the ways in which a force may change the motion of a body
  (iii) identify action-reaction pairs acting on two interacting bodies
  (stating of Newton's Laws is not required)

(b) identify forces acting on a body and draw free body diagram(s) representing the forces acting on the body (for cases involving forces acting in at most two dimensions)

(c) recall and apply the relationship *resultant force = mass × acceleration* to new situations or to solve related problems

(d) explain the effects of friction on the motion of a body

5 Turning Effects of Forces

Content

- Moments
- Equilibrium
- Centre of gravity

Learning Outcomes

Candidates should be able to:

(a) describe the moment of a force about a pivot in terms of its turning effect and relate this to everyday examples

(b) recall and apply the relationship *moment of a force (or torque) = force × perpendicular distance from the pivot* to new situations or to solve related problems

(c) state the principle of moments for a body in equilibrium

(d) apply the principle of moments to new situations or to solve related problems

(e) show an understanding that the weight of a body may be taken as acting at a single point known as its centre of gravity

6 Energy

Content

- Energy stores and transfers
- Work
- Power

Learning Outcomes

Candidates should be able to:

(a) show an understanding that there are energy stores, e.g. kinetic, potential (gravitational, chemical, elastic), nuclear and internal, and that energy can be transferred from one store to another:
  (i) Mechanically (by a force acting over a distance),
  (ii) Electrically (by an electric current),
  (iii) By heating (due to a temperature difference),
  (iv) By propagation of waves (both electromagnetic and mechanical)

(b) recall and apply the relationships for kinetic energy ($E_k = \frac{1}{2} m v^2$) and gravitational potential energy near the Earth's surface ($E_p = mgh$) to new situations or to solve related problems

(c) state the principle of the conservation of energy and apply the principle to new situations or to solve related problems

(d) recall and apply the relationship *work done* = *force* × *distance moved in the direction of the force* to new situations or to solve related problems

(e) recall and apply the relationship *power* = *energy transfer* / *time taken* to new situations or to solve related problems

SECTION III: THERMAL PHYSICS

Overview

When asked what was the most valuable scientific information in a single sentence, Richard Feynman response was, 'All things are made of atoms – little particles that move around in perpetual motion, attracting each other when they are a little distance apart, but repelling upon being squeezed into one another. In that one sentence ... there is an enormous amount of information about the world.' (Six Easy Pieces, p.4)

Understanding thermal physics requires us to approach the concepts from both the macroscopic and microscopic lenses. The *Kinetic Particle Model of Matter* is a cornerstone theory that is used extensively to explain how different types of matter exhibit certain physical properties by relating them to behaviour of atoms and molecules.

By nature, energy exchange takes place between bodies of different temperatures until thermal equilibrium is reached. Energy may be transferred between bodies by heating through processes like conduction, convection and radiation. These processes could cause changes in the molecular structure of matter and result in macroscopic observations, e.g. monsoon winds and ocean currents observed are convectional currents produced in the process of regulating differences in temperature.

7 Kinetic Particle Model of Matter

Content

- States of matter
- Kinetic Particle Model
- Internal energy

Learning Outcomes

Candidates should be able to:

(a) compare the physical properties of solids, liquids and gases

(b) use the kinetic particle model to describe the different states of matter (solids, liquids and gases), relating their physical properties to the arrangement and motion of the particles (e.g. molecules, atoms) and the forces and distances between particles

(c) relate the rise in temperature of a body to the increase in average kinetic energy of all the particles in the body

(d) describe internal energy as an energy store that is made up of the total kinetic energy associated with the random motion of the particles and the total potential energy between the particles in the system

(e) describe melting/solidification and boiling/condensation as processes of energy transfer without a change in temperature

8 Thermal Processes

Content

- Thermal equilibrium
- Conduction
- Convection
- Radiation

Learning Outcomes

Candidates should be able to:

(a) show an understanding that energy is transferred (by heating) from a region of higher temperature to a region of lower temperature until thermal equilibrium is achieved between the two regions

(b) describe, in microscopic terms, how conduction occurs in solids (via vibration of atoms/molecules and movement of electrons)

(c) describe, in terms of density changes, how convection occurs in fluids

(d) explain that energy transfer by electromagnetic radiation does not require a material medium and that this rate of energy transfer to/from a body is affected by its:
(i) surface colour and texture
(ii) surface temperature
(iii) surface area

(e) apply the concepts of conduction, convection and radiation in everyday examples.

SECTION IV: WAVES

Overview

All waves have properties in common and a wave model can be used to explain many phenomena, both natural (like water waves and sound) and artificial (like many forms of electromagnetic waves). The ability of waves to transfer energy at great speed provides valuable propositions.

Much of our current understanding of wave motion has come from the study of acoustics, which is the science of sound. Many of the ancient Greek philosophers were interested in music. They had hypothesized that there was a connection between waves and sound, and that vibrations must be responsible for sounds. Pythagoras observed in 550 BC that vibrating strings produced sound, and worked to determine the mathematical relationships between the lengths of strings that made harmonious tones.

Scientific theories of wave propagation became more prominent in the 17th Century, when Galileo Galilei published a clear statement that connected vibrating bodies to the sounds they produce. In 1640 Robert Boyle's classic experiment on the sound produced by a ticking watch in a partially evacuated glass vessel provided evidence that air is necessary, either for the production or transmission of sound.

The mathematical theory of sound propagation began with Isaac Newton, whose *Principia* (1686) included a mechanical interpretation of sound as being 'pressure' pulses transmitted through neighbouring fluid particles. In the 18th Century, French mathematician and scientist Jean Le Rond d'Alembert derived the wave equation, a thorough and general mathematical description of waves, which laid the foundation for generations of scientists to study and describe wave phenomena.

9 General Properties of Waves

Content

- Describing wave motion
- Wave properties
- Sound

Learning Outcomes

Candidates should be able to:

(a) describe what is meant by wave motion as illustrated by vibrations in ropes and springs and by waves in a ripple tank (including use of the term wavefront)

(b) show an understanding that waves transfer energy without transferring matter

(c) define and use the terms *speed*, *frequency*, *wavelength*, *period* and *amplitude* including graphical representations

(d) recall and apply the relationship *speed of wave* = *frequency* × *wavelength* to new situations or to solve related problems

(e) compare transverse and longitudinal waves and give suitable examples of each

(f) show an understanding that sound can be produced by vibrating sources and a medium is required for the transmission of sound.

(g) describe the longitudinal nature of sound waves in terms of the processes of compression and rarefaction

(h) relate loudness of a sound wave to its amplitude and pitch to its frequency

(i) describe how the reflection of sound may produce an echo, and how this may be used for measuring distances

10 Electromagnetic Spectrum

Content

- Properties of electromagnetic waves
- Applications of electromagnetic waves
- Effects of electromagnetic waves on cells and tissues

Learning Outcomes

Candidates should be able to:

(a) state that all electromagnetic waves are transverse waves that travel with the same speed in vacuum

(b) describe the main regions of the electromagnetic spectrum in order of wavelength and frequency

(c) state examples of typical uses of the following regions of the electromagnetic spectrum:
(i) radio waves (e.g. radio and television communication, astronomy and RFID tags)
(ii) microwaves (e.g. mobile (cell) phones, microwave oven and satellite television)
(iii) infrared (e.g. infra-red remote controllers, intruder alarms and thermal imaging)
(iv) visible light (e.g. photography, optical fibres in medicine and telecommunications)
(v) ultraviolet (e.g. sunbeds, bank note authentication and disinfecting water)
(vi) X-rays (e.g. medical radiology, security screening and industrial defect detection)
(vii) gamma (γ) rays (e.g. sterilising food, detection of cancer and its treatment)

(d) describe how over-exposure to electromagnetic waves can have hazardous effects (e.g. heating and ionising effects of radiation) on living cells and tissue

11 Light

Content

- Reflection of light
- Refraction of light
- Thin converging lenses

Learning Outcomes

Candidates should be able to:

(a) recall and use the terms *normal*, *angle of incidence* and *angle of reflection* to describe the reflection of light

(b) state that, for reflection, the angle of incidence is equal to the angle of reflection and use this principle in constructions, measurements and calculations

(c) recall and use the terms *normal*, *angle of incidence* and *angle of refraction* to describe the refraction of light

(d) recall and apply the relationship *sin i* / *sin r* = *constant* to new situations or to solve related problems

(e) define *refractive index* of a medium in terms of the ratio of speed of light in vacuum and in the medium

(f) describe the action of a thin converging lens on a beam of light

(g) define the *focal length* for a converging lens

(h) describe the characteristics of images (e.g. real / virtual, magnified / diminished, and upright / inverted) formed by a thin converging lens (recall of the characteristics of images formed for specific object distances is not required).

SECTION V: ELECTRICITY AND MAGNETISM

Overview

Electricity and magnetism were seen as separate and independent phenomena in the past. It only was when Danish physicist Hans Christian Ørsted discovered, accidentally, in 1820 that a magnetic needle is deflected when the current in a nearby wire varies – a phenomenon establishing a relationship between electricity and magnetism.

Inspired by Ørsted's discovery, André-Marie Ampère conducted a series of experiments in the same year to designed to elucidate the exact nature of the relationship between electric current-flow and magnetism. Further works by Michael Faraday reinforced the magnetic effect of a current and introduced the idea of a 'field' of action to explain why electricity and magnetism had and 'area of activity'.

However, it was the work of James Clerk Maxwell, a mathematical physicist, who provided mathematical tools and equations to describe Faraday's ideas of the field. His works went on to prove that electromagnetic fields have wave-like properties which was a very important discovery in physics.

12 Electric Charge and Current of Electricity

Content

- Electric charge
- Conventional current and electron flow
- Electromotive force and potential difference
- Resistance

Learning Outcomes

Candidates should be able to:

(a) state that there are positive and negative charges and that charge is measured in coulombs

(b) state that unlike charges attract and like charges repel

(c) state that current is the rate of flow of charge and that it is measured in amperes

(d) distinguish between conventional current and electron flow

(e) recall and apply the relationship *charge* = *current* × *time* to new situations or to solve related problems

(f) state that the electromotive force (e.m.f.) of an electrical source of energy is measured in volts

(g) state that the potential difference (p.d.) across a component in a circuit is the work done per unit charge in driving charges through the component and that it is measured in volts

(h) state that *resistance* = *p.d.* / *current*

(i) apply the relationship $R = V / I$ to new situations or to solve related problems

(j) recall and apply the relationship of the proportionality between resistance and the length and cross-sectional area of a wire to new situations or to solve related problems

13 D.C. Circuits

Content

- Circuit diagrams
- Series and parallel circuits

Learning Outcomes

Candidates should be able to:

(a) draw circuit diagrams with power sources (cell or battery), switches, lamps, light-emitting diodes (LEDs), resistors (fixed and variable), fuses, ammeters and voltmeters

(b) state that the current at every point in a series circuit is the same and apply the principle to new situations or to solve related problems

(c) state that the sum of the potential differences in a series circuit is equal to the potential difference across the whole circuit and apply the principle to new situations or to solve related problems

(d) state that the sum of the currents in the separate branches of a parallel circuit is equal to the current from the source and apply the principle to new situations or to solve related problems

(e) state that the potential difference across the separate branches of a parallel circuit is the same and apply the principle to new situations or to solve related problems

(f) recall and apply the formulae for the effective resistance of a number of resistors in series and in parallel to new situations or to solve related problems

(g) recall and apply the relevant relationships, including $R = V / I$ and those for current, potential differences and resistors in series and in parallel circuits, in calculations involving a whole circuit.

14 Practical Electricity

Content

- Electrical working, power and energy
- Dangers of electricity
- Safe use of electricity in the home

Learning Outcomes

Candidates should be able to:

(a) describe the use of the heating effect of electricity in appliances such as electric kettles, ovens and heaters

(b) recall and apply the relationships $P = VI$ and $E = VIt$ to new situations or to solve related problems

(c) calculate the cost of using electrical appliances where the energy unit is the kW h

(d) state the hazards of using electricity in the following situations:
  (i) damaged insulation
  (ii) overheating of cables
  (iii) damp conditions

(e) explain the use of fuses and circuit breakers in electrical circuits and of fuse ratings

(f) explain the need for earthing metal casings and for double insulation

(g) state the meaning of the terms *live*, *neutral* and *earth*

(h) describe the wiring in a mains plug

(i) explain why switches, fuses, and circuit breakers are fitted to the live wire.

15 Magnetism and Electromagnetism

Content

- Laws of magnetism
- Magnetic properties of matter
- Magnetic field
- Magnetic effect of a current
- Force on a current-carrying conductor

Learning Outcomes

Candidates should be able to:

(a) state the properties of magnets

(b) describe induced magnetism caused by placing magnetic material close to a strong magnet or within a current-carrying solenoid

(c) distinguish between temporary magnets (e.g. iron) and permanent magnets (e.g. steel) in terms of their properties and uses

(d) describe how a bar magnet (e.g. a compass) can be used to determine the direction of a magnetic field

(e) draw the magnetic field pattern around a bar magnet and between the poles of two bar magnets.

(f) draw the pattern of the magnetic field due to currents in straight wires and in solenoids and state the effect on the magnetic field of changing the magnitude and/or direction of the current

(g) describe experiments to show the force on a current-carrying conductor in a magnetic field, including the effect of reversing
(i) the current
(ii) the direction of the field

(h) deduce the relative directions of force, field and current when any two of these quantities are at right angles to each other using Fleming's left-hand rule

(i) explain how a current-carrying coil in a magnetic field (e.g. in a motor) experiences a turning effect (recall of structure of an electric motor is not required)

SECTION VI: RADIOACTIVITY

Overview

Radioactivity was first discovered through the handling of radioactive uranium by physicists Pierre and Marie Curie during which they suffered radioactive burns due to inadequate handling of the substance. *Radioactivity* is the study of the nature of the radiation emitted by radioactive materials. It was later understood that there are three types of emissions: the alpha particles (helium atoms with no electrons), beta particles (fast moving electrons) and the gamma rays (electromagnetic radiation similar to X-rays). These emissions are the result of the decay or disintegration of an unstable atomic nucleus.

Radioactivity have important medical uses, which include the killing of cancer cells. However excessive exposure to radioactivity can cause cancer if the dose is too high. Many early scientists working with radioactive materials died early from the harmful effects of high radiation before proper safety guidelines were drawn. 'Radiometric dating' makes use of a radioactive element's half-life to help determine the age of rocks or carbon.

Large amounts of energy are also involved in radioactive emissions and physicists quickly recognized the power of this. Many scientists working on this from 1930 to 1940 in Europe were forced to leave their home countries, fleeing to the United States due to the development of the war. This led to a 'brain drain' which benefited the United States and allowed them to develop the two atomic bombs which ended the war. This highlights the impact on science on society and human interactions. Since the development of the atomic bomb, much has been learnt about how to control the release of energy and nuclear power can generate electricity with only a fraction of the greenhouse gases released by burning coal and other fossil fuels.

Because radiation cannot be easily seen, it is commonly feared and shunned. Coupled with news about the dangers of nuclear radiation and the potential detriments to health, the general public is apprehensive about the use and application of any form of radiation. This topic aims to provide an objective evaluation of the risks and benefits of the use of radiation through the development of a good understanding of the many practical uses of radioactive materials.

16 Radioactivity

Content

- The composition of the atom
- Radioactive decay
- Dangers and uses of radioactivity

Learning Outcomes

Candidates should be able to:

(a) describe the composition of an atom in terms of a positively charged nucleus (with protons and neutrons) and negatively charged electrons

(b) use the terms proton (atomic) number Z, nucleon (mass) number A and isotope

(c) use and interpret the term nuclide and use the nuclide notation ${}^{A}_{Z}X$

(d) show an understanding that nuclear decay is a random and spontaneous process whereby an unstable nucleus loses energy by emitting radiation

(e) show an understanding of the nature of alpha (α), beta (β), and gamma (γ) radiation (including ionising effect and penetrating power) [β-particles are assumed to be β^- particles only]

(f) show an understanding of background radiation

(g) use the term half-life in simple calculations, which might involve information in tables or decay curves

(h) state the applications (e.g. medical and industrial uses) and hazards of radioactivity.

SUMMARY OF KEY QUANTITIES, SYMBOLS AND UNITS

Students should be able to state the symbols for the following physical quantities and, where indicated, state the units in which they are measured. Students should be able to define those items indicated by an asterisk (*).

Quantity	***Symbol***	***Unit***
length	*l, h …*	km, m, cm, mm
area	*A*	m^2, cm^2
volume	*V*	m^3, cm^3
weight*	*W*	N
mass	*m, M*	kg, g, mg
time	*t*	h, min, s, ms
period*	*T*	s
density*	ρ	g/cm^3, kg/m^3
speed*	*u, v*	km/h, m/s, cm/s
acceleration*	*a*	m/s^2
acceleration of free fall	*g*	m/s^2, N/kg
force*	*F, f*	N
moment of force*		N m
work done*	*W, E*	J
energy	*E*	J, kW h
power*	*P*	W
pressure*	*p, P*	Pa, N/m^2
temperature	θ , *T*	°C, K
frequency*	*f*	Hz
wavelength*	λ	m, cm
focal length	*f*	m, cm
angle of incidence	*i*	degree (°)
angles of reflection, refraction	*r*	degree (°)
potential difference*/voltage	*V*	V, mV
current*	*I*	A, mA
charge	*q, Q*	C, A s
e.m.f.*	*E*	V
resistance	*R*	Ω
proton number	*Z*	
nucleon number	*A*	
half-life	$t_{1/2}$	s
activity of a radioactive source	*A*	Bq

NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
TERM 1 GRADED ASSESSMENT 2024

SUBJECT : SCIENCE PHYSICS 5076/5086 **DATE : 21 FEB 2024**

LEVEL : SECONDARY 4 EXPRESS
SECONDARY 5 NORMAL (A) **DURATION : 50 MIN**

INSTRUCTIONS TO CANDIDATES:

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. Write down your name, class and index number on the **Question Paper** in the spaces provided.
2. Write in dark blue or black pen. You may use an HB pencil for any diagrams or graphs. Do not use correction fluid.
3. This paper consists of **THREE (3) Sections**: **Section A, Section B** and **Section C.**
4. Answer **ALL** questions in **Section A**. Write your answers in the table on page 2.
5. Answer **ALL** questions in **Section B and C** in the spaces provided.
6. The use of an approved scientific calculator is expected, where appropriate.
7. Throughout the paper, you are to take the **acceleration due to gravity on Earth** to be 10 m/s².
8. **DO NOT DETACH** any sections from this paper.

INFORMATION FOR CANDIDATES:

The number of marks is given in brackets **[ ]** at the end of each question.

FOR MARKER'S USE ONLY:

Section	A [5]	B [20]	C [10]	Total [35]	Grade
Score					

This question paper consists of 9 printed pages, including the cover page.

SECTION A : [5 marks]

*Each question is provided with **four** possible answers (**A**, **B**, **C** and **D**). Select the most appropriate answer and write down your answer in the table provided.*

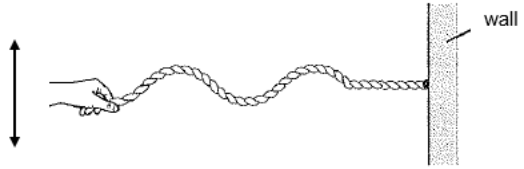
1	2	3	4	5

1 Mary walks bare-footed across a hall with polished marble floor. She then quickly steps onto a piece of carpet in the middle of the hall and exclaims, "The marble floor is so cold! My feet feel warmer on the carpet."

Why does Mary's feet feel cold on the marble floor but warmer on the carpet?

A The marble floor is at a lower temperature than the carpet.
B The marble floor is a poorer emitter of radiant heat than the carpet.
C The marble floor is a better absorber of radiant heat than the carpet.
D The marble floor is a better conductor of thermal energy than the carpet.

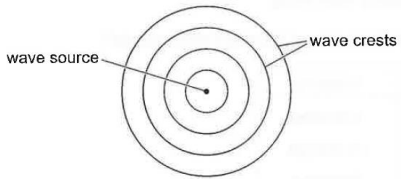
2 A rope is fixed to a wall at one end. The other end of the rope is moved up and down to produce a wave.



During this motion, what is transferred along the rope?

A energy **B** mass
C molecules **D** weight

3 Circular water waves are produced in a ripple tank. The diagram shows the position of the wave crests after 10 s.



What is the frequency of the wave?

A 0.40 Hz
B 0.50 Hz
C 2.0 Hz
D 2.5 Hz

4 When a guitar is strummed, the string vibrates to create a note.

Which option will increase the pitch of the note?

A increase in the amplitude of vibration
B increase in the frequency of vibration
C decrease in the amplitude of vibration
D decrease in the frequency of vibration

5 Which component of the electromagnetic spectrum is used in germicidal lamps to sterilise medical equipment?

A microwaves **B** radio waves
C ultra-violet radiations **D** X-rays

SECTION B : [20 marks]

Answer **ALL** *questions in this section. Show your workings and write your answers in the space provided.*

1 In cold countries, people wear coats that are designed to reduce the rate at which thermal energy is lost from their bodies.

The material for some coats is made from a layer of thin strips of silver-coloured polyester between two layers of fabric, as shown in Fig. 1.1.

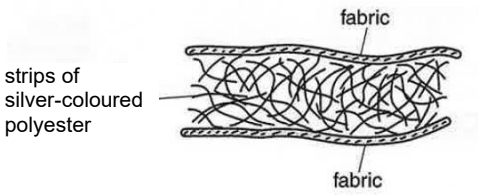


Fig. 1.1

The polyester strips trap small pockets of air between them.

Explain why the layer of silver-coloured polyester strips reduces loss of thermal energy by:

(a) conduction

.....

.....

..... **[2]**

(b) convection

.....

..... **[1]**

(c) radiation

.....

..... **[1]**

2 Fig. 2.1 shows the displacement-time graph and displacement-distance graph of a wave.

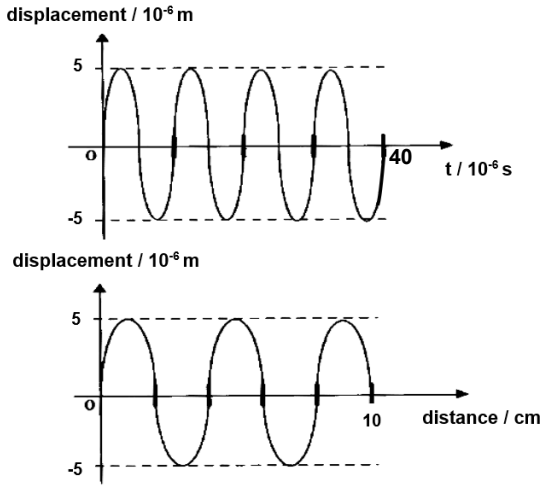


Fig. 2.1

(a) What is the prefix for the factor of 10^{-6}?

..... **[1]**

(b) State the amplitude of the wave.

amplitude = ... **[1]**

(c) Find the wavelength of the wave.

wavelength = ... **[1]**

(d) Find the period of the wave.

period = ... **[1]**

(e) Find the speed of the wave.

speed = ... **[2]**

3 **(a)** Explain what is meant by *longitudinal wave*.

.....

..... **[1]**

(b) Fig.3.1 shows the instantaneous positions of particles in air when a sound wave passes through it.

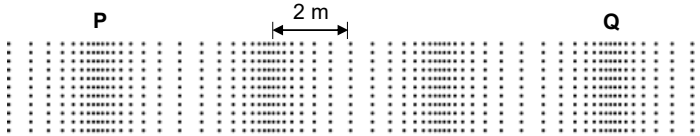


Fig. 3.1

(i) Determine the wavelength of the sound wave.

wavelength = ... **[1]**

(ii) Given that the speed of sound in air is 330 m/s, calculate the frequency of the sound wave.

frequency = ... **[1]**

(iii) In Fig. 3.2, draw the pressure-distance graph for the sound waves shown in Fig. 3.1 from region **P** to region **Q**.

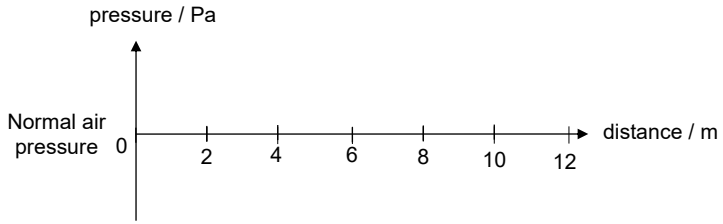


Fig. 3.2

[2]

4 Fig. 4.1 shows the different regions of the electromagnetic (e.m.) waves spectrum in order of increasing wavelength. Three regions are identified by letters **R**, **S** and **T**.

e.m. wave	**R**	microwaves	infra-red	**S**	ultraviolet	x-rays	**T**
typical wavelength	3.0 m	0.03 m	100 μm	0.6 μm	10 nm	0.1 nm	0.001 nm

Fig. 4.1

(a) Besides wavelength, state one difference between waves in regions **R** and **S**.

.....

[1]

(b) State the speed of **R**, **S** and **T** in a vacuum.

.....

[1]

(c) State **one** application of the waves in the region **T**.

.....

[1]

(d) State the order of magnitude of the diameter of a typical atom. Name the region of electromagnetic spectrum that has a wavelength of this same order of magnitude.

.....

.....

[2]

SECTION C : [10 marks]

Answer **ALL** *questions in this section. Show your workings and write your answers in the space provided.*

5 An electric scooter is fitted with an alarm system which is triggered by motion. In addition to it emitting a loud sounding alarm at the scooter, it will also send out the current Global Positioning System (GPS) coordinates of the scooter.

(a) Describe how the sound waves from the alarm reaches the ear drums of a person near the scooter.

.....

.....

.....

[2]

(b) In the event the alarm is triggered, the GPS coordinates is being sent to the owner via satellite in the form of microwaves as shown in Fig. 5.1. The drawing is not to scale.

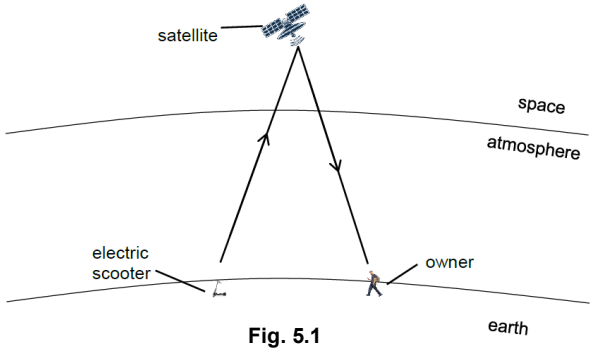


Fig. 5.1

(i) Microwaves are used instead of sound waves for the transmission of GPS coordinates to and from the satellite in space.

State two reason why microwaves are used instead of sound waves.

Reason 1: .....

.....

Reason 2: .....

.....

[2]

(ii) The satellite is 36 000 km above the Earth's surface. Calculate the least time taken for the microwave to be transmitted from the smart lock to the owner.

time = ... **[2]**

(c) The average temperature in the day is 30 °C. During prolonged riding on the scooter, the battery tends to get overheated (to 40 °C) and this drains the power supply. To prevent overheating, engineers studied the current battery design and came up with an improved design as shown in Fig. 5.2.

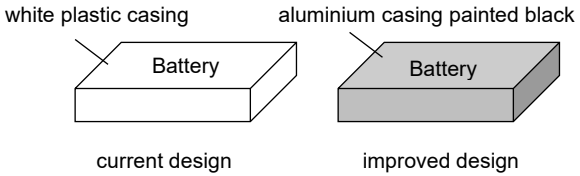


Fig. 5.2

The external casing of the current design is made of white plastic while the improved design is made of aluminium and is painted black.

Explain how the improvement in design helps to reduce the chance of overheating:

(i) with the external casing painted black instead of white.

.....

.....

..... **[2]**

(ii) with the external casing made of aluminium instead of plastic.

.....

.....

..... **[2]**

END OF PAPER

ST. PATRICK'S SCHOOL
TERM 1 GRADED ASSESSMENT 2024

SUBJECT : SCIENCE PHYSICS **DATE : 21 FEB 2024**

LEVEL : SECONDARY 4E (5086)
SECONDARY 5NA (5076) **DURATION : : 50 MIN**

ANSWER SCHEME

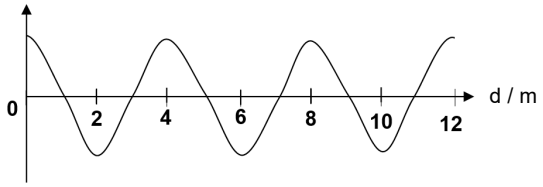
Section A [5 marks]

1	2	3	4	5
D	**A**	**A**	**B**	**C**

Section B [20 marks]

QN	Suggested Answers	Sub Ttl	Ttl
1a	The polyester strips and trapped air are poor conductors of heat, thus reducing heat loss from the body to the surrounding by conduction.	2	**4**
1b	With small pockets of trapped air, it is less likely for convection current to be formed. Hence, heat loss by convection is reduced.	1	
1c	The strips are silver in colour which is a poor absorber of radiant heat. Hence less heat is absorbed from the body.	1	

QN	Suggested Answers	Sub Ttl	Ttl
2a	μ / micro	1	6
2b	5×10^{-6} m	1	
2c	λ = 10/2.5 = 4.0 cm	1	
2d	$T = 40 \times 10^{-6} / 4 = 10 \times 10^{-6}$ s	1	
2e	v = λ / T = 4.0 cm / 10×10^{-6} s = 4.0×10^{6} cm/s	1 1	

QN	Suggested Answers	Sub Ttl	Ttl
3a	Longitudinal waves travels in a direction parallel to its direction of vibration.	1	5
3bi	λ = 2 × 2 = 4 m	1	
3bii	v = fλ f = v/λ = 330 / 4 = 82.5 Hz	1	
3biii	pressure / Pa  Shape of graph – 1 m C and R at the right positions – 1 m	2	

QN	Suggested Answers	Sub Ttl	Ttl
4a	R is not visible, S is visible They have different frequency (either one) (Accept any other possible answers)	1	**5**
4b	3×10^8 m/s	1	
4c	radiation therapy, treat cancer (either one)	1	
4d	1×10^{-10} m X-rays (answer will be "ecf" based on the wavelength stated)	1 1	

Section C [10 marks]

QN	Suggested Answers	Sub Ttl	Ttl
5a	The alarm causes the air particles to vibrate. Series of compressions and rarefactions are formed and travel to the ear.	1 1	10
5bi	Microwaves can travel through space/vacuum while sound waves need a medium to travel and is unable to travel through space/vacuum. Microwaves travels much faster than sound waves and thus signals are sent faster.	1 1	
5bii	Time = distance / speed = 36000 × 1000 × 2 / 3×10^8 = 0.24 s	 1 1	
5ci	Black colour is a good emitter of infrared radiation while white colour is a poor emitter of infrared radiation. Hence, heat is radiated away from the battery to the surrounding at a faster rate to prevent overheating.	1 1	
5cii	Aluminium is a better conductor of heat than plastic. Hence, heat is conducted and distributed throughout the battery case at a faster rate to prevent overheating.	1 1	

NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
TERM 1 GRADED ASSESSMENT 2025

SUBJECT : SCIENCE PHYSICS 5086 **DATE : 06 MAR 2025**

LEVEL : SECONDARY 4 EXPRESS
SECONDARY 5 NORMAL (A) **DURATION : 50 MIN**

INSTRUCTIONS TO CANDIDATES:

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. Write down your name, class and index number on the **Question Paper** in the spaces provided.
2. Write in dark blue or black pen. You may use an HB pencil for any diagrams or graphs. Do not use correction fluid.
3. This paper consists of **THREE (3) Sections**: **Section A, Section B** and **Section C.**
4. Answer **ALL** questions in **Section A**. Write your answers in the table on page 2.
5. Answer **ALL** questions in **Section B and C** in the spaces provided.
6. The use of an approved scientific calculator is expected, where appropriate.
7. Throughout the paper, you are to take the **acceleration due to gravity on Earth** to be 10 m/s².
8. **DO NOT DETACH** any sections from this paper.

INFORMATION FOR CANDIDATES:

The number of marks is given in brackets **[ ]** at the end of each question.

FOR MARKER'S USE ONLY:

Section	A [5]	B [20]	C [10]	Total [35]	Grade
Score					

This question paper consists of 10 printed pages, including the cover page.

SECTION A : [5 marks]

*Each question is provided with **four** possible answers (**A**, **B**, **C** and **D**). Select the most appropriate answer and write down your answer in the table provided.*

1	2	3	4	5

1 There are four spherical objects of the same colour and same type of surface. Which object is the best emitter of infrared radiation?

small surface area at 40 °C	small surface area at 80 °C	large surface area at 40 °C	large surface area at 80 °C
A	**B**	**C**	**D**

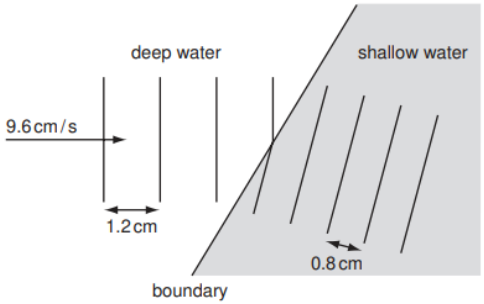
2 The diagrams show different views of a water wave in a ripple tank.

cross-section of wave crests seen from above

Which letters represent a wavelength and a wavefront?

	wavelength	wavefront
A	P	R
B	P	S
C	Q	R
D	Q	S

3 A ripple tank is used to demonstrate refraction of plane water waves.



Waves in deep water have a wavelength of 1.2 cm and a speed of 9.6 cm / s. The wavelength of the waves in shallow water is 0.8 cm.

What is the speed of the waves in the shallow water?

A 6.4 cm / s **B** 8.0 cm / s **C** 9.6 cm / s **D** 14.4 cm / s

4 A guitar player struck a guitar string to produce a sound. The same string is then struck harder to produce a second sound.

Which row about the speed and wavelength of the second sound compared with the first sound is correct?

	speed	wavelength
A	different	different
B	different	same
C	same	different
D	same	same

5 The table below shows common uses for three types of electromagnetic waves.

Which row correctly identifies the correct use of the waves?

	bank note authentication	industrial defect detection	mobile phones
A	microwaves	X-rays	ultraviolet
B	ultraviolet	microwaves	X-rays
C	ultraviolet	X-rays	microwaves
D	X-rays	ultraviolet	microwaves

SECTION B : [20 marks]

Answer **ALL** *questions in this section. Show your workings and write your answers in the space provided.*

1 Fig. 1.1 shows a side view and a top view of a corrugated cardboard cup used to serve hot drinks.

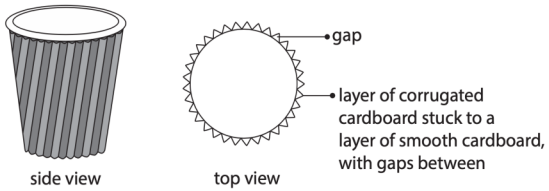


Fig. 1.1

(a) Explain how the design allows the person to safely hold the cup with hot drink.

.....

.....

.....

..... **[2]**

(b) Fig. 1.2 shows two cups of coffee containing coffee at the same temperature. Cup A is a white corrugated cardboard cup. Cup B is a black metal cup.

Cup A Cup B

Fig. 1.2

(i) On Fig. 1.3, sketch the graph for cup B to show its change in temperature after 5 minutes.

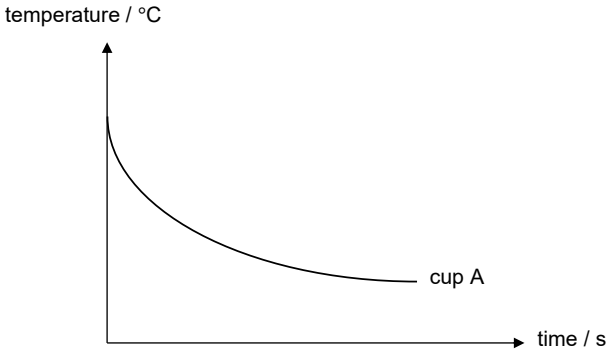


Fig 1.3 **[1]**

(ii) Explain your answer for **(b)(i)**.

.....

.....

.....

..... **[2]**

2 **(a)** Fig. 2.1 and Fig. 2.2 shows the graphs which represent the change in the displacement of a wave with distance and time respectively.

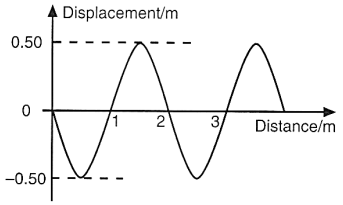


Fig. 2.1

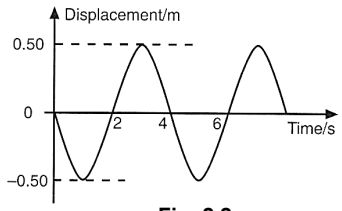


Fig. 2.2

Using the graphs,

(i) state the amplitude of the wave,

amplitude = ... m **[1]**

(ii) state the wavelength of the wave,

wavelength = ... m **[1]**

(iii) explain what is meant by *frequency* of a wave,

.....

..... **[1]**

(iv) calculate the frequency of the wave,

frequency = ... Hz **[1]**

(v) calculate the speed of the wave.

speed = ... m/s **[2]**

(b) When a guitar string is plucked, it causes a longitudinal sound wave in the air. Fig. 2.3 shows the instantaneous positions of particles in air when a sound wave passes through it.

The distance between region of compression and region of rarefaction in the sound wave is 2 m.

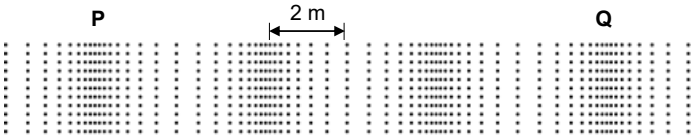


Fig. 2.3

In Fig. 2.4, draw the pressure-distance graph for the sound waves shown in Fig. 2.3 from region **P** to region **Q**.

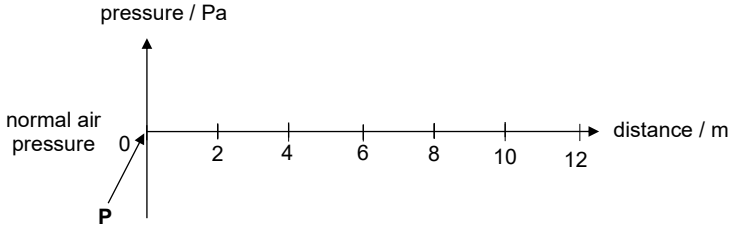


Fig. 2.4 **[2]**

3 Some sailors use sound waves to measure the depth of water beneath their ship. A pulse of sound is transmitted to the sea bed and returns to the ship. Fig. 3.1 shows the arrangement.

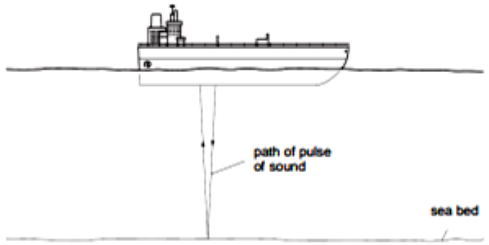


Fig. 3.1

(a) Sound is a longitudinal wave. Explain what is meant by a *longitudinal wave*.

.....

..... **[1]**

(b) The time taken for the sound pulse to reach the sea bed and return to the ship is 0.20 s. The speed of sound in sea water is 1500 m /s. Calculate the depth of the sea.

depth = ... m **[2]**

(c) The speed of sound in air is 330 m/s, explain why sound travels faster in water than in air.

.....

.....

.....

..... **[2]**

(d) Fig. 3.2 shows the displacement-time graph of a sound wave.

On the same axes in Fig. 3.2, draw for another wave which has half the pitch and twice the loudness as the original wave.

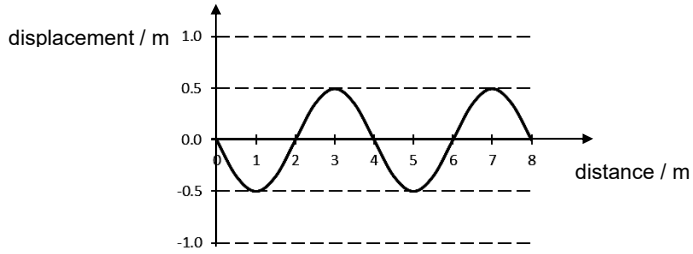


Fig. 3.2 **[2]**

SECTION C : [10 marks]

Answer **ALL** *questions in this section. Show your workings and write your answers in the space provided.*

4 Fig. 4.1 shows regions of the electromagnetic spectrum. Some regions are identified by letters.

P	X-rays	**Q**	**R**	infra-red radiation	microwaves	radiowaves

high frequency ⟵ low frequency

Fig. 4.1

(a) Name the regions identified by the letters.

P: ……

Q: ……

R: …….. **[2]**

(b) State **one** application for each electromagnetic wave:

radiowaves: .....

infra-red radiation: ..... **[2]**

(c) Fig. 4.2 shows a pair of wireless earbuds that are used to listen to music.

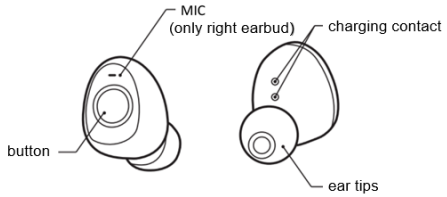


Fig. 4.2

The earbuds receives music from the mobile phone in the form of ultra-high frequency radiowaves.

(i) The radiowaves transmitted from the mobile phone to the earbuds has a wavelength of 155 cm. Calculate the frequency of the radiowaves.

frequency = ... Hz **[2]**

(ii) When radiowaves enter the plastic earbuds from air, the speed of radiowaves decreases.

State what happens to the wavelength of the radiowaves.

.....

..... **[1]**

(d) Certain waves in the electromagnetic spectrum are ionizing. When living matter is exposed to such electromagnetic waves, there are harmful effects.

(i) List down the two ionizing electromagnetic waves.

.....

..... **[1]**

(ii) List down two harmful effects of ionizing electromagnetic waves on living matter.

.....

.....

..... **[2]**

END OF PAPER

ST. PATRICK'S SCHOOL
TERM 1 GRADED ASSESSMENT 2025

SUBJECT : SCIENCE PHYSICS **DATE : 06 MAR 2025**

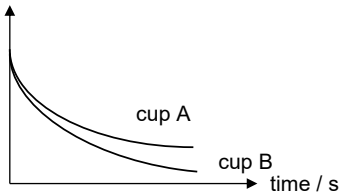
LEVEL : SECONDARY 4E (5086)
SECONDARY 5NA
DURATION : : 50 MIN

ANSWER SCHEME

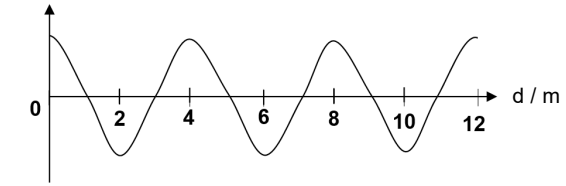
Section A [5 marks]

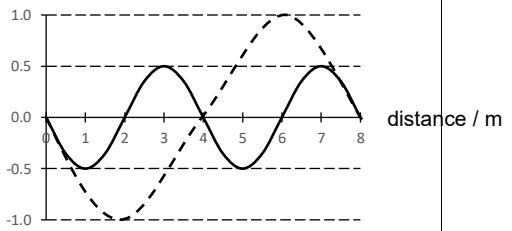
1	2	3	4	5
D	**A**	**A**	**D**	**C**

Section B [20 marks]

QN	Suggested Answers	Sub Ttl	Ttl
1a	There is a layer of air in the gap [1]. Air is a poor thermal conductor and transfers energy by heating slowly, hence reducing energy transferred to hand [1]. OR There is less contact area between the cup and the hand due to the layer of corrugated cardboard [1]. This results in less energy transferred by heating via conduction from the cup to the hand [1].	2	**5**
1bi	temperature / °C  	1	
1bii	A black cup is a good emitter of infrared radiation compared to the white cardboard cup [1]. Metals are better conductors of heat compared to cardboard, allowing greater heat loss thru conduction. [1]	2	

QN	Suggested Answers	Sub Ttl	Ttl
2a	0.50 m	1	**8**
2b	2.0 m	1	
2c	frequency is the number of completed waves generated per second.	1	

2d	f = 1 / T = 1 / 4 = 0.25 Hz	1	
2e	v = f x λ = 2.0 m x 0.25 Hz [1] = 0.5 m/s [1]	2	
2f	pressure / Pa  Shape of graph – 1 m C and R at the right positions – 1 m	2	

QN	Suggested Answers	Sub Ttl	Ttl
3a	Longitudinal waves travels in a direction parallel to its direction of vibration.	1	**7**
3b	speed = 2 x depth / time 1500 = 2 x depth / 0.20 depth = 150 m	2	
3c	Sound travels more quickly through liquids than through gases because the particles of a liquid are closer together [1] and, therefore, can transmit the vibrations (energy) faster. [1]	2	
3d	displacement / m  correct amplitude – 1m correct frequency – 1m	2	

Section C [10 marks]

QN	Suggested Answers	Sub Ttl	Ttl
4a	P: Gamma Rays Q: Ultraviolet Rays R: Visible light 3 correct – 2m, 1 or 2 correct – 1m	2	10
4b	Any one of the following for each EM wave radiowaves [1] radio and television broadcasting radio astronomy radio frequency identification (RFID) Infra-red radiation [1] • Heat treatment for illnesses • Check for diseased crops • Intruder alarm • Remote control • Thermograph	2	
4ci	$v = f \lambda$ $3 \times 10^8 = f \times (155/100)$ [1] $f = 1.94 \times 10^8$ Hz [1]	2	
4cii	By $v = f \lambda$, (frequency remains constant), the wavelength decreases	1	
4di	X ray and Gamma rays	1	
4dii	Biological molecules can be damaged. Cells division can be abnormal. Cancers may develop. Developing foetus may be deformed. Any 2	2	

NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
MASTERY REVIEW 2024

SUBJECT : **SCIENCE PHYSICS 5086** **DATE** : **10 MAY 2024**

LEVEL : **SECONDARY 4 EXPRESS** **DURATION** : **1 H 15 MIN**

INSTRUCTIONS TO CANDIDATES

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. Write down your name, class and index number on the **Question Paper**.
2. Write in dark blue or black pen. You may use an HB pencil for any diagrams or graphs. Do not use correction fluid.
3. This paper consists of **Three (3) Sections** : **Section A**, **Section B** and **Section C**.
4. There are **fifteen** questions in **Section A**. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in the table provided on page **2**.
5. Answer **ALL** questions in **Section B** in the spaces provided.
6. Answer **ONE** question in **Section C** in the spaces provided.
7. The use of an approved scientific calculator is expected, where appropriate.
8. Throughout the paper take the **acceleration due to gravity on Earth** to be 10 m/s^2.
9. **DO NOT DETACH** any sections from this paper.

INFORMATION FOR CANDIDATES :

The number of marks is given in brackets **[ ]** at the end of each question.

SECTION A :	/ 15
SECTION B :	/ 40
SECTION C :	
Question 8	/ 10
Question 9	/ 10
TOTAL	/ 65
GRADE	

This paper consists of 20 printed pages, including the cover page.

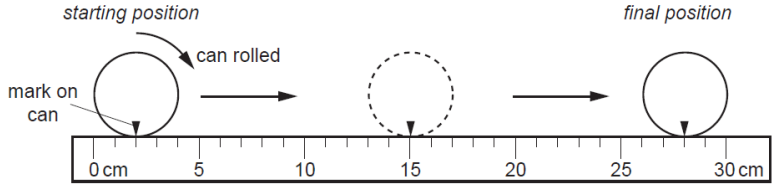
SECTION A : [15 marks]

*Each question is provided with **four** possible answers (**A**, **B**, **C** and **D**). Select the most appropriate answer and write down your answer in the table provided.*

1	2	3	4	5	6	7	8	9	10

11	12	13	14	15

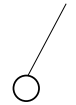
1 A cylindrical can is rolled along the ruler shown in the diagram.



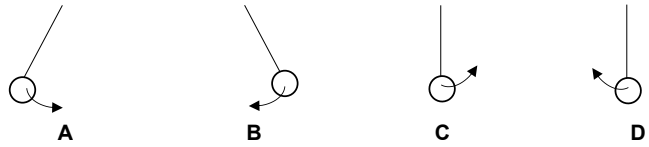
The can rolls over twice.
What is the circumference (distance all round) of the can?

A 13 cm **B** 14 cm **C** 26 cm **D** 28 cm

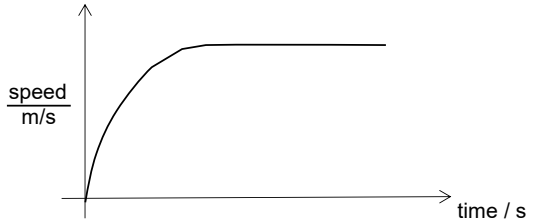
2 A pendulum has a period of 2.0 s. The bob is released from the position shown and the stopwatch started.



Which diagram shows the position and the direction of the pendulum 3 s later?



3 The following graph describes the motion of a man during a journey.



Which statement best describes his motion?

A moving with uniform acceleration and then stops
B moving with non-uniform acceleration and then stops
C moving with uniform acceleration and then with uniform speed
D moving with non-uniform acceleration and then with uniform speed

4 Which statement about a gravitational field is correct?

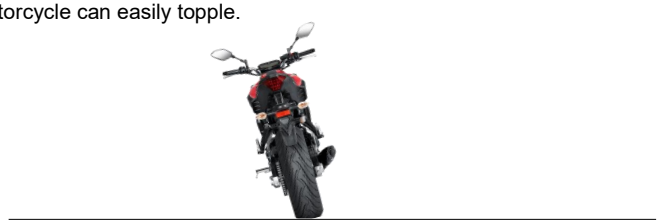
A the gravitational force exerted on an object per unit mass
B the gravitational force exerted on an object per unit volume
C a region in which an object experiences a force due to its mass
D a region in which an object experiences a force due to its volume

5 A rocket was launched from Earth to the International Space Station in outer space to send supplies.

How does the mass and weight of the rocket change as it leaves the Earth's atmosphere?

	mass	weight
A	decreases	no change
B	increases	no change
C	no change	decreases
D	no change	increases

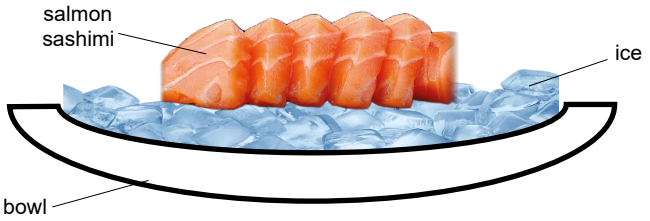
6 A motorcycle can easily topple.



This is because when tilted slightly to the left, the line of action of the weight of the motorcycle through its centre of gravity

A lies inside its base area and produces a clockwise moment.
B lies outside its base area and produces a clockwise moment.
C lies inside its base area and produces an anti-clockwise moment.
D lies outside its base area and produces an anti-clockwise moment.

7 Chilled salmon sashimi (a Japanese dish consisting of raw fish) at a temperature of 15 ºC is served on a bowl of ice. The bowl was kept at a room temperature of 25 ºC before being filled with ice.



How is energy in the internal store transferred?

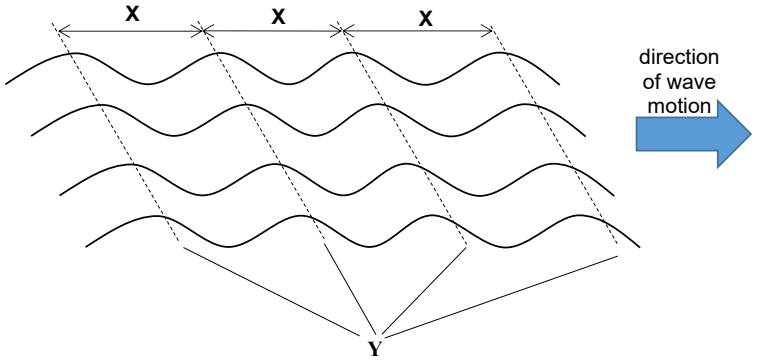
A from the bowl to the salmon
B from the ice to the bowl
C from the salmon to the bowl
D from the salmon to the ice

8 When water in a container freezes, the particles begin moving closer together as the bonds begin to strengthen.

What best describes the change in its internal energy?

A decrease in total kinetic energy
B decrease in total potential energy
C increase in total kinetic energy
D increase in total potential energy

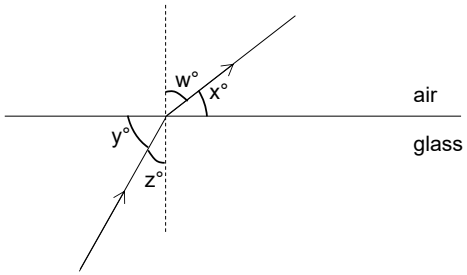
9 The diagram shows water waves in a river moving from left to right..



What do **X** and **Y** represent?

	X	Y
A	period	wavefront
B	wavefront	period
C	wavelength	wavefront
D	wavefront	wavelength

10 The diagram shows light passing through glass into air.



What is the refractive index of glass?

A $\frac{\sin y}{\sin x}$ **B** $\frac{\sin x}{\sin y}$ **C** $\frac{\sin w}{\sin z}$ **D** $\frac{\sin z}{\sin w}$

11 The diagram shows a television remote control.

What is the most likely component of the electromagnetic wave emitted when in use?

A infra-red waves
B microwaves
C radiowaves
D X-rays

12 What is the order for the speed of sound in air, iron and water?

	fastest	→	slowest
A	air	iron	water
B	air	water	iron
C	iron	air	water
D	iron	water	air

13 When a television set is switched on for three hours, 21 600 C of charge passes through it.

What is the average current flowing through the television set?

A 0.5 A
B 2.0 A
C 18.0 A
D 72.0 A

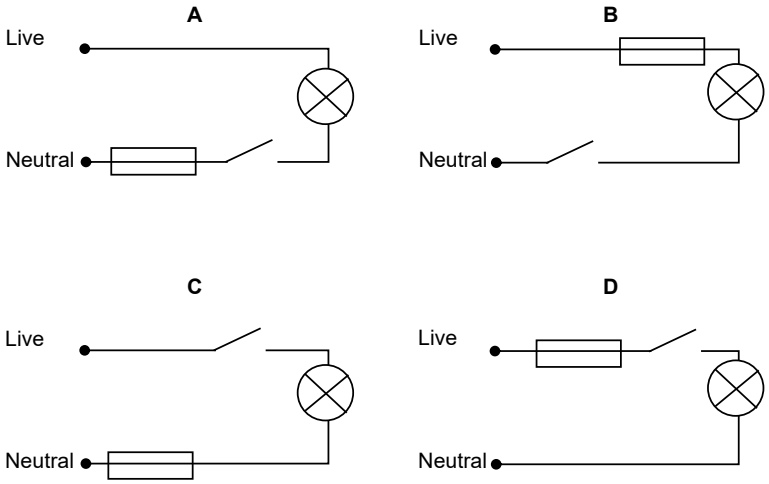
14 An electrician does a check and finds a fuse wire with insufficient resistance.

What type of wire should the electrician use to increase its resistance?

A use a thicker, longer wire
B use a thicker, shorter wire
C use a thinner, longer wire
D use a thinner, shorter wire

15 Fuses and switches are safety devices meant to protect the circuit and user.

Which circuit correctly shows how a fuse and a switch must be connected?



SECTION B : [40 marks]

Answer **ALL** *questions in this section. Show your working and write your answers in the space provided.*

1 **(a)** Identify the quantity measured by each of the following instruments and state its SI unit.

The first example has been done for you.

instrument	quantity measured	SI unit
beam balance	*mass*	*kilogram*
digital calipers		
thermometer		

[2]

(b) Complete the following conversions.

(i) 63 V = ……kV

(ii) 1000 g = ……Mg **[2]**

(c) A student carries out an experiment to measure the diameter of a wire **S**. He coiled wire **S** 25 turns around a pencil as shown in Fig. 1.1. The horizontal length of 25 turns of wire **S** along the pencil is measured to be 6.5 cm.

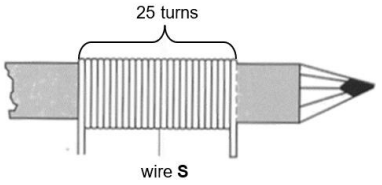


Fig. 1.1

Determine the diameter of the wire, **S**.

diameter = …….. cm **[2]**

2 A stunt scooter rider moves off from rest at a skate park by exerting a constant forward force of 425 N for 5.0 seconds. He encounters a resistive force of 200 N as shown in Fig. 2.1. The mass of the scooter and rider is 90 kg.

Fig. 2.1

(a) Calculate, for the scooter and rider,

(i) the average acceleration,

acceleration = ... m/s^2 **[2]**

(ii) the speed after 5 seconds.

speed = ... m/s **[2]**

(b) The rider jumps together with the scooter, lifting off the ground to cross over obstacles as shown in Fig. 2.2.

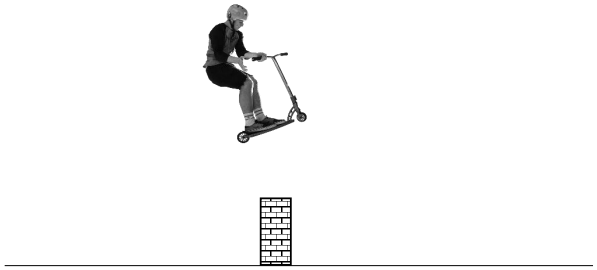


Fig. 2.2

Calculate the minimum upward force the rider needs to exert to lift off the ground.

The gravitational field strength g, is = 10 N/kg.

force = ... N **[1]**

3 **(a)** State the *principle of moments*.

.....

.....

..... **[1]**

(b) Fig. 3.1 shows an object placed on a uniform plank with a support at X.

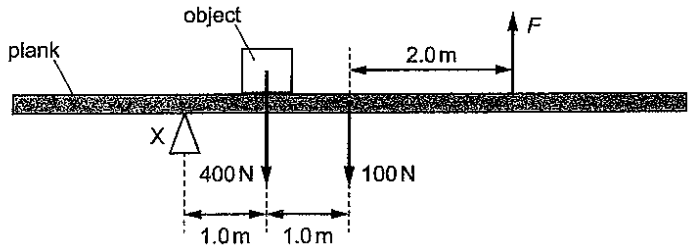


Fig. 3.1

The object weighs 400 N and the plank weighs 100 N.

Calculate the upward force *F* needed to keep the plank balanced.

F = ... N **[2]**

4 Fig. 4.1 shows a cyclist moving down a small smooth slope at **P** before travelling on a flat road at **Q**. Upon passing **P**, the cyclist stops pedaling and the bicycle rolls down the slope.
The total mass of the cyclist and his bicycle is 85 kg.

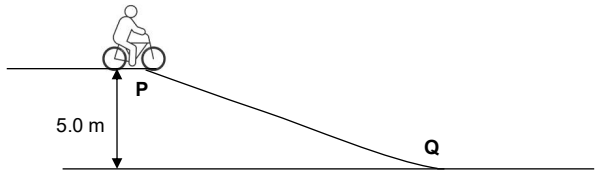


Fig. 4.1

The speed of the cyclist before **P** is 12 m/s.

Take the gravitational field strength to be 10 N/kg.

(a) Calculate:

(i) the total energy of the cyclist before **P**.

total energy before **P** = ... J **[2]**

(ii) the speed of the cyclist upon reaching the bottom of the slope at **Q**.

speed = ... m/s **[2]**

(b) In real life, would the actual speed recorded be lower, same or higher than your calculation in **(a)(ii)**? Explain your answer.

.....

.....

..... **[2]**

5 Fig. 5.1 shows how the pressure changes with time, at a person's ear, for two different sound waves A and B. The sounds are produced by two different sources.

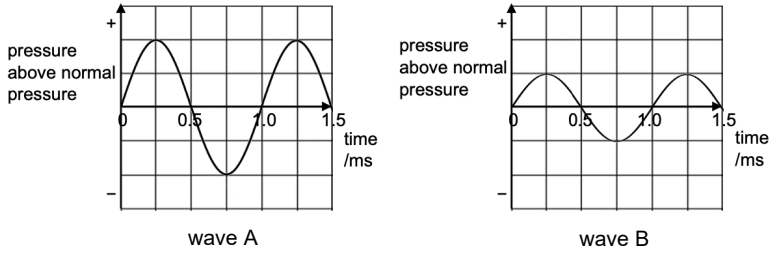


Fig. 5.1

(a) State one similarity and one difference between the two sounds when heard by the person.

difference .....

.....

similarity .....

..... **[2]**

(b) Calculate the frequency of the sound wave A.

frequency = ... Hz **[2]**

6 Fig. 6.1 shows a circuit containing a 6 V battery, two switches, two resistors, and a lamp. All the switches are closed.

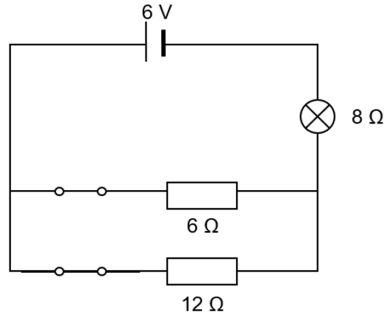


Fig. 6.1

(a) Calculate the effective resistance of the circuit.

effective resistance = ... Ω **[2]**

(b) **(i)** Calculate the current passing through the lamp.

current = ... A **[1]**

(ii) Calculate the potential difference across the lamp.

potential difference = ... V **[1]**

(c) Calculate the current flowing through the 12 Ω resistor.

current = ... A **[2]**

7 As part of Timothy's stamina training for an upcoming triathlon, he completes three parts of a running exercise as follows.

> Part 1 (sprint): accelerate uniformly from rest to 6.0 m/s in 5 s
> Part 2 (maintain): run at constant speed of 6.0 m/s over the next 150 m
> Part 3 (cool down): decelerate uniformly to rest over the next 3 s

(a) Calculate the time taken to complete Part 2 of the exercise.

time = ... s **[1]**

(b) On Fig. 7.1, draw the speed-time graph for Timothy's motion for all three parts of the exercise. **[3]**

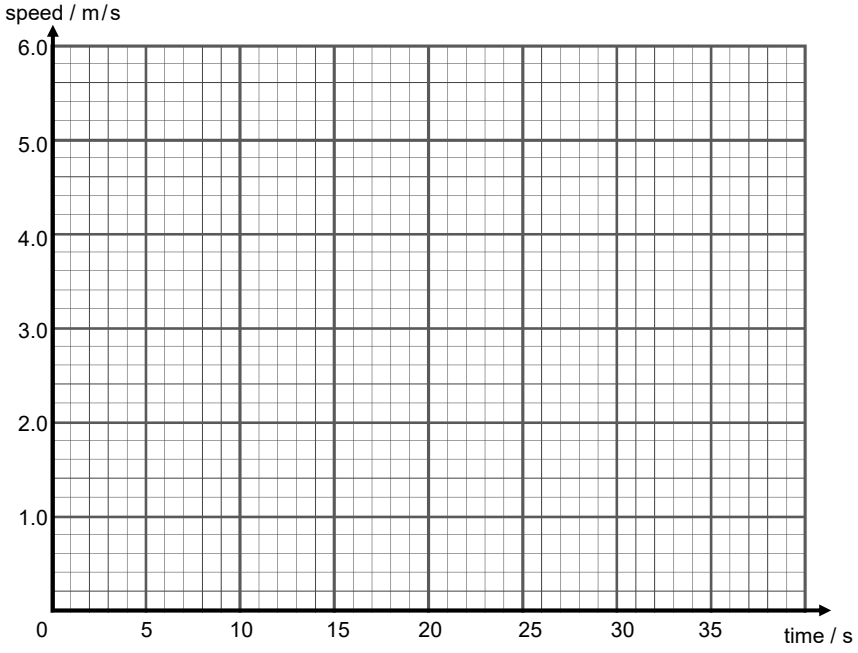


Fig. 7.1

(c) With reference to Fig. 7.1,

(i) Calculate the total distance that Timothy ran for all three parts.

total distance = ... m **[2]**

(ii) Calculate his average speed for his running exercise.

average speed = ... m/s **[2]**

(d) Timothy's coach, who weighs more than Timothy, completes the same running exercise in the same amount of time.

State and explain who developed more power during the run.

.....

..... **[2]**

SECTION C : [10 marks]

Answer **one** question from this section. *Show your working and write your answers in the spaces provided.*

8 A jet engine works on the principle of pushing cold atmospheric air into the jet engine. It then heats up this air in the engine and pushes the heated air out at a higher speed as shown in Fig. 8.1.

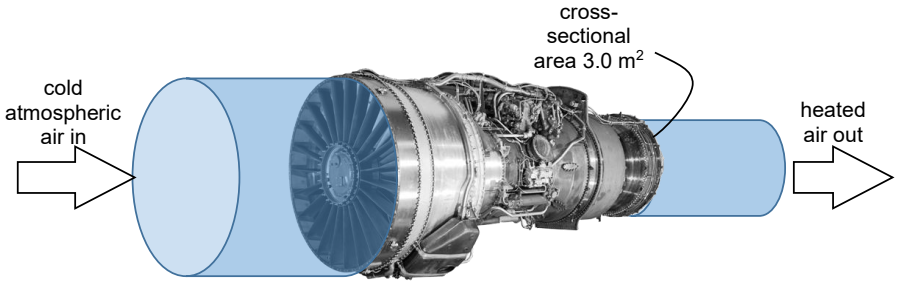


Fig. 8.1

(a) (i) Given the density of the heated air pushed out by the jet engine is 5500 kg/m^3 and its volume is 20 m^3, calculate the mass of the heated air pushed out.

mass = ... kg **[2]**

(ii) Given the pressure of the heated air is 25 000 N/m^2 and the cross-sectional area of the jet engine pushing out the heated air is 3.0 m^2, calculate the force exerted on the heated air as it is pushed out by the jet engine.

force = ... N **[2]**

(b) When the cold atmospheric air passes through the jet engine, it emerges as heated air with a higher density.

Describe how the motion of air molecules changes after air emerges from the jet engine.

.....

..... **[1]**

(c) A large thrust is created when the heated air is compressed in the jet engine and pushed out through the smaller cross-sectional area.

Explain, using kinetic particle model, why the jet engine will work in air but not underwater.

.....

..... **[2]**

(d) The cross section of the jet engine is shown in Fig. 8.2.

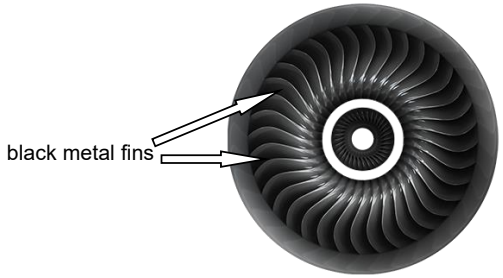


Fig. 8.2

The jet engine consists of multiple black metal fins that are heated. As the air passes through the heated fins, they get heated up.

Explain how the multiple black metal fins help to heat up the air quickly.

.....

.....

.....

.....

..... **[3]**

9 **(a)** Fig. 9.1 shows a ray of light incident at the surface of a flat transparent acrylic plastic block. Two resultant rays are observed.

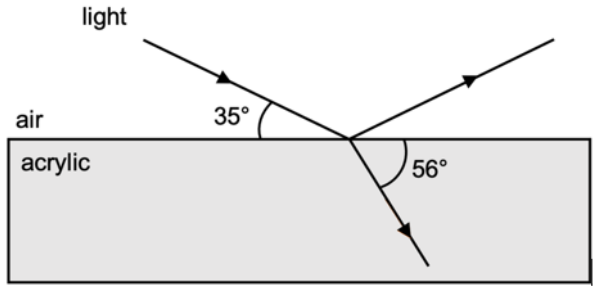


Fig. 9.1

(i) State the angle of incidence.

angle of incidence = ... ° **[1]**

(ii) State the angle of refraction.

angle of refraction = ... ° **[1]**

(iii) Calculate the refractive index of the acrylic plastic.

refractive index = ... **[2]**

(b) Fig. 9.2 represents an object **O** placed in front of a converging lens.

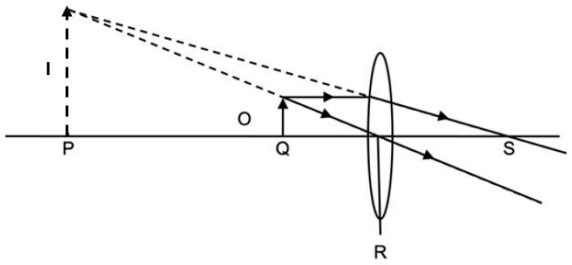


Fig. 9.2

(i) State three characteristics of the image **I**.

.....

..... **[3]**

(ii) The converging lens has a *focal length of 5.0 cm*. State what is meant by this statement.

.....

..... **[1]**

(iii) Name one instrument which makes use of the set-up shown in Fig. 9.2.

..... **[1]**

(iv) Name another instrument, which uses a convex lens to produce a real and magnified image.

..... **[1]**

END OF PAPER

ST. PATRICK'S SCHOOL
MASTERY REVIEW 2024

SUBJECT : SCIENCE PHYSICS 5086 **DATE : xx MAY 2024**

LEVEL : SECONDARY 4 EXPRESS **DURATION : : 1 H 15 MIN**

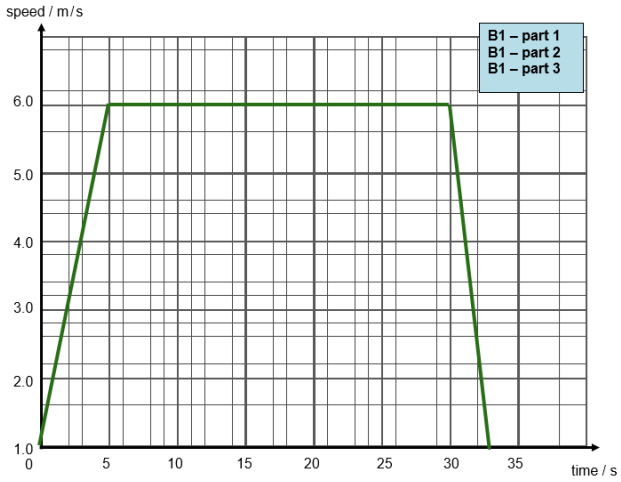
SECTION A [15 marks]

1	2	3	4	5	6	7	8	9	10
A	**B**	**D**	**C**	**C**	**D**	**D**	**B**	**C**	**C**
11	12	13	14	15					
A	**D**	**B**	**C**	**D**					

Section B [40 marks]

QN	Suggested Answers	Sub Ttl	Ttl
1a	**Instrument** / **Quantity measured** / **SI Unit** beam balance / mass / kilogram digital calipers / **length** / **metre/ m** thermometer / **temperature** / **Kelvin/ K**	1 1	**6**
1b	(i) 0.063 kV (ii) 0.001 Mg	1 1	
1c	Diameter of the wire = 6.5 cm / 25 = 0.26 cm	1 1	
2ai	a = F/m = (425-200)/90 = 2.5 m/s^2	1 1	**5**
2aii	a = (v – u)/t v = u + at = 0 + 2.5 x 5 = 12.5 m/s	1 1	
2b	W = mg = 90 x 10 = 900 N	1	
3a	The Principle of Moments state that for an object in **equilibrium**, the sum of the clockwise moments about a **point**/**pivot** is **equals** to the sum of the anti- clockwise moments about the **same** point/pivot.	1	**3**

b	ACM = CM F x 0.04 = 400 x 0.01 + 100 x 0.02 F = 150 N	1 1	
4ai	Before P, total energy = $KE_P + PE_P$ = ½ (85)(12)^2 + 85(10)(5) = 10370 J = 10.4 kJ	1 1	**6**
aii	By Conservation of energy, $KE_P + PE_P = KE_Q$ 10370 = ½ (85)v_Q^2 v_Q = 15.6 m/s	1 1	
b	Speed will be lower Energy is transferred to the surrounding due to friction/air resistance	1 1	
5a	difference: wave A is louder than wave B (reject different amplitude) similarity: wave A and wave B have the same pitch (reject same wavelength)	1 1	**4**
b	f = 1/T = 1 / 1ms = 1 kHz	1 1	
6a	R_{eff} = (1/6 + 1/12)$^{-1}$ = 4.0 Ω Total resistance = 4 Ω + 8 Ω = 12 Ω	1 1	**6**
bi	I = V/R = 6/12 = 0.5 A	1	
bii	p.d across the lamp = I × R = 0.5 × 8 = 4.0 V	1	
c	pd across 12 Ω resistor = 6 – 4 = 2 V Current flowing through 12 Ω resistor = V/R = 2/12 = 0.167 A	1 1	
7a	time = distance / speed = 150 / 6 = 25 s	**1**	**10**

b	 Allow e.c.f	**3**	
ci	total distance = area under speed-time graph $= \frac{1}{2}(6.0)(25 + 33)$ = 174 m Allow e.c.f	**1** **1**	
cii	average speed = total distance / total time = 174 / 33 = 5.27 m/s Allow e.c.f	**1** **1**	
d	Timothy's coach developed more power than Timothy. This is because he has done more work in the same amount of time.	**1** **1**	

Section C [20 marks]

QN	Suggested Answers	Sub Ttl	Ttl
8ai	Mass = D x V = 5500 x 20 = 110 000 kg	1 1	10
aii	F = P x A = 25 000 x 3 = 75 000 N	1 1	
b	Molecules gain kinetic energy, hence they move at faster speeds	1	
c	Molecules in liquids slide past one another, attractive forces between the liquid molecules are stronger than in air. Hence they cannot be compressed to create a thrust.	1 1	
d	Multiple fins provide a larger surface area to increase the rate of emission of radiant heat. Black colour is a good emitter of radiation. Metals are good conductor of heat.	1 1 1	
9ai	angle of incidence *i* = 90 ° – 35 ° = 55 °	1	**10**
aii	angle of refraction *r* = 90 ° – 56 ° = 34 °	1	
aiii	$n = \frac{\sin i}{\sin r}$ $= \frac{\sin 55°}{\sin 34°}$ = 1.46	 1 1	
bi	Virtual Upright Magnified	1 1 1	
bii	The distance between the optical centre R and the principal focus point S is 5.0 cm.	1	
biii	Magnifying glass	1	
biv	Slide projector/photocopier	1	

NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
MASTERY REVIEW 2025

SUBJECT : **SCIENCE (PHYSICS) 5086** **DATE** : **16 MAY 2025**

LEVEL : **SECONDARY 4E5N** **DURATION** : **1 H 15 MIN**

INSTRUCTIONS TO CANDIDATES

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. Write down your name, class and index number on the **Question Paper**.
2. Write in dark blue or black pen. You may use an HB pencil for any diagrams or graphs. Do not use correction fluid.
3. This paper consists of **Three (3) Sections** : **Section A**, **Section B** and **Section C**.
4. There are **fifteen** questions in **Section A**. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in the table provided on page **2**.
5. Answer **ALL** questions in **Section B** in the spaces provided.
6. Answer **ONE** question in **Section C** in the spaces provided.
7. The use of an approved scientific calculator is expected, where appropriate.
8. Throughout the paper take the **acceleration due to gravity on Earth** to be 10 m/s^2.
9. **DO NOT DETACH** any sections from this paper.

INFORMATION FOR CANDIDATES :

The number of marks is given in brackets **[ ]** at the end of each question.

SECTION A :	/ 15
SECTION B :	/ 40
SECTION C :	
Question 8	/ 10
Question 9	/ 10
TOTAL	/ 65
GRADE	

This paper consists of _19_ printed pages, including the cover page.

SECTION A : [15 marks]

*Each question is provided with **four** possible answers (**A**, **B**, **C** and **D**). Select the most appropriate answer and write down your answer in the table provided.*

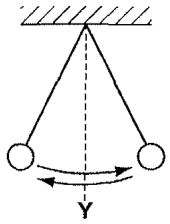
1	2	3	4	5	6	7	8	9	10

11	12	13	14	15

1 A pendulum swings backwards and forwards passing through **Y**, the middle point of the oscillation.

The first time the pendulum passes through **Y**, a stopwatch is started. The twenty-first time the pendulum passes through **Y**, the stopwatch is stopped. The reading is *T*.

What is the period of the pendulum?



A *T*/40 **B** *T*/21 **C** *T*/20 **D** *T*/10

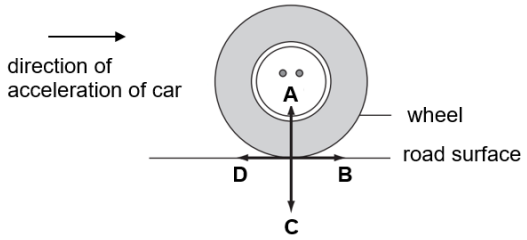
2 Which equation contains two vector quantities?

A acceleration = change in velocity ÷ time taken
B average speed = distance travelled ÷ time taken
C density = mass ÷ volume
D volume = length x width x height

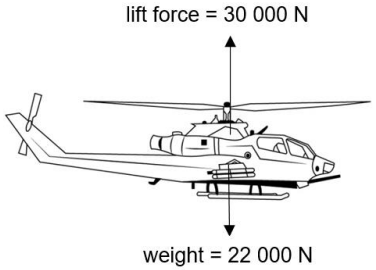
3 An object undergoes free fall. Which row describes the acceleration and the velocity of the object?

	acceleration	velocity
A	constant	constant
B	constant	increasing
C	increasing	constant
D	increasing	increasing

4 The wheel of a moving car is driven by the engine. The car is accelerating in the direction shown below. In which direction does the frictional force act on the wheel?



5 The diagram shows a helicopter with the forces acting on it. Taking g = 10 N/kg.



What is the acceleration of the helicopter?

A 0.364 m/s^2 **B** 1.36 m/s^2 **C** 3.64 m/s^2 **D** 13.6 m/s^2

6 The diagram shows a burning candle.

Which energy store is associated with the burning candle?

A chemical
B elastic
C gravitational
D nuclear

7 Which row describes the shape and the volume of a liquid at constant temperature?

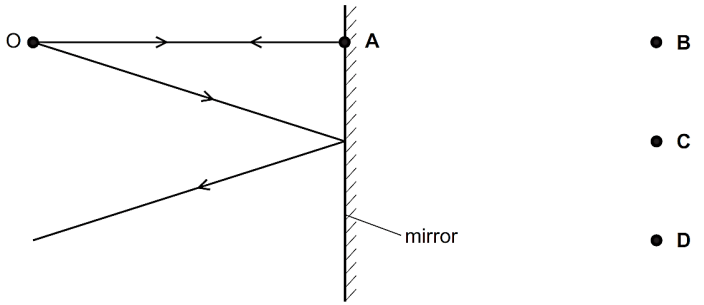
	shape	volume
A	fixed	fixed
B	fixed	not fixed
C	not fixed	fixed
D	not fixed	not fixed

8 A fixed mass of gas is cooled while kept at constant volume. How do the behaviour and arrangement of the molecules of the gas change?

	average speed of the molecules	frequency of collision with walls	average density
A	decreases	decreases	unchanged
B	increases	increases	unchanged
C	decreases	unchanged	unchanged
D	decreases	decreases	increases

9 The diagram shows two divergent rays of light from an object O being reflected from a plane mirror.

At which position, **A**, **B**, **C** or **D**, is the image formed?



10 Which row correctly shows the electromagnetic waves that has a wavelength longer than that of visible light and a frequency greater than that of visible light?

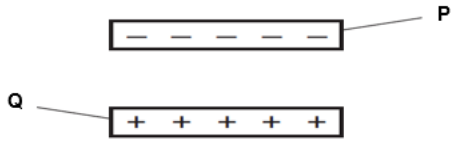
	wavelength longer than visible light	frequency greater than visible light
A	infrared	ultraviolet
B	microwave	radio
C	radio	microwave
D	ultraviolet	infrared

11 Many devices produce electromagnetic waves when operating.

Which device produces electromagnetic waves of the highest frequency?

A mobile phone
B sunbed
C television controller
D toaster

12 A negatively charged plastic rod P is placed above a positive charged plastic rod Q.



What are the directions of the electric forces acting on rod **P** and on rod **Q**?

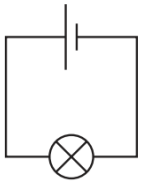
	electrostatic force on rod P	electrostatic force on rod Q
A	upwards	downwards
B	upwards	upwards
C	downwards	downwards
D	downwards	upwards

13 An electric screwdriver's battery takes 20 minutes to charge. The current in the battery during charging is 300 mA. How much charge flows through the battery while it is charging?

A 6.0 C **B** 360 C **C** 6000 C **D** 360 000 C

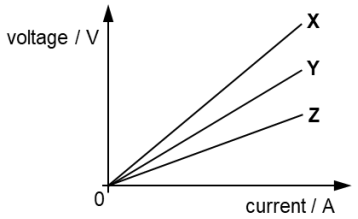
14 In the circuit shown, 20 J of energy is dissipated by the cell in driving 8.0 C of charge round the circuit.

What is the value of the e.m.f. of the cell?



A 0.40 V **B** 2.5 V **C** 28 V **D** 160 V

15 The graph shows the voltage-current graphs for three equal lengths of resistance wire X, Y and Z. They are made of the same material.



The resistance and cross-section area of the wires change from X to Z.

Which row describes these changes?

	resistance	cross-sectional area
A	increases	decreases
B	increases	increases
C	decreases	decreases
D	decreases	increases

SECTION B : [40 marks]

Answer **ALL** *questions in this section. Show your working and write your answers in the space provided.*

1 **(a)** Circle the number in the list that is equal to the diameter of the Earth in metre (m).

1.3×10^3 1.3×10^7 1.3×10^9 1.3×10^{11} **[1]**

(b) Physical quantities, consisting of base and derived quantities, are used in science for measuring the world around us.

Complete Table 1.1 to show the type of physical quantity, and its SI unit symbol. The first one has been done for you.

Table 1.1

Physical quantity	Type of physical quantity	SI unit symbol
speed	derived	m/s
time		
	base	K
volume		m^3

[2]

2 A food service robot that is used to serve food is shown in Fig. 2.1.

The robot starts its motion at a speed of 1.0 m/s and accelerates at a constant rate of 0.5 m/s^2 for the first 4 seconds.

The robot then travels at constant speed for 10 seconds before it decelerates to rest at a constant rate for 4 seconds.

Fig. 2.1

(a) Calculate the speed of the robot at the 4^{th} second.

speed at 4^{th} second = ... m/s **[1]**

(b) In the grid provided in Fig. 2.2, plot the speed-time graph of the robot for its motion during the time interval of 18 seconds.

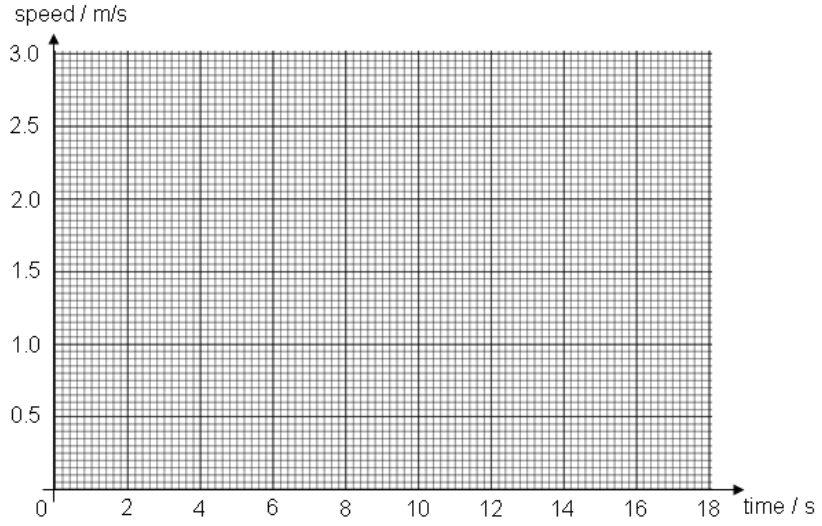


Fig. 2.2

[3]

(c) Calculate

(i) the distance travelled in the first 4 s,

distance = ... m **[2]**

(ii) the deceleration of the robot in the last 4.0 s,

deceleration = ... m/s^2 **[2]**

3 Fig. 3.1 shows a space capsule of mass 300 kg, a height of 7.0 m and a base area of 3.0 m^2.

The space capsule returns to Earth and experiences the Earth's gravitational field.

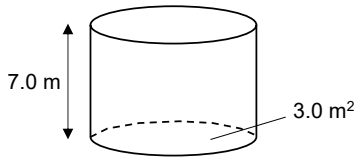


Fig. 3.1

(a) State what is meant by *gravitational field*.

.....

..... **[1]**

(b) The space capsule finally lands safely on soft marshy ground on its base. The gravitational field strength is 10 N/kg.

(i) Calculate the weight of the capsule.

weight = ... N **[1]**

(ii) Calculate the pressure exerted by the capsule on the ground.

pressure = ... Pa **[1]**

(iii) The astronaut has a mass of 100 kg. The area of the sole of each of his boots is 0.015 m^2.

Using calculations, explain why the astronaut is likely to sink into the soft marshy ground, but the space capsule is not.

.....

.....

..... **[2]**

4 A man uses a hammer to pull out a nail by overcoming the frictional force between the nail and the piece of wood, as shown in Fig. 4.1.

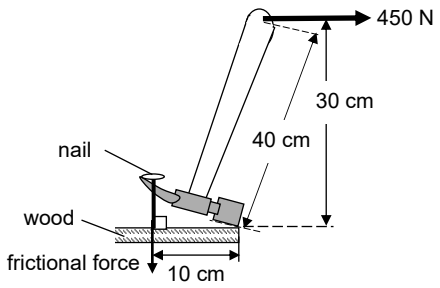


Fig. 4.1

When a force of 450 N is applied as shown, the nail starts to move.

(a) Calculate the frictional force between the nail and the piece of wood.

frictional force = ... N **[2]**

(b) Suggest how less force can be used to pull out the same nail using the same hammer. Explain your answer.

.....

.....

..... **[2]**

(c) The frictional force shown in Fig. 4.1 is also known as the 'frictional force of wood on nail'. It is one force in an action-reaction pair. State and briefly describe the other force in the pair.

.....

.....

..... **[2]**

5 Fig. 5.1 shows a skier taking part in a downhill race.

Fig. 5.1

The mass of the skier, including his equipment, is 75 kg. In the ski race, the total vertical change in height is 980 m.

(a) Calculate the decrease in energy in the gravitational potential store of the skier.

decrease in gravitational potential energy = ... J **[2]**

(b) The skier starts from rest. The total distance travelled by the skier during the descent is 3.0 km. The average resistive force on the skier is 230 N. Calculate the work done against the resistive force.

work done against resistive force = ... J **[2]**

(c) Hence, calculate the speed of the skier as he crosses the finishing line at the end of the race.

speed = ... m/s **[3]**

6 Fig. 6.1 shows a ray of light being partially reflected and partially refracted at the surface of a glass block of refractive index 1.66.

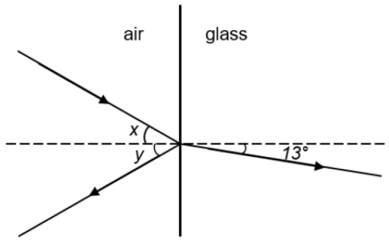


Fig. 6.1
(Not drawn to scale)

(a) Calculate the values of

(i) angle *x*

x = ... ° **[2]**

(ii) angle *y*

y = ... ° **[1]**

(b) The glass block is replaced with diamond which has a higher refractive index than glass.

Explain how the speed of light in diamond will be different from that in the glass block.

.....

..... **[1]**

7 Fig. 7.1 shows two bulbs X and Y rated at 12 V, 24 W, **operating at normal brightness**.

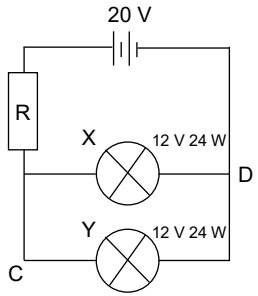


Fig. 7.1

(a) Calculate the current flowing through bulb X.

current flowing through bulb X = ... A **[2]**

(b) Calculate the current flowing through resistor R.

current flowing through resistor R = ... A **[1]**

(c) Calculate the resistance of R.

resistance of R = ... Ω **[2]**

(d) A copper wire is now connected between junctions C and D.

State and explain the effect on each of the bulbs.

.....

.....

.....

..... **[2]**

SECTION C : [10 marks]

Answer **one** question from this section. *Show your working and write your answers in the spaces provided.*

8 Fig. 8.1 shows a sealed tube of air of length 1.0 m with a speaker connected at the right end. The speaker produces a sound wave that travels towards the left end of the tube. A small microphone that detects sound waves is placed at the centre of the tube.

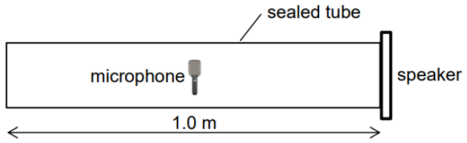


Fig. 8.1

(a) The microphone first detects a sound, S_1, from the speaker that travelled half the tube, and then another sound, S_2, from the reflection off the left end of the tube. The signals registered by the microphone are displayed in Fig. 8.2.

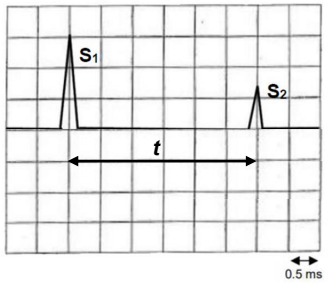


Fig. 8.2

(i) Given that each division on the microphone display represents 0.5 ms.

Determine the time interval, t, between S_1 and S_2.

t = ... ms **[1]**

(ii) Hence, find the speed of sound in air.

speed of sound = ... m/s **[2]**

(iii) The experiment is repeated with a sealed tube filled with water where the microphone can still detect the sound.

How would the time interval between S_1 and S_2 change? Using the idea of particles, explain your answer.

.....

.....

.....

..... **[3]**

(b) Fig. 8.3 (a) represents the original position of the air particles in the tube. Fig. 8.3 (b) represents the position of the same particles as a sound wave passes through the air in the tube at t = 0 s.

Fig. 8.3 (a)

Fig. 8.3 (b) (drawn to scale)

(i) Particle P vibrates between X and Y from its original position as shown in Fig. 8.3 (b). Describe how Fig. 8.3 (a) and (b) show that sound is a longitudinal wave.

.....

..... **[1]**

(ii) On Fig. 8.3 (b), mark out a distance equal to the wavelength of the sound wave. Mark clearly this distance as 'λ' and measure it.

λ = ... cm **[1]**

(iii) Given that the speed of the wave in air is 330 m/s, calculate the frequency of the sound wave.

frequency = ... Hz **[2]**

9 **(a)** A refrigerator, when connected to a 240 V mains supply, has a maximum power of 300 W. On average, the refrigerator consumed 1.5 kWh of electrical energy every 24 hours.

Calculate, for this refrigerator,

(i) the maximum current,

current = ... A **[2]**

(ii) the average power of the refrigerator.

average power = ... W **[2]**

(b) In the cooling system of a refrigerator, a liquid that is very easy to evaporate is pumped through metal pipes inside and outside the freezing compartment as shown in Fig. 9.1.

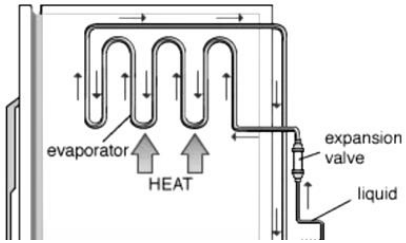


Fig. 9.1

(i) Inside the freezing compartment of the refrigerator, the liquid is changed into vapour.

State how the arrangement of molecules changes when the liquid vaporises and explain why thermal energy is needed to vaporise the liquid.

.....

.....

..... **[2]**

(ii) The vapour from the freezing compartment is pumped to the outside of the refrigerator where it is compressed back into a liquid, causing the liquid to be heated. The warm liquid passes through a metal tube with blackened metal plates attached to it. The metal plates are exposed to the air as shown in Fig. 9.2.

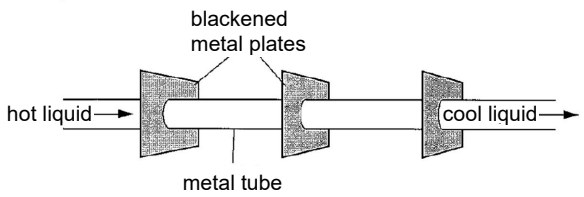


Fig. 9.2

Using the knowledge of thermal energy transfer (conduction, convection and radiation), explain how energy is transferred, as rapidly as possible, from the hot liquid in the tube to the surrounding.

.....

.....

.....

.....

.....

.....

..... **[4]**

END OF PAPER

ST. PATRICK'S SCHOOL
MASTERY REVIEW 2025

SUBJECT : **SCIENCE (PHYSICS) 5086** **DATE** : **16 MAY 2025**

LEVEL : **SECONDARY 4E5N** **DURATION** : **1 H 15 MIN**

SECTION A [15 marks]

1	2	3	4	5	6	7	8	9	10
D	**A**	**B**	**B**	**C**	**A**	**C**	**A**	**B**	**A**

11	12	13	14	15
B	**D**	**B**	**B**	**D**

Section B [40 marks]

QN	Suggested Answers	Sub Ttl	Ttl
1a	1.3×10^7 m	1	**3**
1b		2	

Physical quantity	Type of physical quantity	SI unit symbol
speed	derived	m/s
time	**base**	**s**
temperature	base	K
volume	**derived**	m^3

1 m for 2 correct answers
2 m for 4 correct answers

QN	Suggested Answers	Sub Ttl	Ttl
2a	v = u + at = 1.0 + 0.5 × 4 = 1.0 + 2.0 = 3.0 m/s	1	**8**
2b	 1 m for each part of the graph. Allow ecf from 4 s onwards if the first part of the graph is wrong.	3	
2ci	Distance travelled in the first 4 s = ½ × (1.0 + 3.0) × 4 = 8.0 m Allow ecf from 2a	1 1	
2cii	$a = \frac{v-u}{t} = \frac{0-3.0}{4} = -0.75\ \text{m/s}^2$ Deceleration = 0.75 m/s^2 Allow ecf from 2a	1 1	

QN	Suggested Answers	Sub Ttl	Ttl
3a	Gravitational field is a **region** in which a mass experiences a **force** due to **gravitational attraction**.	1	**6**
3bi	W = mg = 300 × 10 = 3000 N	1	
3bii	$P = \frac{F}{A}$ $= \frac{3000}{3}$ $= 1000\ N/m^2$ = 1000 Pa	1	
3biii	Pressure exerted by astronaut = 1000 / 0.030 = 33000 Pa Pressure on ground by the astronaut is higher than the pressure exerted by the space capsule due to the smaller contact area with the ground.	1 1	

QN	Suggested Answers	Sub Ttl	Ttl
4a	f x 10 = 450 x 30 f = 1350 N	1 1	**5**
4bi	Apply force perpendicular to the handle of hammer. When the force is applied perpendicularly to the handle of the hammer, the perpendicular distance between the pivot to the line of action of the force is increased from 30 cm to 40 cm. For the same moment about the pivot, a smaller force is needed.	1 1	
4bii	It is the frictional force of nail on wood. OR It is acting on the wood by the nail. It is equal and opposite to the frictional force of wood on nail.	1 1	

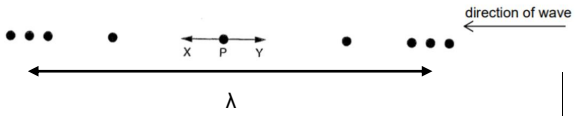
QN	Suggested Answers	Sub Ttl	Ttl
5a	E_P = mgh = 75 × 10 × 980 = 735000 J	 1 1	**7**
5b	Work done against resistive force = 230 × 3000 = 690000 J	 1 1	

5c	E_K = 735000 – 690000 = 45000 J $E_K = ½\ mv^2$ $45000 = ½ \times 75 \times v^2$ $v^2 = 1200$ v = 34.6 m/s	 1 1 1	

QN	Suggested Answers	Sub Ttl	Ttl
6ai	$\eta = \frac{\sin i}{\sin r}$ $1.66 = \frac{\sin x}{\sin 13°}$ $\sin x = 1.66 \sin 13°$ $x = \sin^{-1}(1.66 \sin 13°)$ $x = 21.9°$	 1 1	**4**
6aii	y = x = 21.9°	1	
6b	Speed of light in diamond is slower than that in glass. This is because diamond is optically denser.	1	

QN	Suggested Answers	Sub Ttl	Ttl
7a	P = VI I = P/V = 24 / 12 = 2.0 A	 1 1	**7**
7b	Current flowing through R = 2.0 + 2.0 = 4.0 A	 1	
7c	Voltage across R = 20 – 12 = 8 V R = V/I = 8 / 4.0 = 2 Ω	 1 1	
7d	Both lamps will not light up. Short circuit occurs	1 1	

Section C [10 marks]

QN	Suggested Answers	Sub Ttl	Ttl
8ai	t = 0.5 ms × 6 = 3.0 ms	1	**10**
8aii	Speed = distance / time = (2 × 0.5) / (3.0 × 10^{-3}) = 1.0 / 0.0030 = 333 m/s (to 3 sf)	 1 1	
8aiii	The time interval between S_1 and S_2 will decrease. Sound travels faster in water than in air. The particles in water are more closely packed than the particles in air. Compressions and rarefaction propagates faster in denser medium.	1 1 1	
8bi	The direction of vibration of particle P is parallel to the direction of the wave.	1	
8bii	 The arrow is correctly drawn to one wavelength and labelled with λ. (AWW if not labelled) λ = 8.0 cm (Accept 7.8 cm to 8.2 cm) 1 m for correctly drawn arrow and correctly measured.	1	
8biii	f = v / λ = 330 / 0.080 = 4125 Hz (AWW if ans is 4125 Hz) = 4130 Hz (Answer is dependent on (b)(iii)) 1 m for method mark if 8.0 cm is not converted to 0.080 m	 1 1	

QN	Suggested Answers	Sub Ttl	Ttl
9ai	I = P/V = 300 / 240 = 1.25 A	 1 1	**10**
9aii	P = E/t = 1.5 kWh / 24 h = 62.5 W	 1 1	
9bi	In liquid state, the molecules are closely packed and arranged in a disorderly manner. As the liquid vaporises, the particles move further apart from each other. Energy is needed to break the intermolecular forces of attraction between the molecules in order for them to move further apart.	1 1	
9bii	The metal tube is a good conductor of heat thus thermal energy can be transferred from the liquid to the surroundings and metal plates through the tube at a faster rate. Blackened surface are good emitter of radiant heat / radiation thus thermal energy can be transfer from the metal plate to the surrounding by radiation at a faster rate. The metal plate increases the surface area exposed to the surrounding thus increases the rate of radiation. The surrounding air around the metal tube gets heated and become less dense thus rise, cooler air sinks to replace the heated air. **<u>The movement of air created a convection current cooling the tube</u>**.	1 1 1 1	

TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS

CANDIDATE NAME

CLASS

INDEX NUMBER

SCIENCE (CHEMISTRY/PHYSICS) **5086/01**

Paper 1 Multiple Choice **19 August 2024**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your name, index number on the Answer Sheet.

There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.
Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 18.
The use of an approved scientific calculator is expected, where appropriate.

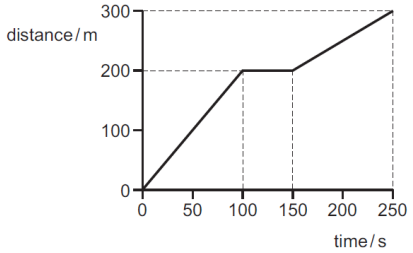
Setters: Ms Esther Foo and Mr David Chung
Markers: Ms Esther Foo and Mr David Chung

This document consists of **18** printed pages.

1 What is the correct order of magnitude for the thickness of hair and the diameter of Earth?

	thickness of hair	diameter of Earth
A	0.1 nm	10 Gm
B	0.1 nm	10 Mm
C	0.1 mm	10 Gm
D	0.1 mm	10 Mm

2 A cyclist rides a bicycle for 250 s.

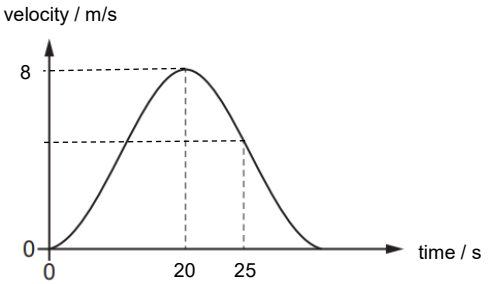


What is his average speed for the whole journey?

A 1.0 m/s **B** 1.2 m/s

C 1.5 m/s **D** 2.0 m/s

3 The velocity-time graph of a moving object is shown below.



What is the acceleration of the object at t = 20 s?

A 0 m/s^2 **B** 0.40 m/s^2

C 0.60 m/s^2 **D** 1.7 m/s^2

4 A 300 kg hot-air balloon is flying up at a constant speed of 5.0 m/s. The gravitational field strength *g* is 10 N/kg.

What is the resultant force acting on the hot air balloon?

A 0 N **B** 30 N

C 3 000 N **D** 15 000 N

5 A magician invited his guest to stand on a tray of eggs, as shown in the picture below. He claimed that he has magically enhanced the strength of the eggs so that they do not crack under the guest's weight.

Which of the following best explains why the eggs do not crack under the guest's weight?

A The large area of contact between the eggs and the guest's feet minimised the force acting on the eggs.

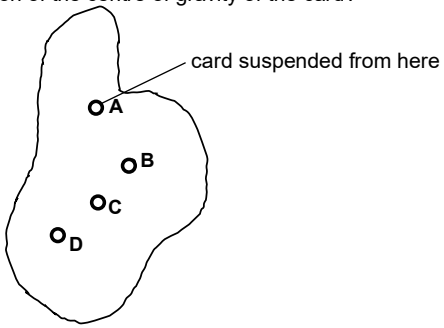
B The large area of contact between the eggs and the guest's feet minimised the pressure exerted on the eggs.

C The large number of eggs strengthened the shell of the eggs.

D The weight of the guest was insufficient to crack the eggs.

6 A card is suspended freely from a pin at A. When the card is displaced slightly, it swings and then comes to a stop in the position shown.

Which is the likely position of the centre of gravity of the card?



7 A stone of weight 100 N is thrown vertically upwards from the ground. 160 J of energy is transferred to the kinetic store in this process.

Ignoring air resistance, what is the amount of energy in kinetic store, the gain in potential store and the work done against gravity when the stone is at 1.00 m above the ground?

	kinetic store	gain in potential store	work done against gravity
A	60 J	60 J	60 J
B	60 J	100 J	60 J
C	60 J	100 J	100 J
D	100 J	160 J	100 J

8 A small emergency generator transfers 432 MJ of energy electrically in twenty-four hours.

What is the average power output of the generator?

A 5.0 kW **B** 5.0 MW

C 18 MW **D** 18 kW

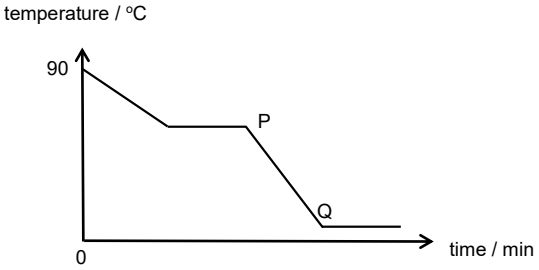
9 Some of the liquid in a dish is heated until boiling as shown in the diagrams.

before boiling when boiling

Which of the following is correct about the liquid molecules?

	kinetic energy of molecules as it approaches boiling	kinetic energy of molecules during boiling
A	decreases	same
B	same	increases
C	increases	same
D	increases	increases

10 A gas at 90 ºC loses transfers energy through vibration to the surroundings. The graph shows how the temperature of the substance changes with time.

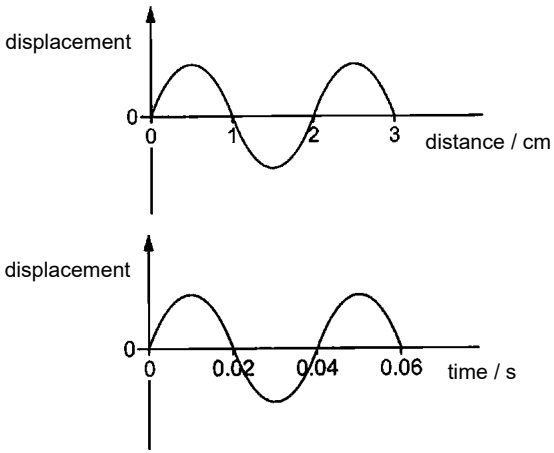


What does part PQ of the graph represent?

A solid freezing **B** gas condensing

C liquid cooling **D** solid cooling

11 The displacement-distance and displacement-time graphs are shown for a water wave in a ripple tank.



What is the speed of the water wave?

A 0.02 cm/s **B** 0.08 cm/s

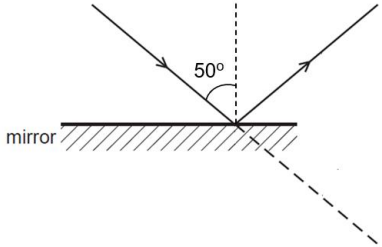
C 25 cm/s **D** 50 cm/s

12 A boy plays a note on the guitar. He then plays a louder note of the same pitch.

Which row correctly compares the speed and frequency of the second note with the first note?

	speed of second note	frequency of second note
A	same	same
B	same	higher
C	higher	same
D	higher	higher

13 A mirror is placed in the path of a ray of light.

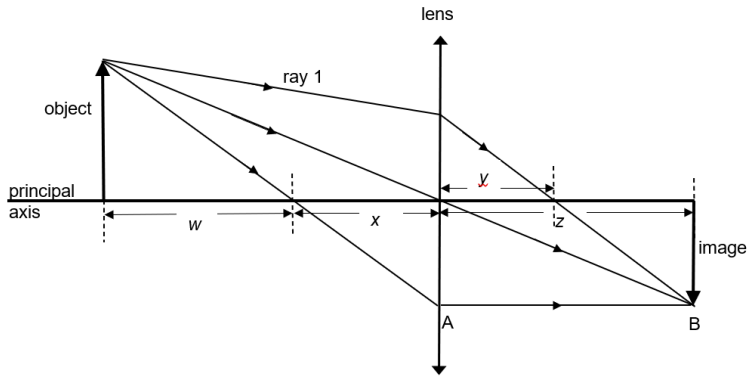


What is the angle of reflection?

A 40 ° **B** 50 °

C 90 ° **D** 140 °

14 The diagram shows the image of an object formed by a thin converging lens. Ray AB is parallel to the principal axis.

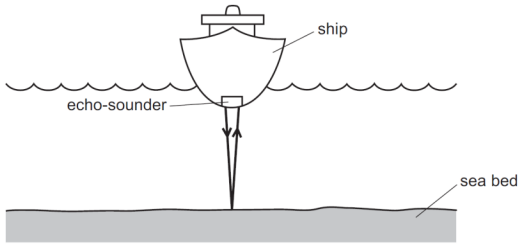


Which distance represents the focal length of the lens?

A w + x **B** x

C y **D** z

15 An echo-sounder on a ship produces a pulse of sound. The echo is received by the echo-sounder after four seconds.



The speed of sound in seawater is 1500 m/s.

What is the depth of the seawater below the ship?

A 750 m **B** 1500 m

C 3000 m **D** 6000 m

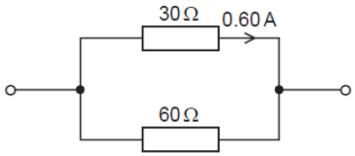
16 A battery moves a charge of 60 C around a circuit in a time of 20 s.

What is the average current in the circuit?

A 0.30 A **B** 3.0 A

C 40 A **D** 1 200 A

17 Two resistors of resistances 30 Ω and 60 Ω are arranged in parallel. The current in the 30 Ω resistor is 0.60 A.

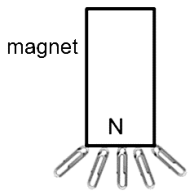


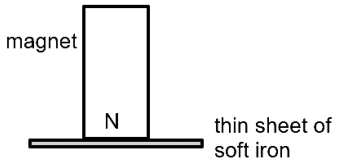
Calculate the current in the 60 Ω resistor.

A 0.30 A **B** 0.90 A

C 18 A **D** 50 A

18 The diagram on the left shows a magnet attracting 5 papers clips using the North pole.





Using the same magnet, a thin sheet of soft iron is now placed just below the North pole as shown in the diagram on the right.

What is the expected number of paper clips that can be attracted directly below the North pole?

A 0 **B** 3

C 5 **D** more than 5

19 The nuclide notation for uranium-235 is $^{235}_{92}U$. How many electrons are there in a neutral atom of uranium-235.

A 0 **B** 92

C 143 **D** 235

20 The half-life of the nuclide radium-225 is 15 days. A pure sample of this nuclide has a mass of 16 g.

How long will it be before the mass of radium-225 in the sample is 2.0 g?

A 45 days **B** 60 days

C 105 days **D** 120 days

Tanjong Katong Girls' School Sec 4 Preliminary Examination 2024

TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS

CANDIDATE NAME

CLASS

INDEX NUMBER

SCIENCE (PHYSICS) **5086/02**

Paper 2 **14 August 2024**
1 hour 15 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions in the spaces provided.

Section B
Contains two questions. Answer **only one out of the two questions** in the space provided.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of physics than for correct answers.

The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	**/ 65**

Setter : Mr David Chung
Markers : Mr David Chung

This document consists of **20** printed pages.

Section A

Answer **all** questions in this section in the spaces provided.
The total mark for this section is 55.

1 **(a)** Force is a vector quantity and mass is a scalar quantity.

Give one other example of

a vector quantity: ……..

a scalar quantity: …… [1]

(b) The kilogram, metre and second are all units of base quantities.

Express the unit of power in terms of the units of base quantities.

unit = …….. [2]

[Total: 3]

2 A box of mass 2.5 kg is at rest. A girl pushes it to the right with a force of 12 N. The frictional force between the box and the surface is 8.0 N.

Fig. 1.1

(a) Calculate the weight of the box.

weight = …….. N [1]

(b) Calculate the acceleration of the box.

acceleration = …….. m / s^2 [2]

(c) Describe the motion of the box if,

(i) the pushing force is increased to 15 N.

……

…… [1]

(ii) the pushing force is reduced to 8.0 N.

……

…… [1]

[Total: 5]

3 Fig. 3.1 shows a force *F* applied on a box to turn it about point **P**. The weight of the box is 80 N.

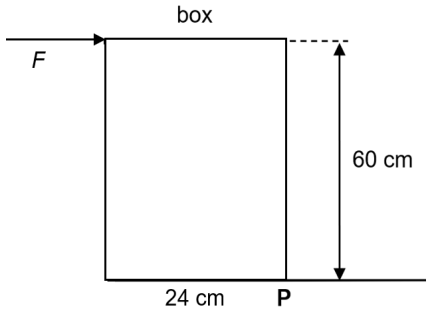


Fig. 3.1

(a) **(i)** On Fig. 3.1, mark with an **X** the position of the centre of gravity of the box. [1]

(ii) Draw an arrow to indicate the weight of the box. [1]

(b) By taking moments, calculate the minimum value of force *F* to just turn the box about **P**.

force = …….. N [2]

(c) The base area of the box is 0.32 m^2. Calculate the total pressure exerted by the box on the ground.

total pressure = …….. N/m^2 [2]

[Total: 6]

4 A 25 kg model car, placed at the top of ramp **A**, is released from rest. It reaches a speed of 20 m/s at point **X** before rolling to a stop at the top of ramp **B**.

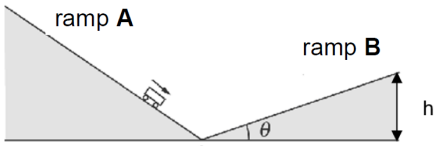


Fig. 4.1

(a) State the *Principle of Conservation of Energy*.

.....

..... [1]

(b) Calculate the amount of energy in the kinetic store of the car at point **X**.

kinetic store = ... J [2]

(c) What is the maximum height, h, at which the car will reach along ramp **B**?
The gravitational field strength is 10 N/kg.

h = ... m [2]

(d) Will the value of h be higher or lower in reality? Explain your answer.

.....

.....

..... [2]
[Total: 7]

5 Fig. 5.1 shows that a 1.0 m length of the wire (resistance 6.4 Ω) is connected in series with a switch, a cell of electromotive force (e.m.f.) 1.2 V and a resistor of resistance 9.6 Ω.

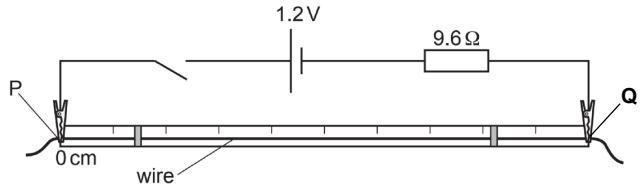


Fig. 5.1

The switch is closed.

(a) Explain what is meant by *electromotive force (e.m.f.)*.

.....

..... [1]

(b) Calculate the average current flowing through the 1.0 m length of the wire when the circuit was switched on for 10 seconds.

current =..... A [2]

(c) The clip at point **Q** is disconnected and connected along the resistance wire such that it is closer to point **P**.

(i) State what happens to the resistance of this resistance wire with this new connection.

..... [1]

(ii) State what happens to the average current flowing through the circuit compared to the current calculated in (b).

..... [1]

[Total: 5]

6 The following figure shows the structure of a hand-dryer, which produces hot air for drying wet hands. When the push button is pressed, the time switch turns on the fan and heater for 30 seconds.

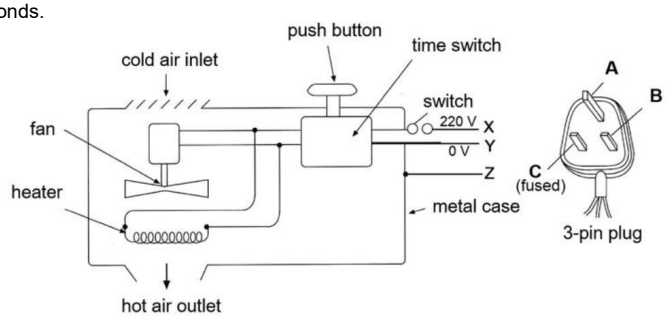


Fig. 6.1.

(a) State which pins (**A**, **B** or **C)** of the fused plug, should each of the wire **X**, **Y** and **Z** of the hand-dryer be connected to.

wire	X	Y	Z
pin			

[2]

(b) Explain why the switch of the hand-dryer is placed in wire **X** instead of wire **Y**.

……

…… [1]

(c) The hand-dryer is labelled '220 V, 2400 W'.
8 A, 10 A, 13 A and 15 A fuses are available for use. Suggest the most suitable fuse rating for this appliance and explain your choice.

……

…… [2]

[Total: 5]

7 Fig. 7.1 shows one method of telecommunication using electromagnetic radiation between Singapore and Sydney. Electromagnetic signals are sent via satellite in space.

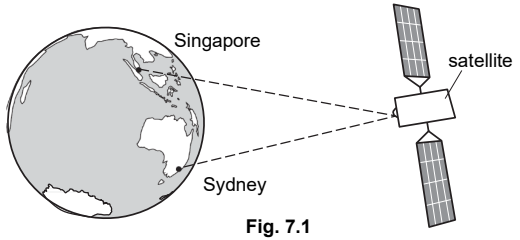


Fig. 7.1

(a) State which component of the electromagnetic spectrum is used for transmitting the signals.

…… [1]

(b) A transmitter in Singapore sends out electromagnetic signals of wavelength 0.050 m to the satellite.

(i) State a property of electromagnetic waves.

……

…… [1]

(ii) Calculate the frequency of the electromagnetic signal from the transmitter. Express your answer in MHz.

frequency =…….. MHz [2]

[Total: 4]

8 Fig. 8.1 shows a d.c. motor.

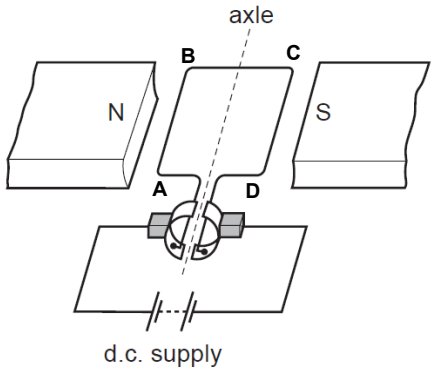


Fig. 8.1

When a current flows through coil **ABCD**, it turns.

(a) State the direction in which the coil will turn.

..... [1]

(b) Explain why the coil turns when a current flows through the coil.

.....

.....

.....

..... [2]

(c) State what happens if the poles on the magnet are reversed.

..... [1]

[Total: 4]

9 Table 9.1 shows a series of readings taken of the count rate, ***R*** from a radioactive isotope decay which emits *α*-particles.

t / min	*R* / per min
0	320
20	185
40	100
60	55
80	33
100	20
120	10
140	10

Table 9.1

(a) State what is an *α-particle*.

..... [1]

(b) **(i)** By plotting a decay curve of ***R*** against time, determine the half-life of this radioactive isotope.

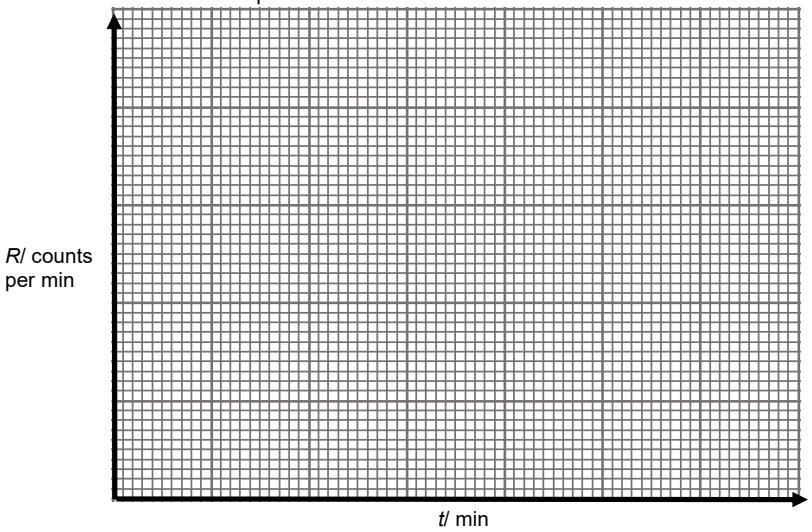


Fig. 9.1

half-life = ... min [2]

(ii) From the decay curve, indicate the likely background radiation value.

……. counts per min [1]

(b) The radioactive isotope is identified to be a heavy element, radium-226 (Ra). Complete the following nuclide equation after radium-226 undergoes an alpha decay followed by a beta decay

[2]

$$^{226}_{88}\text{Ra} \xrightarrow{\alpha\text{ - decay}} \square\!\!\square\ \text{Rn} \xrightarrow{\beta\text{ - decay}} \square\!\!\square\ \text{Po}$$

10 Two identical metal kettles were used to boil water as shown in Fig. 10.1. The water was initially at room temperature of 30 °C. Kettle **A** has a white outer surface while kettle **B** has a black outer surface. Both the kettles are placed over a stove to boil water.

kettle **A** kettle **B**

Fig. 10.1

Fig. 10.2 shows how the temperature of the water in kettle **A** changes with time as heat is applied to the water at a constant rate when kettle **A** initially contains 0.50 kg of water.

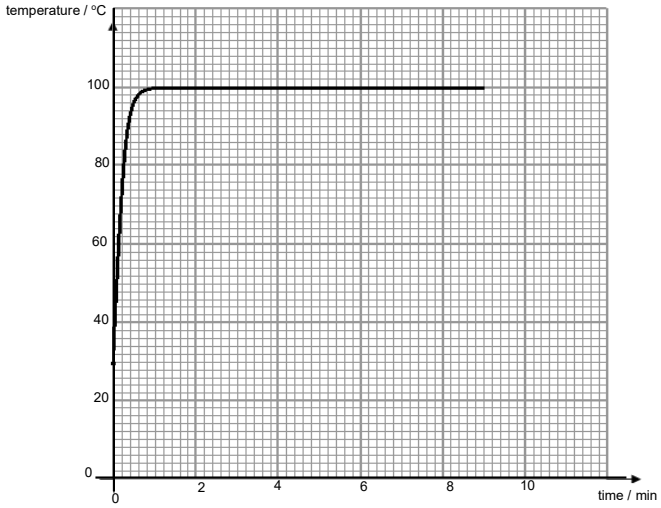


Fig. 10.2

(a) Explain why the temperature of the water does **not** increase further when it reaches 100 °C, even though heat is still supplied to the water.

……...

……...

……. [2]

(b) Explain, using kinetic theory, why a liquid has a fixed volume, but a gas does not.

.....

.....

..... [1]

(c) **(i)** The graph in Fig. 10.3 below shows how the temperature of boiling water in kettle B changes with temperature as it cools.

On Fig. 10.3, sketch a graph to show how the temperature of water will change when an equal mass of boiling water in kettle A is cooled. [1]

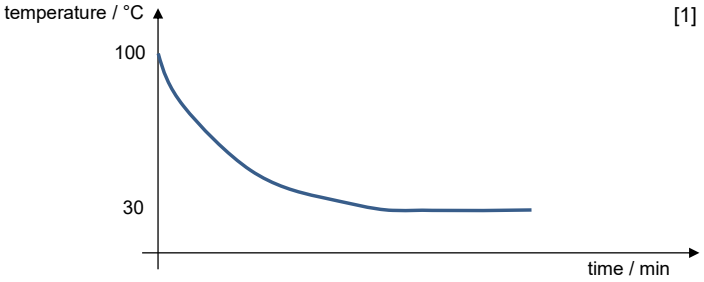


Fig. 10.3

(ii) Explain your answer.

.....

.....

..... [2]

(d) Fig. 10.4 shows a heat sink attached to an electronic device to help with heat removal to protect the device from damage due to overheating.

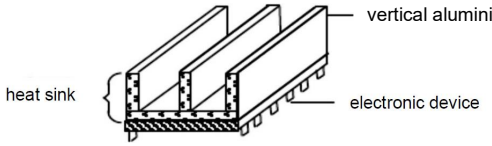


Fig. 10.4

State the thermal processes and explain how the stated design of the heat sink help with the heat removal process. [4]

Design	Thermal Process(s)	Explanation
made of aluminium		....
multiple vertical fins		....

[Total: 10]

Section B

Answer **only one of two** questions in this section.
The total mark for this section is 10.

11 The overall stopping distance of a cyclist is made up of two parts as shown in Fig. 11.1.

- the distance the cyclist travels during the reaction time of the cyclist (the thinking distance)
- the distance the cyclist travels after the brakes are applied (the braking distance)

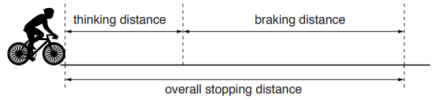


Fig. 11.1 (Not to scale)

(a) A cyclist was traveling in a straight line along a horizontal road at a constant speed of 8.4 m/s. A tree fell in front of the cyclist at time t = 0. After an initial reaction time of 0.4 s, the cyclist applies his brakes and slows down at a constant rate and comes to rest 2.0 s later.

(i) Complete the speed-time graph in Fig. 11.2 to show the journey from the time he sees the tree until he stops. [2]

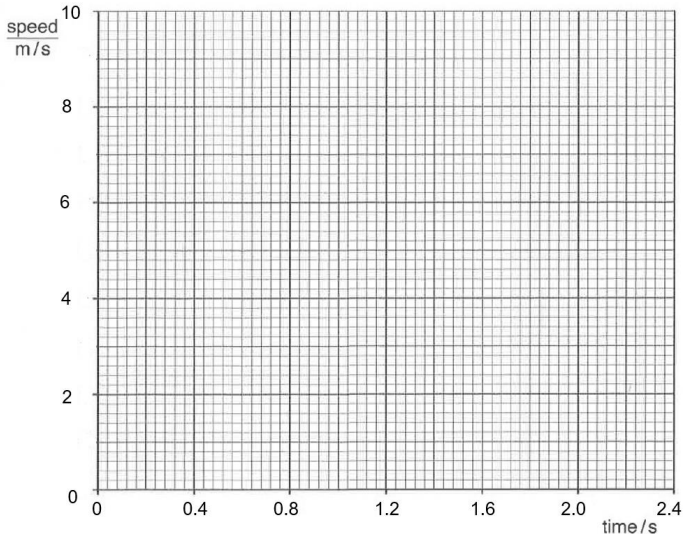


Fig. 11.2

(ii) From Fig. 11.2, calculate the overall stopping distance.

overall stopping distance = ……[2]

(iii) Calculate the deceleration of the cyclist after he applied his brakes.

deceleration = ……[2]

(b) Fig. 11.3 shows a coin being dropped from a height of 380 m above ground. The coin was initially at rest.

The gravitational field strength g is equal to 10 N/kg.

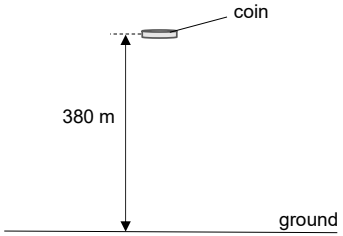


Fig 11.3

(i) Determine the speed of the coin when it is 200 m above the ground. You may ignore air resistance.

speed = ... m/s [3]

(ii) When air resistance is negligible, a heavier coin hits the ground at the same speed as a lighter coin when they are both dropped from the same height.

Explain why.

……

……

…… [1]

[Total: 10]

12 **(a)** Fig 12.1 shows the position of the image of an object seen by the eye using a plane mirror.

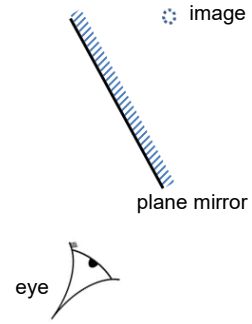


Fig 12.1

(i) Describe fully how the distance of the image from the mirror can be used to locate the position of the object.

……

…… [1]

(ii) On Fig 12.1, construct a ray diagram to locate the position of the object. [2]

(b) Fig 12.2 shows a light ray hitting surface **A** of a rectangular glass block with a refractive index of 1.5. A protractor is also shown.

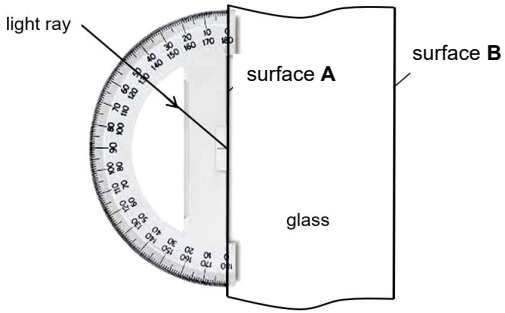


Fig 12.2

(i) Determine the angle of refraction at surface **A**.

angle of refraction = …… [2]

(ii) Given that the speed of light before entering the glass block is 3.0×10^8 m/s, determine the speed of light travelling through the glass block.

speed of light in glass = …… [2]

(c) Fig 12.3 shows an inverted image formed by an object using a lens.

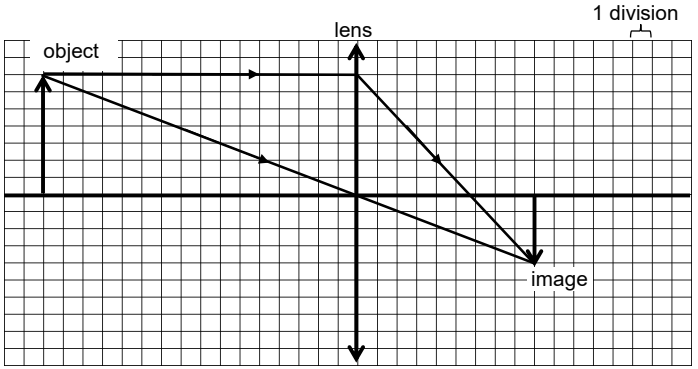


Fig 12.3

(i) State two characteristics of the image formed by the lens.

…… [1]

(ii) Explain how these characteristics show that the lens is a converging lens.

……

…… [1]

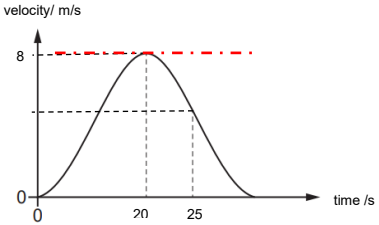
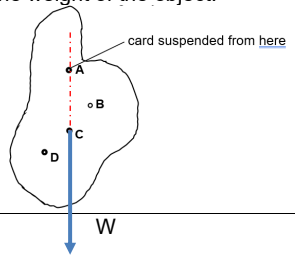
(iii) State one use of such lens setup.

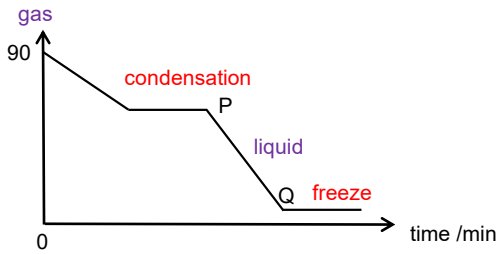
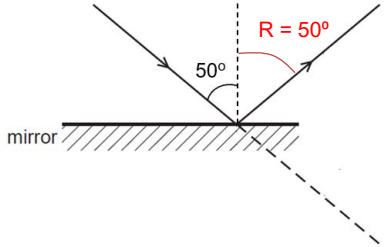
…… [1]

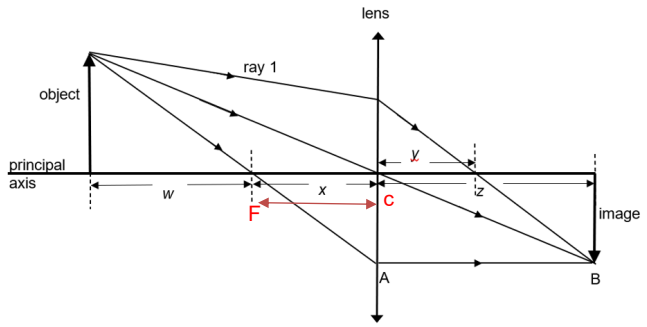
[Total: 10]

Solution to Sec 4 Sci (Phy) Prelim 2024 Paper 1

1	**D**	6	**C**	11	**D**	16	**B**
2	**B**	7	**C**	12	**A**	17	**A**
3	**A**	8	**A**	13	**B**	18	**A**
4	**A**	9	**C**	14	**B**	19	**B**
5	**B**	10	**C**	15	**C**	20	**A**

Qn	Solution	Ans
1	Diameter of human hair: 0.0001 m ~ 0.1 mm Radius of earth: 6 378 000 m ~ 10 Mm	**D**
2	Average speed = Total Distance/ Total Time = 300 m / 250 s =1.2 m/s	**B**
3	Gradient of velocity-time graph equal to gradient of the tangent at that point.  Gradient of tangent at 20s is zero. Hence, acceleration at 20s is 0 m/s^2	**A**
4	Object undergoing constant speed => forces are balanced => resultant force = 0N	**A**
5	P = F/A As the eggs do not crack, this implies that the pressure acting on the eggs are small. This is achieved as the area of contact between the eggs and the guest's feet is large.	**B**
6	A freely suspending object will only come to rest when the centre of gravity is directly below the pivoting point. When this occurs, the perpendicular distance from the line of action due to W to the pivoting point is zero. Therefore, there will not be any resultant moment due to the weight of the object. 	**C**

7	Gain in G.P Store at 1.00 m = 10 kg x 10 N/kg x 1.0 m = 100 J Kinetic store at 1.00 m = 160 J – 100 J = 60 J Work done against gravity = Gain in G.P Store at 1.00 m = 100 J	**C**
8	Power = E/ t = 432 000 000 J / (24 x 60 x 60)s = 5000 W = 5.0 kW	**A**
9	Before boiling, energy stores in the liquid will increase as temperature increases. During boiling, energy stores in the liquid will remain constant and temperature remains constant.	**C**
10	 At PQ, the state of the substance is liquid. Since the temperature is decreasing with time, the substance is undergoing a cooling process.	**C**
11	From graph, Wavelength of wave, λ = 2 cm Time period, T = 0.04 s Frequency = 1/T = 1/0.04 s = 25 Hz V = fλ = 2 x 25Hz = 50 cm/s	**D**
12	Loudness affects amplitude of sound wave Pitch affects the frequency of sound wave Speed of sound wave is affected by the density of the medium. Since there is no change in medium in which the sound wave is travelling in and the pitch is the same. Hence, both speed and frequency will remain the same.	**A**
13	Angle of reflection = angle of incidence Since angle of incidence is 50º, hence, angle of reflection is 50º. 	**B**

14	Focus length is the distance between the optical centre, c and principal focus, F.  	**B**
15	2 d = speed x time taken 2 d = 1500 m/s x 4 s d = 3000 m	**C**
16	I = Q/t = 60 C / 20 s = 3.0 A	**B**
17	Current through 60 Ω is half of that of 30 Ω. = 0.60 A/ 2 = 0.30 A p.d. across 30 Ω = 30 Ω x 0.60 A = 18 V p.d. across 60 Ω = 18 V Current through 60 Ω = 18 V/ 60 Ω = 0.30 A	**A**
18	Thin iron sheet will act as magnetic shield. Thus, there will not be any magnetic field attracting the paper clips.	**A**
19	A neutral nuclide will have the same number of proton and electrons. Since $^{235}_{92}$Uhas 92 protons, the number of electrons will be 92.	**B**
20	16 g → 8 g → 4 g → 2 g Following nuclide has gone through 3 half-life. Since the half life of 225-Ra is 15 days. Duration for nuclide mass to reduce to 2 g = 15 x 3 = 45 days.	**A**

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Secondary Four Express Academic
PRELIMINARY EXAMINATION 2024

NAME

CLASS **REGISTER NUMBER**

SCIENCE (PHYSICS,CHEMISTRY) **5086/01**

Paper 1 Multiple Choice **19 August 2024**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your Name, Class and Index Number on the Answer Sheet and Question Booklet.

There are **forty** questions. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.

Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

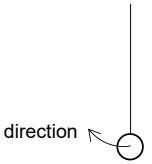
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on this booklet.
A copy of the Data Sheet is printed on page 18.
A copy of the Periodic Table is printed on page 19.
The use of an approved scientific calculator is expected, where appropriate.

1 Which is a vector quantity?

A distance
B energy
C force
D speed

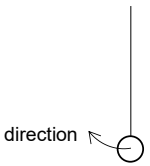
2 A pendulum has a period of 2.0 s.

A stopwatch is started when the pendulum is vertical and is moving to the left, as shown.

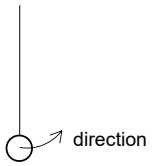


Which diagram shows the position and direction of the pendulum 5.0 s later?

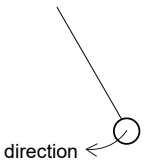
A



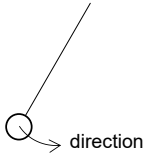
B



C



D



3 A car moving at 30 km/h speeds up with a constant acceleration for 6 minutes, reaching a final speed of 70 km/h.

What is the distance travelled during this time?

A 3.0 km
B 4.0 km
C 5.0 km
D 7.0 km

4 An object of mass 60 kg is pushed across a floor by a force of 300 N. The total frictional force acting on the object is 180 N.

What is the acceleration of the object?

A 2.0 m/s^2

B 3.0 m/s^2

C 5.0 m/s^2

D 8.0 m/s^2

5 A car of weight 11 000 N moves with constant velocity along a horizontal road. A driving force of 5000 N acts on the car.

What is the force opposing the motion of the car and the resultant force on the car?

	opposing force / N	resultant force / N
A	5000	0
B	5000	6000
C	11 000	0
D	11 000	6000

6 An astronaut in his spacesuit has a mass of 90 kg on Earth. He can jump 15 cm high off the surface of the Earth.

Why can the astronaut jump higher when he is on the moon?

A On the moon, his mass is larger than on Earth.

B On the moon, his mass is the same as on Earth.

C On the moon, his weight is smaller than on Earth.

D On the moon, his weight is the same as on Earth.

7 A tennis ball of mass 56 g is travelling is travelling at 1500 metre / minute.

Which expression is equal to the kinetic energy, in joule (J), of the tennis ball?

A $\frac{1}{2} \times 0.056 \times (25)^2$

B $\frac{1}{2} \times 56 \times (25)^2$

C $\frac{1}{2} \times 0.056 \times (1500)^2$

D $\frac{1}{2} \times 56 \times (1500)^2$

8 A heated surface loses heat by radiation.

Which of the following factors does not affect the rate of energy transfer by radiation?

A the area of the surface

B the colour of the surface

C the surrounding air pressure

D the temperature of the surface

9 Some gas is heated in a sealed container.

Which of the following does not occur?

A The force due to the collisions between the gas molecules and container walls increases.

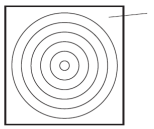
B The number of collisions per second by the gas molecules on the container walls increases.

C The average kinetic energy of gas molecules increases.

D The average distance between gas molecules increases.

10 The diagrams show examples of wave motion.

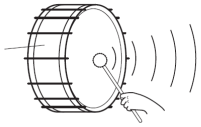
I



ripple tank

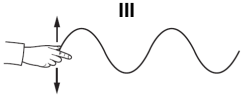
waves on water

II



waves in air

III



waves on a rope

IV

waves in a spring

Which waves are longitudinal?

A II only

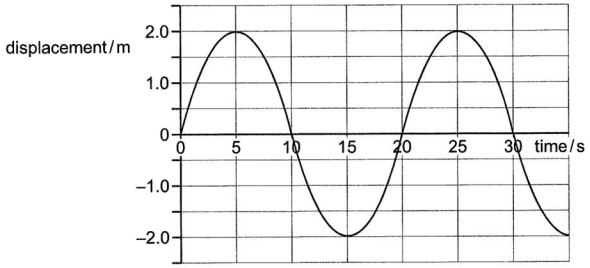
B II and IV only

C III and IV only

D I, II and IV

11 A boat oscillates vertically as a water wave passes.

The graph shows how the displacement of the boat from its equilibrium position varies with time.



Which characteristics of the wave can be deduced from this graph?

A Its amplitude is 2.0 m and its speed 0.40 m/s.

B Its amplitude is 2.0 m and its frequency 0.050 Hz.

C Its wavelength is 20 m and its speed is 0.40 m/s.

D Its wavelength is 20 m and its frequency 0.050 Hz.

12 Which of the following statements about electromagnetic waves is correct?

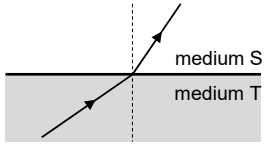
A Blue light has a higher frequency than red light.

B Blue light has a higher speed than red light in vacuum.

C Infra-red radiation has a shorter wavelength than ultra-violet radiation.

D Microwaves have a shorter wavelength than visible light.

13 The diagram shows a ray of light moving from medium S to medium T.



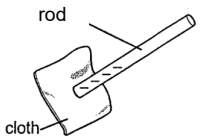
Which row compares medium S and medium T?

	medium S	medium T
A	light travels faster	high refractive index
B	light travels faster	low refractive index
C	light travels slower	high refractive index
D	light travels slower	low refractive index

14 A plastic rod is rubbed with a cloth. The cloth becomes negatively charged.

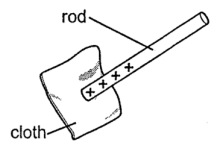
Which diagram shows the charge on the rod and describes the movement of charge?

A



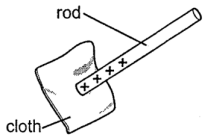
negative charges move from the cloth onto the rod

B



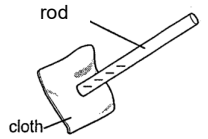
negative charges move from the rod onto the cloth

C



positive charges move from the cloth onto the rod

D



positive charges move from the rod onto the cloth

15 The current in a light bulb is 3 A. It is switched on for 15 minutes.

How much charge flows through the light bulb?

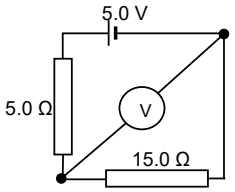
A 5 C

B 45 C

C 300 C

D 2700 C

16 A circuit is set up as shown in the figure below.



What is the reading on the voltmeter?

A 1.25 V

B 3.00 V

C 3.75 V

D 15.0 V

17 A wire of length l and cross-sectional area A has a resistance R.

Another wire of the same material has length 2l and cross-sectional area ½ A.

What is the resistance of the new wire?

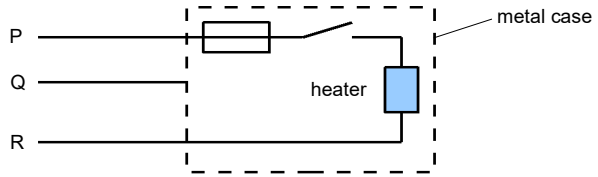
A ½ *R*

B *R*

C 2*R*

D 4*R*

18 The diagram below shows the electrical set-up for an electric heater.

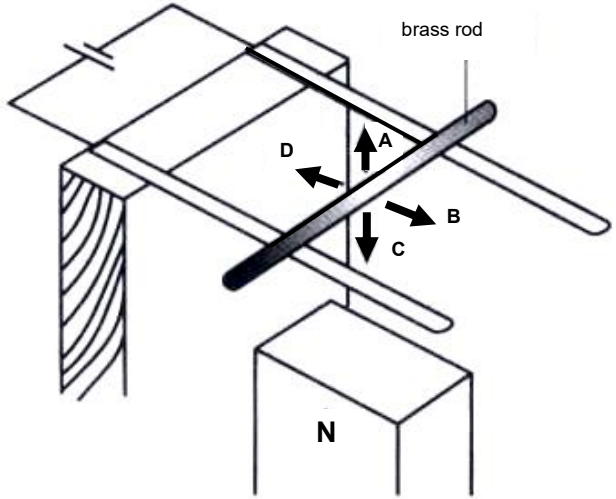


The heater requires a current of 10 A to operate.

Which of the following correctly states the current in each wire when the heater is working normally?

	P	Q	R
A	0 A	0 A	10 A
B	10 A	0 A	0 A
C	10 A	0 A	10 A
D	10 A	10 A	10 A

19 A brass rod is supported on two copper rails which are connected to battery. The north pole of the magnet is placed beneath the rails as shown in the diagram below.



In which of the directions **A**, **B**, **C** or **D** does the brass rod experience a force?

20 Which of the following statements is not true for a beta particle?

A It has negative electrical charge.

B It can be stopped by a sheet of paper.

C It is an electron.

D It can ionize a gas.

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Secondary Four Express
PRELIMINARY EXAMINATION 2024

NAME

CLASS **REGISTER NUMBER**

SCIENCE (PHYSICS) **5086/02**

Paper 2 **19 August 2024**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, register number and class on all the work you hand in.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
Do not use staples, paper clips, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units

Section A
Answer **all** questions. Write your answers in the spaces provided on the question paper.

Section B
Answer **one** questions.
Write your answers in the spaces provided on the question paper.

The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
SECTION A (55 marks)	
SECTION B (10 marks)	
significant figure	
units	
TOTAL (65 marks)	

[Turn over

This document consists of 17 printed pages

SECTION A

Answer **all** the questions in the spaces provided.

1 Fig. 1.1 shows two experiments where one is conducted on the Earth while the other is conducted on the Moon. The same beam balance was used in both experiments. The gravitational field strength on Moon is one sixth that of the Earth.

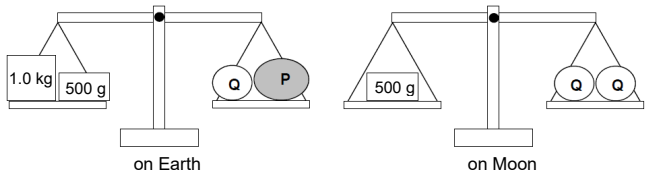


Fig. 1.1

(a) Determine the mass of object **P** and object **Q**.

object **P** = ……g [1]

object **Q** = ……g [1]

(b) State two assumptions you made in your calculations in (a).

……

……

…… [2]

2 Fig. 2.1 shows a trolley **P** on a horizontal table. Fig. 2.2 shows an identical trolley **Q**, but is loaded with steel bars, on the same table. Both trolleys are initially at rest. A horizontal force of 10 N is then applied to each of the trolley for 0.20 s.

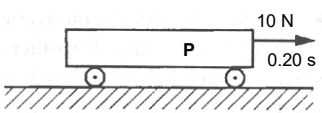


Fig. 2.1

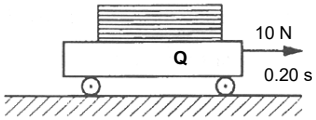


Fig. 2.2

(a) After 0.20 s, trolley **P** moves to the right with a speed of 5.0 m/s but trolley **Q** moves to the right with a speed of 1.0 m/s.
Explain why these speeds are different.

.....

.....

..... [2]

(b) Trolley **P** is now turned over so that it is resting on its top surface, as shown in Fig. 2.3.

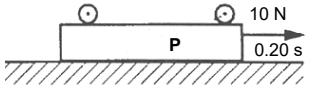


Fig. 2.3

(i) Explain why the same horizontal force acting for the same duration will now cause a smaller speed change.

.....

..... [1]

(ii) Explain why the speed rapidly reduces to zero once the 10 N force is removed.

.....

..... [1]

3 Fig. 3.1 shows a heavy piece of metal being pulled from position **X** to position **Y**. The metal has a weight of 2500 N and is pivoted freely at **O**.

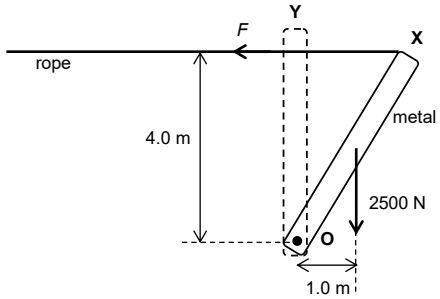


Fig. 3.1

(a) When the piece of metal is at position **X**, the rope is pulled with a horizontal force F. The metal is in equilibrium at this instant.

(i) Calculate the moment of the metal's weight about the pivot **O** when it is at position **X**.

moment = ...Nm [1]

(ii) Hence, calculate the horizontal force F exerted.

force = ...N [1]

(b) When the horizontal force F doubles, the metal starts to move from position **X** to **Y**. The magnitude of force F remains the same while the metal moves.

State how the moment of F about the pivot **O** changes as the metal moves from position **X** to **Y**.
Explain your answer.

.....

.....

..... [2]

4 Fig. 4.1 shows a cup in which hot coffee is served for takeout at a cafe. The design of the cup consists of the following:

- a thin plastic lid
- two layers of dark cardboard arranged in the manner shown in Fig. 4.2.

Fig. 4.1

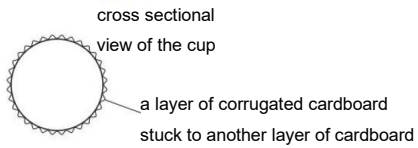


Fig. 4.2

(a) Explain how the design of the cup allows a customer to hold a cup of hot coffee comfortably.

.....

..... [1]

(b) Explain how the plastic lid helps to keep the coffee warm.

.....

..... [1]

(c) Suggest how you will modify the design of the cup to keep coffee hot for a longer period.
Explain your answer.

.....

.....

..... [2]

5 Fig. 5.1 shows circular wavefronts of water waves produced by a dipper. The distance between point **P** and point **Q** on the water wave is 8.0 cm.

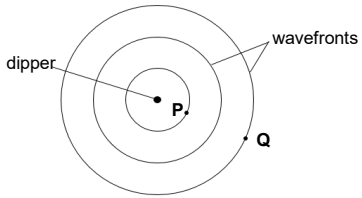


Fig. 5.1

(a) State what is meant by "…*wavefronts*…".

.....

..... [1]

(b) The dipper moves repeatedly through a maximum vertical distance, from the lowest point to the highest point, of 4.0 cm.
On Fig. 5.2, sketch the graph to show how the displacement of water molecules varies along **PQ**.
Label the graph drawn A.

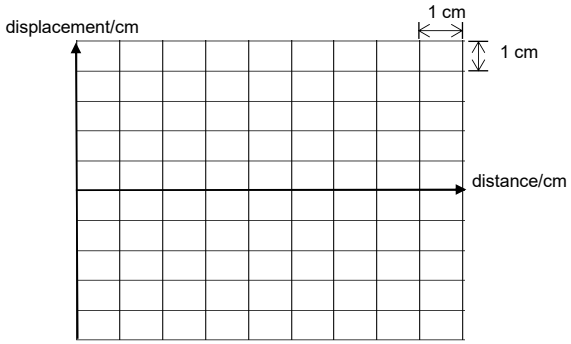


Fig. 5.2

[1]

(c) The dipper operates at a frequency of 20 Hz.
Determine the time taken for the water waves to propagate from point **P** to point **Q**.

time = ……s [2]

(d) On the same Fig. 5.2, sketch another graph to show how the displacement of water along **PQ**, will change if the frequency of dipper is halved and maximum vertical distance doubled. [1]
Label the graph drawn B.

6 Every element will absorb a particular set of electromagnetic waves. Based on this characteristic, we can identify the elements present in any planet and star in the universe.

Table 6.1 shows the wavelengths of the electromagnetic waves that are absorbed by four elements.

element	wavelength / nm
iron	300
hydrogen	430 and 650
helium	580
sodium	720

Table 6.1

(a) Calculate the frequency of the electromagnetic wave with the lowest frequency that is being absorbed by the elements.

frequency = ……Hz [2]

(b) In the electromagnetic spectrum, visible light has wavelengths ranging from 400 nm to 700 nm.

(i) State the component of the electromagnetic spectrum that is absorbed by sodium.

…… [1]

(ii) State an application of this component.

…… [1]

7 An object with a height of 15.0 cm is placed 30.0 cm in front of a thin converging lens to produce a real image which is twice the size of the object.

(a) Using the scale in Fig.7.1, draw suitable light rays to locate the image of the object. [3]
Label the image **I** clearly on Fig. 7.1.

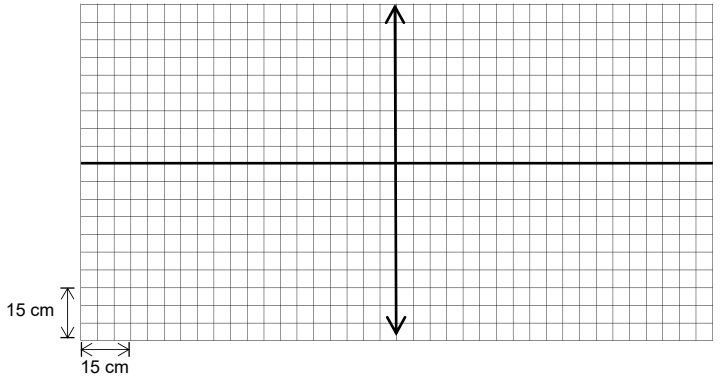


Fig. 7.1

(b) From your scaled ray diagram in Fig. 7.1, determine the focal length of the lens used.
Label the focal point **F** of the lens clearly on Fig. 7.1.

focal length = ……cm [2]

8 Fig. 8.1 shows an electrical circuit containing a 9.0 V electric cell, several resistors, two switches, an ammeter and a voltmeter. When switches **X** and **Y** are closed, the voltmeter and ammeter readings are 4.3 V and 1.9 A respectively.

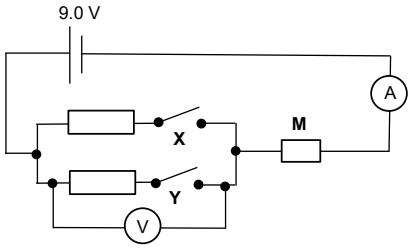


Fig. 8.1

(a) Calculate the total resistance in the entire circuit.

resistance = ……Ω [1]

(b) Calculate the potential difference across resistor **M**.

potential difference = ……V [1]

(c) Calculate the resistance of resistor **M**.

resistance = ……Ω [1]

(d) State how the ammeter and the voltmeter readings will change when switch **X** is opened while switch **Y** remains closed.
Circle the correct answer.

ammeter's reading: increase / decrease / remains the same

voltmeter's reading: increase / decrease / remains the same [2]

9 Fig. 9.1 shows an electromagnet that controls two lamps, **A** and **B**.

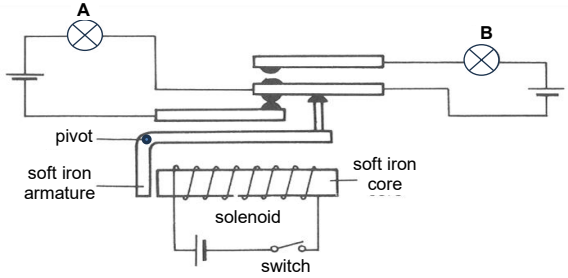


Fig. 9.1

(a) Explain how lamp **A** goes off and lamp **B** lights up when the switch is closed.

……

……

……

…… [3]

(b) State one change when the soft iron core is replaced with a steel core.

……

…… [1]

10 **(a)** β-radiation is emitted during the spontaneous radioactive decay of an unstable nucleus.

(i) State the nature of a β-radiation.

…… [1]

(ii) State one property of β-radiation.

……

…… [1]

(iii) Explain the meaning of "…*spontaneous radioactive decay*…".

……

…… [1]

(b) A sample, whose half-life is 8 days, contains 16 g of radioactive material.

(i) Determine the amount of radioactive material left in the sample after 32 days.

mass = ……g [1]

(ii) State two ways to control exposure to radiation.

……

……

…… [2]

11 Jacob released a 10 g marble from a slope shown in Fig. 11.1. The gravitational field strength is 10 N/kg and the radius of the loop is 15 cm.

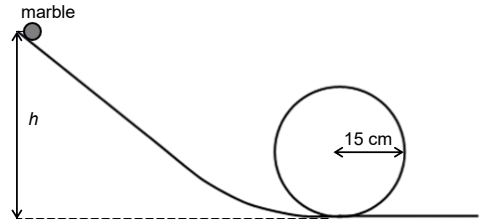


Fig. 11.1

If the marble is to complete its path along the track without falling off the loop, it must maintain a speed of at least 2.0 m/s.

(a) Explain what is meant by "…*gravitational field strength*…"

……

…… [1]

(b) On Fig. 11.1, mark, with an **X**, the position on the loop where the marble has the **lowest** speed. [1]

(c) Calculate the minimum energy in the kinetic store of the marble at the point marked in **(b)**.

energy = ……J [2]

(d) Calculate the energy in the gravitational potential store of the marble at the point marked in **(b)**.

energy = ……J [2]

(e) Hence, calculate the minimum height from which the marble should be released so that it will be able to complete the track without falling off.

height = ……m [2]

(f) In real-life, when Jacob released the marble from the height calculated in **(e)**, state whether the marble will be able to complete the track without falling off.
Explain your answer.

……

……

…… [2]

SECTION B

Answer **one** question.

Write your questions in the spaces provided.

12 Fig. 12.1 shows the distance-time graphs of two trains, **P** and **Q**. Both trains travel between the same two stations on parallel tracks.
Train **Q** starts its journey at time t = 0 and train **P** starts its journey at t = 10 minutes.

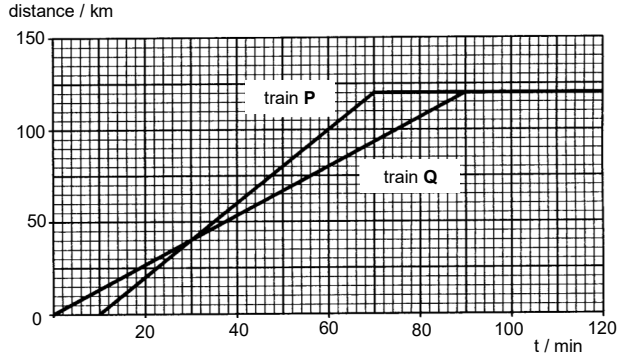


Fig. 12.1

(a) Explain how Fig. 12.1 shows that, when moving, train **P** is travelling at a higher speed than train **Q**.

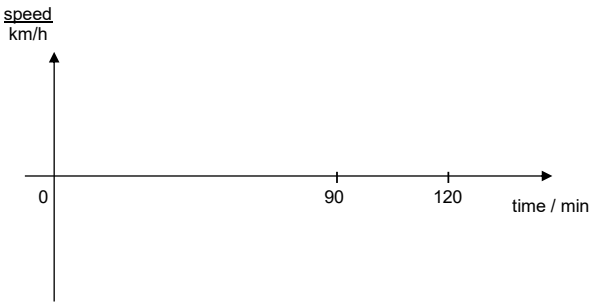
……

…… [1]

(b) Calculate the speed of train **Q** when it is moving, **in km/h**.

speed = ……km/h [2]

(c) On the axes provided below, sketch the corresponding speed-time graph for train **Q**.



[2]

(d) Another train, **R,** makes the same journey but it leaves the station 30 minutes after train **P**. Train **R** travels at twice the speed of train **P**.

(i) Sketch the distance-time graph for train **R** on Fig. 12.1. [2]

(ii) Hence, determine the time at which train **R** overtakes train **Q**.

time = ……min [1]

(iii) Train **R** has a mass of 25 000 kg and the frictional force on the track is 5400 N. Determine the engine thrust needed for the train to reach an initial acceleration of 1.0 m/s^2.

thrust = ……N [2]

13 An electric kettle, with several heating elements, is to be used on a 240 V mains supply. Fig 13.1 shows the arrangement of the heating elements **K**, **L** and **M** in the kettle. Each heating element is a resistor. Each heating element operates at a power of 1.0 kW when switched on.

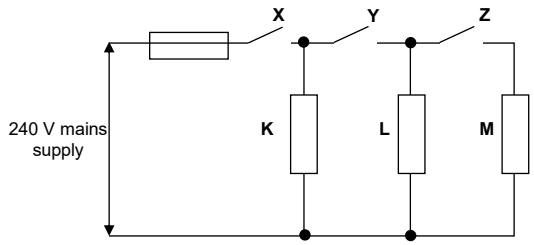


Fig. 13.1

(a) When a heating element is switched on for 30 minutes, calculate the

(i) current flowing through it,

current = ……A [1]

(ii) amount of charges flowing through it.

charges = ……C [2]

(b) State the purpose of the fuse present in the circuit.

……

…… [2]

(c) Each unit of electrical consumption costs about 30 cents and the kettle is to operate at 3.0 kW for 30 minutes.

(i) State which switch(es) should be closed.

switch(es) = …… [1]

(ii) Calculate the current flow through the fuse.

current = ……A [1]

(iii) Suggest a suitable fuse rating to be used in the circuit.

rating = ……A [1]

(iv) Determine the cost of operating the kettle.

cost = ……cents [2]

~ End of Paper ~

Answers

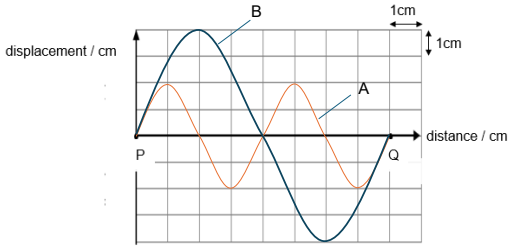
1	C	**11**	B	21		31	
2	B	**12**	A	22		32	
3	C	**13**	D	23		33	
4	A	**14**	B	14		34	
5	A	**15**	D	25		35	
6	C	**16**	C	26		36	
7	A	**17**	D	27		37	
8	C	**18**	C	28		38	
9	D	**19**	B	29		39	
10	B	**20**	B	30		40	

For 5NA, question 20 is changed. The answer is D

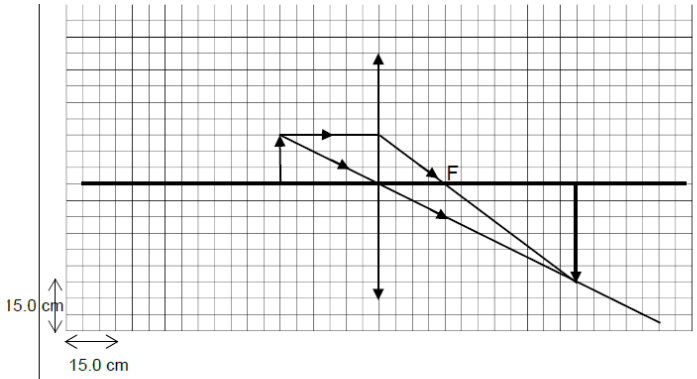
Marking Scheme for 2024 Prelim Sec 4E Science P2

Section A (55m)

Qn	Answers	Mark
1a	**Ans**: Mass of Q+Q $= 500\ g$ Mass of P+Q $= 1500\ g$ Mass of Q $= 250\ g$ [1] Mass of P $= 1500\ g - 250\ g = 1250\ g$ [1] Comments: 1. s	2
1b	**Ans**: (Any two logical answers + OWTTE) • The **balance** is in **equilibrium/is horizontal**. • all strings are **taut/tight**. • **Amount of matter/mass remains the same** for P or Q Comments: 1. s	2
2a	**Ans:** • Since **Q has larger mass**, [1] • its **acceleration will be smaller** compared to P. [1] • With different accelerations, **P** and **Q** will end up with different speeds after 0.2 s. ** No marks if student wrote "**P** and **Q** have different masses/accelerations". Student must state whose mass/acceleration is larger/smaller Comments: 1. s	2
2bi	**Ans:** • **Larger Friction** / **Smaller net force (F_{net})** is acting on trolley P [1] • resulting in smaller acceleration ➔ smaller speed increment after 0.2s.	1
2bii	**Ans:** • When 10 N force is removed, the larger friction results in a **negative net force** [1] which causes deceleration, which leads to the eventual speed of zero. Comments: 1. s	1
3ai	**Ans**: $Moment = 2500 \times 1.0$ $= 2500\ Nm$ [1] Comments: 1. s	1
3aii	**Ans**: Total anticlockwise moment = Total clockwise moment $F \times 4.0 = 2500$ $F = 625N$ or $630N$ [1] Comments: **1. s**	1
3b	**Ans:** • Moment of F about O ➔ **increases** [1] • As the metal moves from position X to Y, the **perpendicular distance** from the line of action of F to the pivot O **increases**. [1] • Hence, the moment of F about O increases. Comments: 1. s	2
4a	**Ans:** • Trapped **air** inside corrugated cardboard, is **a poor conductor of heat** [1] • It will reduce the heat conducted outwards. • Thus, allowing customer to hold the cup comfortably. *No marks for stating cardboard is a bad conductor ➔ qn as for "design" Comments: **1. s**	1

4b	**Ans:** • Prevent **<u>convection current from occurring</u>** OR **<u>cold air from coming in contact with the hot coffee</u>** [1] Comments: **1. s**	1
4c	**Ans:** • Change to **<u>white colour</u>** [1] • **<u>White</u>** is a **<u>bad absorber</u>** of heat [1] OR • Add another **<u>layer of cardboard</u>** [1] • **<u>Air</u>**/**<u>cardboard</u>** is a **<u>bad conductor</u>** of heat [1] *cannot change size/material of the cup (must use cardboard) ➔e.g cannot use "ceramic" (as there is no evidence that ceramic is a better insulator than cardboard) **Comments:** **1. s**	2
5a	**Ans**: • A wavefront is an **<u>imaginary</u>** line on a wave that joins **<u>all adjacent points that are in phase</u>**. [1] **Comments:** **1. s**	1
5b & 5d	**ANS:**  Comments: 1. s	1 1

5c	**Ans:** $v = f\lambda$ $= 20 \times 4$ $= 80cm/s$ [1] $speed = \frac{Dist}{time}$ $t = \frac{Dist}{speed}$ $= \frac{8}{80}$ $= 0.10s$ [1] Comments: **1. s**	2
6a	**Ans**: $v = f\lambda$ $f = \frac{v}{\lambda}$ $= \frac{3\times10^{8}}{720\times10^{-9}}$ [1] $= 4.17\times10^{14}Hz$ or $4.2\times10^{14}Hz$ [1] Comments**:** **1. s**	2
6bi	**Ans**: Infra-red radiation [1] Comments**:** **1. s**	1
6bii	**Ans:** Any possible application • Cooking, remote control, intruder alarms etc. [1] *allow e.c.f from (bi) Comments: 1. s	1

7a	**Ans:**  [1] ray that passes through optical centre to determine position of image [1] ray that pass through focal point [1] object, arrows, and image correctly labelled Comments: 1. s	3
7b	**Ans:** • focal length = 20.0cm (accept 15 to 25 cm) [1] • focal point F label clearly on Fig. 6.1 [1] Comments: 1. s	2
8a	**Ans**: $V_T = I_T R_T$ $R_T = \frac{9.0}{1.9}$ $= 4.7\Omega$ [1] Comments: 1. s	1

8b	**Ans**: $V_T = V_{//} + V_M$ $9.0 = 4.3 + V_M$ $V_M = 4.7V$ [1] Comments: 1. s	1
8c	**Ans**: $V_M = I_T R_M$ $R_M = \frac{4.7}{1.9}$ $= 2.47\Omega$ or 2.5Ω [1] Comments: 1. s	1
8d	**Ans**: Decrease, increase [1] Comments: 1. s	1
9a	**Ans:** When switch is closed, • the **soft-iron gets magnetized** and **attracts the soft iron armature**.[1] • The lower set of contacts are **separated** / the **circuit for lamp A breaks** and hence lamp A goes off. [1] • The upper set of contacts are **closed** / the **circuit for lamp B is closed** and hence lamp B lights up. [1] Comments: 1. s	3
9b	**Ans: OWTTE** [either] • When switch is closed, **Lamp A will go off (Lamp B will light up)** only **after some time** (not immediately) OR • When switch is opened, **Lamp A will still remains off (Lamp B will still remains lit)** only **for some time** (not immediately) Comments: 1. s	1

10ai	**Ans:** • It is a fast-moving **electron**. [1] Comments: 1. s	1
10aii	**Ans: (any one)** • absorbed by **thin layer of aluminium** / **0.5 to 2 m of air layer** OR • can be **deflected** by **electric/magnetic fields/negative charges** Comments: 1. s	1
10aiii	**Ans:** • decay occurs and **cannot be affected** by **physical and chemical means** OR **heating, cooling, chemical means or any other methods** (list any **two factors**) Comments: 1. s	1
10bi	**Ans:** $32\text{days} = 4 \text{ half-lives}$ $mass = 16 \div 2 \div 2 \div 2 \div 2$ $= 1.0g$[1] Comments: 1. s	1
10bii	**Ans: Any two of the following** • Reduce exposure time. • Increase distance between the source and yourself. • Use shielding. • Store radioactive material in sealed container/lead box. Comments: 1. s	2
11a	**Ans:** • The amount of gravitational force per unit mass placed at that point. [1] Comments: 1. s	1
11b	**Ans**: • X is at the top of the loop Comments: 1. s	1
11c	**Ans**:	2
	$E_K = \frac{1}{2}mv^2$ $= \frac{1}{2}\left(\frac{10}{1000}\right)(2.0)^2$ [1] $= 0.020J$ [1] **minus 1 mark if not in values used are not SI units (part c to e→ minus ONCE only) Comments: 1. s	
11d	**Ans**: $E_P = mgh$ $= \left(\frac{10}{1000}\right)(10)(0.30)$ [1] $= 0.030J$ [1] **minus 1 mark if not in values used are not SI units (part c to e→ minus ONCE only) **Comments:** **1. s**	2
11e	**Ans**: $E_{TOTAL} = E_K + E_P$ $= 0.020 + 0.030$ $= 0.050J$ [1] $\frac{1}{2}mv^2$ $E_P = E_{TOTAL}$ $mgh = 0.050J$ $h = \frac{0.050}{\left(\frac{10}{1000}\right)(10)}$ $= 0.50m$ [1] **minus 1 mark if not in values used are not SI units (part c to e→ minus ONCE only) **allow e.c.f. **Comments:** **1. s**	2
11f	**Ans:** • **Not able** to complete [1] • Because there will be **energy lose to do work against air resistance** OR **work done against friction along the slope**. (no mark for stating "energy lose to surrounding) [1] • Hence the energy in kinetic store/speed will be not sufficient. Comments: 1. s	2

Section B (10m – Two Qns Choose one)

Qn	Answers	Mark
12a	**Ans:** • The **<u>gradient</u>** of the graph for train **<u>P is steeper</u>** than that of train Q. [1] Comments: 1. s	1
12b	**Ans**: $Speed_Q = gradient$ $= \frac{120-0}{1.5hr-0}$ [1] $= 80km/h$ [1] *minus 1 mark if student uses 90min or km/min or m/s" Comments: 1. s	2
12c	**Ans:** • 0 to 90min = horizontal line + label 80km/h [1] • 90 min to 120min = horizontal line @ 0 km/h [1] Comments: 1. s	2
12di	**Ans:** • Straight line, starts at 40, ends at 70 min [1] • Horizontal line @ 120 km + after 70 min [1] Comments: 1. s	2
12dii	**Ans:** • Time at which R overtakes Q @ t = 60 mins [1] **Comments:** **1. s**	1
12diii	**Ans**: $F_{net} = ma$ $Thrust - 5400 = (25000)(1.0)$ [1] $Thrust = 30400N$ [1] **Comments:** **1. s**	2

13ai	**Ans**: $P = IV$ $1000 = (I)(240)$ $I = 4.17A$ OR $4.2A$ [1] **Comments:** **1. s**	1
13aii	**Ans**: $I = \frac{Q}{t}$ $Q = (4.17)(30 \times 60)$ $= 7510C$ or $7500C$ [1] **Comments:** **1. s**	2
13b	**Ans:** • When **<u>excess/high current</u>** flows in the circuit, the fuse will **<u>melt</u>** [1] • and d**<u>isconnect the appliance from high voltage</u>**. [1] Comments: 1. s	2
13ci	**Ans**: X, Y and Z [1] **Comments:** **1. s**	1
13cii	**Ans**: $I = (4.17)(3)$ $= 12.5A$ [1] *allow e.c.f from (ci) **Comments:** **1. s**	1
13ciii	**Ans**: 13A [1] *allow e.c.f from (cii) **Comments:** **1. s**	1
13civ	**Ans**: $Energy_{TOTAL} = Pt$ $= (3.0kw)\left(\frac{30}{60}\right)$ $= 1.5kWh$ [1] $COST_{TOTAL} = (1.5)(30cents)$ $= 45cents$ [1] *minus 1 mark if unit for time is in MINUTE *Allow answer to be in Dollars **Comments:**	2

NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2025

SUBJECT : **SCIENCE (PHYSICS/CHEMISTRY) (5086/01)**

DATE : **19 AUGUST 2025**

LEVEL : **SECONDARY 4 EXPRESS / 5 NORMAL (A)**

DURATION : **1 HOUR**

INSTRUCTIONS TO CANDIDATES:

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A, B, C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the separate **OPTICAL ANSWER SHEET**.

INFORMATION FOR CANDIDATES:

Each correct answer will score one mark. Marks will not be deducted for wrong answers.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.
Your total score for Paper 1 will be the number of correct answers given.

This question paper consists of 21 printed pages, including the cover page, datasheet and Periodic Table.

1 Length, temperature and mass are examples of physical quantities.

Which of the following is correct about physical quantities?

A They have magnitude only.
B They have magnitude and a unit only.
C They have magnitude and direction only.
D They have magnitude, direction and a unit.

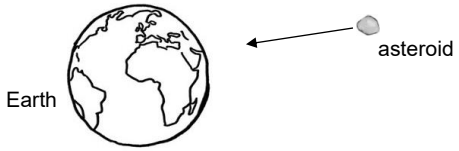
2 A parachutist steps off an airplane in mid-air. The amount of time from when he steps off the plane and the speed of his fall is shown in his smart watch.

Air resistance is negligible.

Which one of the following shows the correct reading on his smart watch?

A **B** **C** **D**

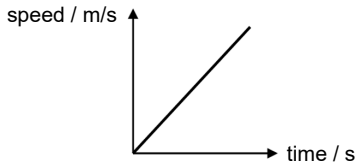
3 An asteroid is entering the Earth's atmosphere.



How do the mass and weight of the asteroid change as it enters the Earth's atmosphere?

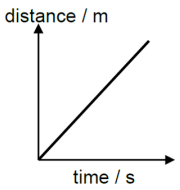
	mass	weight
A	decreases	no change
B	increases	no change
C	no change	decreases
D	no change	increases

4 The diagram shows a speed-time graph of a short journey.

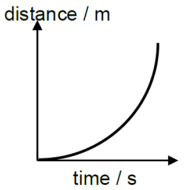


Which distance-time graph represents the same journey?

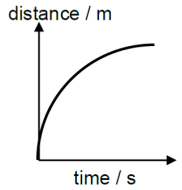
A



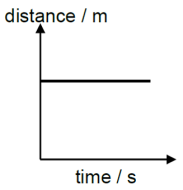
B



C



D



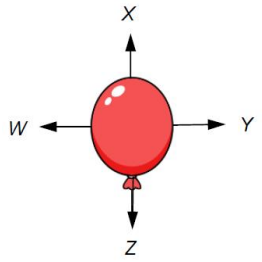
5 Four of the gravitational forces that act between bodies in the Solar System are described below.

P: the force on the Moon due to the Earth
Q: the force on the Earth due to the Sun
R: the force on the Earth due to the Moon
S: the force on the Moon due to the Sun

Which two forces form a Newton's third law action-reaction pair?

A P and Q
B Q and S
C P and R
D R and S

6 Four forces *W*, *X*, *Y* and *Z* act on a balloon. The directions of the forces are shown.

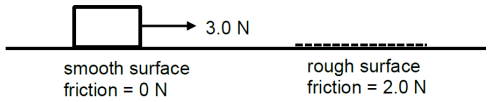


The balloon moves horizontally to the right with a constant speed.

Which statement must be correct?

A All four forces are of equal magnitude.
B *X* and *Z* are equal in magnitude but *Y* is larger than *W*.
C *W* and *Y* are equal in magnitude but both are larger than *X* and *Z*.
D *W* and *Y* are equal in magnitude and *X* and *Z* are equal in magnitude.

7 A box was pulled with a constant force of 3.0 N, towards a rough surface where friction is 2.0 N.



Which statement describes the motion of the box as it enters the rough surface?

A The box slows down.
B The box stops immediately.
C The box moves at a constant speed.
D The box continues to accelerate, but at a lower rate.

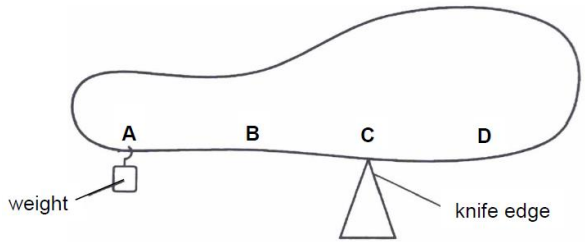
8 A rectangular object of dimensions 0.75 m × 1.0 m × 2.0 m has a weight of 42000 N. It is placed on a flat horizontal surface.

What is the minimum pressure that the object can exert on the surface?

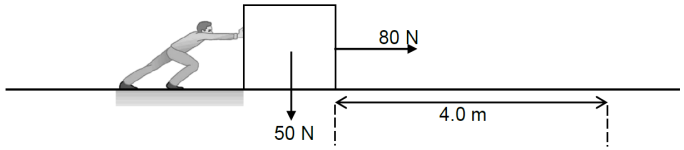
A 14000 N/m^2
B 21000 N/m^2
C 28000 N/m^2
D 56000 N/m^2

9 A non-uniform object is balanced on a knife edge, by suspending a weight from the left-hand end of the object.

Where is the centre of gravity of the object?



10 A man pushes a box weighing 50 N across a floor. He exerts a force of 80 N and the box moves 4.0 m in 5.0 seconds.



What is the average power produced by the man?

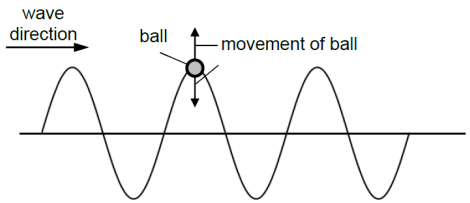
A 40 W
B 64 W
C 1000 W
D 1600 W

11 In liquids, thermal energy is transferred by convection.

What is the cause of convection?

A change in density
B change in mass
C molecules expanding
D molecules vibrating

12 A ball floating in a ripple tank begins to move vertically up and down as a wave passes beneath it as shown in the diagram.



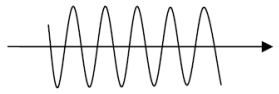
Which statement is correct?

A Energy is not transferred in the wave direction, but water is.
B Energy is transferred in the wave direction, but water is not.
C Both energy and water are transferred in the wave direction.
D Neither energy nor water is transferred in the wave direction.

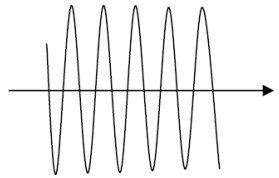
13 The diagram shows traces of four different sound waves drawn to the same scale.

Which trace shows the loudest, but lowest-pitched sound?

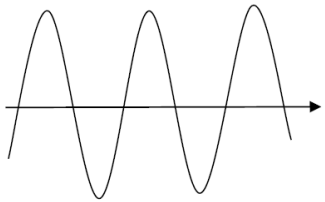
A



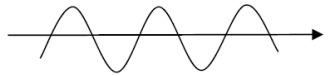
B



C



D



14 The diagram shows the various regions in the electromagnetic spectrum.

J	microwaves	K	L	ultra-violet radiation	M	N

Which is correct about the electromagnetic waves?

A K is visible light wave in the spectrum.
B Overexposure to M can cause sun burns.
C J has the highest frequency while N has the longest wavelength.
D M is used to scan luggage for hazardous materials in the airport.

15 An object is placed in front of a thin converging lens at a distance equal to twice the focal length of the lens.

Which description of the image formed by the lens is correct?

A virtual, upright, magnified
B virtual, inverted, magnified
C real, upright, same size as object
D real, inverted, same size as object

16 To fully charge the battery of a portable electric saw, a current of 5.0 A is used for four hours.

How much charge does the battery store?

A 20 C **B** 1200 C
C 2880 C **D** 72000 C

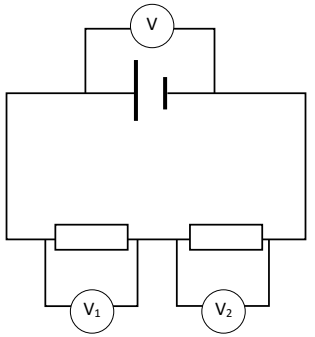
17 A wire of length L has a resistance of 3.0 Ω. When connected to a cell, the current in the wire is 5.0 A.

The wire is now replaced by a wire of the same material and cross-sectional area but length 2L.

What is the resistance of the wire and current through it?

	resistance	current
A	1.5 Ω	2.5 A
B	1.5 Ω	10 A
C	6.0 Ω	2.5 A
D	6.0 Ω	10 A

18 A circuit is shown below.



Which equation for the voltmeter readings is correct?

A $V = V_1 = V_2$ **B** $V = V_1 \times V_2$
C $V = V_1 + V_2$ **D** $V = V_1 - V_2$

19 Three metal bars, X, Y and Z, exhibit the following magnetic properties.

- X is attracted by both ends of Z.
- Y can be repelled by Z.

Which row correctly describes X, Y and Z?

	X	Y	Z
A	magnetised	unmagnetised	magnetised
B	magnetised	unmagnetised	unmagnetised
C	unmagnetised	magnetised	magnetised
D	unmagnetised	magnetised	unmagnetised

20 Technetium-99m is one of the most medically used radioactive isotopes for imaging study. It has a half-life of 6 hours.

The measured activity initially is 600 Bq when the background radiation is 32 Bq.

What is the measured activity 18 hours later, assuming that the background activity does not change?

A 71 Bq **B** 103 Bq
C 107 Bq **D** 142 Bq

END OF PAPER

NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2025

SUBJECT : SCIENCE (PHYSICS) (5086/02) **DATE :** 19 AUG 2025

LEVEL : SECONDARY 4 EXPRESS / 5 NORMAL (A) **DURATION :** 1 H 15 MIN

INSTRUCTIONS TO CANDIDATES

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. Write down your name, class and index number on the **Question Paper**.
2. Write in dark blue or black pen. You may use an HB pencil for any diagrams or graphs. Do not use correction fluid.
3. This paper consists of **Two (2) Sections** : **Section A** and **Section B.**
4. Answer **ALL** questions in **Section A** in the spaces provided.
5. Answer **ANY ONE** questions in **Section B** in the spaces provided.
6. The use of an approved scientific calculator is expected, where appropriate.
7. Throughout the paper take the **acceleration due to gravity on Earth** to be 10 m/s^2.
8. **DO NOT DETACH** any sections from this paper.

INFORMATION FOR CANDIDATES :

The number of marks is given in brackets **[ ]** at the end of each question.

PAPER 1	/ 20
PAPER 2	
SECTION A :	/ 55
SECTION B :	
Question 11	/ 10
Question 12	/ 10
TOTAL	/ 85
GRADE	

This paper consists of _16_ printed pages, including the cover page.

SECTION A : [55 marks]

Answer **ALL** *questions in this section. Show your working and write your answers in the space provided.*

1 **(a)** Circle the most precise instrument in the list below for measuring the diameter of a tube with an approximate diameter of 3.0 cm.

half metre rule measuring tape

digital calipers digital micrometer screw gauge **[1]**

(b) Convert the following quantities:

(i) 1500 mm = ... m **[1]**

(ii) 3.0 MJ = ... kJ **[1]**

2 A stone of weight 0.82 N is dropped into a measuring cylinder containing 32 cm^3 of water. The water level rises to 65 cm^3 graduation mark. The gravitational field strength is 10 N/kg.

(a) Calculate the mass of the stone.

mass = ... kg **[1]**

(b) Calculate the density of the stone in g/cm^3. Show your working clearly.

density = ... g/cm^3 **[2]**

3 Fig. 3.1 is a graph showing how the speed of a car changes with time during part of a journey.

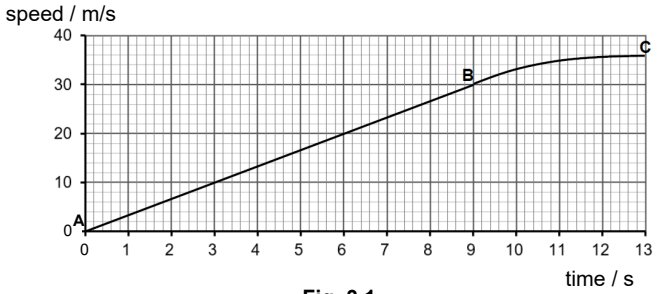


Fig. 3.1

(a) Calculate the distance the car travels between A and B.

distance = ... m **[1]**

(b) Calculate the acceleration of the car between **A** and **B**.

acceleration = ... m/s^2 **[2]**

(c) The mass of the car is 1250 kg. Calculate the resultant force on the car as it travels between **A** and **B**.

resultant force = ... N **[2]**

(d) Describe the motion of the car between B and C.

.....

..... **[1]**

4 A solid substance is heated until its temperature rises from 5°C to 150°C.

Fig. 4.1 shows how the temperature of the substance changes with time.

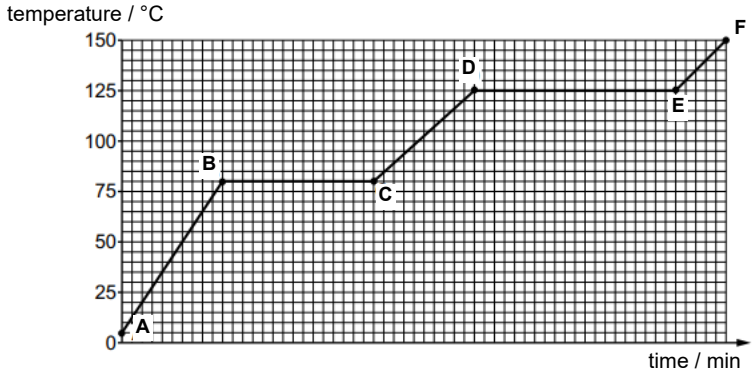


Fig. 4.1

(a) State the melting and boiling point of the substance.

melting point: ..... °C boiling point: ..... °C **[1]**

(b) Using the kinetic particle model of matter, state two **differences** between the particles of the substance in AB and CD.

.....

.....

.....

..... **[2]**

(c) The temperature of the substance remains constant from B to C even though the substance is heated. Explain why.

.....

.....

.....

..... **[2]**

5 The ripple tank setup shown in Fig. 5.1 consists of a shallow glass-bottomed tray which contains water at a constant depth. A light source is directly above the tray and a white screen is placed below.

Waves are formed by a dipper moving up and down. These waves are seen as bright lines on the screen below the tray as shown in Fig. 5.2.

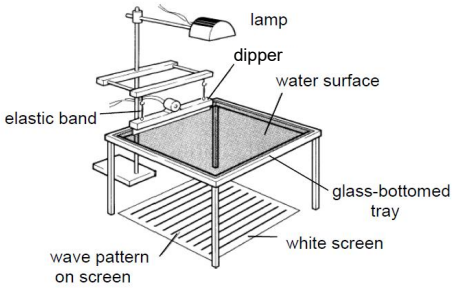


Fig. 5.1

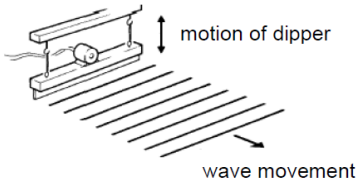


Fig. 5.2

(a) The dipper vibrates vertically at a frequency of 50 Hz. This creates a water wave travelling at a constant speed of 15 cm/s. Calculate the wavelength of the water wave.

wavelength = ... cm **[2]**

(b) In Fig. 5.2, indicate clearly a distance of 5 wavelengths. Label this distance as 5λ. **[1]**

(c) The wave speed increases as the depth of the water increases.

Water is added to the tray to increase the depth of water to twice the original depth. The dipper vibrates at the original frequency. Explain the change to the wavelength of the water wave.

.....

.....

.....

..... **[2]**

6 **(a)** Fig. 6.1 shows a smartphone that receives a Wi-Fi signal to produce music.

Fig. 6.1

(i) Wi-Fi signal makes use of radio waves, a type of *transverse* wave while music is sound wave, a *longitudinal* wave. Explain the difference between *transverse* and *longitudinal* waves.

.....

.....

..... **[1]**

(ii) An application is installed on the smartphone to determine the speed of sound. Fig. 6.2 shows a loud sound signal is transmitted. It reaches a flat vertical wall placed *x* m away. An echo is received 1.5 s later. It was found that the speed of sound is 333 m/s.

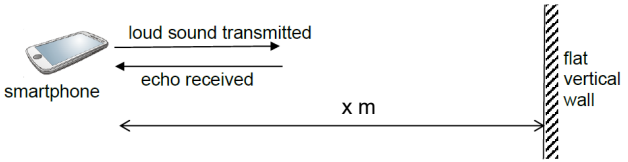


Fig. 6.2

Determine the distance, *x* m, of the wall from the smartphone.

distance = ... m **[2]**

(b) Ultra-violet rays and X-rays are components of the electromagnetic spectrum that are used in hospitals. For each component, state how they are used in the hospital.

Ultra-violet rays: .....

X-rays: ..... **[2]**

7 Fig. 7.1 shows a ray of red light striking on a right-angled glass prism.

The refractive index of the glass is 1.5.

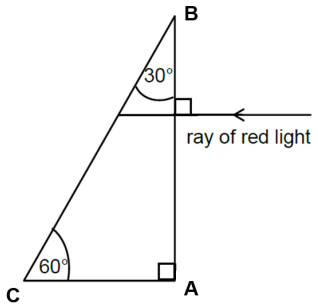


Fig. 7.1

(a) State the angle of incidence at AB.

angle of incidence = ... ° **[1]**

(b) Calculate the angle of refraction at BC.

angle of refraction = ... ° **[2]**

(c) Complete Fig. 7.1 accurately to show the path of the light ray when it leaves the prism. Label the angles made by the ray with the normal at the glass-air boundary at BC. **[2]**

(d) The speed of light in air is 2.99×10^8 m/s. Calculate the speed of light in the glass prism.

speed = ... m/s **[1]**

8 An 800 W iron and a 100 W fan are used at home, both operating at a voltage of 240 V.

(a) Fig. 8.1 shows the iron and fan connected to the mains supply of 240 V. L and N are the live and neutral wire respectively. I_L is the current flowing in the live wire.

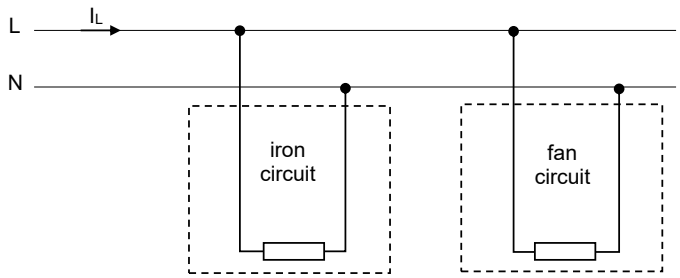


Fig. 8.1

(i) State the voltage and colour of wire L and N.

wire	voltage / V	colour
L		
N		

[2]

(ii) Using appropriate calculations, state the value of I_L for the different situations indicated.

situation	value of I_L / A
when only the fan is switched on.	
when both the iron and fan are switched on.	

Appropriate calculations:

[3]

(b) In one day, the iron is used for 30 minutes and the fan for 8 hours.

Calculate the cost of using both the iron and fan for one day if the cost of 1 kWh is $ 0.30.

cost = $ ..... **[2]**

9 Fig. 9.1 shows an apparatus used to demonstrate the motor effect. P is a short length of copper rod resting on two other bare copper wires.

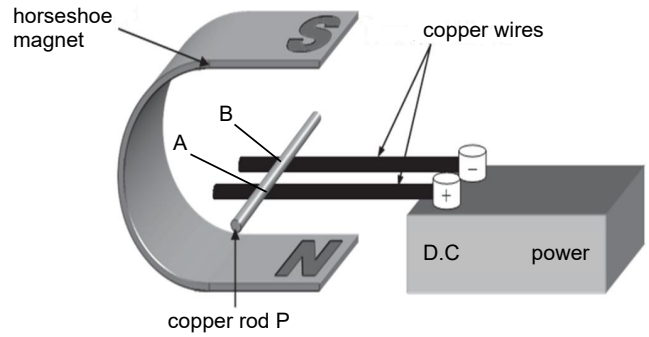


Fig. 9.1

(a) Tick (✓) the correct answer to show the direction of the conventional current flows through copper rod P.

Conventional current flows from

☐ A to B

☐ B to A **[1]**

(b) **(i)** On Fig. 9.1, draw an arrow to show the direction copper rod P would roll when the D.C. power supply is switched on. **[1]**

(ii) Explain why the copper rod P moves in the direction stated in **(ii)**.

.....

.....

..... **[2]**

(c) State one modification to make the copper rod P roll in the opposite direction as stated in **(b)(i)**.

..... **[1]**

10 **(a)** Table 10.1 describes four nuclides.

Table 10.1

name of nuclide	nuclide notation
Plutonium-238	$^{238}_{94}Pu$
Thorium-234	$^{234}_{90}Th$
Uranium-235	$^{235}_{92}U$
Uranium-238	$^{238}_{92}U$

Each nuclide can be used once, more than once, or not at all.

State

(i) **two** nuclides with the same number of protons.

.....

[1]

(ii) **two** nuclides with the same number of nucleons.

.....

[1]

(iii) **one** of the four nuclides with the most electrons orbiting when it is a neutral atom.

.....

[1]

(b) Thorium-234 is a radioactive isotope with a half-life of 24 days.

A sample of radioactive material contains 80 mg of thorium-234. Calculate the mass of thorium-234 remaining after 72 days.

mass of thorium-234 remaining = ... mg **[2]**

(c) A suitable radiation detector is placed in front of a radioactive source. Different materials are placed between the source and the detector. The detector measures the amount of radiation reaching it per minute (the count rate). Fig. 10.1 shows the arrangement of the apparatus.

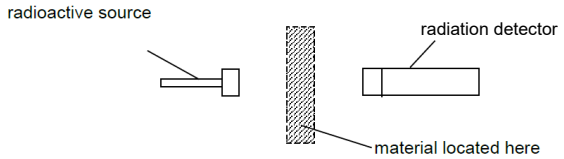


Fig. 10.1

The count rate produced by the source is measured for different materials. The results are shown in Table 10.2.

Table 10.2

Material between source and detector	Count per minute
2 cm air	2500
thin paper	1250
2 mm aluminum	1250
2 cm lead	310

Using the data obtained, state whether the radiation listed below is being emitted by the radioactive source. In each case, explain your answer.

(i) beta-particle

.....

.....

.....

[2]

(ii) gamma rays

.....

.....

.....

[2]

(d) State one way to control exposure to ionising radiation.

.....

.....

[1]

SECTION B : [10 marks]

Answer **any one** question. *Show your working and write your answers in the spaces provided.*

11 Fig. 11.1 shows a model of the human arm. The rubber band represents the muscle that moves part of the arm XY up.

A mass is suspended from XY as shown in Fig. 11.2. The weight of section XY is negligible and the model is at rest.

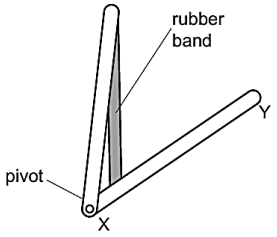


Fig. 11.1

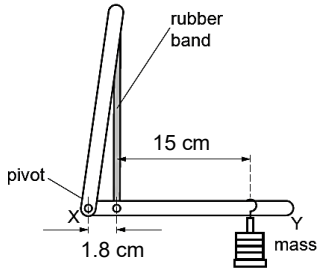


Fig. 11.2
(Not drawn to scale)

(a) **(i)** State how the dimensions of the rubber band change as the mass is added to section XY.

.....

[1]

(ii) State the energy store in the stretched rubber band.

.....

[1]

(b) **(i)** State the principle of moments.

.....

.....

.....

[2]

(ii) Explain why the force that the rubber band exerts on section XY is larger than the weight of the mass.

.....

.....

.....

.....

[2]

(iii) The mass suspended from section XY in Fig. 11.2 has a weight of 4.0 N.

Calculate the force that the rubber exerts on section XY.

force = ... N **[2]**

(iv) State and explain how your answer to **(b)(iii)** will be different if the weight of section XY is **not** negligible.

.....

.....

.....

.....

[2]

12 A black car is initially at rest at the bottom of a hill. Fig. 12.1 shows the car accelerating up a hill on a sunny day.

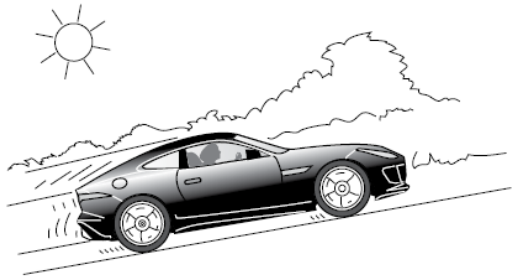


Fig. 12.1

(a) Explain which thermal energy transfer process is involved in resulting the black car receiving heat directly from the sun.

.....

..... **[1]**

(b) Identify and describe, in microscopic terms, how energy is transferred from the exposed metal parts to the cooler metal parts of the car.

.....

.....

.....

..... **[2]**

(c) The driver needs to step on the accelerator to increase the speed of the car up the hill.

(i) State the energy store(s) at the bottom of the hill and at the top of the hill.

Energy store(s) at the bottom of the hill:

.....

Energy store(s) at the top of the hill:

..... **[2]**

(ii) Using the principle of conservation of energy, describe the energy transfer between the energy stores identified in **(i)**. Assume there is no transfer of energy to the surroundings.

.....

.....

.....

..... **[2]**

(d) The car has a mass of 1600 kg. When it reaches a vertical height of 100 m, it is moving at a speed of 15 m/s.

Determine the total amount of energy in the energy stores at this height. Take gravitational field strength to be 10N/kg.

total amount of energy = ... J **[3]**

END OF PAPER

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2025

SUBJECT : SCIENCE (PHYSICS) (5086/2) **DATE :** 19 AUG 2025

LEVEL : SECONDARY 4E5N **DURATION :** 1 H 15 MIN

Paper 1 [20 marks]

1	2	3	4	5	6	7	8	9	10
B	**A**	**D**	**B**	**C**	**D**	**D**	**B**	**D**	**B**

11	12	13	14	15	16	17	18	19	20
A	**B**	**C**	**D**	**D**	**D**	**C**	**C**	**C**	**B**

Paper 2

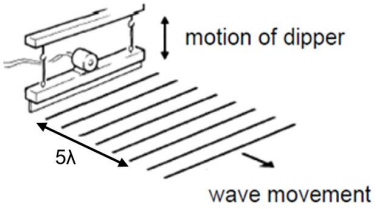
Section A [55 marks]

QN	Suggested Answers	Sub Ttl	Ttl
1a	Digital calipers	1	**3**
1bi	1500 mm = 1500 × 10^{-3} m = 1.5 m	 1	
1bii	3.0 MJ = 3000 kJ	1	

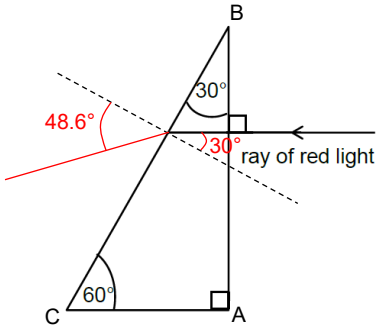
QN	Suggested Answers	Sub Ttl	Ttl
2a	M = W/g = 0.82 / 10 = 0.082 kg	1	**3**
2b	m = 0.082 kg = 82 g V = 65 − 32 = 33 cm^3 Density = m/V = 82 / 33 = 2.5 g/cm^3 (accept 2.48 g/cm^3) Correct values of m and V [1] Correct value of density to the correct sf [1]	 1 1	

QN	Suggested Answers	Sub Ttl	Ttl
3a	Distance = Area under speed-time graph = ½ × 9 × 30 = 135 m	 1	**6**
3b	$a = \frac{v-u}{t}$ $= \frac{30-0}{9}$ $= 3.33\ m/s^2$	 1 1	
3c	F = ma = 1250 × 3.3333 = 4170 N (accept 4200 N)	 1 1	
3d	It is undergoing **<u>decreasing</u>** acceleration.	1	

QN	Suggested Answers	Sub Ttl	Ttl
4a	Melting point = 80 °C Boiling point = 125 °C Both correct answers [1m]	1	**5**
4b	Any two of the following: • Particles in AB vibrate about their fixed positions while particles in CD slight pass one another. • Particles in AB are orderly arranged while particles in CD are randomly arranged. • The forces of attraction between particles in AB are strong while the forces of attraction between particles in CD are moderately strong.	2	
4c	When the substance is heated, thermal energy is used to **<u>weaken the forces of attraction</u>** between the particles causing them to move further apart from one another. The energy in the **<u>internal potential store</u>** increases, The **<u>average energy in the internal kinetic energy store remains the same</u>**, hence the temperature remains constant. Must mention internal potential store and internal kinetic store before the 1 m is awarded.	1 1	

QN	Suggested Answers	Sub Ttl	Ttl
5a	$\lambda = \frac{v}{f}$ $= \frac{15}{50}$ $= 0.30$ cm Accept 0.300 cm but do not accept 0.3 cm Correct formula – 1 m	1 1	**5**
5b	 Any 5 wavelengths. The starting and ending of the distance must be clearly indicated.	1	
5c	At greater depth, the speed of the wave increases. Since the dipper is set to vibrate vertically at the original frequency, frequency of the waves remains unchanged. According to the wave equation, λ = v/f, wavelength of the waves increases.	1 1	

QN	Suggested Answers	Sub Ttl	Ttl
6ai	Transverse wave is a wave which travel in a direction perpendicular to the direction of vibration of the particles. Longitudinal wave is a wave which travel in a direction parallel to the direction of vibration of the particles.	1	**5**
6aii	v = 2d/t 333 = (2x) / 1.5 2x = 333 × 1.5 x = 250 m Award 1 m once the students consider t/2 or 2x due to echo method in the calculations.	1 1	
6b	Ultraviolet rays: To sterilize room / to treat skin disease X-rays: To scan the bone / internal organ of body.		

QN	Suggested Answers	Sub Ttl	Ttl
7a	Angle of incidence = 0°	1	
7b	$\eta = \frac{\sin r}{\sin i}$ (since light travels from glass into air) $\eta = \frac{\sin a}{\sin g}$ $1.5 = \frac{\sin a}{\sin 30°}$ $a = 48.6°$ Hence, angle of refraction = 48.6°	1 1	
7c	 Refracted ray refracted away from normal at boundary AB – 1m Correct labelling of angles (ecf from 7b) – 1m	2	
7d	$\eta = \frac{c}{v}$ $1.5 = \frac{2.99 \times 10^8}{v}$ $v = 1.99 \times 10^8$ m/s (Accept 2.0×10^8 m/s)	1	

QN	Suggested Answers	Sub Ttl	Ttl
8ai	<table><tr><th>Wire</th><th>Voltage / V</th><th>Colour</th></tr><tr><td>L</td><td>**240**</td><td>**Brown**</td></tr><tr><td>N</td><td>**0 V (Accept 0 to 1 V)**</td><td>**Blue**</td></tr></table> Correct voltage – 1 m Correct colours – 1 m	2	
8aii	Current drawn by iron = 800 / 240 = 3.333 A Current drawn by fan = 100 / 240 = 0.417 A Current drawn by both iron and fan = 3.75 A <table><tr><th>Situation</th><th>Value of I_L / A</th></tr><tr><td>when only the fan is switched on.</td><td>**0.417 (Accept 0.42 A)**</td></tr><tr><td>when both the iron and fan are switched on.</td><td>**3.75 (Accept 3.8 A)**</td></tr></table>	1 1 1	
8b	Total power used = 0.8 kW × ½ h + 0.10 kW × 8 h = 1.2 kWh Total cost = 1.2 × \$0.30 = \$0.36	1 1	

QN	Suggested Answers	Sub Ttl	Ttl
9a	A to B	1	
9bi	Arrow pointing to the right	1	
9bii	When the power supply is switched on, **magnetic field of current in P interacts with the magnetic field of the horse magnet.** By Fleming's Left Hand Rule, a **force is produced** on rod P and causing it to roll to the right.	1 1	
9c	Any one of the following: Reverse the polarity of the battery / Reverse the current Reverse the poles of the magnet.	1	

QN	Suggested Answers	Sub Ttl	Ttl
10ai	uranium-235 and uranium-238 Both correct – 1 m	1	
10aii	plutonium-238 and uranium-238 Both correct – 1 m	1	
10aiii	plutonium -238	1	
10b	80 mg $\xrightarrow[24\text{ days}]{}$ 40 mg $\xrightarrow[24\text{ days}]{}$ 20 mg $\xrightarrow[24\text{ days}]{}$ 10 mg or 3 half-lives 1st half-life = 80 ÷ 2 = 40 mg 2nd half-life = 40 ÷ 2 = 20 mg 3rd half-life = 20 ÷ 2 = 10 mg Show 3 half-lives – 1 m Final value of 10 mg – 1 m	1 1	
10ci	Beta particles are not emitted. The readings of the detector for thin paper and 2 mm aluminium are the same. Showing that only alpha particles cannot pass through while the rest of the radiation are able to pass through.	1 1	
10cii	Gamma rays are emitted. The radiation was stopped by the 2 cm lead and there is a drop in the reading. The remaining low count rate may be due to background radiation.	1 1	
10d	State any one of the ways to control exposure to radiation: ▪ Reduce exposure time e.g. An experiment set-up should be prepared first before introducing the radioactive source. ▪ Experiments involving radioactive materials should only be carried out in designated locations ▪ Increase distance between the source and living tissues e.g. use long tongs or remote-controlled devices to increase the distance between radioactive materials and the body. ▪ Have shielding when handling radioactive materials e.g.wear lead-lined gloves and suits, to absorb ionising radiations, thus		

	protect the body or use thick concrete walls and lead-lined doors for rooms in which ionising radiation is used. ▪ Store radioactive materials in sealed containers that will absorb the ionising radiations. An example of such a container is a lead box and must be clearly labelled and kept in a secured place.		

Section B [10 marks]

QN	Suggested Answers	Sub Ttl	Ttl
11ai	Longer OR Thinner or smaller cross-sectional area	1	**10**
11aii	Elastic potential store	1	
11bi	When an object is in equilibrium, the sum of clockwise moments about a pivot is equal to the sum of anticlockwise moments about the same pivot.	1 1	
11bii	Perpendicular distance of rubber band to pivot is smaller than the perpendicular distance of the mass to the pivot. Force is inversely proportional to the distance as the moment is the same/constant. OR Since moment = force x perpendicular distance between pivot and line of action of the force, a larger force is needed to produce the same anti-clockwise moment.	1 1	
11biii	Using principle of moments Total clockwise moments = total anticlockwise moments F x 1.8 = 4 x 16.8 F = 37.3 N	 1	
11biv	Force that the rubber exerts on section XY is greater. The weight of XY produce/contributes to the clockwise moment.	1 1	

QN	Suggested Answers	Sub Ttl	Ttl
12a	Radiation Black is a good absorber of thermal radiation via electromagnetic waves from the sun. [E]	1	**10**
12b	Conduction The atoms nearer to the surface gets heated up and vibrate more vigorously about their fixed position. They collide onto the neighbouring atoms and energy is transferred to the less energetic atoms at the cooler end. Presence of the free moving electrons in metal move easily and quickly to transfer energy to the cooler end.	1 1	
12ci	Energy store(s) at the bottom of the hill: Chemical potential store Energy store(s) at the top of the hill: Kinetic store and gravitational potential store (Both must be stated to get 1 m)	1 1	
12cii	Using the principle of conservation of energy, energy from the chemical potential store is transferred (mechanically by the force produced by the engine) to the kinetic store and gravitational potential store of the car. The energy transferred from the chemical potential store is equal to the total increase of the energy in the kinetic store and gravitational potential store. NOTE: **DO NOT ACCEPT "convert" and must be "transferred"**	1 1	
12d	Total energy in the energy stores = ½ mv^2 + mgh = ½ × 1600 × 15^2 + 1600 × 10 × 100 = 180000 + 1600000 = 1780000 J	 2 1	