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YISHUN TOWN SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2024

SEC 4 EXPRESS

PHYSICS

(6091/1)

DATE : 27 August

DAY : Tuesday

DURATION: 1 hr

MARKS: 40 marks

ADDITIONAL MATERIALS

Multiple Choice Answer Sheet (OMS)

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces provided at the top of this page.

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. Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

INFORMATION FOR CANDIDATES

Any rough working should be done in this booklet.

You may use an approved calculator.

This question paper consists of **16** printed pages.

1 A student makes three statements.

- A larger object will always have a larger inertia.
- A smaller object will always have a smaller density.
- When the mass of an object is kept constant, the gravitational force acting on it must also remain constant.

How many statements are always true?

A 0
C 2

B 1
D 3

2 A list of 8 physical quantities is shown below:

Length	Time	Energy	Force
Speed	Weight	Mass	Acceleration

How many of them are derived units?

A 3
C 5

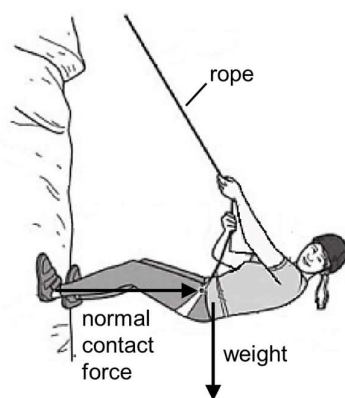
B 4
D 6

3 What is the conversion factor for converting nanohertz (nHz) to gigahertz (GHz)?

A 10^{-9}
C 10^{-15}

B 10^{-12}
D 10^{-18}

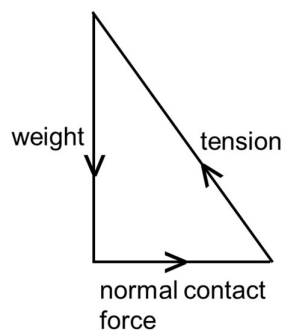
- 4 The figure (not drawn to scale) below shows a climber supported by a rope on a vertical wall.



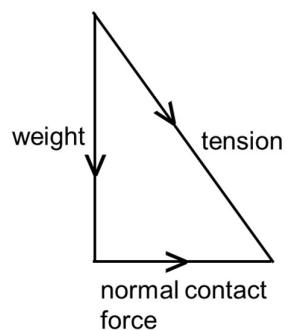
The weight and normal contact force are shown by the labelled arrows.

Which vector diagram is correct?

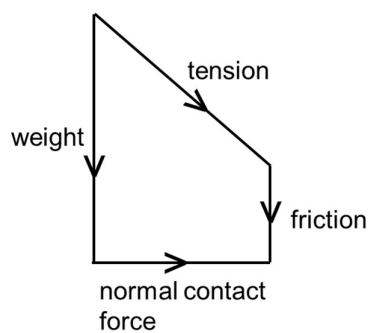
A



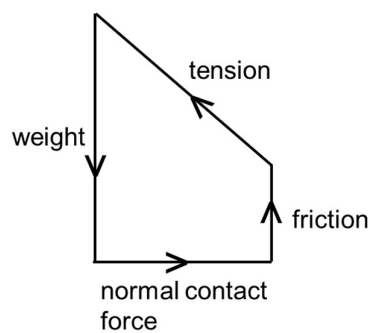
B



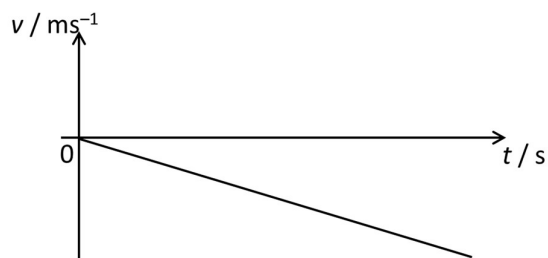
C



D



- 5 The velocity – time graph of a body is shown below.



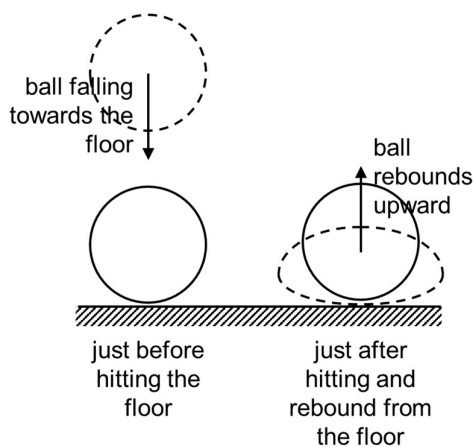
Paul makes four statements about the motion of the body.

1. The body is accelerating in the negative direction.
2. The body is decelerating.
3. The acceleration of the body is decreasing.
4. The speed of the body is increasing.

Which statements are correct?

- A** 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

- 6 A ball is dropped downwards, hits the floor and rebounds upward. The figure below shows the instance of the ball just before and right after it hits the floor.



Which row shows the correct description of the acceleration just before and after the ball hits the floor?

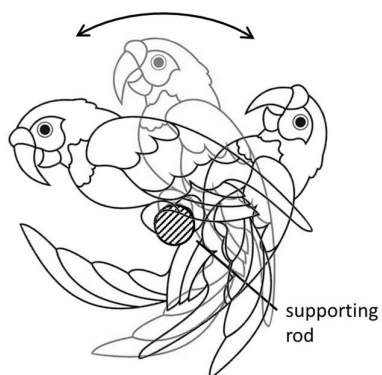
	just before hitting the floor	just after hitting the floor
A	acceleration is 10 m/s^2 downwards	acceleration is 10 m/s^2 upwards
B	acceleration is 0 m/s^2 downwards	acceleration is 0 m/s^2 upwards
C	acceleration is 0 m/s^2 downwards	acceleration is 0 m/s^2 downwards
D	acceleration is 10 m/s^2 downwards	acceleration is 10 m/s^2 downwards

- 7 A momentary force is applied to a disc on a frictionless surface.

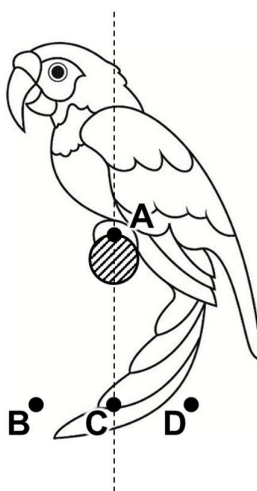
The effect of air resistance is negligible. Which statement best describes the subsequent motion of the disc?

- A It accelerates uniformly.
- B It decelerates to rest uniformly.
- C It moves with uniform velocity.
- D It stops abruptly.

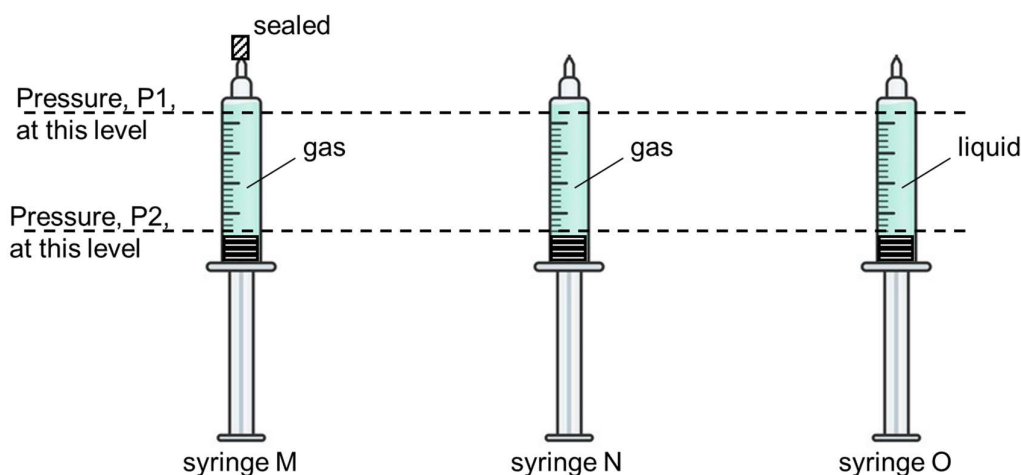
- 8 A parrot shaped toy is designed to oscillate about a supporting rod as shown below.



Where should the center of gravity be located so that the toy is the most stable?



- 9 The diagram shows three syringes. Syringe M and N contains gas, while syringe O contains liquid. Only syringe M is sealed. The temperature is kept constant.



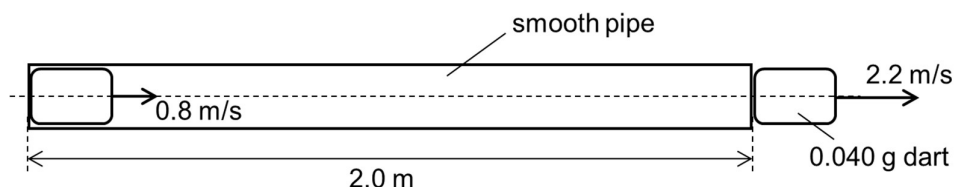
Which row describes the pressure correctly in each syringe?

	syringe M	syringe N	syringe O
A	$P_1 = P_2$	$P_1 = P_2$	$P_1 < P_2$
B	$P_1 = P_2$	$P_1 < P_2$	$P_1 = P_2$
C	$P_1 < P_2$	$P_1 < P_2$	$P_1 < P_2$
D	$P_1 < P_2$	$P_1 = P_2$	$P_1 = P_2$

- 10 Aeroplanes use barometers to determine their height from the sea level. The average height of the atmosphere is 18 km and the average density of air is 1.1 kg/m^3 .

What is the barometer reading when an aeroplane is flying at 12 km above sea level?

- A** 66 Pa **B** 130 Pa **C** 66 000 Pa **D** 130 000 Pa
- 11 Blow darts are used by some tribes to hunt. The diagram below show a 0.040 g dart speeding up along a 2.0 m long smooth pipe from 0.8 m/s to 2.2 m/s.



By applying the principle of energy conservation, what is the average force acting on the dart?

- A** $2.0 \times 10^{-5} \text{ N}$ **B** $4.2 \times 10^{-5} \text{ N}$
C $2.0 \times 10^{-2} \text{ N}$ **D** $4.2 \times 10^{-2} \text{ N}$

12 A cup of coffee is warmed from 20 °C to 30 °C. Which energy store of the coffee rises?

- A Its heat store.
- B Its internal energy store.
- C Its thermal potential energy store.
- D Its kinetic energy store.

13 An African elephant has a mass of 6000 kg and each of its four feet has an area of 0.20 m².

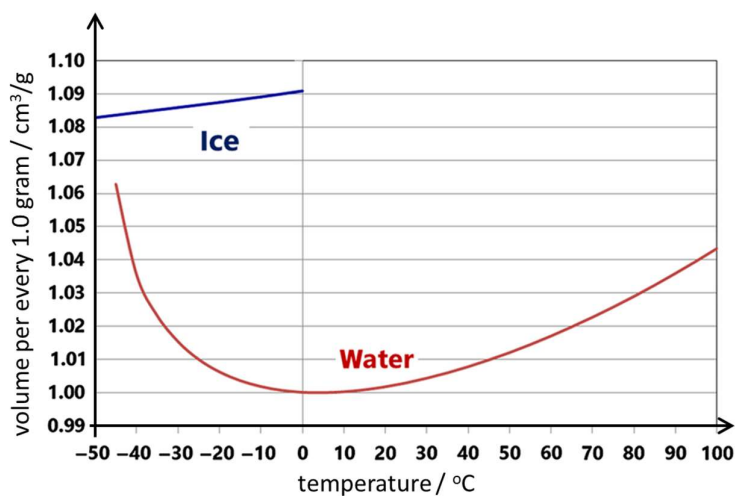
What is the average pressure due to the elephant when it is standing stationary on all four feet on level ground?

- A 19 kPa B 60 kPa C 75 kPa D 300 kPa

14 Which process in the convection of thermal energy occurs in a fluid?

- A The bulk movement of fluid of different temperature due to changes in density.
- B The ions that become less dense will rise, while cooler ones sink.
- C Increased ionic vibration passing on to neighbouring ions.
- D The expansion and contraction of ions caused by temperature changes forms the convection current.

15 The graph below records how the volume of 1.0 g of ice and water changes with temperature.



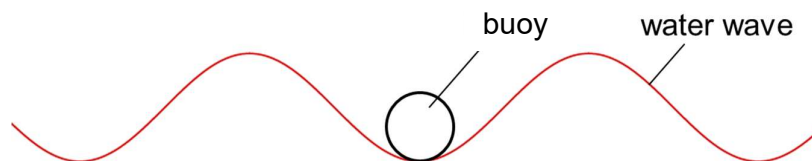
Three students make statements about this result.

- student 1: Water will always transfer heat to ice.
student 2: The density of ice is always lower than water below 0 °C.
student 3: Water contracts from negative temperature to 0 °C.

Which students are correct?

- A 1 only B 2 and 3 C 2 only D 3 only

- 16 Which statement about evaporation is **not** correct?
- A Evaporation can only occur in liquid.
 - B Evaporation can occur even when the liquid is already losing heat to the surrounding.
 - C Molecules at the surface leave only if it has absorbed enough energy from the surrounding to overcome the attractive forces.
 - D During evaporation, the average internal kinetic energy of the liquid will decrease.
- 17 In an experiment, 1500 J of energy is used to heat 0.020 kg of water in a beaker made of a material with excellent thermal conductivity. The specific heat capacity of water is 4200 J/kgK and the change in temperature of water is 12 °C. Assuming the beaker and water are always at the same temperature, what is the heat capacity of the beaker?
- A 41 J/K B 84 J/K C 209 J/K D 492 J/K
- 18 Which statement concerning transverse waves is correct?
- A The direction of wave travel and energy transfer is the perpendicular to each other.
 - B The speed of the wave can be measured from the speed of a wave front travelling forward.
 - C The wave requires a medium so that particles can vibrate and form a wave.
 - D The wave will cause particles to move from one end of the wave to another.
- 19 A speedometer is aimed at a buoy floating in a water tank. A vibrator is then used to generate a transverse wave in the water tank as shown and the wave causes the buoy to vibrate.



The speedometer measures the instantaneous velocity of the buoy and records it in a table.

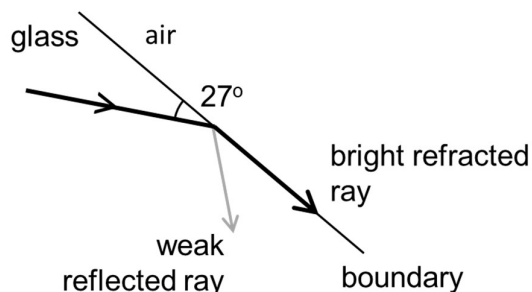
time / s	0.0	0.1	0.2	0.3	0.4	0.5
velocity / m/s	3.142	2.542	0.971	-0.971	-2.542	-3.142

time / s	0.6	0.7	0.8	0.9	1.0	1.1
velocity / m/s	-2.542	-0.971	0.971	2.542	3.142	2.542

Which property of the transverse wave can be obtained from the data?

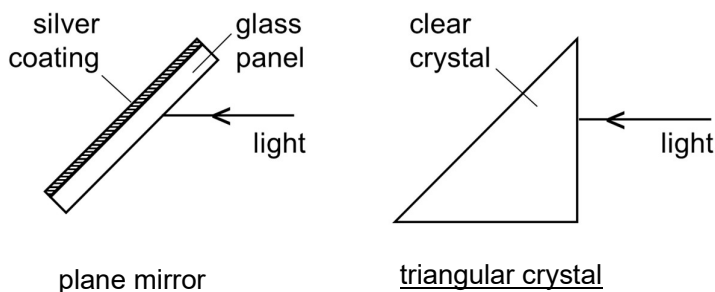
- A wavelength
- B amplitude
- C period
- D average speed

- 20 A ray of light in a glass block strikes the surface of the block and is refracted.



Through which angle does the direction of the ray deviate as it strikes the surface of the block?

- A 27° B 54° C 63° D 126°
- 21 We can change the direction of a horizontal beam of light by reflecting it through a plane mirror or a triangular crystal as shown below.



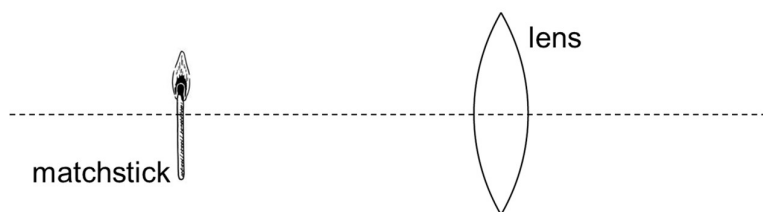
In complex optical machinery, triangular crystals are more commonly used to reflect light. Statements 1 and 2 refer to the advantage of using a triangular crystal as the reflector.

1. There is less distortion in the reflected image.
2. The reflecting surface is less exposed to environmental elements.

Which statements are correct?

- A neither of the statements
B both statements
C statement 1 only
D statement 2 only

- 22 A lighted matchstick is placed 20 cm from a converging lens with a focal length of 10 cm.



How much should the matchstick move in order to form a beam of light on the other side of the lens?

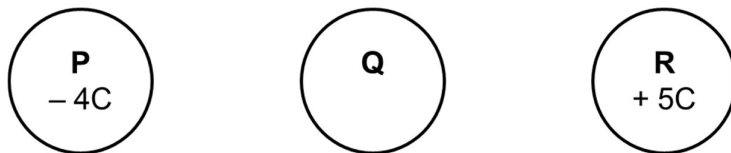
- A 5 cm to the right
B 5 cm to the left
C 10 cm to the right
D 15 cm to the right
- 23 The speed of light in plastic and glass is 2.3×10^8 m/s and 1.5×10^8 m/s respectively. What is the correct order of the refractive index of air, plastic and glass?

	lowest refractive index	→	highest refractive index
A	air	plastic	glass
B	air	glass	plastic
C	glass	air	plastic
D	glass	plastic	air

- 24 Which of the following is an application of microwaves?

- A satellite communication
B signal broadcasting on Earth
C sun tanning
D transfer heat

- 25 Three identical conducting spheres, P, Q and R with different charges are separated from each other as shown. P is negatively charged at -4 C, Q is neutral and R is at $+5$ C.



The three spheres are then brought together and make contact. Which row describes the charges on each sphere?

	sphere P	sphere Q	sphere R
A	positively charged	positively charged	positively charged
B	neutral	neutral	positively charged
C	negatively charged	neutral	positively charged
D	neutral	positively charged	neutral

26 Which statement describes the direction shown on an electric field line?

- A** It shows the direction of velocity of a positive ion in the field.
- B** It shows the direction of force acting on a positive ion in the field.
- C** It shows the direction of velocity of a negative ion in the field.
- D** It shows the direction of force acting on a negative ion in the field.

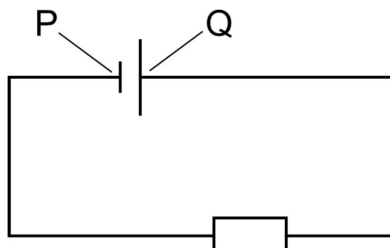
27 Danny has a positively charged plastic rod, a negatively charged metal sphere and an earth wire. The metal sphere is kept on an insulated stand throughout. He wants to charge the sphere positively and carries out the following steps:

1. He brings the rod close to, but not touching the sphere.
2. He connects the earth wire to the sphere while keeping the rod in place.
3. He removes the earth wire, before moving the rod far away from the sphere.

What is the outcome of Danny's procedure?

- A** He succeeds and the sphere is positively charged.
- B** He fails and the sphere is now neutral.
- C** He fails and the sphere remains negatively charged.
- D** The outcome cannot be determined because there is no information on which side of the sphere the earth wire is connected to.

28 There are 240 C of electrons flowing in the circuit shown below every minute.



What does this statement mean?

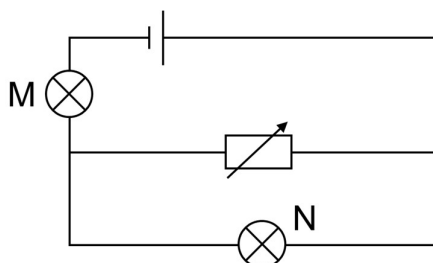
- A** There are 240 electrons flowing from P to Q every minute.
- B** There are 240 electrons flowing from Q to P every minute.
- C** 4.0 A of current flows from P to Q.
- D** 4.0 A of current flows from Q to P.

- 29** The efficiency of a lighting device converting electrical energy to light energy is 95%. An engineer requires the device to emit 8.0 J of light energy per minute from an electrical supply with an EMF of 9.0 V.

What should be the current flowing through the device?

- A** 0.016 A **B** 0.14 A **C** 0.89 A **D** 0.94 A

- 30** The circuit below shows a circuit with 2 light bulbs, M and N, and a rheostat.



The rheostat is kept initially at $4.0\ \Omega$. It is then adjusted to $0.0\ \Omega$. Which row shows how the brightness of M and N changes?

	M	N
A	brighter	dimmer
B	brighter	off
C	dimmer	brighter
D	dimmer	off

- 31** Which safety feature in an electrical circuit is optional in some cases?

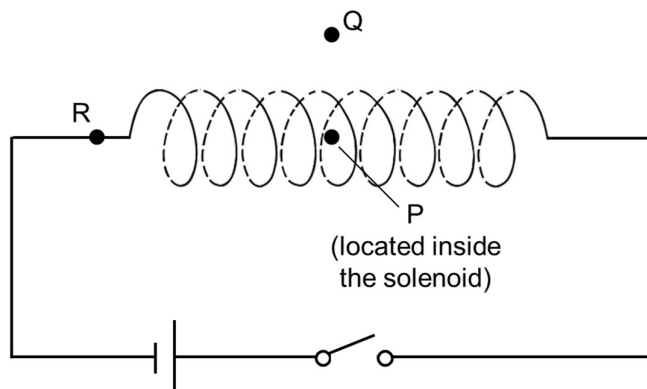
- A** switch **B** earth wire
C fuse **D** circuit breaker

- 32** A device has a power rating of 240 V, 2000 W. This device is connected to a supply of 120 V.

When the device is switched on, what is its power output?

- A** 500 W **B** 1000 W **C** 2000 W **D** 4000 W

- 33** A solenoid is connected to a DC supply and three compasses, P, Q and R, are placed around the solenoid as shown below.

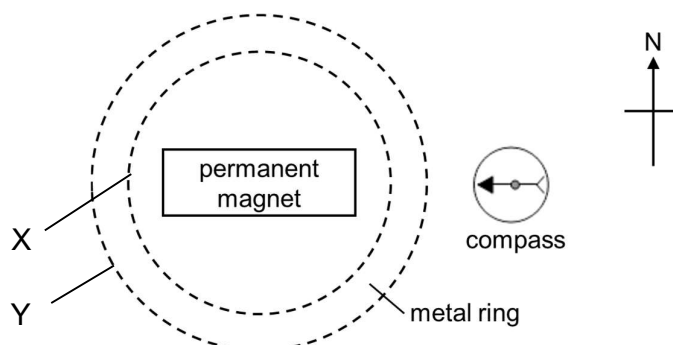


When the switch is closed, which row shows the direction in which the compass needles point to?

	P	Q	R
A	→	←	→
B	←	→	←
C	←	←	→
D	→	→	←

- 34** A magnet and a compass is placed next to each other as shown. Under the influence of the magnet, the compass pointer is deflected from the North direction.

Two different metal rings (X and Y) are then placed around the magnet, occupying the dotted area, together, one after another.



When metal ring X is placed first around the magnet, the compass pointer continues to point left. However, when metal ring Y is placed around the magnet, the compass pointer returns to the North direction.

What are rings X and Y made of?

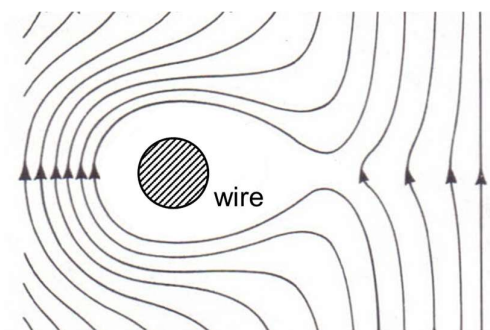
	ring X	Ring Y
A	aluminium	copper
B	copper	iron
C	iron	aluminium
D	iron	steel

- 35** Two identical parallel wires, P and Q, are placed next to each other. The current I_P flowing in P and the current I_Q flowing in Q are in the same direction but I_P is twice of I_Q .

Which row about the force F_P acting on wire P and the force F_Q acting on wire Q is correct?

	direction of F_P	direction of F_Q	magnitude
A	→	←	$2F_P = F_Q$
B	←	→	$F_P = F_Q$
C	→	←	$F_P = 2F_Q$
D	→	←	$F_P = F_Q$

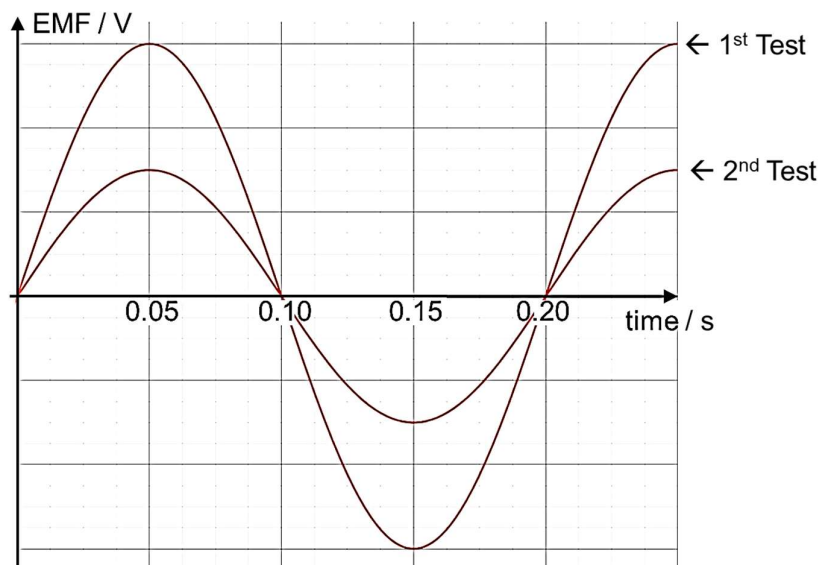
- 36** The diagram below shows the resultant field pattern around the cross-section of a direct-current carrying straight wire placed in a uniform magnetic field.



What is the direction of the current flowing through the wire?

- | | |
|---------------------------|-------------------------|
| A left | B right |
| C out of the paper | D into the paper |

- 37 Alex conducts two tests on a handheld generator. The first test is used as a reference and Alex makes one change in the second test. An EMF vs time graph is used to record the output for both tests, as shown below.

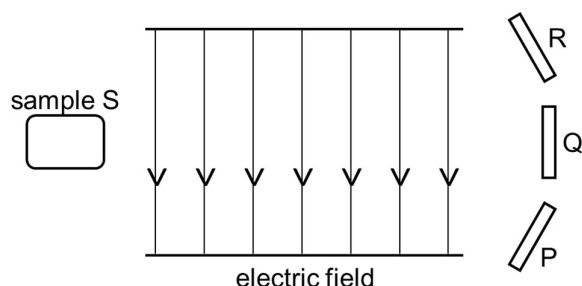


What change has Alex made in the second test?

- A Alex rotates the generator handle at half its initial speed.
 - B Alex weakens the strength of the magnet in the generator by half.
 - C Alex rotates the generator handle in the opposite direction.
 - D Alex shortens the length of the generator handle by half.
- 38 The atom, ${}^{133}_{55}\text{X}$, is a neutral atom. Which row shows the correct number of protons, neutrons and electrons in this atom?

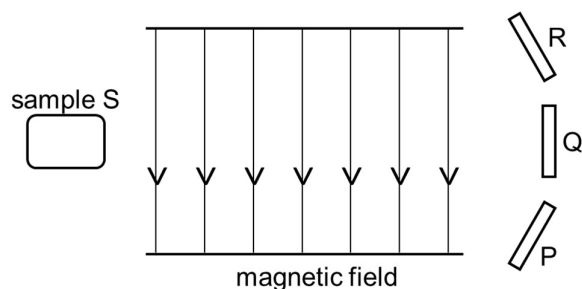
	protons	neutrons	electrons
A	133	55	133
B	55	78	55
C	78	55	78
D	55	133	55

- 39** The set up below is used to determine the type of radiations emitted by a radioactive isotope. It makes use of an electrical field to separate the different types of radioactive emission. Three detectors, P, Q and R, are positioned on the other side of the electric field. The detectors will light up whenever charged particles or gamma rays strike it.



When sample S is tested, only detector P and Q light up.

Sample S is tested again but instead of an electric field, a magnetic field is used.



Which row shows the result of this test?

	P	Q	R
A	off	lights up	lights up
B	lights up	lights up	off
C	off	lights up	off
D	off	off	off

- 40** Radioactive materials are hazardous. Which statement about these possible dangers is true?
- A** Only radioactive materials with long half-life are dangerous.
 - B** Materials that emit only alpha-particles must be kept in thick lead containers.
 - C** Radioactive materials are safe to handle after two half-lives.
 - D** Beta-particles can pass through skin and damage body cells below the skin.