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BROADRICK SECONDARY SCHOOL

SECONDARY 4 EXPRESS

PRELIMINARY EXAMINATION 2024

PHYSICS

6091/01

Paper 1 Multiple Choice

September 2024

Additional Materials: Multiple Choice Answer Sheet

1 hour

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, index number and class on the OTAS 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 OTAS answer sheet.

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.

This question paper consists of **19** printed pages including this page.

- 1 A light year is the distance light travels in 1 year (365 days).

Which of the following is the nearest estimate of 1 light year?

- A** 10 000 km **B** 10 000 Mm **C** 10 000 Gm **D** 10 000 Tm

- 2 The SI unit for pressure is Pascal and the symbol is Pa.

Which of the following symbols are the equivalent base unit for pressure?

- A** kg m s^2 **B** kg m / s^2 **C** $\text{kg m}^3 / \text{s}^2$ **D** kg / m s^2

- 3 Two objects have the same size and shape but one is heavier than the other. They are each dropped from rest in air.

Which of the following statements is correct?

- A** The heavier object has a higher initial acceleration and a higher terminal velocity.
B The heavier object has a higher initial acceleration and the same terminal velocity.
C The heavier object has the same initial acceleration and a higher terminal velocity.
D The heavier object has the same initial acceleration and the same terminal velocity.

- 4 A small jet plane is at rest on a runway, ready for take off. The average acceleration during take-off is 2.2 m / s^2 and the minimum speed required for take-off is 66 m / s .

What is the minimum length of runway required for the jet plane to take off?

- A** 145 m **B** 990 m **C** 1980 m **D** 4356 m

- 5 A man is sitting on a bench.

Two forces act on him – his weight, W and the normal contact force, N .

Which of the following makes an action-reaction pair with his weight, W ?

- A** The force acting on the bench by the man.
B The force acting on the Earth by the man.
C The force acting on the man by the bench.
D The force acting on the man by the Earth.

6 In which of the following scenarios is the resultant force on the moving body equal to zero?

- A a bicycle decelerating along a straight horizontal track
- B a car turning a corner at constant speed
- C a rock falling freely on the Moon
- D a train going up a hill along a straight path at constant speed

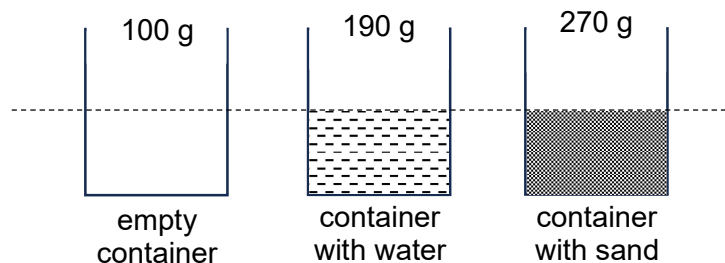
7 The following table shows the masses and weights of object W, X, Y and Z on some planets.

Object	Mass / kg	Weight / N
W	40	360
X	20	200
Y	10	40
Z	5	45

Which two objects are likely to be on the same planet?

- A W and X
- B W and Z
- C X and Y
- D Y and Z

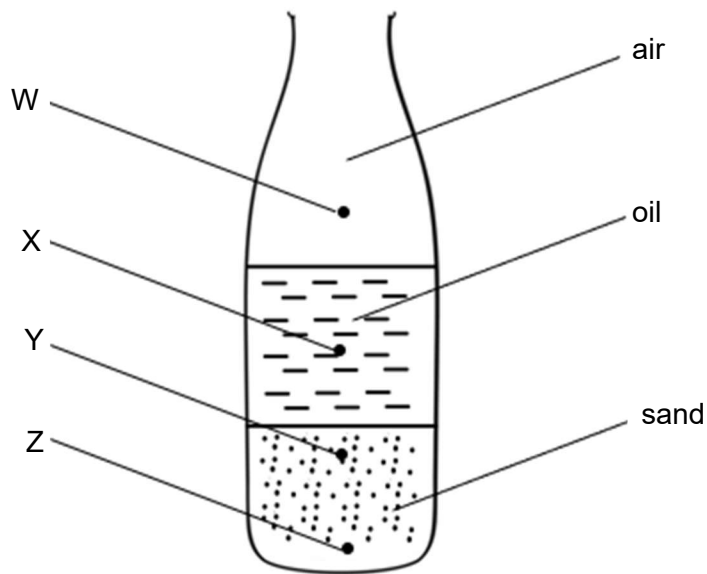
8 The diagrams show three identical containers. The first is empty and the other two contain water and sand respectively. The density of water is 1 g / cm^3 .



What is the density of the sand?

- A 1.12 g / cm^3
- B 1.25 g / cm^3
- C 1.89 g / cm^3
- D 2.70 g / cm^3

- 9 The diagram shows a bottle containing air, some oil and 150 g of sand.

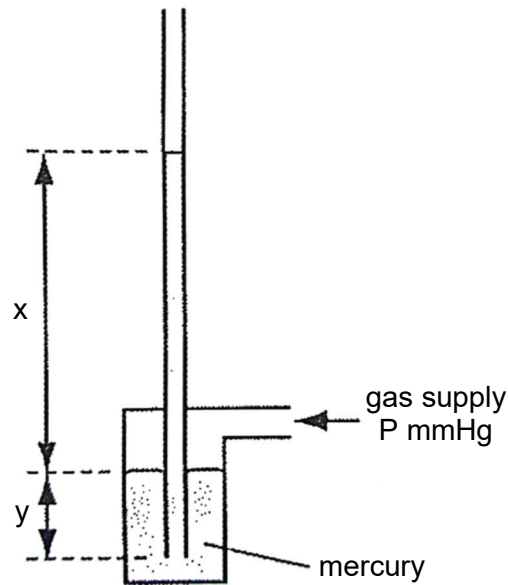


Another 50 g of sand is added to the bottle.

How does the centre of gravity move?

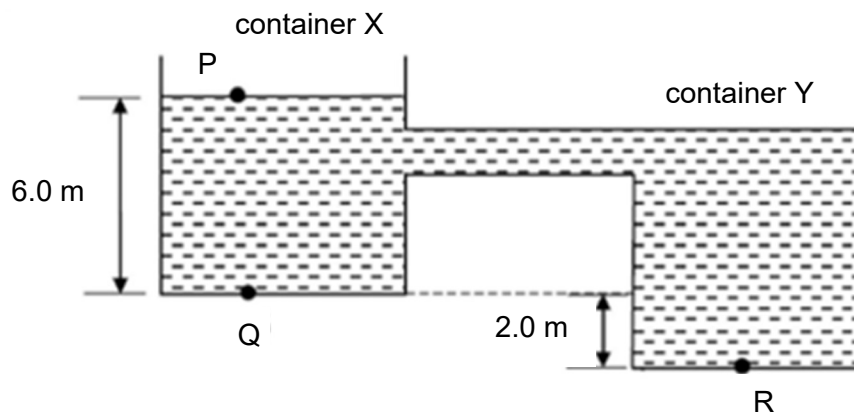
- A** from W towards X
- B** from X towards Y
- C** from Y towards X
- D** from Y towards Z

- 10** An open tube stands, with one end in mercury, in a chamber that is connected to a gas supply. The pressure of the gas is P mmHg. The atmospheric pressure is A mmHg. x and y are measured in millimetres.



Which of the following is equivalent to P mmHg?

- A** x mmHg **B** $(x + A)$ mmHg **C** $(x - A)$ mmHg **D** $(x + y + A)$ mmHg
- 11** Two containers X and Y are connected as shown. They are filled with the same liquid.



The pressure at P is 100 000 Pa and the pressure at Q is 160 000 Pa. The gravitational field strength is 10 N / kg .

What is the pressure at R ?

- A** 80 000 Pa **B** 140 000 Pa **C** 160 000 Pa **D** 180 000 Pa

- 12 The following are eight different energy resources.

Biofuels	Geothermal reservoirs	Nuclear fuels	Tides
Fossil fuels	Hydropower	Solar power	Wind

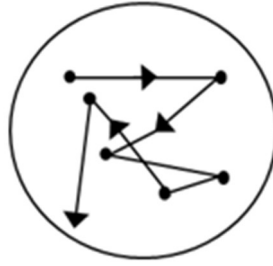
How many of these energy resources are renewable?

- A** 4 **B** 5 **C** 6 **D** 7
- 13 An object of mass 40 kg falls freely from a height of 20 m on the moon. The gravitational field strength on the moon is 1.6 N / kg.
- If 200 J of energy is transferred to the internal store of the surroundings as the object falls, what is the speed of the object when it hits the ground?
- A** 7.35 m / s **B** 8.00 m / s **C** 19.7 m / s **D** 20.0 m / s
- 14 A series of experiments were carried out to estimate the useful power output of a student running up flights of stairs, ignoring the work done against friction and air resistance.

Which of the following measurements is **not** required for these experiments?

- A** time taken to run up the flights of stairs
B total horizontal distance covered by the flights of stairs
C total vertical height of the flights of stairs
D weight of the student

- 15** Smoke particles in a transparent container are observed under a microscope. A small point of light is seen to move around as shown.



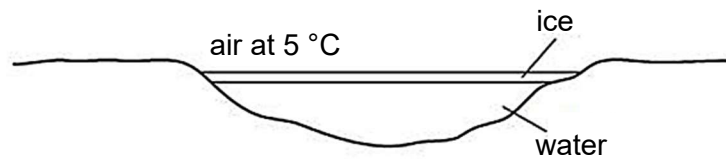
When the temperature in the container is raised, what change can be observed?

- A** The small point of light becomes brighter.
 - B** The small point of light changes direction more frequently.
 - C** The small point of light increases in size.
 - D** The small point of light moves slower.
- 16** Which of the following describes a substance in the liquid state?
- A** The substance does not have a fixed volume and the particles move very fast.
 - B** The substance has a fixed volume and the particles are arranged in a regular manner.
 - C** The substance has a fixed volume and the particles move around freely and randomly.
 - D** The substance has a fixed volume and the particles vibrate very fast.
- 17** A solid X is in thermal equilibrium with a solid Y. Solid Y is at the same temperature as solid Z. The three bodies are made of different materials and have different masses.

Which of the following statements is true?

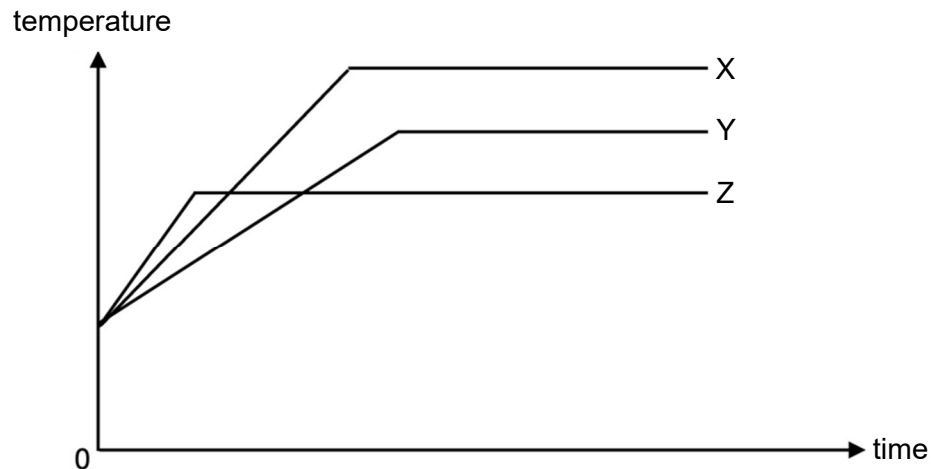
- A** There is no net transfer of energy when X is placed in thermal contact with Z.
- B** X and Y have the same specific heat capacity.
- C** Y and Z have the same internal energy.
- D** Y is not in thermal equilibrium with Z.

- 18 The diagram shows a frozen pond with the surface of the ice slowly melting as thermal energy is gained from the warmer air above it.



By which process(es) is / are thermal energy transferred from the air to the ice?

- A conduction only
 - B conduction and convection only
 - C conduction and radiation only
 - D conduction, convection and radiation
- 19 Equal masses of three liquids X, Y and Z are heated from room temperature. Heat energy is supplied at the same rate to each liquid. The graph below shows how the temperature of each liquid varies with time after heating starts.



What can be deduced from the graph?

- A X gains the most internal energy.
- B Y has the largest specific heat capacity.
- C Z has the lowest melting point.
- D Z has the smallest specific latent heat of vaporisation.

- 20 Some liquid in a dish evaporates.



before evaporation



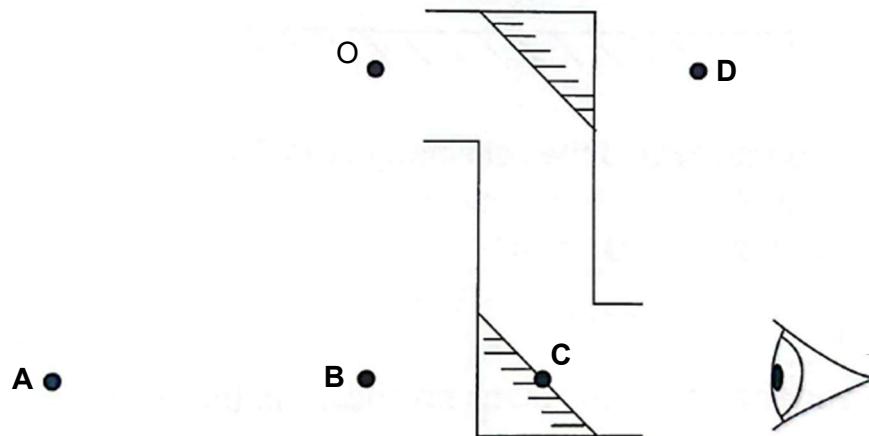
after evaporation

Which row best describes the energy states of the liquid molecules?

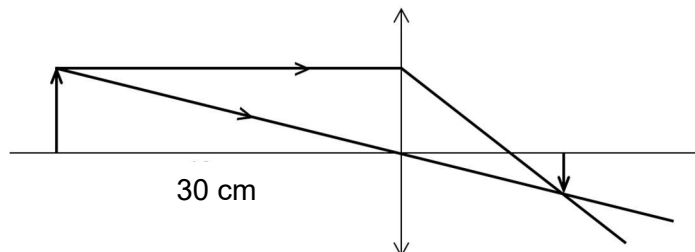
	molecules that escape to the surroundings have	molecules in the liquid have greater average kinetic energy
A	high energy	before evaporation
B	high energy	after evaporation
C	low energy	before evaporation
D	low energy	after evaporation

- 21 The diagram shows an object viewed using two mirrors. A person looks into the mirrors as shown.

At which position is the image of O seen?



- 22 The diagram (not drawn to scale) shows an object placed 30 cm in front of a thin converging lens, used to form a real image in a camera.

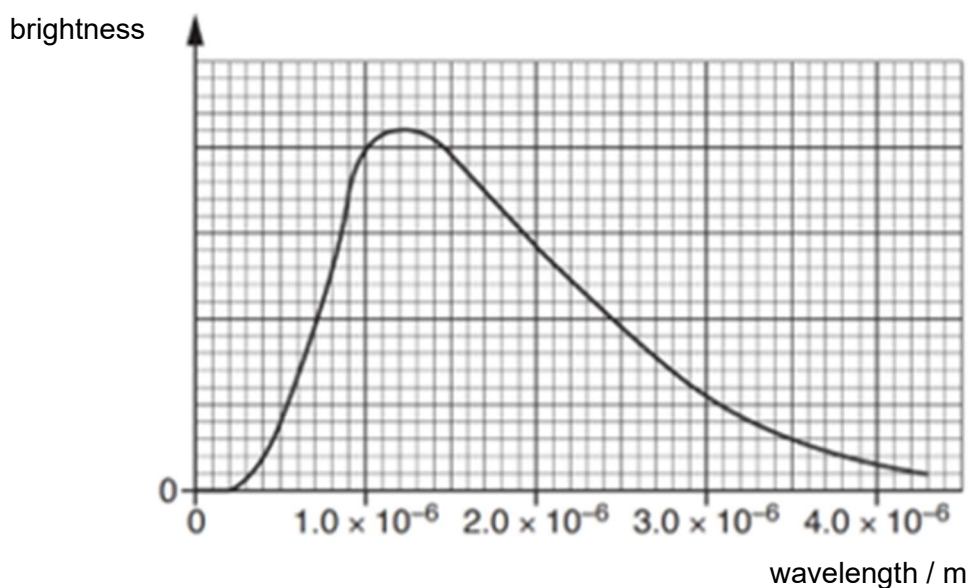


What is a possible focal length of this lens?

- A** 10 cm **B** 15 cm **C** 30 cm **D** 60 cm
- 23 In the electromagnetic spectrum shown below, which quantity increases from left to right?

Radio waves	Microwaves	Infra-red radiation	Visible light	Ultraviolet radiation	X rays	Gamma rays
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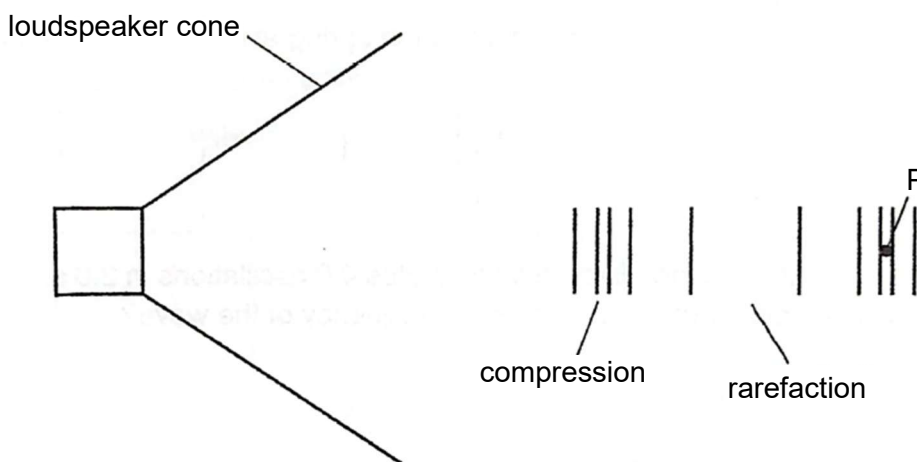
- A** amplitude **B** frequency **C** velocity **D** wavelength
- 24 A star emits electromagnetic radiation over a range of wavelengths. The diagram shows how the brightness of the radiation from the star varies with wavelength.



What is the frequency of the brightest radiation emitted from the star?

- A** 7.0×10^{13} Hz **B** 1.0×10^{14} Hz **C** 2.5×10^{14} Hz **D** 1.5×10^{15} Hz

- 25** Compressions and rarefactions propagate out from a loudspeaker cone as it vibrates backwards and forwards. The frequency of the vibration is 5 Hz.

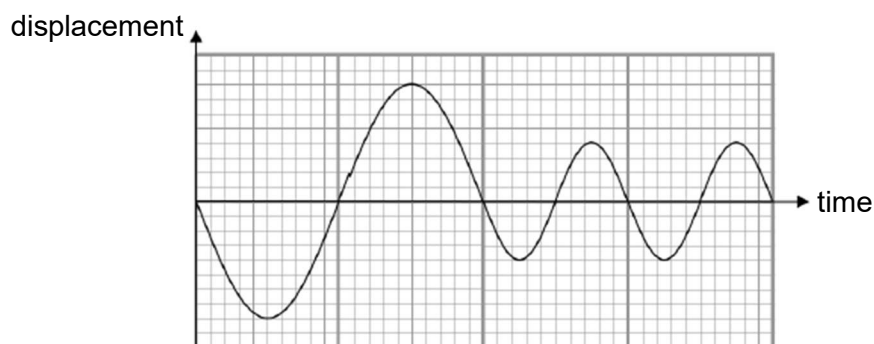


Point P is at the centre of a compression.

How much time elapses before the next rarefaction arrives at P?

- A** 0.1 s **B** 0.2 s **C** 0.4 s **D** 5.0 s

- 26** The displacement-time graph shows how a sound wave changes with time.



Which row shows the change in loudness and pitch of the sound wave?

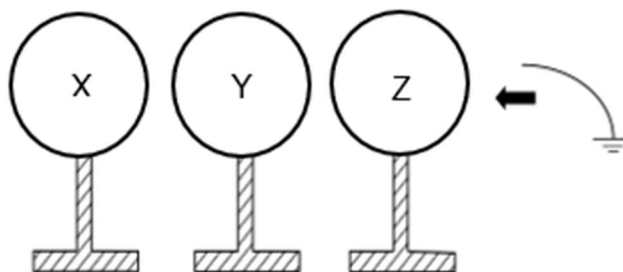
	loudness	pitch
A	decreases	no change
B	decreases	increases
C	increases	decreases
D	increases	increases

- 27 Three students made statements about audible sound, ultrasound and ultra-violet radiation.

statement	
1	The frequencies of audible sound and ultrasound are the same but lower than the frequency of ultra-violet radiation.
2	The speeds of audible sound and ultrasound in air are the same but are lower than the speed of ultra-violet radiation.
3	The speeds of audible sound, ultrasound and ultra-violet radiation increase as they travel from gas to solid.

Which of the statements above are correct?

- A statement 1 and 2
 B statement 2 and 3
 C statement 2 only
 D statement 3 only
- 28 The diagram shows metal spheres X, Y and Z mounted on insulating stands that are placed close to, but not touching each other.

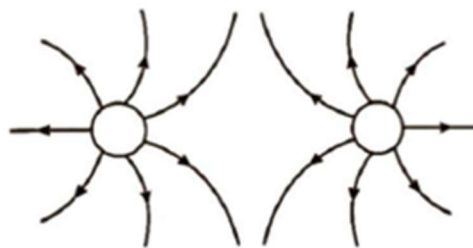


X is negatively charged, while Y and Z are electrically neutral and Z is momentarily earthed.

Which of the following statements about Y and Z is correct?

- A Both Y and Z become positively charged.
 B Both Y and Z remain neutral.
 C Y becomes positively charged and Z becomes negatively charged.
 D Y remains neutral and Z becomes positively charged.

- 29 The diagram shows the electric field pattern between two isolated point charges.



Which two point charges produces this electric field pattern?

A



B



C



D



- 30 In 6.0 s, 5.6×10^{19} electrons pass through a resistor. As the electrons pass, thermal energy is produced in the resistor at a rate of 8.0 W. The charge on an electron is 1.6×10^{-19} C.

What is the potential difference across the resistor?

- A** 1.12 V **B** 1.49 V **C** 5.36 V **D** 8.96 V

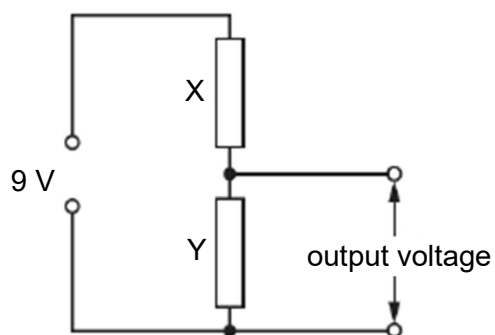
- 31 The resistance of a piece of wire of length 1 m and diameter 0.2 mm is R.

A second piece of wire made of the same material is 3 m longer than the first wire and has a diameter half of that of the first wire.

What is the resistance of the second piece of wire in terms of R?

- A** 0.75 R **B** R **C** 12 R **D** 16 R

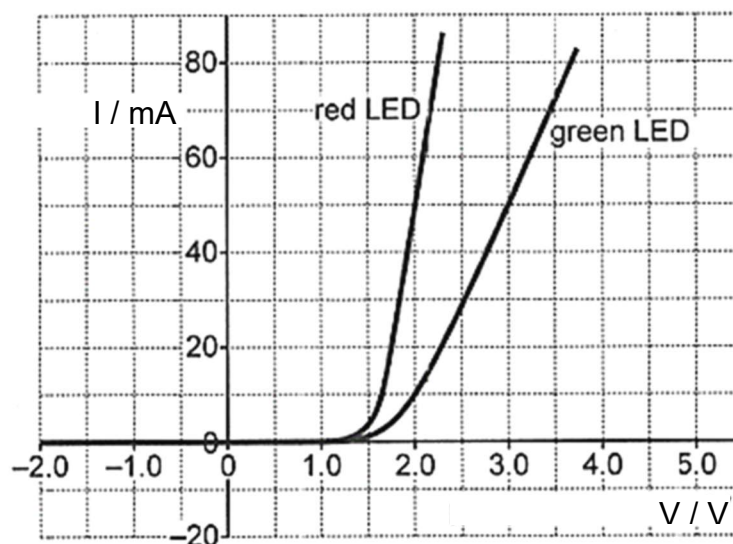
- 32 Two resistors X and Y are connected in series with a 9 V supply. The output voltage across Y is 3V.



What is the output voltage when the resistance of Y is halved and the resistance of X remains unchanged?

- A** 0.75 V **B** 1.50 V **C** 1.80 V **D** 2.25 V

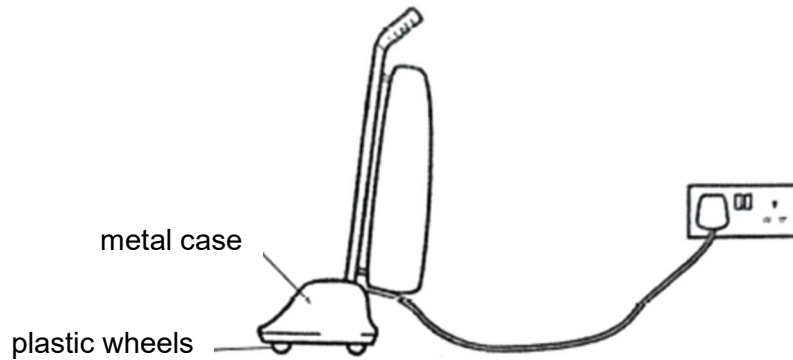
- 33 The diagram shows the I-V characteristic graph for a red light-emitting diode (LED) and a green light emitting diode (LED).



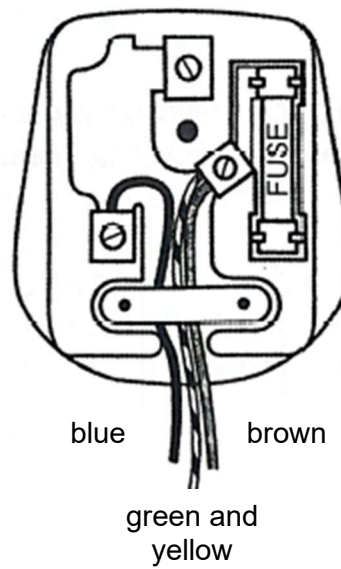
Which of the following conclusions is true?

- A When the current in the red LED and the green LED are both 50 mA, both LEDs are equally bright.
 - B When the current in the red LED and the green LED are both 50 mA, the red LED is brighter.
 - C When the p.d. across the red LED and the green LED are both 2.0 V, the green LED is brighter.
 - D When the p.d. across the red LED and the green LED are both 2.0 V, the red LED is brighter.
- 34 What is the primary purpose of a circuit breaker in an electrical circuit?
- A To convert the alternating current supply to a direct current output.
 - B To increase the voltage supplied to the appliances connected in the circuit.
 - C To prevent excessive current flow in the event of an electrical fault.
 - D To vary the size of the current flowing in the circuit.

- 35 The diagram shows an old vacuum cleaner with a metal case and plastic wheels.



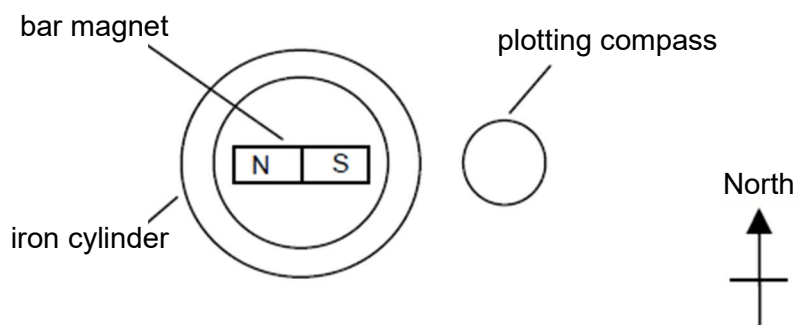
The plug of the vacuum cleaner is incorrectly wired, as shown.



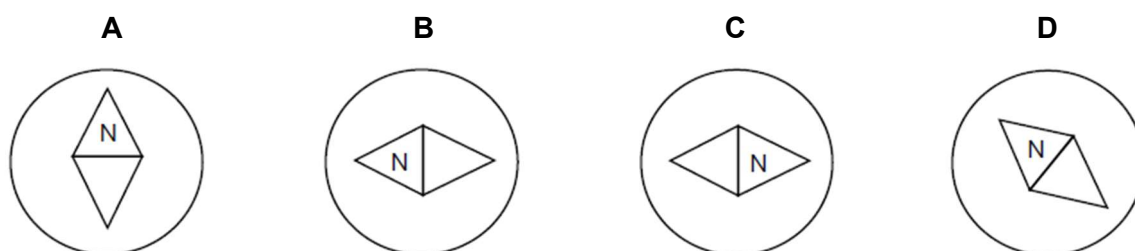
What is the effect of using the plug wired this way?

- A The fuse in the plug blows.
- B The metal case of the vacuum cleaner becomes live.
- C The vacuum cleaner catches fire.
- D The vacuum cleaner does not work.

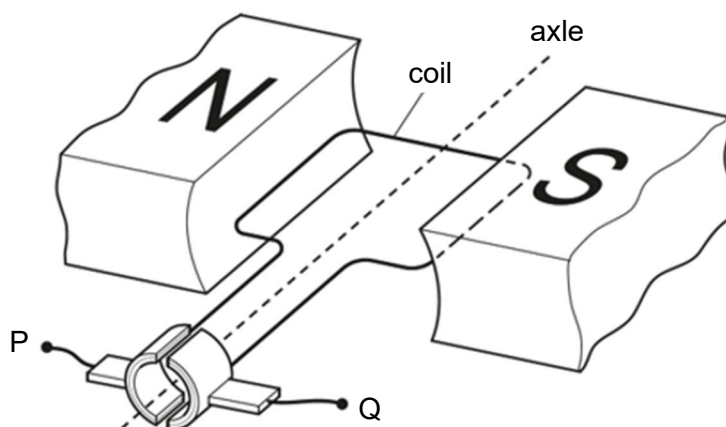
- 36 A bar magnet is placed in a hollow iron cylinder. A small plotting compass is placed near the bar magnet as shown.



Which diagram shows the direction in which the compass needle points?



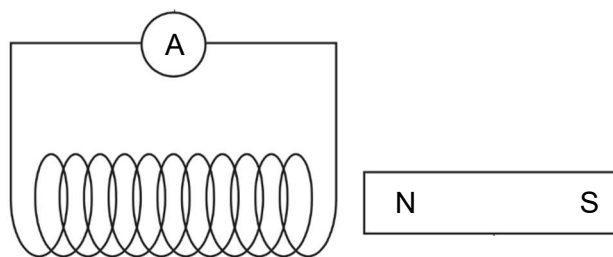
- 37 The diagram below shows the structure of a motor with the coil in the horizontal position.



Which of the following will result in the coil rotating in the clockwise direction with a faster rate of rotation?

- A pass a large current through the coil from P to Q
- B pass a small current through the coil from P to Q
- C pass a large current through the coil from Q to P
- D pass a small current through the coil from Q to P

- 38 The diagram shows a coil of wire that is connected to a sensitive ammeter and a bar magnet.



Which of the following does **not** cause a reading on the ammeter?

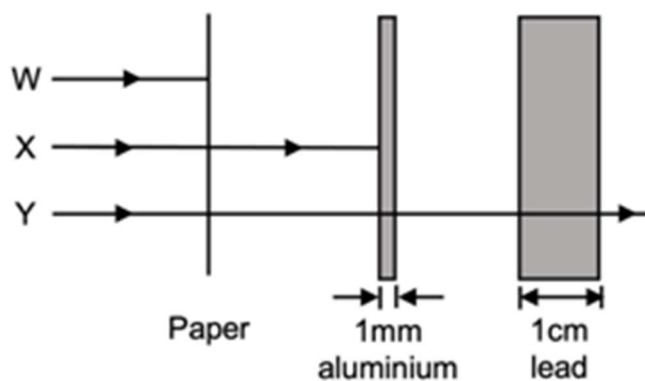
- A moving both the coil and the magnet away from each other at the same speed
 - B moving both the coil and the magnet to the left at the same speed
 - C moving both the coil and the magnet towards each other at the same speed
 - D rotating the magnet 180° clockwise such that the south pole is closer to the coil
- 39 In Singapore, transformers are used to provide a 240 V output from a 400 kV supply.

What are the suitable numbers of turns for the primary coil and secondary coil in an ideal transformer?

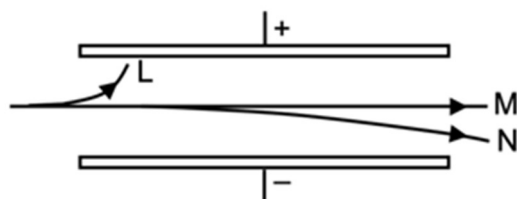
	number of turns on the primary coil	number of turns on the secondary coil
A	30	50000
B	240	400
C	400	240
D	50000	30

40 The following show different behaviours of α -particles, β -particles and gamma radiation.

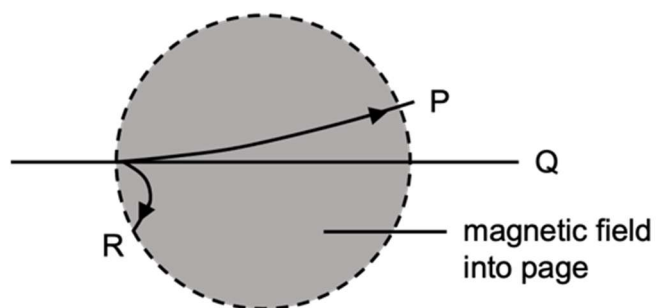
- They are absorbed to different extents in solids.



- They behave differently in an electric field.



- They behave differently in a magnetic field.



Which three labels in the figures above refer to the same kind of radiation?

- A W, L, P
- B X, L, R
- C Y, N, P
- D Y, N, Q

End of paper