H

NATIONAL JUNIOR COLLEGE

SENIOR HIGH 2 PRELIMINARY EXAMINATION

Higher 2

CANDIDATE NAME			
SUBJECT CLASS		REGISTRATION NUMBER	

PHYSICS **9749/01**

Paper 1 Multiple Choice **24 September 2025**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THE INSTRUCTION FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, subject class and registration number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **thirty** questions on 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.

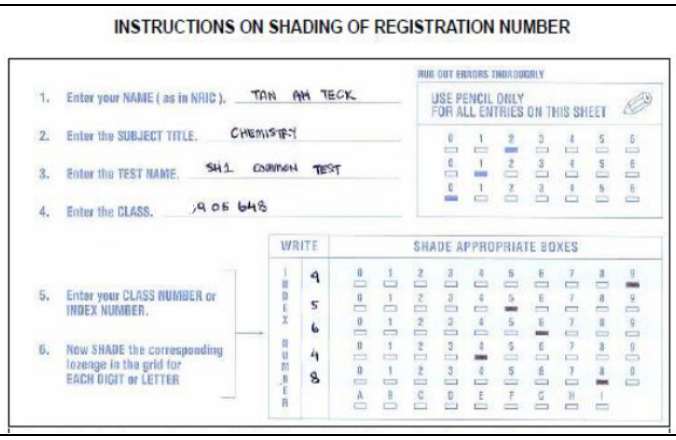
Read the instructions on the Answer Sheet very carefully.

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.
The use of an approved scientific calculator is expected, where appropriate.

The OAS index number is in a 5-digit format.

The 5-digit format is as follows: **1st digit** and the **last four digits** of the Reg Number.

e.g. **2**00**5011** becomes **25011**



This document contains **13** printed pages and **3** blank pages.

[Turn over

Data

speed of light in free space	$c = 3.00 \times 10^{8}\,\mathrm{m\,s^{-1}}$
permeability of free space	$\mu_0 = 4\pi \times 10^{-7}\,\mathrm{H\,m^{-1}}$
permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\,\mathrm{F\,m^{-1}}$
	$(1/(36\pi)) \times 10^{-9}\,\mathrm{F\,m^{-1}}$
elementary charge	$e = 1.60 \times 10^{-19}\,\mathrm{C}$
the Planck constant	$h = 6.63 \times 10^{-34}\,\mathrm{J\,s}$
unified atomic mass constant	$u = 1.66 \times 10^{-27}\,\mathrm{kg}$
rest mass of electron	$m_e = 9.11 \times 10^{-31}\,\mathrm{kg}$
rest mass of proton	$m_p = 1.67 \times 10^{-27}\,\mathrm{kg}$
molar gas constant	$R = 8.31\,\mathrm{J\,K^{-1}\,mol^{-1}}$
the Avogadro constant	$N_A = 6.02 \times 10^{23}\,\mathrm{mol^{-1}}$
the Boltzmann constant	$k = 1.38 \times 10^{-23}\,\mathrm{J\,K^{-1}}$
gravitational constant	$G = 6.67 \times 10^{-11}\,\mathrm{N\,m^{2}\,kg^{-2}}$
acceleration of free fall	$g = 9.81\,\mathrm{m\,s^{-2}}$

Formulae

uniformly accelerated motion	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
work done on / by a gas	$W = p\Delta V$
hydrostatic pressure	$p = \rho gh$
gravitational potential	$\phi = -Gm/r$
temperature	$T/\text{K} = T/^\circ\text{C} + 273.15$
pressure of an ideal gas	$p = \frac{1}{3}\frac{Nm}{V} < c^2 >$
mean translational kinetic energy of an ideal gas molecule	$E = \frac{3}{2}kT$
displacement of particle in s.h.m.	$x = x_0 \sin\omega t$
velocity of particle in s.h.m.	$v = v_0 \cos\omega t$ $= \pm\omega\sqrt{x_0^2 - x^2}$
electric current	$I = Anvq$
resistors in series	$R = R_1 + R_2 + \ldots$
resistors in parallel	$1/R = 1/R_1 + 1/R_2 + \ldots$
electric potential	$V = \frac{Q}{4\pi\varepsilon_0 r}$
alternating current / voltage	$x = x_0 \sin\omega t$
magnetic flux density due to a long straight wire	$B = \frac{\mu_0 I}{2\pi d}$
magnetic flux density due to a flat circular coil	$B = \frac{\mu_0 NI}{2r}$
magnetic flux density due to a long solenoid	$B = \mu_0 nI$
radioactive decay	$x = x_0 \exp(-\lambda t)$
decay constant	$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$

[Turn over

1 What is the order-of-magnitude of the mass of **twelve** one-dollar ($1) Singapore coins?

A 10^0 g **B** 10^1 g **C** 10^2 g **D** 10^3 g

2 A student takes measurements to calculate the density of a liquid in a beaker.

The height of the liquid is 0.20 m $\pm$ 2%.

The internal diameter of the beaker is 0.05 m $\pm$ 3%.

The mass of the liquid is 0.36 kg $\pm$ 10%.

What is the percentage uncertainty in the calculated density of the liquid?

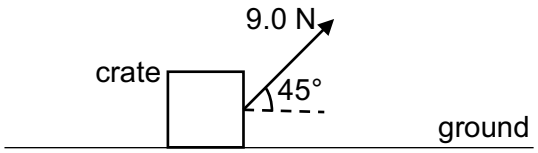
A 2 % **B** 5 % **C** 15 % **D** 18 %

3 A student throws a stone upwards at an initial speed of 15.0 m s^{-1}.

What is the displacement of the stone after 2.00 s?

A 1.12 m **B** 10.4 m **C** 11.5 m **D** 12.6 m

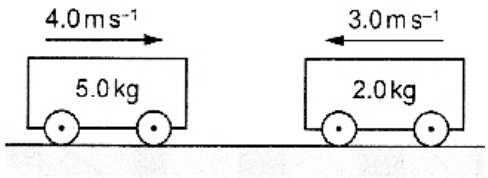
4 A student pulls a 2.0 kg crate with a force of 9.0 N directed at an angle 45° from the horizontal as shown in the diagram. A frictional force of 2.0 N acts between the crate and the ground.



What is the acceleration of the crate?

A 2.2 m s^{-2} **B** 3.2 m s^{-2} **C** 3.5 m s^{-2} **D** 4.5 m s^{-2}

5 Two frictionless trolleys move along the same straight line towards one another. Their masses and velocities before collision are shown.



The trolleys collide and stick together.

What is the final kinetic energy of the trolleys after the collision?

A 0.71 J **B** 14 J **C** 31 J **D** 35 J

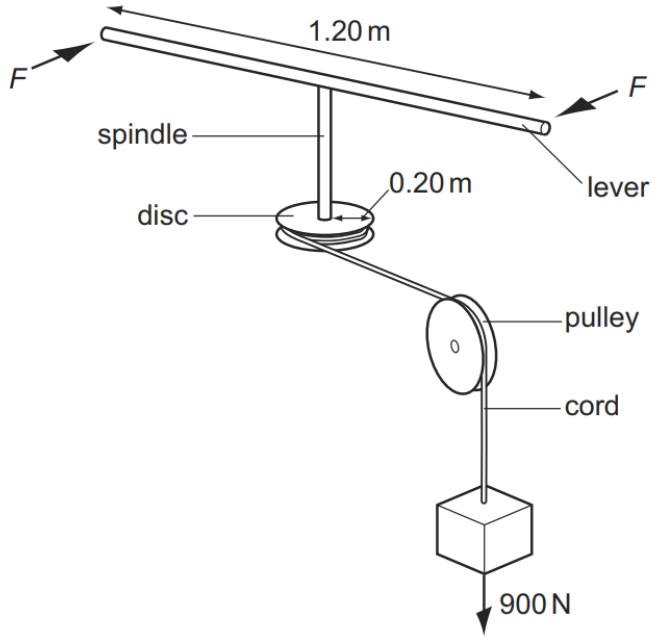
6 A spring hangs from the ceiling of a stationary train and a 1.2 kg mass is hung on the spring.

The mass causes an extension of 2.4 cm on the spring when it is hung vertically.

What is the extension of the spring when the train accelerates horizontally at a rate of 5.0 m s^{-2}?

A 1.2 cm **B** 2.6 cm **C** 2.7 cm **D** 3.6 cm

7 A spindle is attached at one end to the centre of a lever 1.20 m long and at its other end to the centre of a disc of radius 0.20 m. A cord is wrapped round the disc, passes over a pulley and is attached to a 900 N weight.



What is the minimum force *F*, applied to each end of the lever, that could lift the weight?

A 75 N **B** 150 N **C** 300 N **D** 950 N

8 A turbine at a hydroelectric power station is situated at a vertical distance 30 m below the level of the surface of a large lake. The water passes through the turbine at a rate of 5.7 m^3 s^{-1}.

The overall efficiency of the turbine and generator system is 90%. The density of water is 1000 kg m^{-3}.

What is the useful power output of the power station?

A 0.15 MW **B** 1.5 MW **C** 1.7 MW **D** 90 MW

9 A small coin of mass 10 g is placed on a horizontal rotating disc at a distance of 5.0 cm from the centre of the disc. The maximum frictional force between the coin and the disc is 0.20 N.

What is the largest angular velocity that the disc can have without coin slipping?

A 0.060 rad s^{-1} **B** 1.0 rad s^{-1} **C** 20 rad s^{-1} **D** 400 rad s^{-1}

10 An astronaut of mass m in a spacecraft experiences a gravitational force $F = mg$ when stationary on the launchpad. The spacecraft is launched vertically upwards with an acceleration of $0.2g$.

What is the gravitational force on the astronaut immediately after launch?

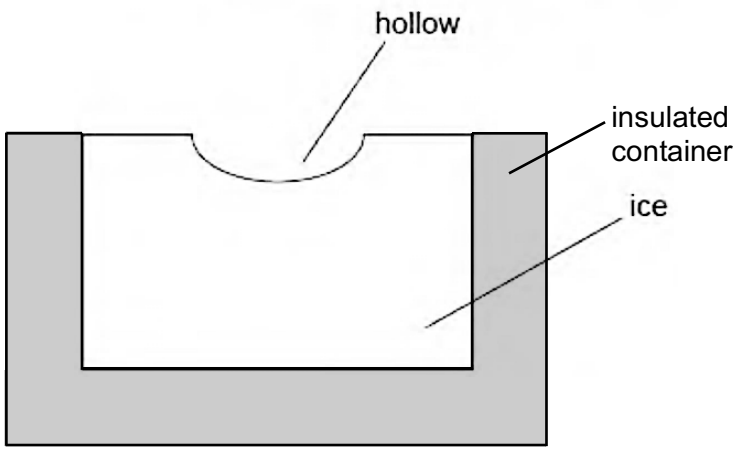
A $1.2mg$ **B** mg **C** $0.8mg$ **D** 0

11 The gravitational field strength at the surface of Neptune is approximately equal to the gravitational field strength at the surface of the Earth. The mass of Neptune is 17 times the mass of the Earth.

What is the value of the ratio $\frac{\text{radius of Neptune}}{\text{radius of Earth}}$?

A 0.059 **B** 0.24 **C** 4.1 **D** 17

12 A huge block of ice at 0°C with a hollow in its top surface is placed in an insulated container as illustrated.



A mass of 160 g of water at 100°C is poured into the hollow. The water has a specific heat capacity 4.20 kJ kg^{-1} K^{-1} and ice has a specific latent heat of fusion 336 kJ kg^{-1}.

After thermal equilibrium has been reached, the total mass of the water in the hollow is measured.

What is the mass of the water in the hollow assuming no thermal exchange with the surroundings?

A 100 g **B** 200 g **C** 260 g **D** 360 g

13 A system absorbs 80 J through heating while doing 100 J of external work.

What is the change in internal energy of the system?

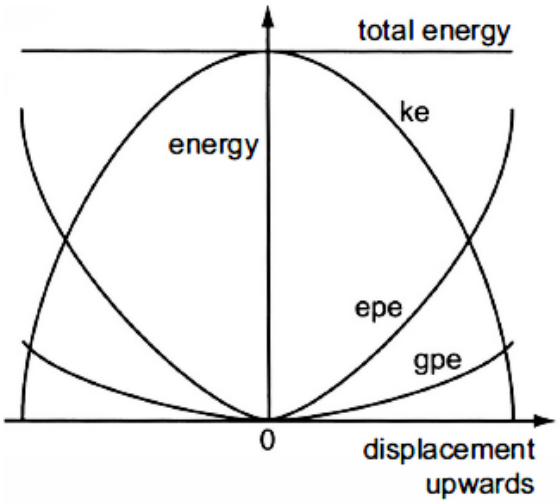
A –100 J **B** –20 J **C** +80 J **D** +180 J

14 A mass attached to a spring is undergoing simple harmonic oscillations vertically.

Interchange between kinetic energy (ke), gravitational potential energy (gpe) and elastic potential energy (epe) takes place.

Which graph shows the interchange of the energy?

A



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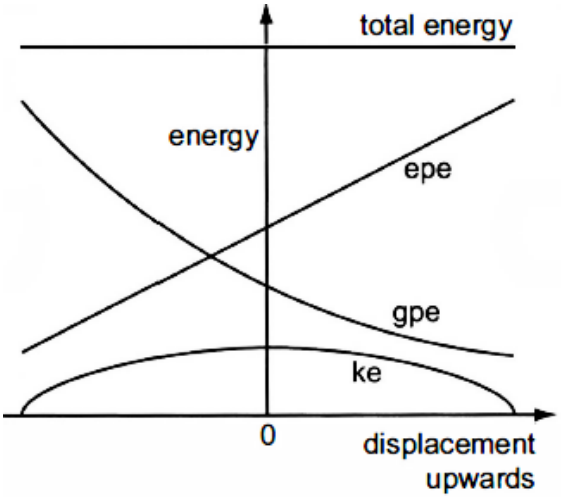

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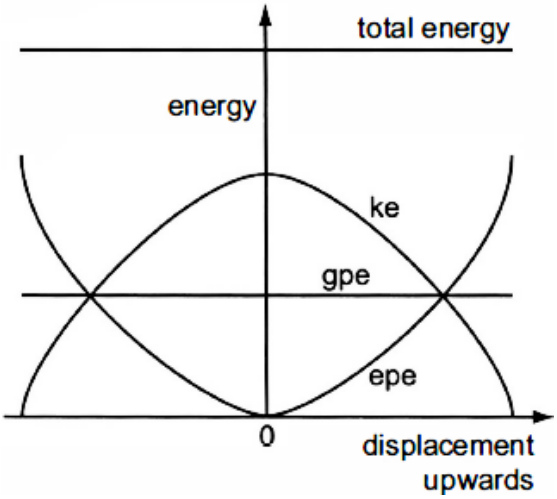
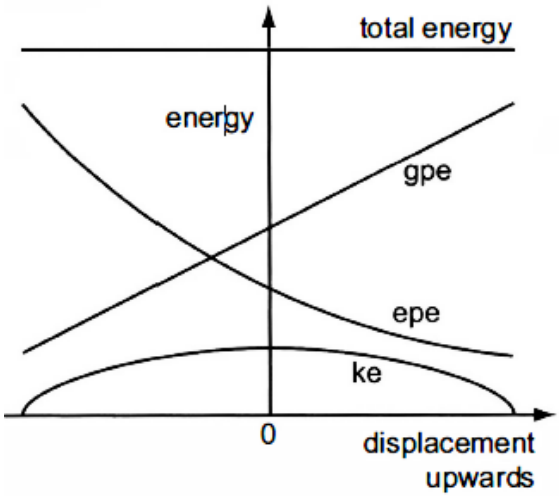
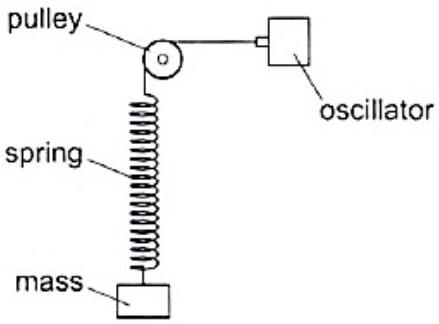


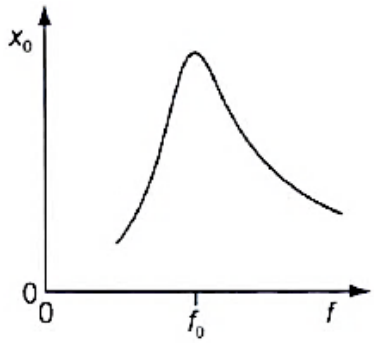
D



15 A mass, suspended from a helical spring, is made to oscillate.

The graph shows the variation with frequency f of the amplitude x_0 of vibration of the mass.

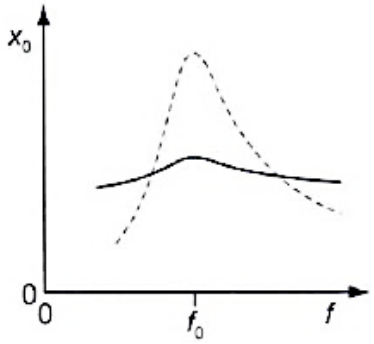




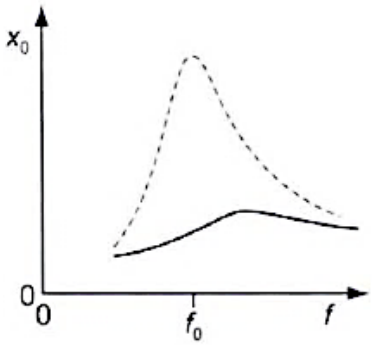
A sheet of cardboard of negligible mass is now fixed to the mass on the spring to cause light damping of the oscillations.

Which graph shows how x_0 will vary with f over the same frequency range? The dotted line represent the original curve.

A



B



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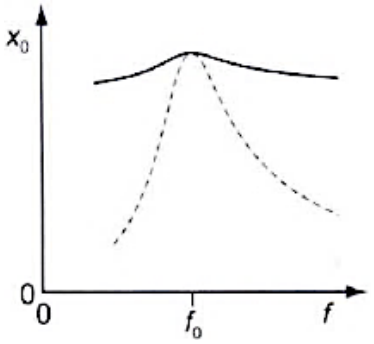
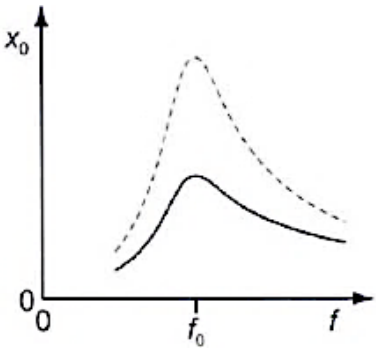
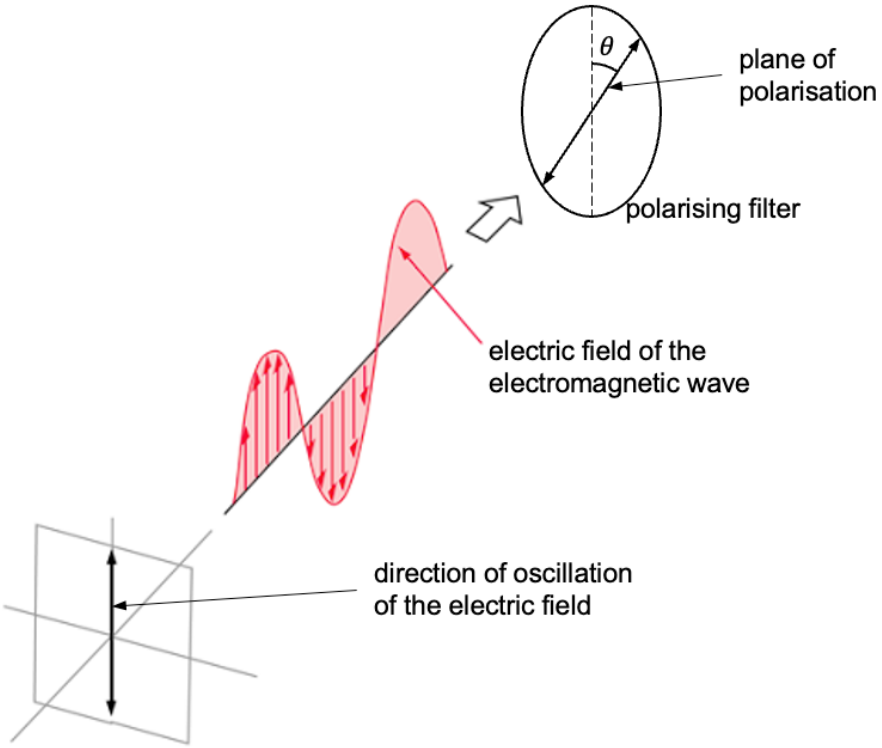


D



16 A plane-polarised electromagnetic wave is incident on a polarising filter as shown below.



The electric field of the wave before reaching the filter is vertical and the magnitude E of the field is

$$E = E_0 \sin(\omega t).$$

where E_0 is the amplitude and t is the time.

The plane of polarisation of the filter is at θ from the vertical.

What is the amplitude of the electric field emerging from the filter?

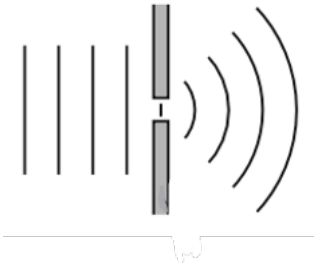
A $E_0^2 \cos^2 \theta$

B $E_0 \cos \theta$

C $E_0 \sin \theta$

D $E_0^2 \sin^2 \theta$

17 The diagram shows a water wave in a shallow tank. The wave is diffracted though a gap in a barrier and spreads. The wavelength of the wave is much smaller than the width of the gap.



The wavelength of the wave and the width of the gap are both changed by a small amount.

Which combination of changes **must** increase the amount of spreading due to diffraction?

	wavelength	width of gap
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

18 Light of wavelength 567 nm is incident normally on a diffraction grating.
The grating has 400 lines per mm.

What is the angle between the second-order and the third-order maxima?

A 13.1 ° **B** 13.9 ° **C** 15.9 ° **D** 27.0 °

19 Two point charges are separated by a distance of 200 mm. The force of attraction between them is 180 μN.

The distance between the point charges is increased to 600 mm.

What is the new force of attraction?

A 20 μN **B** 45 μN **C** 60 μN **D** 90 μN

20 An alpha particle is moving towards a stationary gold nucleus. The alpha particle has a kinetic energy 9.0×10^{-13} J when it is a large distance from the gold nucleus.

The gold nucleus contains 79 protons.

What is the closest possible distance of approach of the alpha particle to the gold nucleus?

A 2.5×10^{-16} m **C** 4.0×10^{-14} m

B 2.0×10^{-14} m **D** 2.0×10^{-7} m

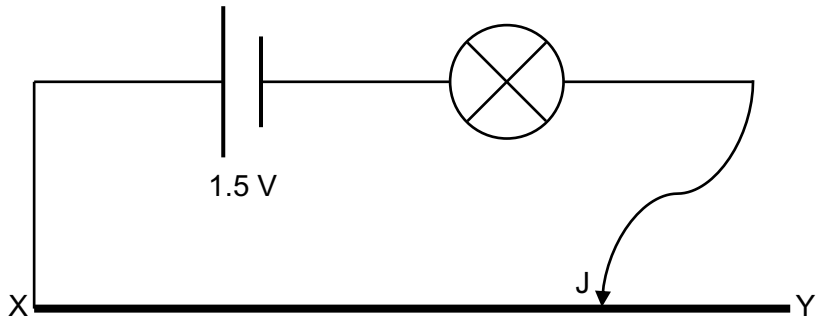
21 A copper wire of cross-sectional area 1.0 mm^2 carries a current of 0.30 A.

If the free electron density of copper is 8.5×10^{28} m^{-3}, what is the drift velocity of the electrons in the copper wire?

A 2.2×10^{-5} m s^{-1} **C** 2.2×10^{-2} m s^{-1}

B 2.2×10^{-3} m s^{-1} **D** 2.2×10^{-1} m s^{-1}

22 A cell of e.m.f. 1.5 V of negligible internal resistance is connected in series with a lamp of resistance 10 Ω which is in turn connected to a resistance wire XY of length 1.00 m with total resistance 20 Ω via a movable jockey J.



When J is at X, the power of the lamp is *P*.

Assuming that the resistance of the lamp remains constant, what is the power of the lamp when the length XJ is 0.50 m?

A 0.13 *P* **B** 0.25 *P* **C** 0.50 *P* **D** 0.75 *P*

23 A 150 mm long wire is at right angles to a uniform magnetic field and carries an electric current. When the current in the wire is increased by 4.0 A, the force acting on the wire increases by 3.6×10^{-3} N.

What is the magnetic flux density of the field?

A 6.0×10^{-6} T **B** 6.0×10^{-3} T **C** 1.7×10^{2} T **D** 1.7×10^{5} T

24 A beam consists of ionised atoms of two isotopes of an element. When the beam enters a uniform magnetic field, the ions move in circular paths. The ions have the same charge and travel at the same speed when they enter the magnetic field.

Which statement is true?

A The force acting on an ion is different for each isotope.

B The radius of the path followed by an ion is different for each isotope.

C The kinetic energy of an ion increases for both isotopes.

D The acceleration of an ion is the same for both isotopes.

25 A circular coil with a radius of 0.10 m has 200 turns. The coil rotates at 50 revolutions per second about an axis which is perpendicular to a uniform magnetic field and in the plane of the coil. The magnetic flux density of the field is 0.20 T.

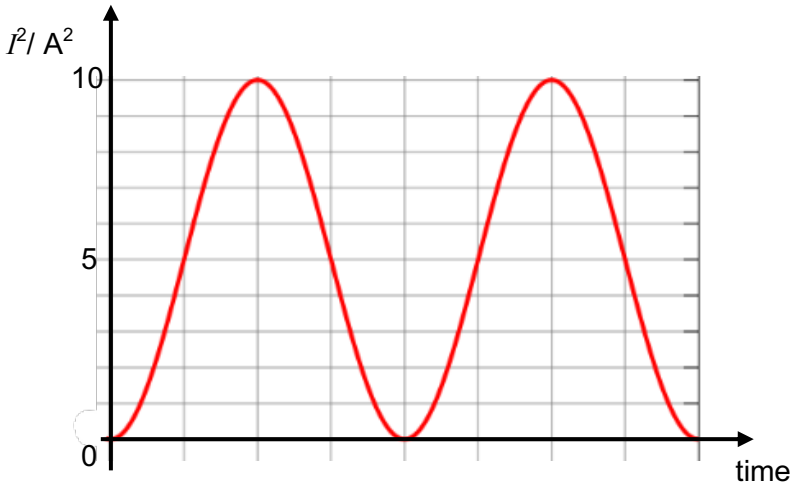
The maximum induced e.m.f. E_0 is given by the expression

E_0 = maximum magnetic flux linkage × angular speed of the coil

What is the maximum e.m.f. induced in the coil?

A 63 V **B** 126 V **C** 195 V **D** 395 V

26 The alternating current from an a.c. mains supply varies sinusoidally. The graph shows how the square of the current I in a given resistor varies with time.



Which direct current in the same resistor would generate the same average power as that from the alternating current?

A 2.2 A **B** 2.8 A **C** 3.2 A **D** 7.1 A

27 Removed, not in 9478 syllabus.

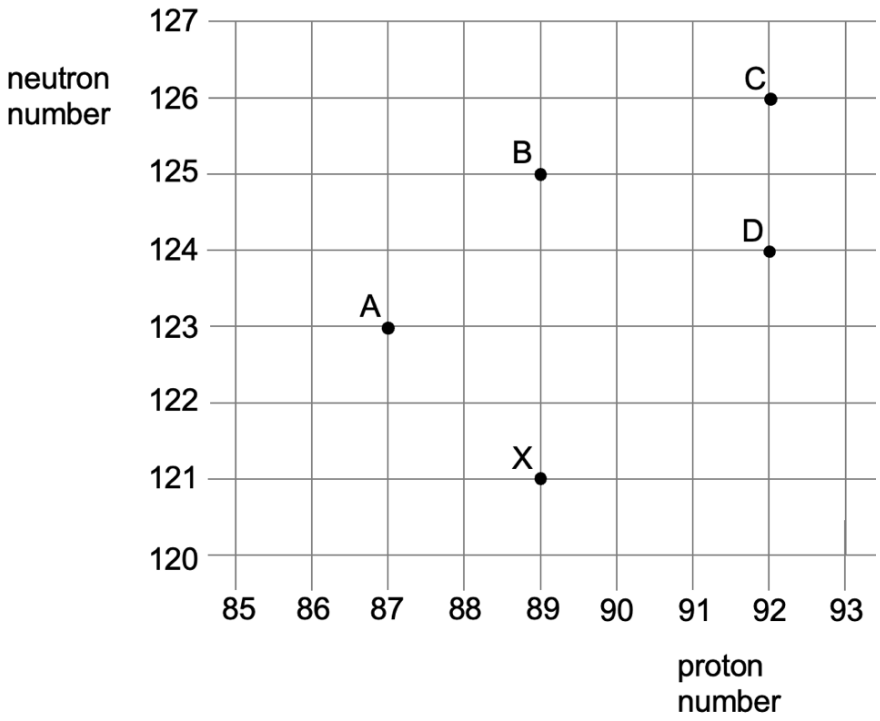
28 Electrons are accelerated through a potential difference and produce similar diffraction patterns as a wave of wavelength 2.0 pm.

What is the kinetic energy of one of the electrons?

A 1.5×10^{-14} J **C** 6.0×10^{-14} J

B 3.0×10^{-14} J **D** 1.2×10^{-13} J

29 Which of the following nuclides will produce nuclide X by undergoing a series of decays to emit an alpha particle and two beta particles?



30 Antimony-124 undergoes radioactive decay, with a half-life of 60 days, to becomes tellurium-124. Tellurium-124 is stable.

Initially, a sample of antimony-124 contains no tellurium.

For this sample, after what period of time will the ratio of antimony-124 to tellurium-124 be $\frac{1}{2}$?

A between 30 days and 60 days

B 60 days

C between 60 days and 120 days

D 120 days

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