



COMPASSVALE SECONDARY SCHOOL
Secondary Four Express / Five Normal (Academic)
Preliminary Examination 2024

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INDEX
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PHYSICS

6091/01

Paper 1 Multiple Choice

23 August 2024

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name and index number on the Answer Sheet in the spaces provided.

There are **forty** 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 optical mark 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.

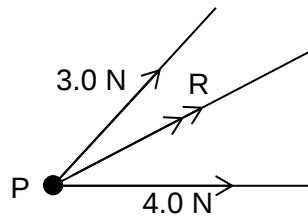
The use of an approved scientific calculator is expected, where appropriate.

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

Set by: Mr E Chng

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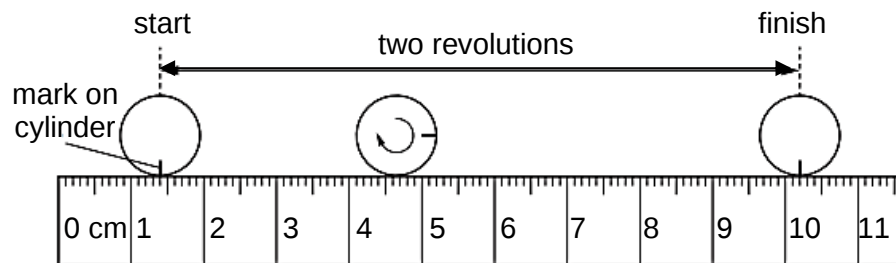
- 1 The diagram shows the resultant R of a 3.0 N force and a 4.0 N force that act at a point P .



The angle between the 3.0 N force and the 4.0 N force can be any value from 0° to 90° .

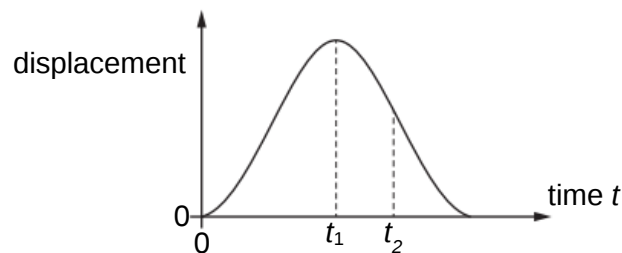
Which value of R is **not** possible?

- A 4.0 N B 5.0 N C 6.0 N D 7.0 N
- 2 A small cylinder is rolled along a ruler and completes two revolutions.



What is the circumference of the cylinder?

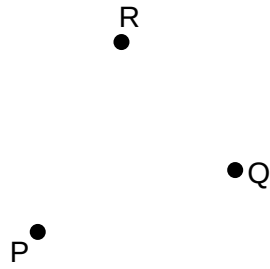
- A 4.4 cm B 4.6 cm C 8.8 cm D 10.2 cm
- 3 A train sets off from a station at time $t = 0$. The graph shows how the displacement between the train and the station varies with time.



Which statement about the movement of the train between time t_1 and t_2 is correct?

- A Its speed is decreasing and it is moving away from the station.
- B Its speed is decreasing and it is moving towards the station.
- C Its speed is increasing and it is moving away from the station.
- D Its speed is increasing and it is moving towards the station.

- 4 Three locations P, Q and R are shown below.



One object moves directly from P to R.
In a shorter time, a second object moves from P to Q to R.

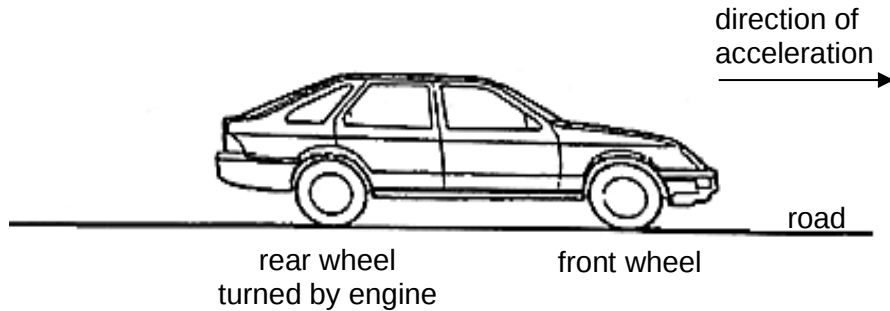
Which statement about the journey taken by the two objects is correct?

- A They have the same average speed.
 - B They have the same average velocity.
 - C They have the same displacement.
 - D They have the same distance.
- 5 A student drops a table-tennis ball in air.

What happens to the velocity and to the acceleration of the ball during the first few seconds after it is released?

	velocity	acceleration
A	decreases	increases
B	decreases	unchanged
C	increases	decreases
D	increases	unchanged

- 6 The rear wheel of a car is turned in a clockwise direction by the engine as the car accelerates to the right, as shown in the diagram. The front wheel of the car is dragged along as the car moves.



What are the directions of the frictional forces acting on the front and rear wheels?

	direction of frictional force on front wheel	direction of frictional force on rear wheel
A	to the right	to the right
B	to the right	to the left
C	to the left	to the right
D	to the left	to the left

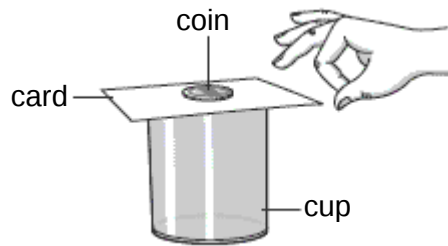
- 7 A spacecraft moves from Earth towards the Moon.

At a point in its journey, the weight of the spacecraft is zero.

Which statement best explains why the weight of the spacecraft is zero?

- A** The gravitational field of the Earth is negligible.
- B** The gravitational field of the Earth is balanced by the gravitational field of the Moon.
- C** The spacecraft is moving at constant speed.
- D** The spacecraft is not moving.

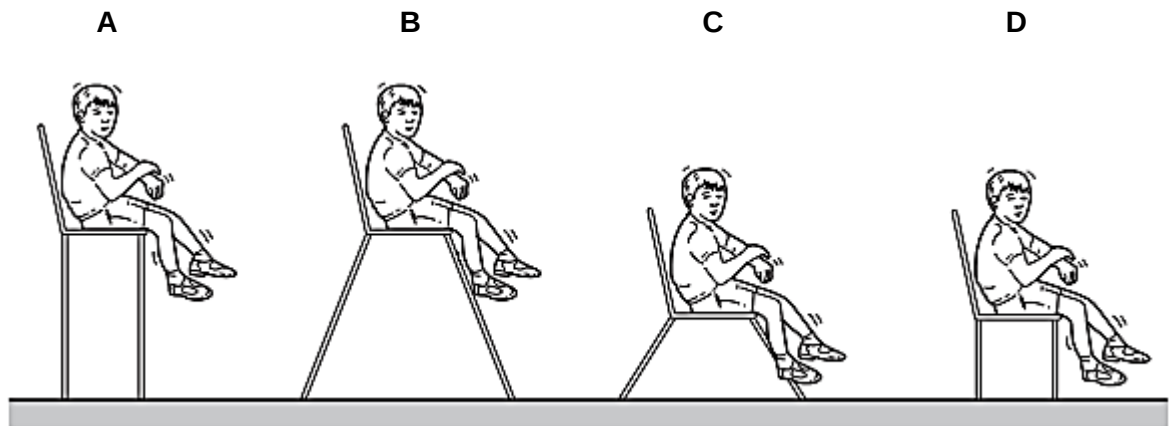
- 8 The diagram shows a coin placed on a card above a cup.



When the card is flicked to the side, the coin does not move with the card but instead drops down into the cup.

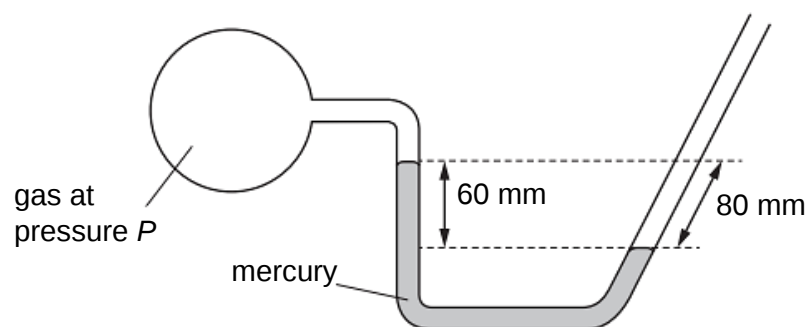
Which statement explains this observation?

- A The coin experienced a reluctance to change its motion.
 - B The coin experienced weightlessness at the moment of impact.
 - C The cup exerted an attractive force on the coin.
 - D The gravitational force acting on the coin was too great as compared to the flick.
- 9 Which chair is the **least** stable if the child moves?



- 10** The diagram shows a mercury manometer. The tube is open to the atmosphere on the right-hand side.

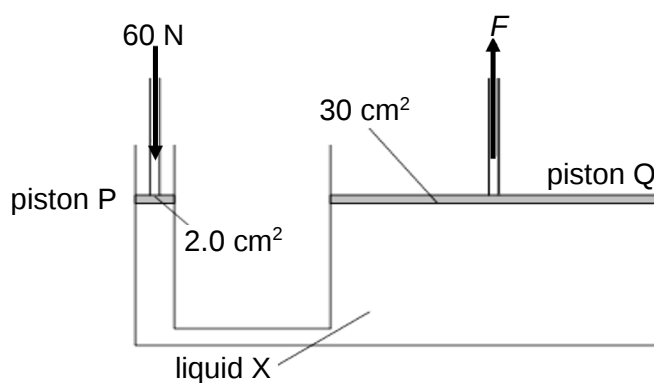
The left-hand side is connected to a container containing a gas at pressure P .



The atmospheric pressure is 760 mmHg.

What is the pressure of P ?

- A** 680 mmHg **B** 700 mmHg **C** 820 mmHg **D** 840 mmHg
- 11** A hydraulic press contains an incompressible liquid X. Piston P has an area of 2.0 cm^2 and piston Q has an area of 30 cm^2 .



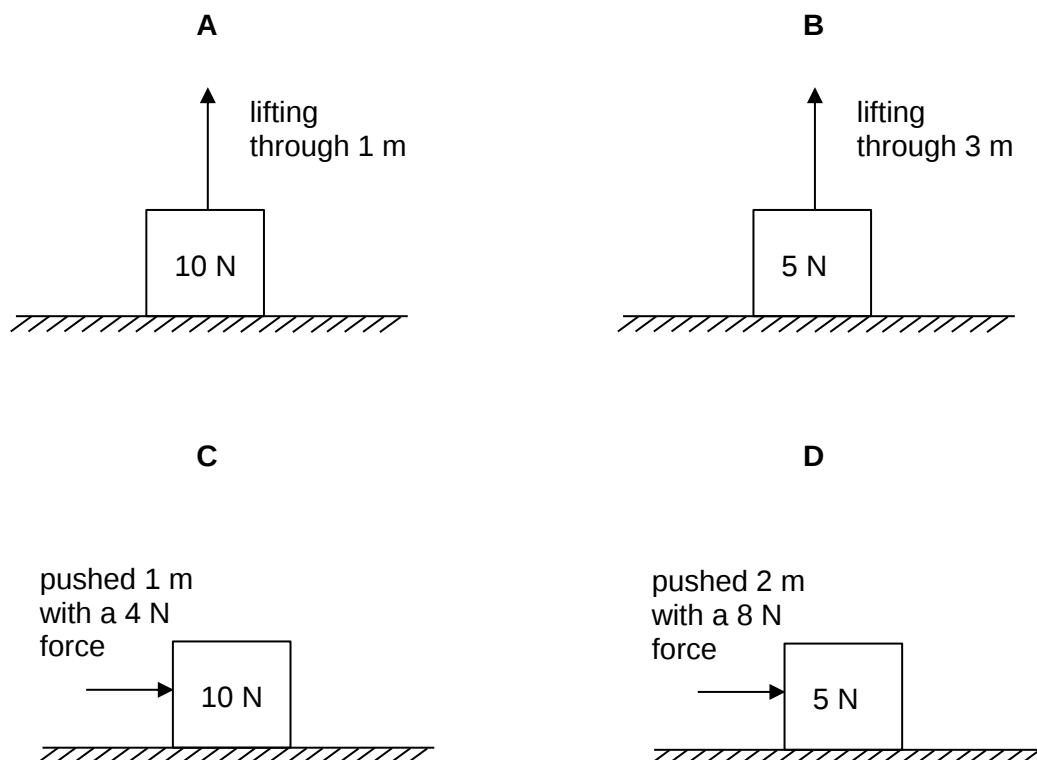
A downward force of 60 N is exerted on piston P and moves piston P downwards through a distance of 15.0 cm.

What is the upward force F exerted on piston Q, and the distance d moved by piston Q?

	F / N	d / cm
A	900	0.50
B	900	1.0
C	1800	0.50
D	1800	1.0

- 12** A student does some simple exercises using different blocks.

In which exercise does she do the most amount of work?



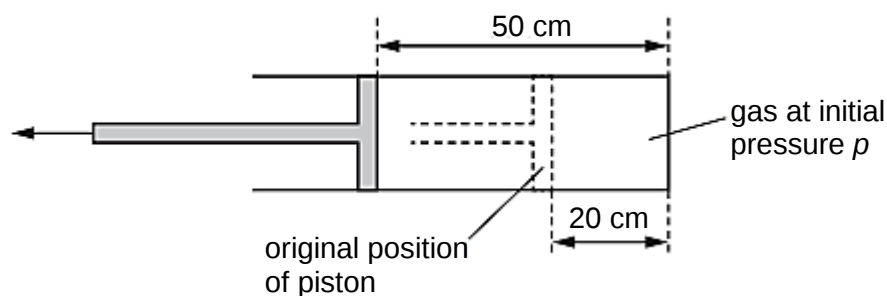
- 13** The diagram shows a burning candle.



What is the main energy transfer taking place?

- A** chemical potential store to internal store
- B** chemical potential store to light store
- C** internal store to light store
- D** light store to internal store

- 14** A gas is trapped inside a cylinder by a movable piston. The length of the gas column is 20 cm and the pressure inside the cylinder is p .



The piston is pulled out and the length of the gas column is now 50 cm. The temperature of the gas does not change.

Which statement correctly explains what happens to the pressure of the gas?

- A** The pressure of the gas decreases as the particles collide less frequently with the walls of the container.
 - B** The pressure of the gas decreases as the particles move more slowly throughout the container.
 - C** The pressure of the gas increases as the particles collide more frequently with the walls of the container.
 - D** The pressure of the gas increases as the particles move more quickly throughout the container.
- 15** A fixed mass of gas is heated while kept at constant volume.

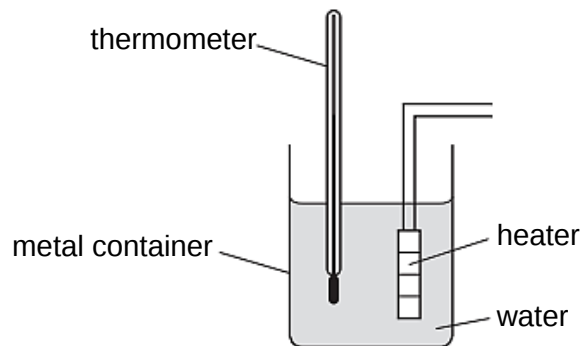
How do the properties of the molecules of the gas change as it is heated?

	average speed	frequency of collision	average distance between molecules
A	decrease	decrease	unchanged
B	decrease	decrease	increase
C	increase	increase	unchanged
D	increase	unchanged	decrease

- 16 In an experiment where the Brownian motion of smoke particles in air is studied, it is observed that the heavier particles settle at the bottom of the glass cell relatively quickly while the much smaller particles remain suspended in air for long periods of time.

This is because

- A random collisions with the air molecules keep the particles suspended.
 - B the effect of air pressure on the smaller particles is greater.
 - C the gravitational force acting on the small particles is negligible.
 - D the smaller particles have the same density as the air molecules.
- 17 The diagram shows a set of apparatus used to determine the specific heat capacity of water.



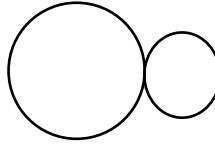
What does **not** decrease the rate at which energy is transferred to the surroundings?

- A painting the outer surface of the container black
 - B placing a lid on the container
 - C placing the apparatus in a vacuum chamber
 - D wrapping the container with felt
- 18 Energy is transferred at the same rate to the internal stores of 200 g of paraffin and 200 g of water in similar containers.

The temperature of the paraffin rises faster because paraffin

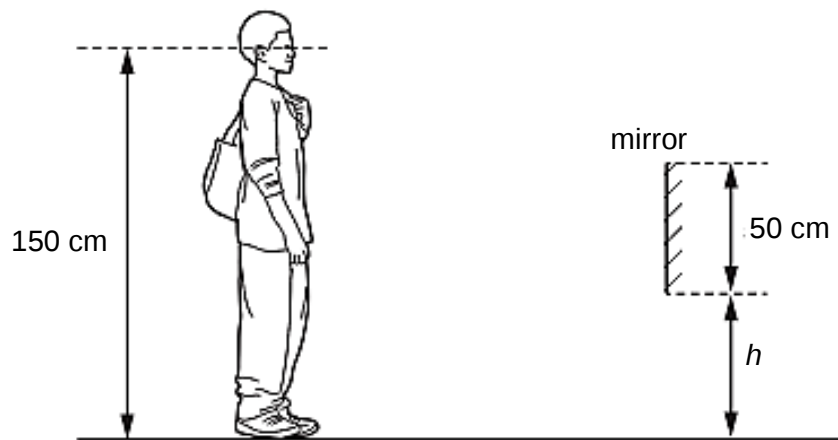
- A has a higher specific heat capacity than water.
- B has a lower latent heat of vaporisation than water.
- C has a lower melting point than water.
- D has a lower specific heat capacity than water.

- 19** The diagram shows two metal spheres of different radii in thermal contact in vacuum.



Given that the spheres are at the same temperature, which statement must be correct?

- A** Both spheres radiate energy at the same rate.
 - B** Each sphere has the same energy in its internal store.
 - C** The larger sphere has a greater average energy in its internal store per atom than the smaller sphere.
 - D** There is no net transfer of energy by heating between the spheres.
- 20** A shoe shop puts a mirror on the wall so that customers can look at their shoes. The length of the mirror is 50 cm. A customer has eyes 150 cm above ground level.

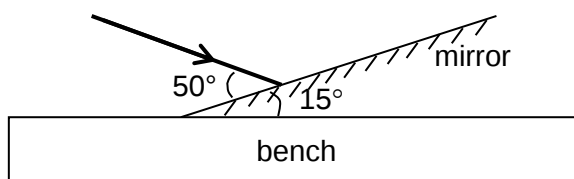


The bottom of the mirror is at height h above the ground.

What is the smallest value of h that allows the customer to see an image of his shoes in the mirror?

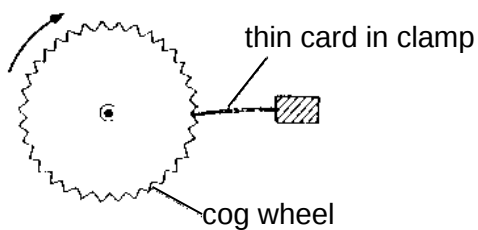
- A** 0 cm **B** 25 cm **C** 50 cm **D** 75 cm

- 21** A mirror is tilted at an angle of 15° to a table top.
A light ray is directed so that it hits the mirror at an angle of 50° to the surface of the mirror.



What is the angle of reflection of the light ray?

- A** 15° **B** 40° **C** 50° **D** 55°
- 22** A piece of thin card was held against the teeth of a cog wheel.

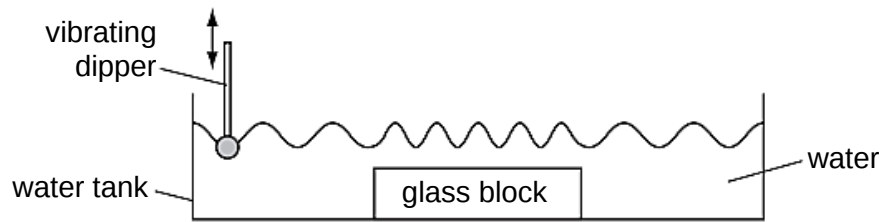


When the wheel is turned at high speed, a note is heard.

How can the pitch of this note be raised?

- A** Use a thicker card.
B Use a thinner card.
C Turn the wheel more quickly.
D Press the card against the teeth with a greater force.

- 23** A ripple tank is used to show wave behaviour. The dipper vibrates up and down at a constant frequency.



What happens to the frequency and to the speed of the wave as it reaches the glass block?

	frequency	speed
A	decreases	increases
B	decreases	remains the same
C	remains the same	decreases
D	remains the same	increases

- 24** Microwaves are used to transmit television signals to and from a satellite.

Which statement about microwaves is correct?

- A** They have a longer wavelength than radio waves.
- B** They penetrate the atmosphere without significant loss of energy.
- C** They travel much faster than radio waves in a vacuum.
- D** They warm the satellite and stop it from freezing.

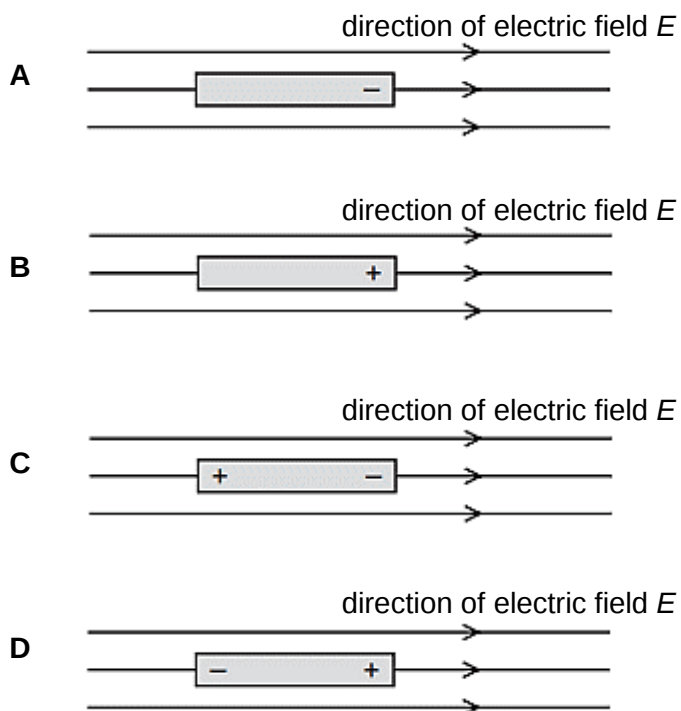
- 25 The table lists the main components of the electromagnetic spectrum and their approximate frequency range.

	frequency / Hz
radiowaves	10^3 to 10^9
microwaves	10^9 to 10^{12}
infra-red	10^{12} to 10^{14}
visible light	10^{14} to 10^{15}
ultra-violet	10^{15} to 10^{18}
X-rays	10^{18} to 10^{21}
gamma rays	10^{19} to 10^{22}

Which range of frequencies are used by instruments to detect cracks inside a block of metal?

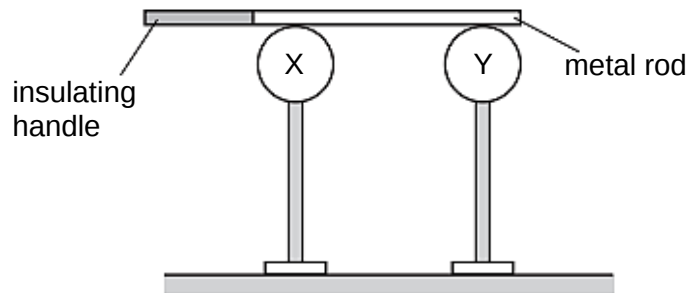
- A 10^3 Hz to 10^{12} Hz
 B 10^{12} Hz to 10^{15} Hz
 C 10^{15} Hz to 10^{18} Hz
 D 10^{18} Hz to 10^{22} Hz
- 26 An initially uncharged copper rod is placed in a uniform electric field E . The rod is parallel to the field.

Which diagram shows the charges induced on the rod?



- 27** Two metal spheres are mounted on insulating stands. Sphere X is initially uncharged and sphere Y is initially positively charged.

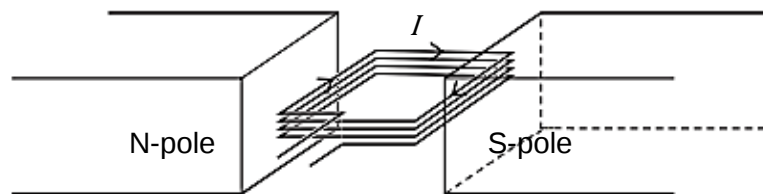
A metal rod, held by an insulating handle, is placed in contact with X and Y as shown.



What are the charges on X and on Y after the rod is placed in contact with them?

	charge on X	charge on Y
A	positive	negative
B	positive	positive
C	positive	uncharged
D	uncharged	positive

- 28** A coil P of N turns is made from a length L of wire. The coil carries a current I when between two magnetic poles.



A similar coil Q of $2N$ turns is made from a length $2L$ of identical wire. It also carries a current I when between the two magnetic poles.

Which coil has the greater resistance and which coil experiences the greater turning effect?

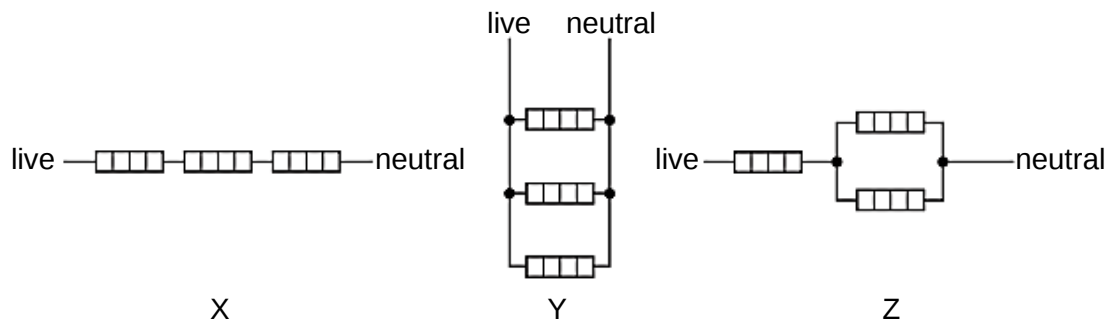
	greater resistance	greater turning effect
A	P	P
B	P	Q
C	Q	P
D	Q	Q

- 29** A physical quantity is defined as 'the energy transferred by a source in driving a unit charge across an electrical component.'

What is this quantity called?

- A** current
- B** electromotive force
- C** potential difference
- D** power

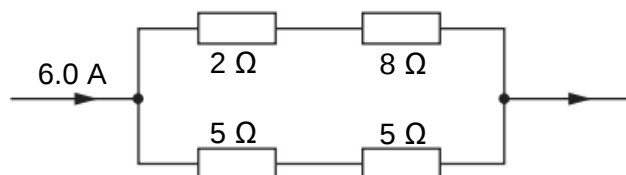
- 30** Three identical heating elements are wired up to the mains supply in the three arrangements shown.



In which arrangement is the current from the supply lowest and in which is it highest?

	lowest current	highest current
A	X	Y
B	X	Z
C	Y	X
D	Y	Z

- 31** The diagram shows part of an electric circuit.

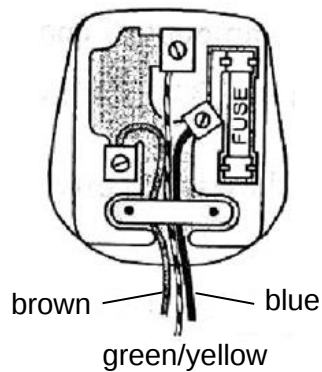


What is the current in the $2\ \Omega$ resistor?

- A** 0.6 A
- B** 1.2 A
- C** 3.0 A
- D** 6.0 A

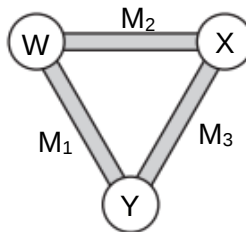
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- 32** A plug is wrongly wired as shown below. It is connected to a vacuum cleaner with a metal casing.



What will be the effect of using a plug wired in this way?

- A** The appliance cannot be turned on.
B The appliance will be 'live' even when the fuse is blown.
C The metal casing will become 'live'.
D The neutral wire will melt.
- 33** Magnets M_1 , M_2 and M_3 are joined by iron balls W, X and Y as shown.



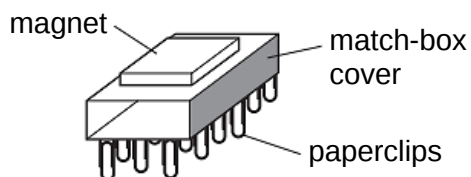
Magnetic poles are induced in the iron balls W and X as shown.



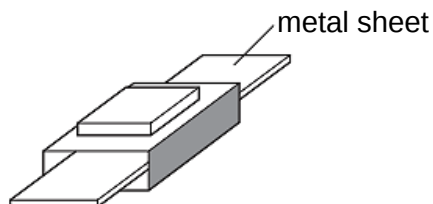
Which diagram shows the poles induced in ball Y?



- 34** A teacher sticks a magnet to the top surface of a match-box cover. The bottom surface is placed in a small tray of iron paperclips. As the match-box cover is lifted up, a large number of paperclips are held on the bottom surface.



Sheets of metal are placed inside the match-box cover, between the magnet and the paperclips.



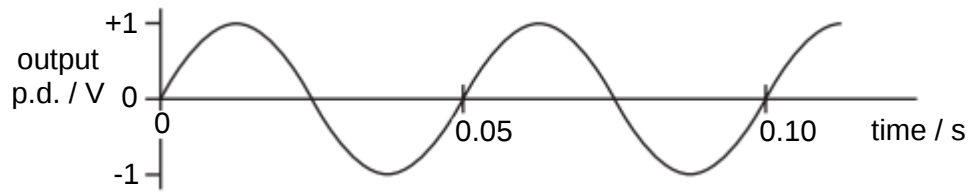
When sheet X is placed inside, the paperclips stay attached. When sheet Y is placed inside, all the paperclips fall off.

Which metals are the sheets made from?

	sheet X	sheet Y
A	aluminium	copper
B	copper	iron
C	iron	aluminium
D	iron	copper

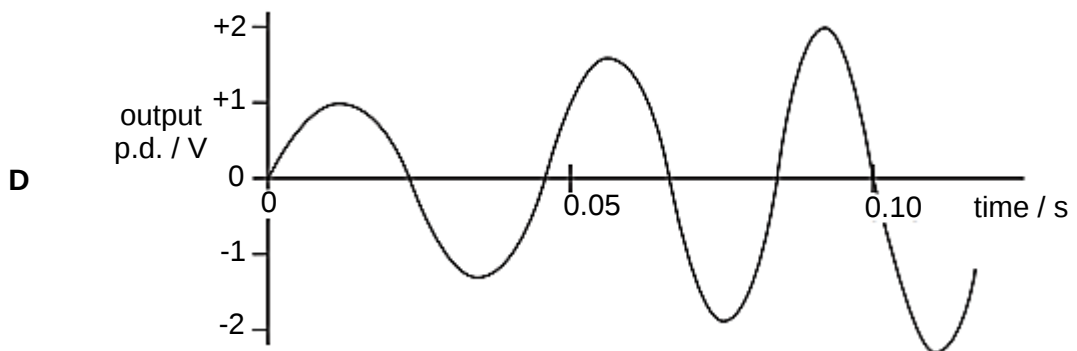
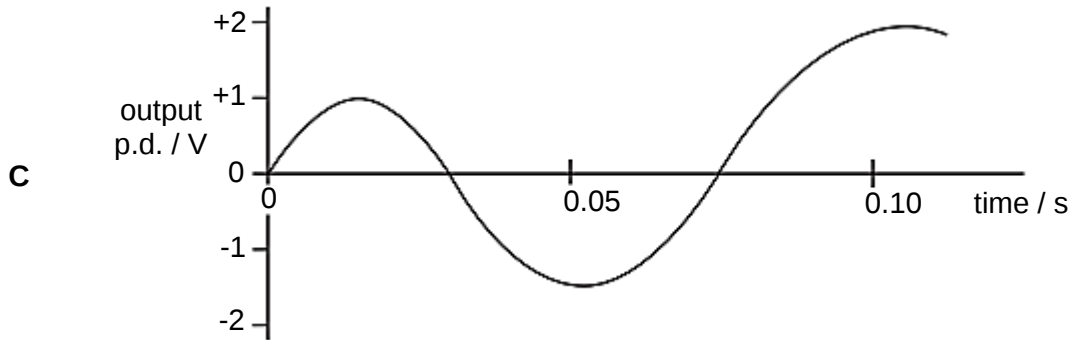
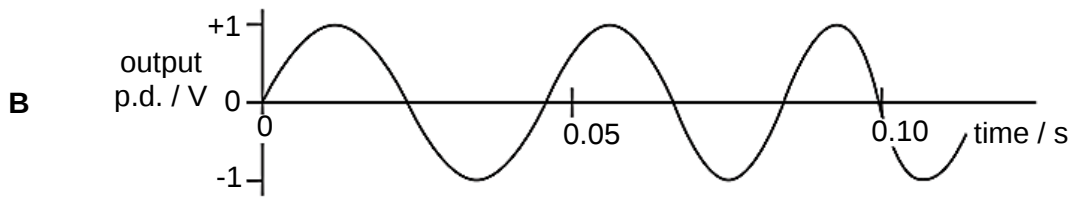
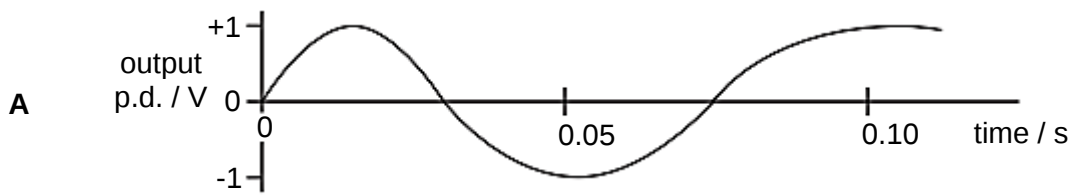
- 35** Why is electrical energy usually transmitted at high voltage?
- A** As little energy as possible is wasted in the transmission cables.
 - B** The current in the transmission cables is as large as possible.
 - C** The resistance of the transmission cables is as small as possible.
 - D** The transmission system does not require transformers.

- 36 The graph shows the output of an a.c. generator. The coil in the generator rotates 20 times in one second.

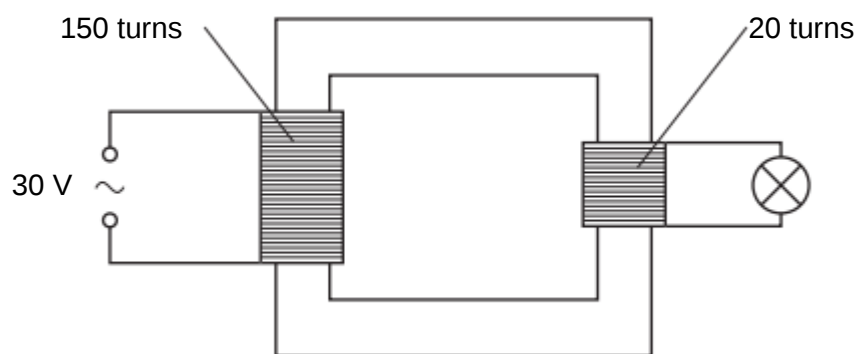


The speed of rotation of the coil steadily increases.

Which graph best shows how the output changes?



- 37 A student uses a transformer to light a lamp using a 30 V a.c. supply.



What is the potential difference across the lamp?

- A** 4.0 V **B** 30 V **C** 230 V **D** 600 V
- 38 A nucleus of phosphorus $^{32}_{15}\text{P}$ emits a beta-particle to form a new nucleus.

What is the nucleon number and what is the proton number of the new nucleus?

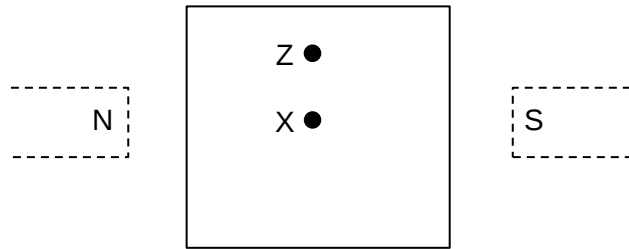
	nucleon number	proton number
A	28	13
B	31	14
C	31	15
D	32	16

- 39 In the treatment of brain cancer, a patient's head is enclosed in a helmet containing a number of radioactive sources. The radiation from each source is directed towards the cancerous tissues.

Which nuclide is the most suitable for these sources?

	nuclide	radiation	half-life
A	caesium-137	gamma	30 years
B	californium-246	alpha	36 hours
C	sodium-24	beta	15 hours
D	strontium-90	beta	29 years

- 40** A narrow beam of radiation from a radioactive source travels out of the page through the point X.



The poles of a magnet are placed on either side of the beam. Radiation is now detected both at X and at Z.

Which types of radiation are present in the beam?

- A** alpha and beta radiation
- B** alpha and gamma radiation
- C** alpha, beta and gamma radiation
- D** beta and gamma radiation