Index Number		Name	

Anglo-Chinese School (Independent)
A Methodist Institution (Founded 1886)

PRELIMINARY EXAMINATION 2024
YEAR 4 EXPRESS

PHYSICS **6091 / 01**

Thursday **15 August 2024** **1 hour**

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.

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 **2B pencil** on the separate **OTAS**.

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.

Unless otherwise stated, take gravitational field strength, ***g***, to be 10 N kg^{-1}.

1 The following physical quantities can be either positive or negative.

s : displacement of a particle along a straight line
θ : temperature on the Celsius scale
q : electric charge
V : potential difference on a digital voltmeter

Which of these quantities are scalars?

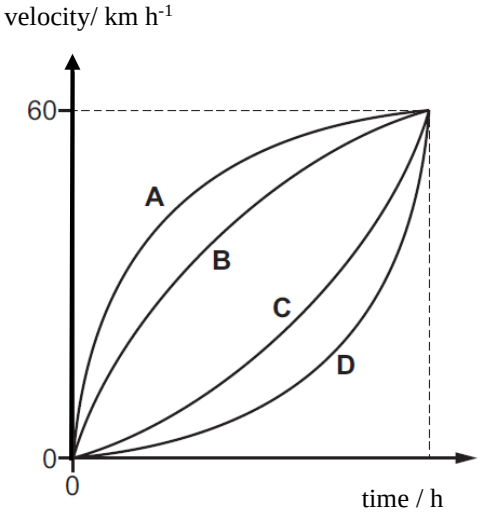
A **s**, **θ**, **q**, **V**
B **θ**, **q**, **V**
C **θ**, **V**
D **θ** only

2 Which is a pair of SI base units?

A Ampere, Voltage
B Degree Celsius, Second
C Kelvin, Kilogram
D Metre, Newton

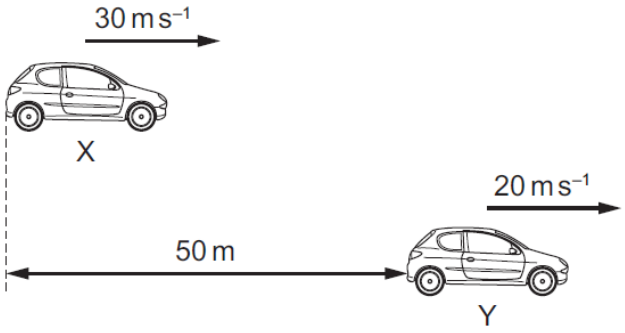
3 Four cars, **A**, **B**, **C** and **D**, move from rest in a straight line. The cars take the same time to accelerate to a velocity of 60 km h^{-1}. Their velocity–time graphs are shown.

Which car reaches a velocity of 60 km h^{-1} in the longest distance?



4 Two cars **X** and **Y** are positioned as shown at time t = 0 s. They are travelling in the same direction.

Car **X** is 50 m behind car **Y** and has a constant velocity of 30 m s^{-1} as shown below. Car **Y** has a constant velocity of 20 m s^{-1}.



What is the value of time t when car **X** is level with car **Y**?

A 1.7 s
B 2.5 s
C 5.0 s
D 10.0 s

5 What is meant by the weight of an object?

A The gravitational field acting on the object.
B The gravitational force acting on the object.
C The mass of the object multiplied by the gravitational force acting on the object.
D The object's mass multiplied by its acceleration.

6 The gravitational field strength in space is smaller than on the Earth's surface. A rocket is used to launch a satellite from the Earth's surface into space. How are the mass and the weight of the satellite affected as the satellite moves away from the surface of the Earth and into space?

A Both the mass and the weight of the satellite are unaffected.
B Both the mass and the weight of the satellite decreases.
C The mass of the satellite is unaffected and the weight of the satellite increases.
D The mass of the satellite is unaffected and the weight of the satellite decreases.

7 A cyclist is riding at a steady speed on a level road.

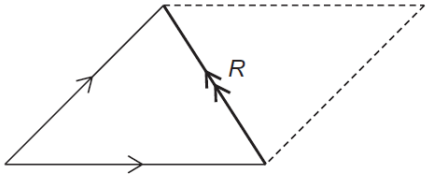
According to Newton's third law of motion, what is equal and opposite to the backward push of the back wheel on the road?

A Force exerted by the cyclist on the pedals.
B Forward push of the road on the back wheel.
C Tension in the cycle chain of the bicycle.
D Total air resistance and frictional force acting on the cyclist.

8 The diagram shows arrows representing two vector quantities.

Which diagram shows the resultant ***R*** of these two vectors?

A



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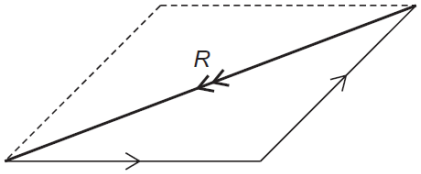

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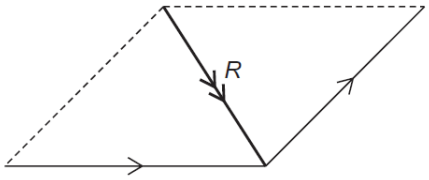

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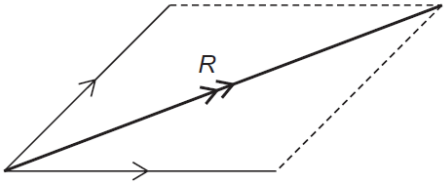
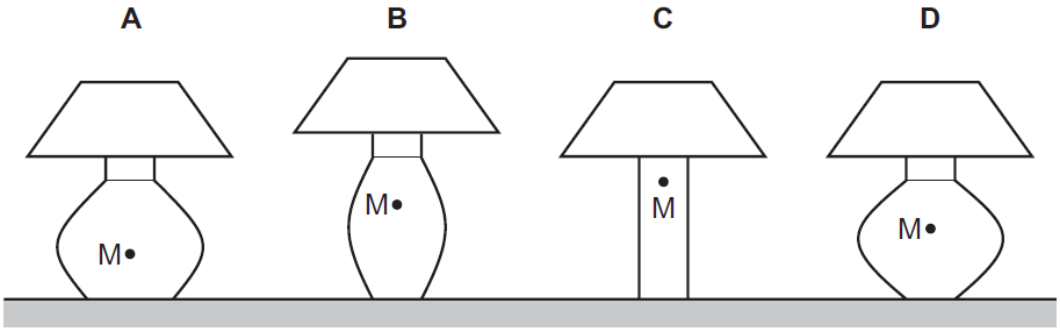


9 Four table lamps are shown below with the position **M** of the centre of mass in each case.

Which lamp is the least stable?

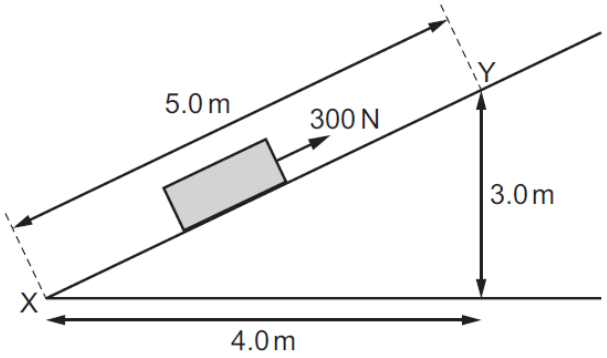


10 In a coal-fired power station, the coal is burnt and internal store (heat) is produced. The internal store is used to produce electrical store.

In which order does the energy pass through parts of the power station?

A boiler → generator → turbine
B boiler → turbine → generator
C turbine → boiler → generator
D turbine → generator → boiler

11 A 300 N force is applied to a box to move it up a ramp, as shown in the diagram below.



How much work is done by the force when moving the box from point **X** to point **Y**?

A 300 J
B 600 J
C 900 J
D 1500 J

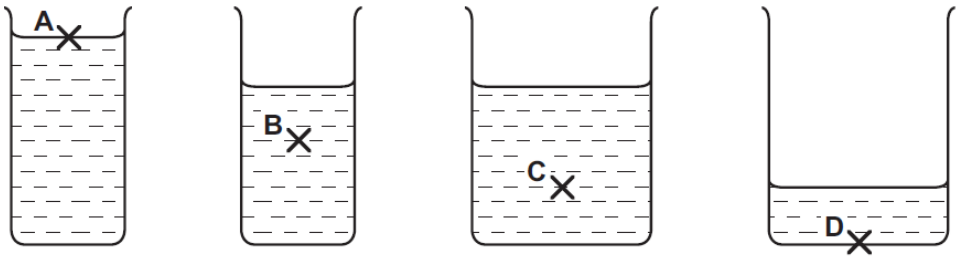
12 A small hydroelectric power station diverts water from a river. Every second, 30 kg of water flows through a pipe and falls through a vertical drop of 18 m. The efficiency of the power station is 75%. The gravitational field strength g is 10 N / kg.

What is the power output?

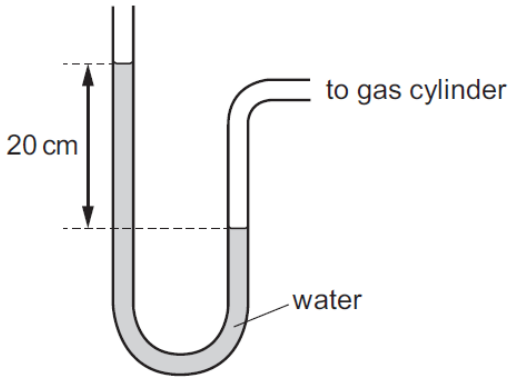
A 1350 W
B 4050 W
C 5400 W
D 405 kW

13 Four beakers contain the same liquid.

At which point is the pressure the greatest?



14 The pressure of a gas in a cylinder is measured using a water manometer. The density of water is 1000 kg/m^3 and the gravitational field strength ***g*** is 10 N/kg.



How much higher is the gas pressure than the atmospheric pressure?

A 2000 Pa
B 101 000 Pa
C 200 000 Pa
D 301 000 Pa

15 In an experiment to demonstrate Brownian motion, smoke particles in a container are illuminated by a strong light source and observed through a microscope.

The particles are seen as small specks of light that are in motion.

What causes the Brownian motion?

A Collisions between the air molecules and smoke particles.
B Collisions between the smoke particles and the walls of the container.
C Convection currents within the air molecules as they are warmed by the light source.
D Kinetic energy gained by the smoke particles due to the absorption of light.

16 Which statement about thermal radiation is correct?

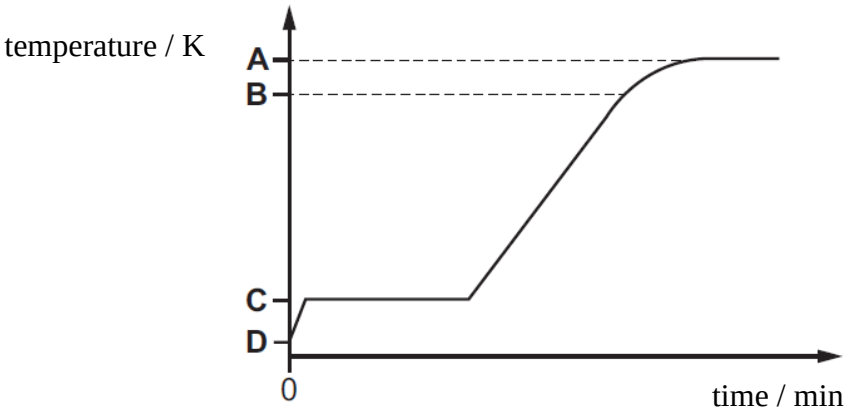
A Thermal radiation emits better on white surfaces than black surfaces.
B Thermal radiation is a longitudinal wave.
C Thermal radiation travels only as an ultra-violet wave.
D Thermal radiation travels at the speed of light in a vacuum.

17 Which of the following correctly describes the molecules in a beaker of water at 55 °C?

A All the molecules travel at the same speed. This speed is not large enough for any of the molecules to leave the surface of the water. There are attractive forces between the molecules.
B The molecules have a range of speeds. Some molecules travel sufficiently fast to leave the surface of the water. There are no forces between the molecules.
C The molecules have a range of speeds. Some molecules travel sufficiently fast to leave the surface of the water. There are attractive forces between the molecules.
D The molecules have a range of speeds. The fastest molecules are unable to leave the surface of the water. There are attractive forces between the molecules.

18 Some ice cubes are taken from a freezer and heated in a container. The readings of temperature and time are recorded on the graph.

Which temperature is 0 °C?

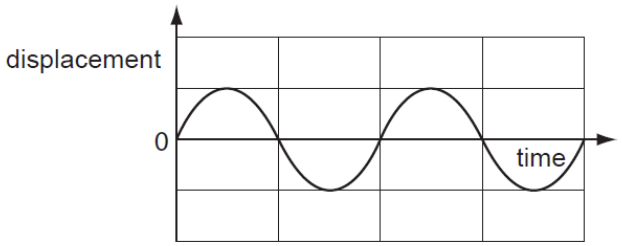


19 In an experiment to find the heat capacity and specific heat capacity of a metal, it is found that 5200 J is needed to raise the temperature of a 2.0 kg block by 20 °C.

Find the values for the heat capacity and specific heat capacity of the metal given by these results?

	Heat Capacity / (J/°C)	**Specific Heat Capacity / J/(kg K)**
A	260	130
B	2600	52 000
C	52 000	2600
D	208 000	104 000

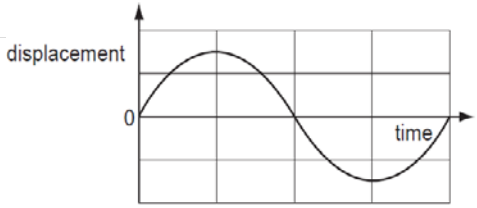
20 A displacement-time graph is shown for a particular wave.



A second wave of similar type has twice the amplitude and half the frequency.

When drawn on the same axes, what would the second wave look like?

A



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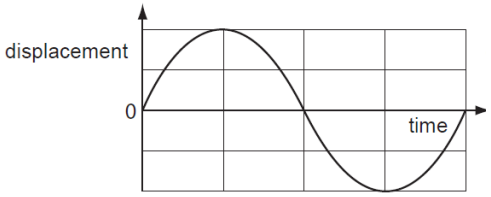

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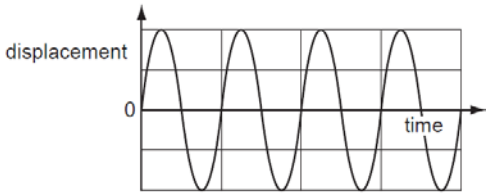

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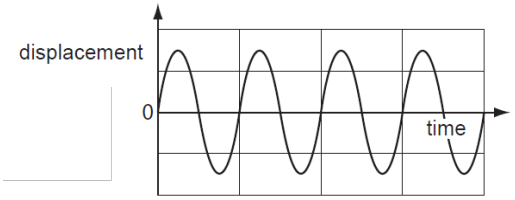
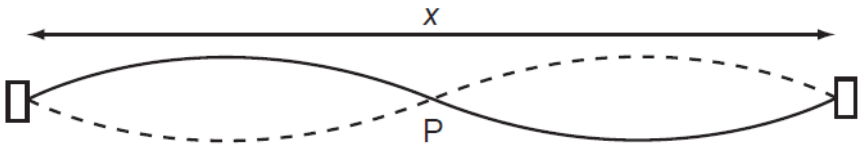


21 The diagram below represents a wave on a stretched string. The frequency of the wave is 2.0 Hz and the length ***x*** is 10 m.



Which row correctly represents the length ***x***, type and speed of wave?

	Length *x*	**Type of wave**	**Speed of wave / m/s**
A	One wavelength	Longitudinal	20
B	One wavelength	Transverse	20
C	Half wavelength	Transverse	10
D	Two wavelengths	Transverse	40

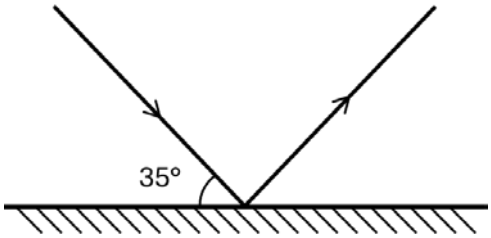
22 Which statement is correct for longitudinal waves but **not** correct for transverse waves?

A Both waves can only travel through a medium.
B Both waves can transfer energy in the direction of travel.
C Both waves consist of peaks and troughs.
D Both waves travel at the speed of light in vacuum.

23 Which of the following is an application of infra-red radiation?

A Destroying kidney stones
B Heating
C Radiotherapy
D Satellite communications

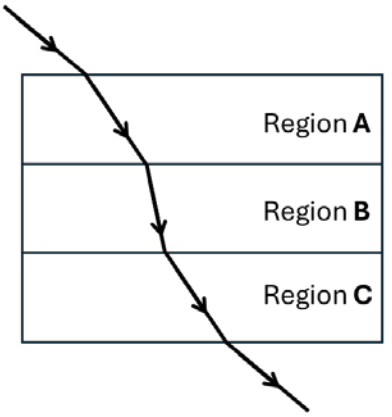
24 The diagram shows a ray of light reflected by a plane mirror.



What is the angle of reflection?

A 35°
B 55°
C 90°
D 125°

25 A light ray undergoes refraction as it travels from air to region **A** to region **B** to region **C** and back out into air.



Which of the following shows the possible refractive index for each region?

	Region **A**	Region **B**	Region **C**
A	1.1	1.3	1.5
B	1.3	1.5	1.1
C	1.3	1.5	1.3
D	1.5	1.3	1.5

26 Which of the following statements about total internal reflection is **incorrect**?

A Light must be travelling from an optically less dense medium to an optically denser medium for total internal reflection to occur.
B The angle of incidence must be greater than the critical angle for total internal reflection to occur.
C An application of total internal reflection is in the use of optical fibres for transfer of information.
D During total internal reflection, the angle of reflection is equal to the angle of incidence.

27 Three copper spheres, **X**, **Y** and **Z** are suspended in pairs to observe if they attract or repel each other.

The following observations were found:
1) **X** is attracted to **Y**
2) **X** and **Z** repel each other
3) **Y** is attracted to **Z**

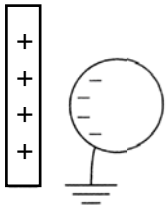
Which of the following shows the electric charge of each sphere?

	X	**Y**	**Z**
A	positive	neutral	negative
B	neutral	positive	negative
C	neutral	negative	neutral
D	positive	neutral	positive

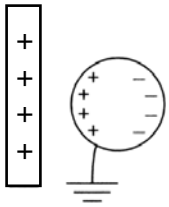
28 A positively charged plastic rod is held near a positively charged metal sphere. The metal sphere is then earthed.

Which diagram shows the distribution of charges in the earthed metal sphere?

A



B



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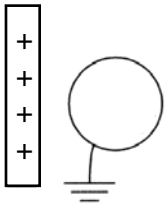

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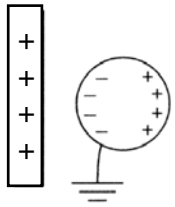
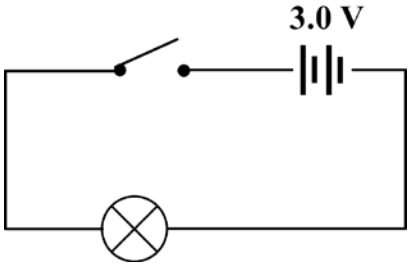


29 A circuit diagram is shown below.



In which direction does conventional current flow in the circuit, and how much work is done by the battery when 5.0 C of charge passes through the circuit?

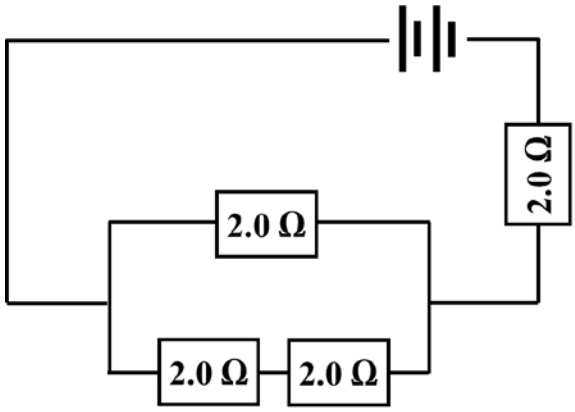
	Direction of current	**Work done by battery / J**
A	clockwise	0.60
B	anticlockwise	0.60
C	clockwise	15
D	anticlockwise	15

30 A metal wire **P** has a resistance of 10.0 Ω. Another metal wire **Q** is made of the same material but has twice the diameter and three times the length of **P.**

What is the resistance of **Q**?

A 7.5 Ω
B 10.0 Ω
C 15.0 Ω
D 60.0 Ω

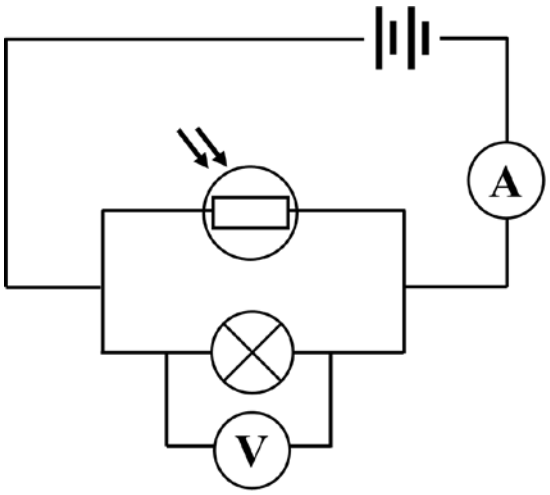
31 An electrical circuit is shown below.



What is the effective resistance in this circuit?

A 2.7 Ω
B 2.8 Ω
C 3.3 Ω
D 8.0 Ω

32 An electrical circuit with a light bulb and a light dependent resistor arranged in parallel is shown below.



When bright light is shone on the light dependent resistor, what happens to the ammeter and voltmeter readings?

	Ammeter reading	**Voltmeter reading**
A	decrease	no change
B	increase	no change
C	decrease	increase
D	increase	increase

33 The cost of a unit of (kWh) of electricity is 20 cents.

A lamp rated 240 V, 100 W was switched on for 2 hours in a day.
Then a cooker rated 200 V, 2.5 kW was switched on for 0.5 hours in a day.

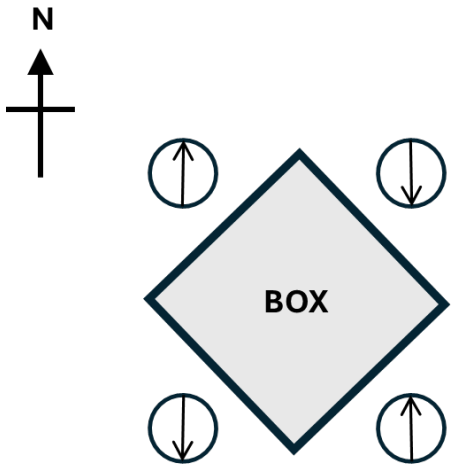
What is the total cost of operating the lamp and cooker in one day?

A $0.12
B $0.29
C $1.01
D $1.30

34 Which are the correct wires to connect the fuse and switch in an electrical appliance?

	Fuse	**Switch**
A	live wire	live wire
B	live wire	neutral wire
C	earth wire	live wire
D	neutral wire	neutral wire

35 Four compasses are placed around a box. After some time, the arrows of the compasses settle into the orientations shown below.



What could be inside the box?

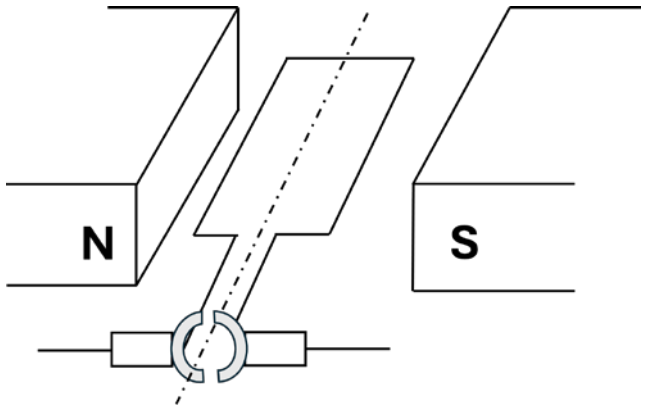
A A bar magnet oriented with its N pole facing up.
B A bar magnet oriented with its N pole facing down.
C A bar magnet oriented with its N pole facing to the left.
D A bar magnet oriented with its N pole facing to the right.

36 Refrigerators usually have a magnet lined along the edge of their doors to ensure the refrigerator doors close securely.

What type of material should be used to make this magnet and what is the reason for this?

	Material	**Reason**
A	soft magnetic material	the material must be easily magnetised
B	soft magnetic material	the material must not be easily demagnetised
C	hard magnetic material	the material must be easily magnetised
D	hard magnetic material	the material must not be easily demagnetised

37 A d.c. motor with a split ring commutator is shown below. The split ring commutator reverses the direction of the current every half a cycle.



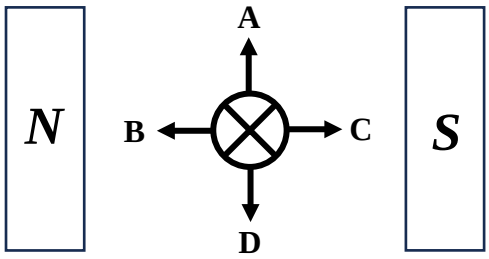
The coil is initially positioned parallel to the magnetic field. When current flows through the coil, the wires on the left and right of the coil experience forces due to the motor effect.

What is the force experienced by the wires and moment acting on the coil after a quarter of a revolution (coil rotates 90°)?

	Force	**Moment**
A	zero	zero
B	zero	non-zero
C	non-zero	zero
D	non-zero	non-zero

38 As a conductor moves through a magnetic field, an induced current is produced in the conductor as shown below.

Which direction is the conductor moving in?



39 A lead nucleus consists of 82 protons and 132 neutrons. It emits two beta particles.

Which of the following best describes the nucleus after it undergoes the two beta emissions?

	Atomic number	**No. of neutrons**	**Nucleon number**
A	82	130	212
B	82	132	214
C	84	130	214
D	84	132	216

40 Which nuclear emission is correctly matched to its application?

	Nuclear emission	**Application**
A	alpha	sterilization of medical equipment
B	alpha	measure thickness of materials
C	beta	treatment of thyroid disorder
D	gamma	determine the age of rocks