NORTH VISTA SECONDARY SCHOOL
Preliminary Examination 2023
Secondary 4 Express / 5 Normal Academic

40

CANDIDATE NAME

CLASS

INDEX NUMBER

PHYSICS

6091/01

29 August 2023

1 hour

Paper 1 Multiple Choice

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

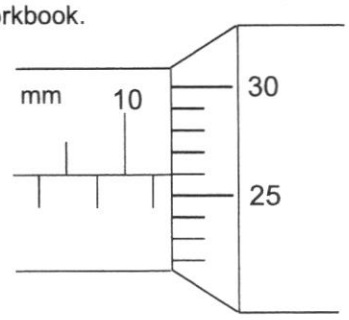
Write in soft pencil.
Do not use staples, paper clips, glue or correction tape/fluid.
Write your full name, register number and class on the Answer Sheet in the spaces provided unless this has been done for you.

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

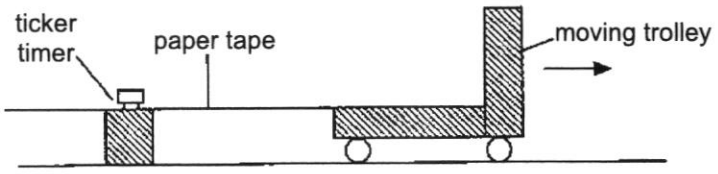
1 The diagram shows part of a micrometer screw gauge used by a student to measure the thickness of his Physics workbook.



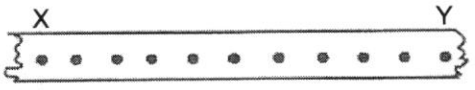
What is the thickness of the workbook?

A 10.26mm **B** 10.76mm **C** 11.26mm **D** 11.76mm

2 A pupil uses a ticker-timer to investigate the movement of a trolley.



A paper tape is attached to the trolley. When the trolley moves to the right, it pulls the paper tape through the ticker timer. Every second, the ticker-timer puts 60 dots on the paper tape. A section of the paper tape is shown.



What length of time corresponds to the distance between X and Y on the tape?

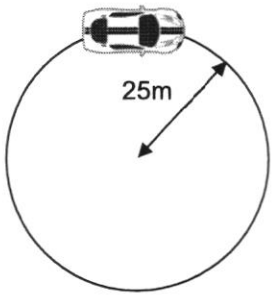
A 0.10s

B 0.11s

C 0.17s

D 0.18s

3 A car travels around a circular path of radius 25m. It completes one round in 1.0 minute.



What is the velocity of the car?

A 0m/s **B** 0.42m/s **C** 2.6m/s **D** 25m/s

4 Object X falls freely from rest for 3.0s and object Y also falls freely from rest for 6.0s.

Which statement is correct?

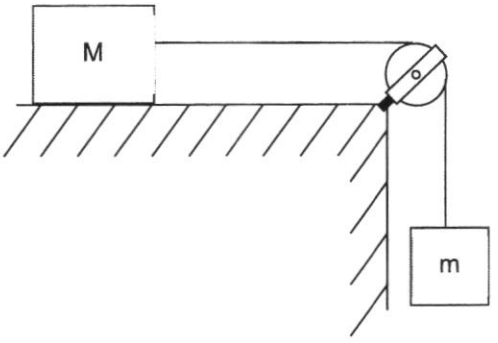
A Y falls half as far as X.

B Y falls twice as far as X.

C Y falls three times as far as X.

D Y falls four times as far as X.

5 Two blocks M and m are connected by a light string passing over a smooth pulley as shown below.



When m is released, the blocks move with constant speed. After a while, the string is cut in between.

Which row correctly describes the motion of the blocks immediately after the string is cut?

	M	m
A	stops moving	moves with constant speed
B	moves with constant speed	accelerates
C	decelerates	moves with constant speed
D	decelerates	accelerates

6 What quantity must be changing when a body is accelerating uniformly?

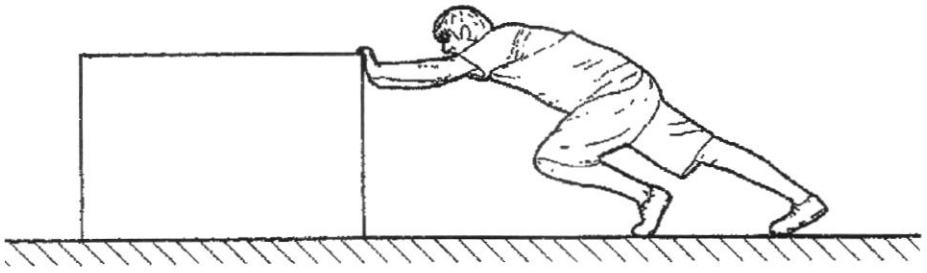
A force acting on the body

B mass of the body

C speed of the body

D velocity of the body

7 A man pushes a heavy box along the ground.



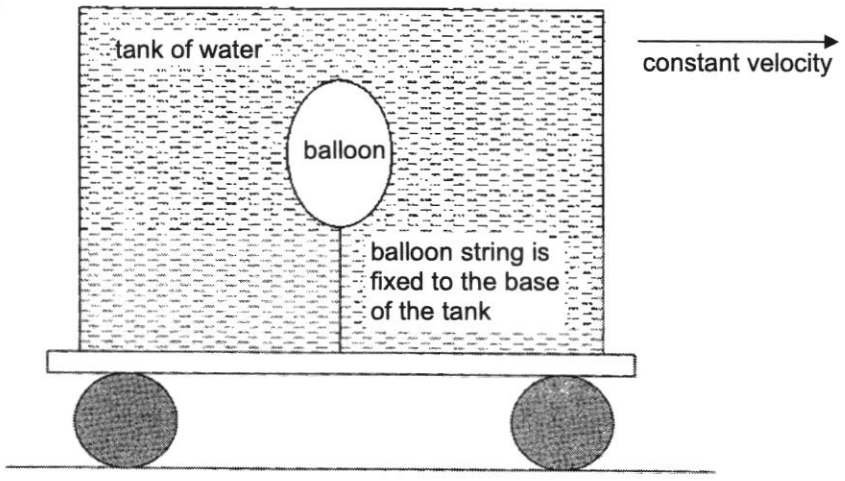
A force acts between the man's hands and the box.

Another force acts between the man's feet and the ground.

In which direction do these forces act on the man?

	force on man's hands	force on man's feet
A	towards the left	towards the right
B	towards the left	towards the left
C	towards the right	towards the right
D	towards the right	towards the left

8 The figure shows a sealed tank filled to the brim with water and mounted on wheels. A balloon is fixed at the base of the tank. The tank is initially moving at a constant velocity on a horizontal surface.



Which statement correctly describes the motion of the balloon when the tank slows down?

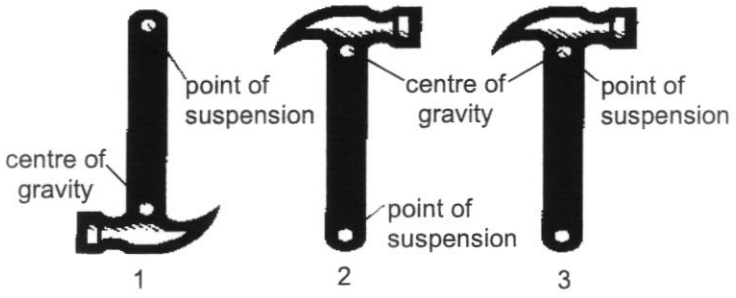
A The balloon will move backward.

B The balloon will move forward.

C The balloon will remain in its original position.

D The balloon will start to oscillate back and forward.

9 A hammer can be suspended in equilibrium from three different positions as shown.

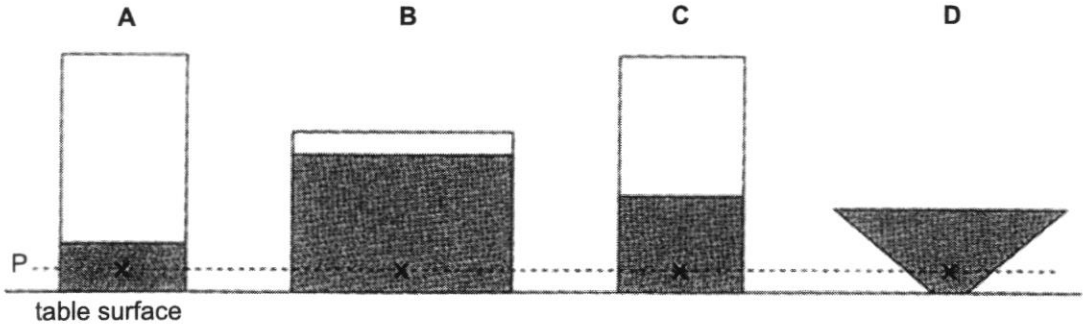


Which equilibriums are correctly matched with the three positions?

	neutral equilibrium	stable equilibrium	unstable equilibrium
A	3	1	2
B	1	2	3
C	2	1	3
D	3	2	1

10 The diagram below shows four containers filled with water.

Which container has the largest pressure at level P?



11 In which situation is work **not** done by the person?

A A boy catching a ball falling in air.

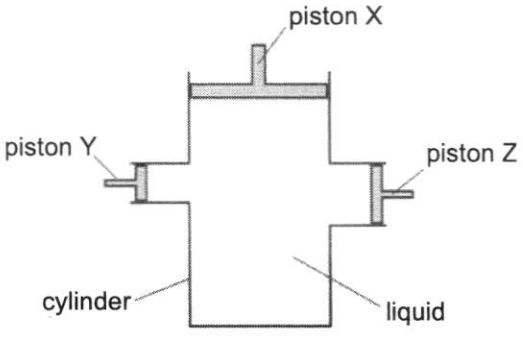
B A boy tossing a ball into the air.

C A baseball player hitting the ball with his bat.

D A woman pushing her shopping cart.

12 Piston X is pushed into a hydraulic cylinder. Piston X produces a pressure P_X in the liquid in the cylinder.

The diagram shows the cylinder viewed from above.



view from above

There are two other pistons, Y and Z, in the cylinder.

The pressures on piston Y and Z are P_Y and P_Z.

What is the relationship between P_X, P_Y and P_Z?

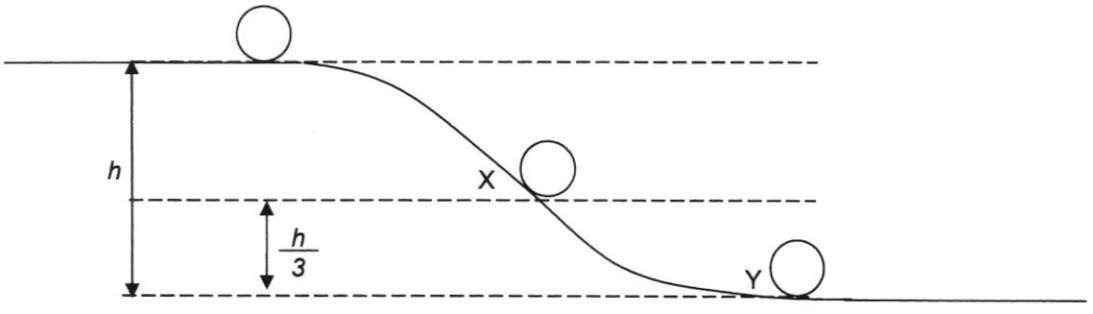
A $P_X = P_Y + P_Z$

B $P_X > P_Z > P_Y$

C $P_X < P_Z < P_Y$

D $P_X = P_Y = P_Z$

13 A ball, initially at rest, rolls down a smooth slope as shown in the figure below.



Which statement is true?

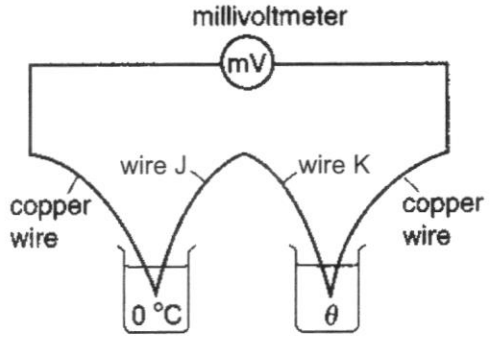
A Kinetic energy at X is $\frac{1}{3}$ the kinetic energy at Y.

B Kinetic energy at X is $\frac{2}{3}$ the kinetic energy at Y.

C Kinetic energy at X is double the kinetic energy at Y.

D Kinetic energy at X is three times the kinetic energy at Y.

14 For the thermocouple to be used in the measurement of temperature, what should the two wires J and K be made of?



	wire J	wire K
A	copper	copper
B	copper	iron
C	iron	copper
D	iron	iron

15 Brownian motion is often demonstrated by viewing illuminated smoke particles, contained in a sealed transparent cell, through a low power microscope.

Which statement is **not** correct?

A Air molecules are too small to be observed through the microscope.

B Small specks of light are seen moving about in random motion.

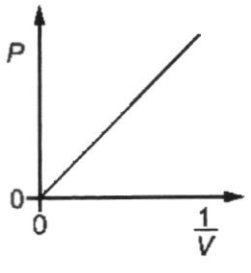
C The observed motion is caused by the random motion of the smoke particles.

D The speed of the observed motion would decrease if temperature dropped.

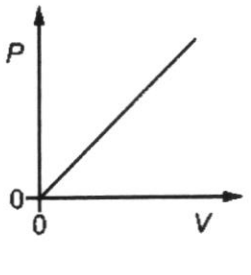
16 The pressure P of some trapped air is varied. The mass and the temperature of the trapped air remain constant.

Which graph shows how the volume V of the air varies with the pressure P?

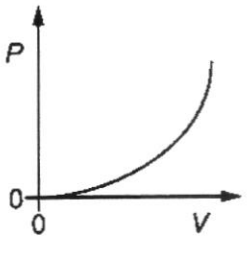
A



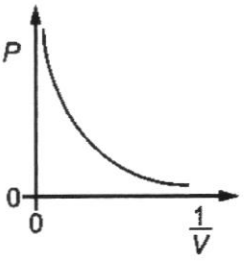
B



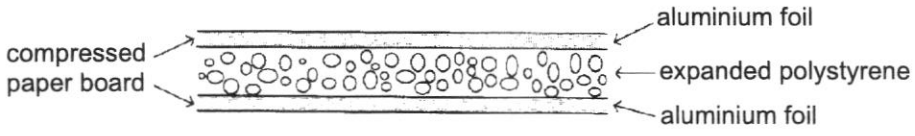
C



D



17 The diagram shows a section through a particular type of building board.



Which row best explains why such boards provide good heat insulation from the surrounding?

	aluminium foil	expanded polystyrene
A	good conductor	good emitter
B	good conductor	poor emitter
C	good emitter	poor conductor
D	poor emitter	poor conductor

18 The specific heat capacity of two materials P and Q are 900J/(kg°C)$^{-1}$ and 1800J/(kg°C)$^{-1}$.

Which statement is correct?

A For the same temperature rise, P requires twice the amount of heat compared to Q

B For the same temperature rise, P requires half the amount of heat compared to Q.

C P feel colder than Q when you touch it.

D P is a better conductor of heat than Q.

19 A kilogram of a substance has no fixed volume.

Thermal energy removed from the substance strengthens the forces of attraction between its molecules.

What is happening?

A A solid is being cooled.

B A liquid is at its freezing point.

C A liquid is being cooled.

D A gas is at its condensation point.

20 Water evaporates from a shallow dish.

A student can change three things to the experiment namely;

the depth of the water in the dish

the surface area of the dish

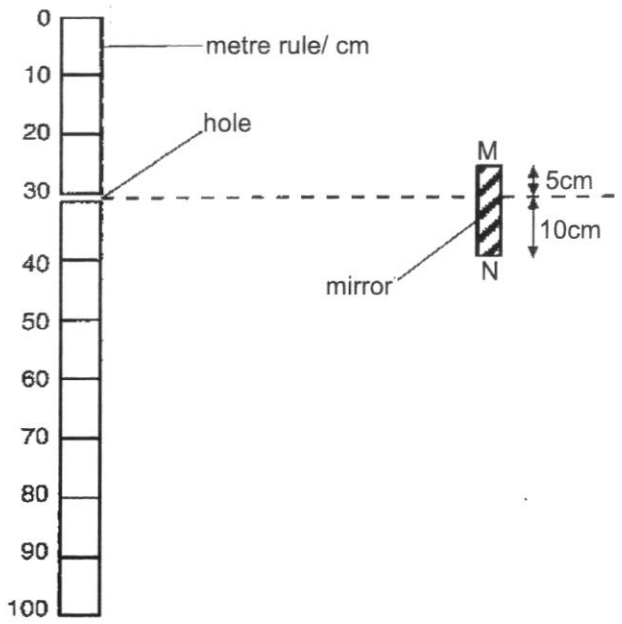
the volume of water in the dish

How many of these changes, if any, would alter the rate at which evaporation occurs?

A 0 **B** 1 **C** 2 **D** 3

21 The figure shows the cross section of a metre rule with a small hole drilled at the 30cm mark.

A plane mirror MN is placed in front of the ruler and is parallel to it.



If an observer peeps through the hole at the mirror, how much of the rule can the observer see?

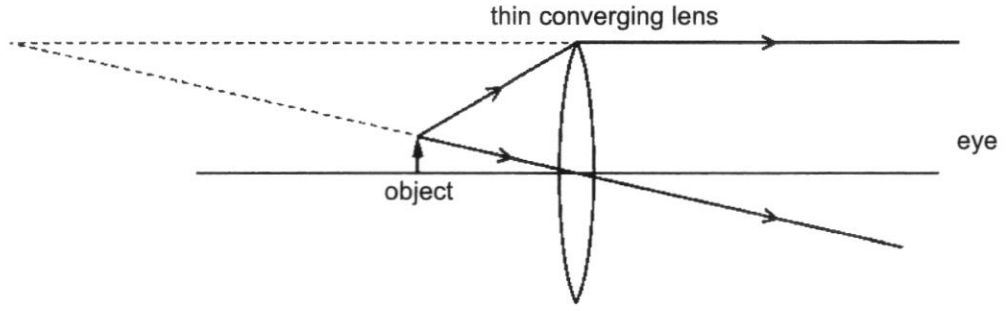
A between the 0cm and 90cm mark of metre rule

B between the 10cm and 70cm mark of metre rule

C between the 20cm and 50cm mark of metre rule

D between the 20cm and 60cm mark of metre rule

22 An object is viewed through a thin converging lens. The diagram shows the paths of two rays from the top of the object to an eye.



How does the image compare with the object?

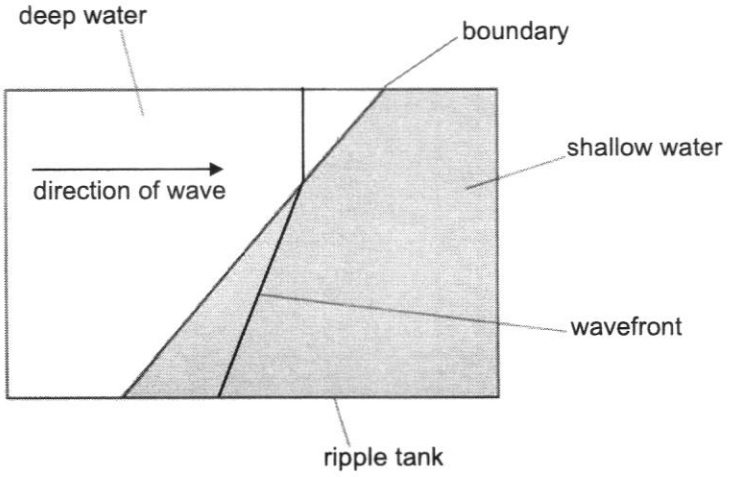
A It is larger and inverted.

B It is larger and upright.

C It is smaller and inverted.

D It is smaller and upright.

23 The diagram shows one wavefront of a wave as it travels from deep water to shallow water in a ripple tank.



What happens as the wavefront moves into the shallow water?

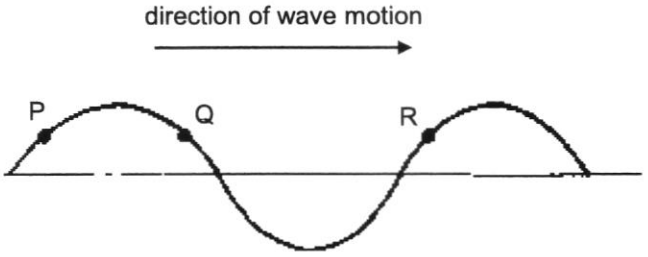
A The speed of the wavefront increases.

B The speed of the wavefront decreases.

C The wavelength of the wave remains constant.

D The wavelength of the wave increases

24 The diagram shows a progressive transverse wave at a certain instant when travelling from left to right.



Which row correctly shows the direction of motion of the particles at P, Q and R?

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

25 Which component of the electromagnetic spectrum has the longest wavelength?

A gamma rays **B** microwaves

C infra-red radiation **D** visible light

26 An exploding star gives out energy in the form of waves. The waves travel to Earth through space.

Which wave could not be received from the star?

A infra-red waves **B** light waves

C sound waves **D** radio waves

27 A student stands at a distance x in front of a large wall.

He claps his hands at a regular rate so that each clap coincides with the echo from the previous clap.

In t seconds, he claps his hands N times.

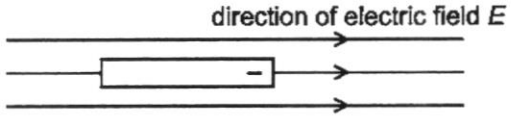
Which expression is used to calculate the speed of sound in air?

A $\frac{x}{Nt}$ **B** $\frac{2x}{Nt}$ **C** $\frac{Nx}{t}$ **D** $\frac{2Nx}{t}$

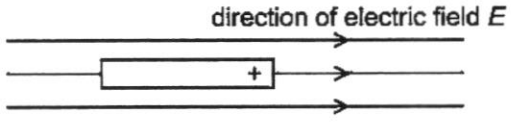
28 An initially uncharged copper rod is placed in a uniform electric field E. The rod is parallel to the field.

Which diagram shows the charges induced on the rod?

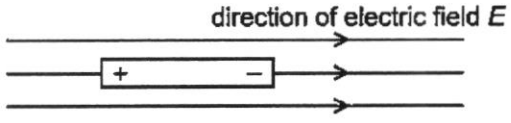
A



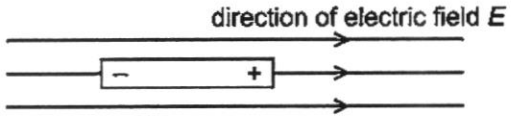
B



C



D

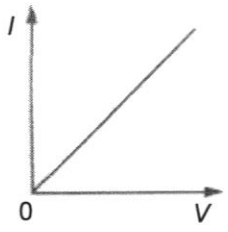


29 Which changes to a wire will double its resistance?

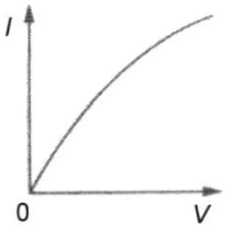
	cross-sectional area	length
A	double	double
B	no change	halve
C	halve	halve
D	halve	no change

30 Which graph best represents how current *I* varies with voltage *V* in a component in which the resistance decreases as the current increases?

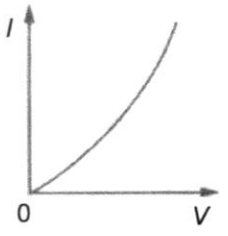
A



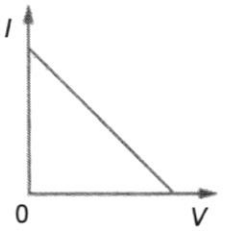
B



C



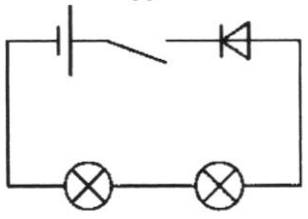
D



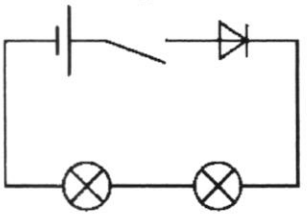
31 In the circuits shown, all the cells are identical and all the lamps are identical. The switches are closed.

In which circuit are both lamps the brightest?

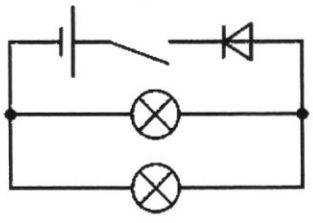
A



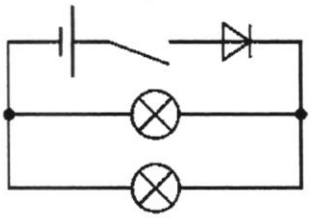
B



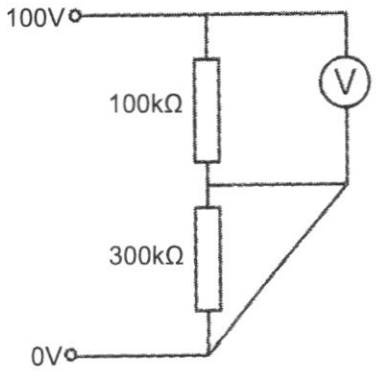
C



D



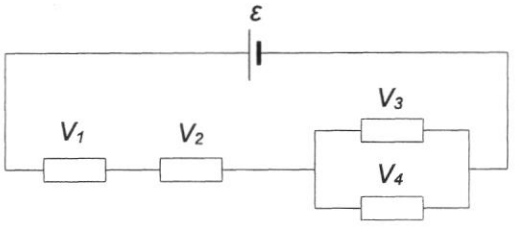
32 What is the reading on the voltmeter in the potential divider circuit below?



A 25V **B** 33V

C 50V **D** 100V

33 The diagram below shows a circuit with 4 resistors connected to one dry cell. The potential difference across each resistor is V_1, V_2, V_3 and V_4 respectively.



Which equation correctly shows the emf ε of the dry cell?

A $\varepsilon = V_1 + V_2 + V_3$ **B** $\varepsilon = V_1 + V_2 + (1/V_3 + 1/V_4)^{-1}$

C $\varepsilon = V_1 + V_3 + V_4$ **D** $\varepsilon = V_1 + V_2 + V_3 + V_4$

34 What quantity is measured in kilowatt-hour?

A charge **B** energy

C power **D** voltage

35 In the three-pin plug of a heater, a fuse is connected at the live wire but not at the neutral wire.

Which statement correctly explains the above statement?

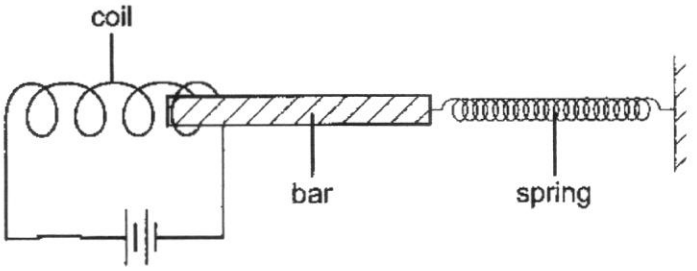
A The neutral wire is always at a voltage lower than that of the live wire.

B The live wire carries a larger current than the neutral wire

C If the fuse in the neutral wire 'blew', the heater still works.

D If the fuse in the neutral wire 'blew', the heater could still be at the mains voltage.

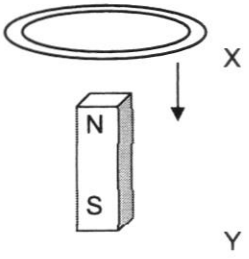
36 The diagram shows a locking device. When the current is switched off, the spring pulls the bar to the right.



Which materials should the coil and the bar be made from?

	coil	bar
A	copper	iron
B	iron	copper
C	iron	steel
D	steel	steel

37 A copper ring is dropped over a bar magnet from point X to Y as shown in the figure.



As seen from the top, which statement about the induced current in the ring at point X and Y is correct?

A It flows in a clockwise direction at both X and Y.

B It flows in an anti-clockwise direction at X and then a clockwise direction at Y.

C It flows in a clockwise direction at X and then an anti-clockwise direction at Y.

D It flows in an anti-clockwise direction at both X and Y.

38 What is the function of slip rings in an a.c. generator?

A to lead the induced current in and out of coil

B to ensure smooth rotation

C to provide mechanical energy

D To store the induced e.m.f. of the coil

39 The diagram shows a beam of electrons about to enter a magnetic field. The magnetic field is directed into the page.

What is the direction of the deflection of the electrons as they enter the magnetic field?

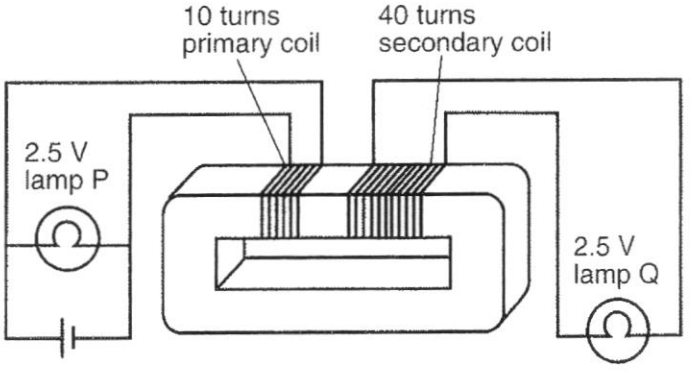
A down the page

B into the page

C out of the page

D up the page

40 A student sets up a model transformer as shown below.



It is connected to 2.5V d.c. supply.

Both lamps have a voltage of 2.5V.

What does the student notice about the lamps?

	Lamp P	Lamp Q
A	normal brightness	not lit
B	very bright	dim
C	normal brightness	very bright
D	dim	very bright

End of Paper

NORTH VISTA SECONDARY SCHOOL
Preliminary Examination 2023
Secondary 4 Express / 5 Normal Academic

80

CANDIDATE NAME

CLASS

INDEX NUMBER

PHYSICS

6091/02

28 August 2023

1 hour 45 minutes

Paper 2 Theory

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your full name, register number and class on the cover page of the question paper.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction tape/fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

The number of marks is given in brackets [ ] at the end of each question or part question.

SECTION A

Answer **all** the questions in this section.

1 **(a)** Speed is a scalar quantity.

Underline **all** the quantities in the list below that are also scalars.

acceleration distance power weight energy moment

[1]

(b) When two forces of 10N are added, they may produce a resultant force that has any value between 0 and 20N.

(i) Describe how it is possible to produce a zero resultant force from the two forces of 10N.

.....

..... [1]

(ii) Describe how it is possible to produce a resultant force of 20N from the two forces of 10N.

.....

..... [1]

(iii) In the space below, draw a scale drawing to show how a resultant force of about 10N may be obtained from the two 10N forces.

Clearly label the forces and the resultant.

[2]

2 Fig. 2.1 shows the velocity-time graph for the motion of a boy on a skateboard.

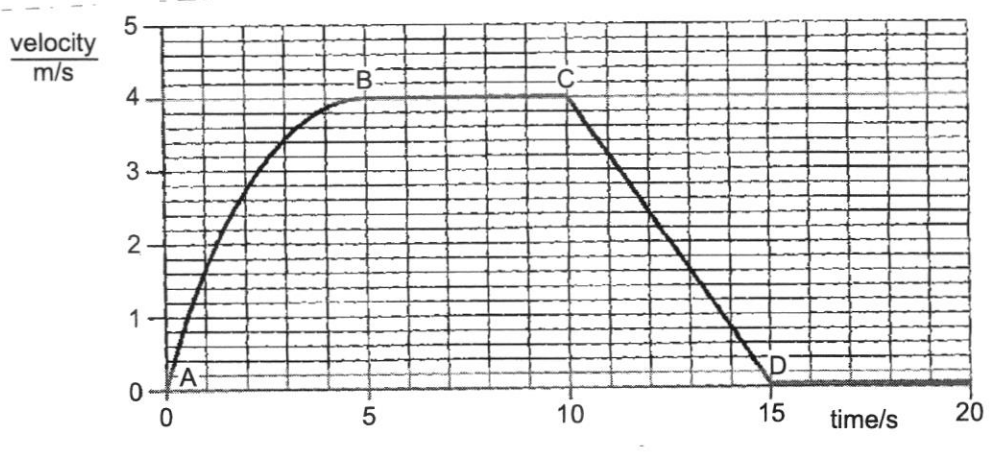


Fig. 2.1

(a) Define *acceleration*.

.....[1]

(b) Describe how the acceleration of the boy changes between point A and D.

.....

.....

.....[3]

(c) **(i)** State how a student can use the figure to show that the boy travelled for 46m.

.....[1]

(ii) Determine the average speed of the boy while he was moving.

average speed = ... [1]

3 Fig. 3.1 shows a concrete bench of weight 2700N.

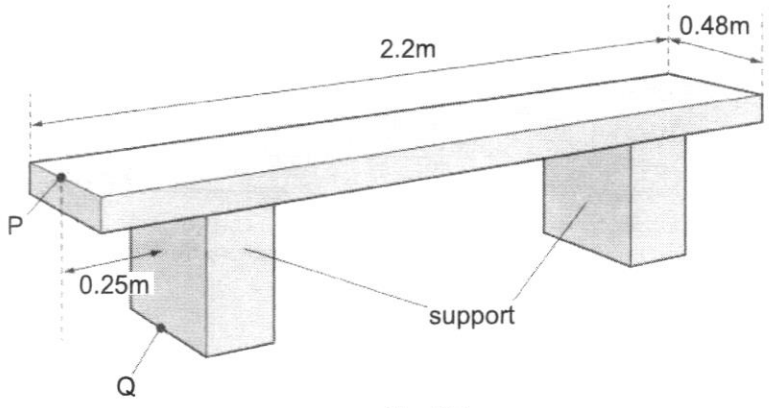


Fig. 3.1

(a) Each of the two supports has an area of $0.045m^2$ in contact with the ground.

Calculate the pressure on the ground due to the bench.

pressure = ... [2]

(b) The centre of gravity of the bench is 1.1m from the left-hand end of the bench and 0.24m from the front.

(i) Suggest **one** reason why the centre of gravity is in this position.

.....

..... [1]

(ii) There is a force exerted vertically downwards from the point P shown in Fig. 3.1.

Calculate the maximum force that can be exerted vertically downwards at P without the bench rotating about the point Q.

maximum force = ... [3]

4 A student sets up the apparatus to find the relationship between temperature and the pressure of carbon dioxide as shown in Fig 4.1.

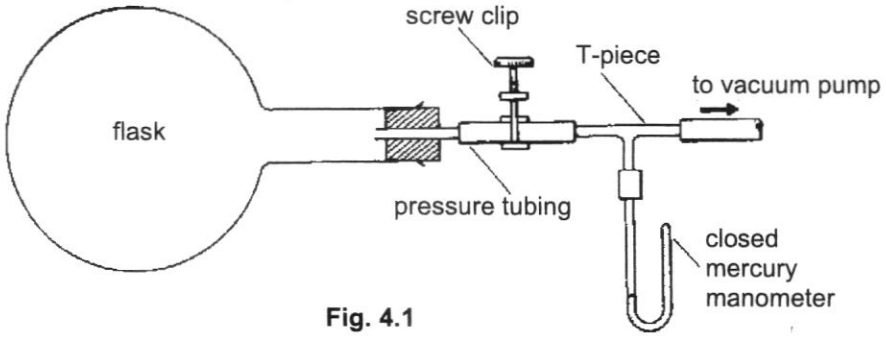


Fig. 4.1

Air is first removed from the flask using a vacuum pump. Once all the air is removed from the flask, the vacuum pump is replaced by a carbon dioxide gas cylinder to introduce carbon dioxide into the flask.

Carbon dioxide is passed into the flask until the pressure of the carbon dioxide in the flask reached standard atmospheric pressure (76cmHg) at constant room temperature of 30°C.

(a) Explain how the student knows that air is totally removed from the flask.

.....[1]

(b) On Fig. 4.2, draw and label the mercury levels in the manometer when the pressure of carbon dioxide in the flask reaches standard atmospheric pressure.

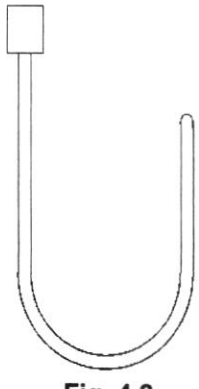


Fig. 4.2

[1]

(c) The screw clip is closed, and the flask is sealed with carbon dioxide at standard atmospheric pressure. The flask is then cooled to 20°C.

Using ideas about molecules, explain what happens to the pressure of carbon dioxide in the flask when its temperature decreases.

.....

.....

.....

.....[3]

5 The lines in Fig. 5.1 represents the positions of particles in a wave.

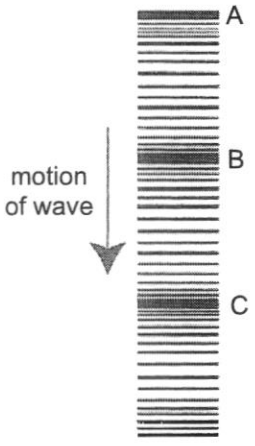


Fig. 5.1

The wave is moving downward with a frequency of 2000Hz and speed of 1500m/s.

(a) Using Fig.5.1, state and explain if the wave is a transverse or longitudinal wave.

.....

..... [1]

(b) Describe what happens to distance between the adjacent particles, as the wave moves through the medium.

.....

..... [1]

(c) Calculate the distance between A and C.

distance = ... [2]

(d) The frequency of the wave is doubled.

State the effect, if any, on the speed and wavelength of the wave.

.....

..... [2]

6 An electrostatic generator is used to produce sparks as shown in Fig. 6.1.

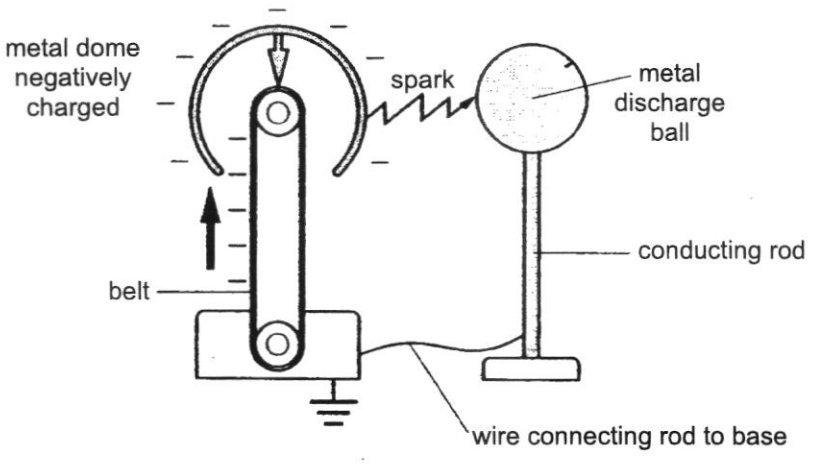


Fig. 6.1

The belt carries negative charge to the dome, making it negatively charged.

(a) **(i)** Before a spark is produced, the discharge ball becomes positively charged.

Describe and explain the movement of electrons in the discharge ball and in the conducting rod as the ball becomes charged.

.....

.....

..... [2]

(ii) On Fig. 6.1, mark with a cross to show where there are the most positive charges on the discharge ball. [1]

(b) When there is enough negative charge on the dome, a spark jumps between the dome and the discharge ball.

A charge of 0.0025mC flows in a time of 0.0012s.

Calculate the average current. Give your answer to a suitable number of significant figures.

current = ... [3]

7 An electric circuit contains a 650Ω resistor and a light-dependent resistor (LDR). Fig. 7.1 is the circuit diagram.

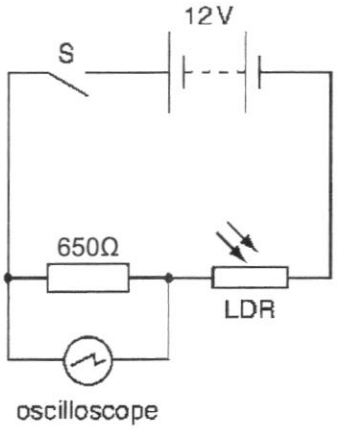


Fig. 7.1

The electromotive force (e.m.f.) of the battery is 12V.

(a) State what is meant by the *e.m.f. of the battery is 12V.*

.....

..... [1]

An oscilloscope is connected across the fixed resistor. Fig. 7.2 shows the oscilloscope, including the settings of the timebase and the Y-gain controls. Line Q shows the position of the trace on the oscilloscope when the switch S is open.

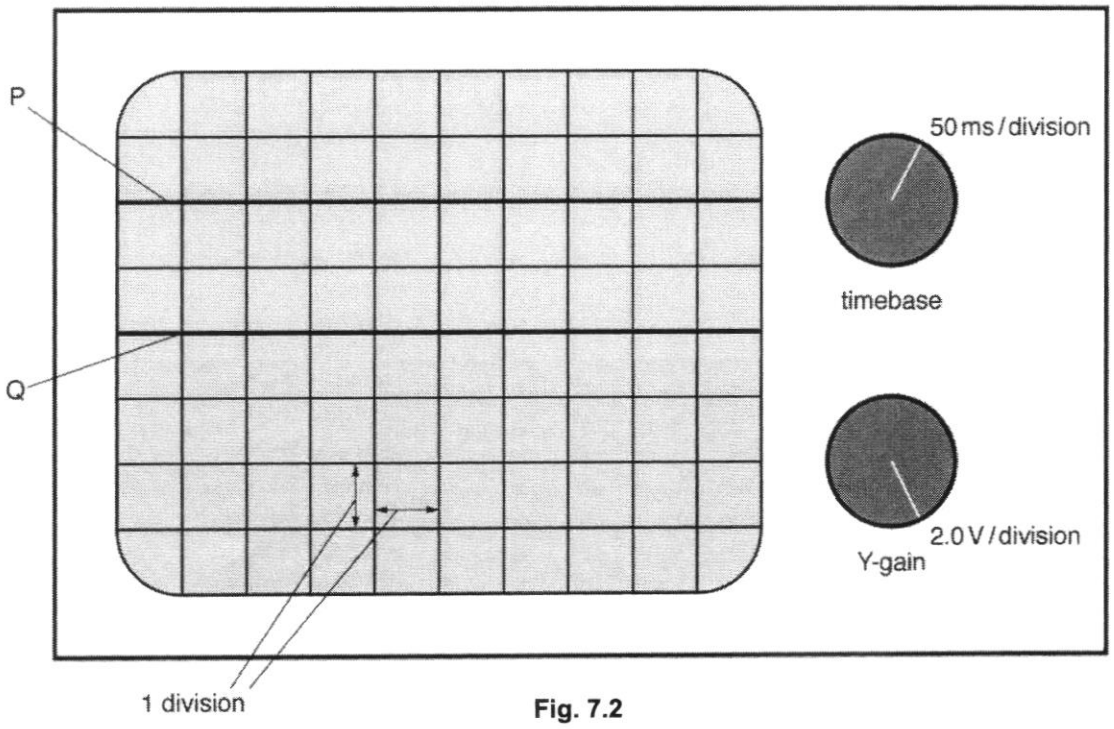


Fig. 7.2

(b) The switch S is closed and the trace on the oscilloscope moves to the position shown by line P in Fig. 7.2.

(i) Determine the potential difference (p.d.) across the 650Ω resistor.

p.d. = ... [1]

(ii) Determine the resistance of the LDR.

resistance = ... [2]

(c) The intensity of the light incident on the LDR gradually decreases.

State and explain how the trace on the oscilloscope screen moves.

.....

.....

.....

..... [3]

8 Fig. 8.1 shows a simple apparatus set up by a student, to study the current flowing through a solenoid from terminal **X** to **Y**.

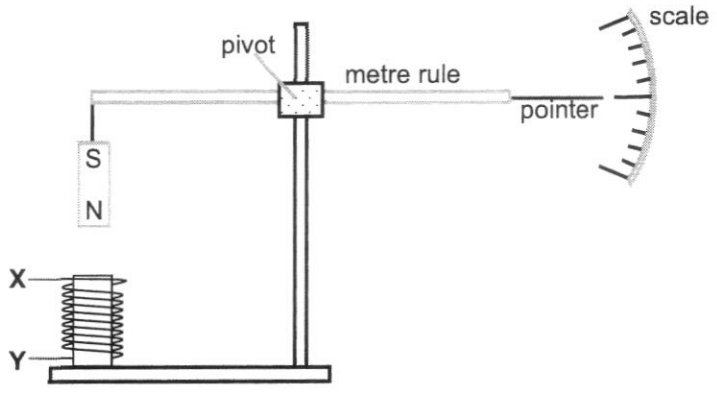


Fig. 8.1

(a) Fig. 8.2 shows the bar magnet used in the set-up.

Fig. 8.2

On Fig. 8.2, draw the magnetic field pattern of the bar magnet. [2]

(b) Explain how Fig. 8.1 can be used to measure the magnitude of current when a direct current supply is connected across **XY**.

.....

.....

.....

..... [3]

(c) Suggest a way to increase the sensitivity of this set-up.

..... [1]

(d) Another student connects a centre-zero galvanometer across **XY**. He then sets the magnet to vibrate up and down vertically.

Describe and explain what is likely to be observed on the galvanometer.

.....

.....

.....

.....

..... [3]

SECTION B

Answer **all** the questions in the spaces provided.
Answer only one of the two alternative questions in **Question 11**.

9 In 2020, three space missions were sent toward Mars, by the national space agencies of China, the United Arab Emirates and the United States of America.

Fig. 9.1 shows the paths taken by Earth and Mars as they orbit around the Sun.

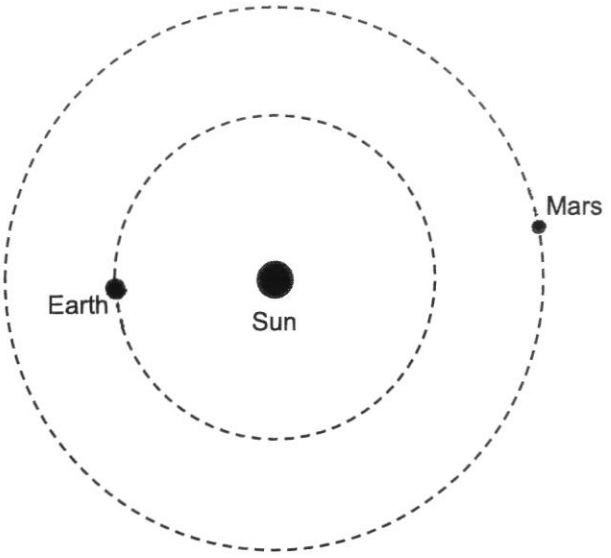


Fig. 9.1

Details about the two planets Earth and Mars are shown in Table 9.1.

Table 9.1

	Earth	**Mars**
average radius/ km	6370	3390
average surface temperature/ °C	14	−63
atmospheric pressure at surface/ kPa	101	0.64
gravitational field strength/ Nkg^{-1}	10	3.7
average density of planet/ kgm^{-3}	5.51×10^3	3.95×10^3
average radius of orbit around Sun/ km	150×10^6	227×10^6

(a) The national space agencies use radio waves to communicate with the spacecraft.

(i) Using Table 9.1, explain why the distance between Earth and Mars varies approximately between 75×10^6km and 380×10^6km.

.....

.....

..... [2]

(ii) Calculate the minimum time for a radio wave to travel from Earth to Mars.

time = ... [2]

(b) One of the missions had a drone-like vehicle flying over the surface of Mars. As the four rotor blades spin, they push air vertically downwards.

Fig. 9.2 shows the vehicle moving upwards at one point in the flight.

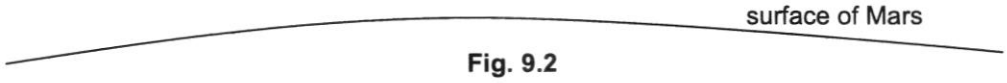


Fig. 9.2

(i) On Fig. 9.2, draw and label the forces that act on the vehicle. [3]

(ii) The vehicle weighed 18N on Earth.

Using Table 9.1, calculate the weight of the vehicle on Mars.

weight on Mars = ... [2]

(iii) Using Newton's laws, explain how the vehicle can move upwards at a constant speed.

.....

.....

..... [2]

(iv) Using Table 9.1, suggest why such a flight is technologically very difficult.

.....

..... [1]

10 Fig. 10.1 shows the passage of a ray of blue light into a semi-circular glass block. The ray strikes the straight face of the semi-circular glass block at its centre **O**.

The incident ray is split into two rays – a reflected ray **R** and a transmitted ray **T**. As the angle of incidence θ varies, the intensities of the rays **R** and **T** change. Fig. 10.2 shows how the intensities of rays **R** and **T** change as θ increases.

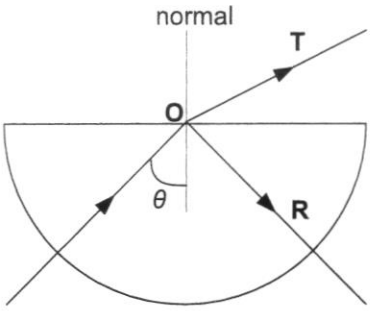


Fig. 10.1

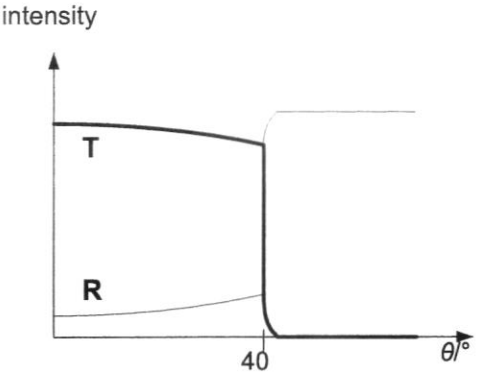


Fig. 10.2

(a) Explain the drastic change of intensities of rays **R** and **T** at $\theta = 40°$, in Fig. 10.2.

.....

.....

..... [2]

(b) The refractive index of glass for blue light is approximately 1.56.

(i) Define the term *refractive index*.

.....

..... [1]

(ii) Using Fig. 10.2, show that the refractive index is 1.56.

[2]

(c) The ray of blue light is now moved to strike the upper face of the semi-circular glass block as seen in Fig. 10.3.

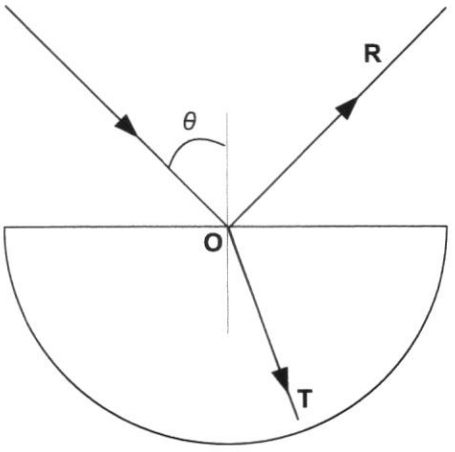


Fig. 10.3

The angle of incidence θ is then varied.

(i) Explain why the intensities of rays **R** and **T** as seen in Fig. 10.2 will not be observed in Fig. 10.3 as the angle of incidence θ varies.

.....

..... [1]

(ii) The refractive index of glass for red light is slightly smaller than for blue light.

A ray of red light strikes the same upper face of the semi-circular glass block at **O** with the same angle of incidence θ.

On Fig. 10.3, draw the path of the ray of red light inside the semi-circular glass block and out into air. [2]

11 EITHER

(a) An object is dropped from rest. The principle of conservation of energy provides a method of finding an approximate value for the speed with which the object hits the ground.

(i) State the *principle of conservation of energy*.

.....

..... [2]

(ii) Explain how the principle may be used to find an approximate value for the speed. Explain why the value obtained is only an approximate.

.....

.....

..... [2]

(b) An air gun pellet of mass 10g hits a steel plate at a speed of 300m/s. During the impact, 40% of the pellet's kinetic energy is converted to thermal energy in the pellet.

The specific heat capacity of the pellet is 130J/(kg °C).

(i) Calculate the rise in temperature of the pellet.

rise in temperature = ... [3]

(ii) The pellet comes to a rest inside the steel plate.

Explain how temperature rise of the pellet causes the internal energy of the steel plate to rise and state the effect on the molecules of the steel plate.

.....

.....

.....

..... [3]

OR

Fig. 11.1 shows an electric kettle.

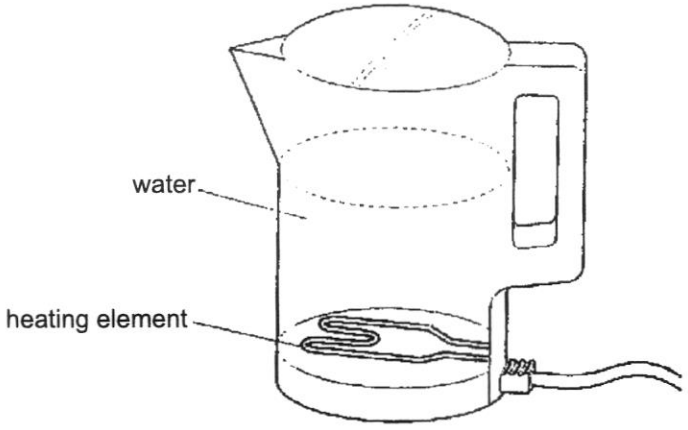


Fig. 11.1

(a) The specific latent heat of vaporisation of water is 2.36×10^6 J/kg.

A student uses this value of specific latent heat of vaporisation of water to measure the electric power input to the kettle.

Suggest how this can be done, stating clearly the readings that are taken and how the power is calculated.

.....

.....

.....

.....

.....

.....

..... [5]

(b) The kettle has an electrical power input of 2000W and is used for 15 minutes per day.

Calculate the daily cost of heating water if 1kWh of energy costs 28 cents.

cost = ... [2]

(c) The kettle is connected to a power supply with a voltage of 250V and contains a circuit breaker that allows a maximum current of 10A.

(i) Calculate the current in the kettle.

current = ... [2]

(ii) State **one** advantage of using a circuit breaker rather than a fuse.

.....

..... [1]

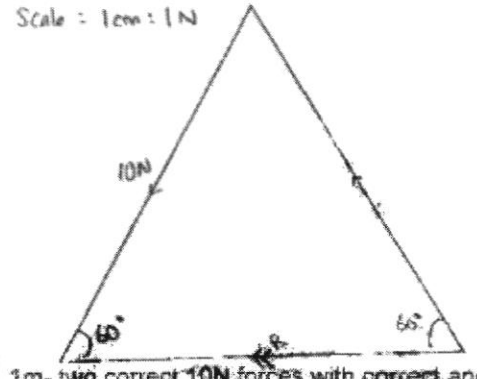
End of Paper

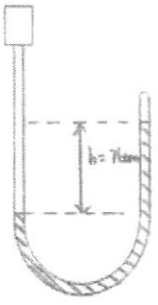
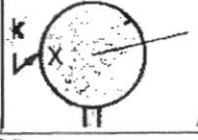
Answers

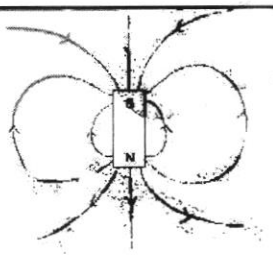
1	B
2	C
3	A
4	D
5	D
6	D
7	D
8	A
9	A
10	B
11	A
12	D
13	B
14	D
15	C
16	A
17	D
18	B
19	D
20	B
21	C
22	B
23	B
24	D
25	B
26	C
27	D
28	D
29	D
30	C
31	D
32	D
33	A
34	B
35	D
36	A
37	C
38	A
39	A
40	A

Marking Scheme

Section A

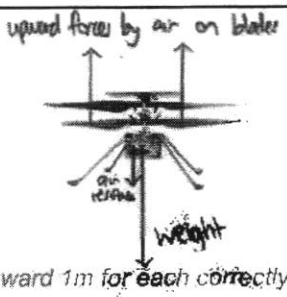
1	(a)	acceleration distance power weight energy moment *Award 1m if all are correct.*	
	(b)	(i)	Both 10N force are parallel and acting in opposite direction. [1]
		(ii)	Both 10N force are parallel and acting in same direction. [1] Award 1m if only opposite + same direction are mentioned in (i) and (ii).
		(iii)	 1m- two correct 10N forces with correct angles and direction 1m- correct resultant of 10N with correct angles and direction [accept parallelogram method]
2	(a)	**Acceleration is the rate of change of velocity** [1]	
	(b)	During section AB, the boy experiences decreasing acceleration. [1] BOD accelerating at a decreasing rate During section BC, the boy experiences zero acceleration. [1] BOD "not accelerating velocity is constant Did not accept does not accelerate or no acceleration" During section CD, the boy experiences constant deceleration of 0.8m/s². [1] Accept constant acceleration of - 0.8m/s². **Award 2m if descriptions are cortect but *without values*.**	
	(c)	(i)	Area under velocity-time graph [1]
		(ii)	Average speed = total distance/ total time = 46/15 = 3.1m/s (accepted 3 s.f.) [1]
3	(a)	P = F / A = 2700 / (2× 0.045) [1] = 30 000 Pa [1]	
	(b)	(i)	The bench is made of a uniform material and is symmetrical left-to-right or symmetrical front-to-back. [1]
		(ii)	Taking moment about Q, ACW moment of force P = CW moment of weight F x 0.25 [1] = 2700 × (1.1 – 0.25) [1] F = (2700 × 0.85) / 0.25 F = 9180 N or 9200N [1]

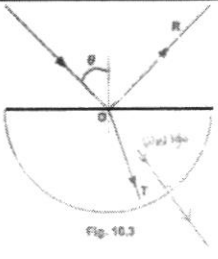
4	(a)	The mercury levels on both sides of the manometer will be the same when the flask is filled with vacuum. [1] Accepted w/o "both sides" as levels = both sides Did not accept "manometer will show a reading of 0cmHg
	(b)	 1m – for correct drawing of height with label Accepted: h_{atm} BOD: P_{atm}
	(c)	When temperature decreases, the carbon dioxide molecules will lose kinetic energy and move slower, [1] causing less frequent and less forceful collisions between the molecules and the walls of the flask, [1] (accept: "less frequently and less vigourously") hence pressure which is average force per unit area decreases. [1]
5	(a)	Longitudinal wave as the wave is made up of compressions and rarefactions. [1] *Accept " Particles vibrates parallel or in the same direction as wave motion* *Accept "motion/movement of particles is parallel to direction/motion of wave* *BOD: "Particles travel (should be vibrate) parallel to motion of wave"*
	(b)	distance between the adjacent particles increases and decreases as the waves moves through the medium. [1]
	(c)	$v = f\lambda$ $1500 = (2000)\,\lambda$ $\lambda = 0.75m$ [1] AC= $2\lambda = 1.5m$ [1] (accept 1.50m)
	(d)	Speed of wave is unchanged as the sound is still travelling in same medium. [1] Since $v = f\lambda$ and speed remains constant when frequency doubles, wavelength must halved. [1] Did not accept/zero mark if student wrote 2 sets of different answers)
6	(a) (i)	The negatively charged metal dome causes the electrons in left-hand side of the metal discharge ball to move to the right of the ball and down the conducting rod into the earth/ground [1] as like charges repel. [1]
	(ii)	 *Award 1m for cross drawn on the left-hand side of ball*
	(b)	$I = Q/t$ $= (0.0025 \times 10^{-3})\,(0.0012)$ [1] $= 2.1 \times 10^{-3}$ A or 0.0021A or 2.1mA [2] *Award 1m for answer if s.f. is wrong* *0m if answer is wrong but s.f. is correct*

7	(a)	12J of work done by a source in driving a unit charge/ 1 coulomb of charge around a complete circuit [1]	
	(b)	(i)	4.0V [1]
		(ii)	4.0 = (650/ (650+R) × 12 [1] R= 1300 Ω [1] OR I = 4.0/650 = 0.006153A [1] R= (12 - 4.0)/ 0.006153 = 1300 Ω [1]
	(c)	resistance of LDR increases [1] total resistance in the circuit increase and current decreases OR p.d. across 650Ω resistor / oscilloscope decreases OR p.d. across LDR increases [1] trace moves down the screen [1] accept: "trace decreases" ECF 1m for whole question if student wrote R $_{LDR}$ decreases and correctly explain accordingly.	
8	(a)	 Award 1m for correct shape Award 1m for correct direction Candidates are to take note 1.the spacing between the magnetic field lines should increase . further away from magnet 2. the magnetic filed fines should not touch eash othe 3. the middle magnetic field line at the end of magnet should be drawn with ruler	
	(b)	When a direct current flows through the solenoid, an electromagnet with N pole at X is created. [1] It then repel the hanging magnet as like poles repel. [1] The line of action of the repulsive magnetic force acting at a perpendicular distance about the pivot then creates a clockwise moment/ turning effect, causing the pointer to turn and show a value on the scale. [1] OR When a direct current flows through the solenoid, a magnetic field is created. [1] It then exerts an attractive or repulsive magnetic force on the hanging magnet. [1] The line of action of the magnetic force acting at a perpendicular distance about the pivot then creates a moment/ turning effect, causing the pointer to turn and show a value on the scale. [1] Candidates are to take note that an electromagnet is created when current flows through the solenoid. This is not induced magnetism.	
	(c)	Accept any one [1] • Increase the no. of turns in solenoid • Increase the strength of the hanging magnet • Use a longer ruler *Don't accept "Increase the distance between the pivot and the magnet"* Some candidates seem to have difficulties understanding the word " sensitivity".	

	(d)	Needle in galvanometer deflects left and right repeatedly. [1] When the magnet vibrates up and down, as there is a change of magnetic flux linking/ magnetic field cutting the solenoid, an induced e.m.f., hence induced current in the closed circuit is produced. [1] According to Lenz's laws, a North pole and South pole will be induced near X when the magnet moves down and up respectively, causing the induced current to flow in one direction and then in another direction [1] Most of the candidates can correctly identify the concept needed but lose marks for not explaining fully.

Section B

9	**(a)**	**(i)**	Smallest distance is when they are on the same side of sun, distance = $227 \times 10^6 - 150 \times 10^6 = 77 \times 10^6$m [1] Greatest distance is when they are on opposite side of the sun, distance= $227 \times 10^6 + 150 \times 10^6 = 377 \times 10^6$m [1] Clear explanation in words were also accepted.
		(ii)	v= 3.0×10^8m/s [1] v =smallest distance /t t= smallest distance/ v = $(77 \times 10^6 \times 10^3) / (3.0 \times 10^8)$ or $(75 \times 1^{r}$ $?^8)$ = 260s or 250s A significant number of candidates dir) m.
	(b)	**(i)**	 *Award 1m for each correctly drawn force with.* Candidates have difficulties with drawing air res d force by air correctly.
		(ii)	Mass = 18/10 = 1.8kg [1] Weight on Mars = 1.8 × 3.7 = 6.7N or 6.66N [1] Question is well done.
		(iii)	The upward force of the air on the vehicle balances the total downward force of the air resistance and the weight of the vehicle.[1] According to Newton's first law, a moving object will continue its motion at a constant velocity as there is no resultant force on the vehicle. [1] *Accept Newton's second law. Allow ecf from (b)(i)* Candidates are advised to read question carefully as this question is not testing on Newton's 3rd law
		(iv)	The atmospheric pressure on surface of Mars is very low, showing the amount of air is very thin. Hence it is difficult for the upward force by the air on the rotor's blades to push the vehicle up. [1] Most candidates can identify that the low atmospheric pressure on moon is an issue but did not get a mark as candidates did not elaborate further how the low atmospheric pressure affects the flight.
10	**(a)**		The critical angle of the glass block is 40°. [1] As the angle of incidence in the optically denser medium increases to more than 40°, all the light is totally internally reflected, and no light is transmitted. [1]

			Candidates are advised to read question carefully as this question as some candidates describe the change in the graph instead of explaining it. A significant number of candidates are not able to identify that 40° is the critical angle. Some misconception of TIR happening at critical angle is also seen.
	(b)	(i)	Refractive index of a medium is the ratio of speed of light in vacuum to the speed of light in the medium. [1] Generally well-done, although a few candidates give answer for refractive index of 1.56 or give the wrong definition involving sin i and sin r.
		(ii)	n = 1 / sin c = 1 / sin 40° [1] = 1.56 [1] Question is well-done.
	(c)	(i)	Total internal reflection will not occur as the light is traveling from an optically less dense to an optically denser medium. hence light will always refract out of the glass block. [1] Generally well-done. Some candidates lost the mark for not explaining fully
		(ii)	 *1m for the correct refracted ray inside the glass block with correct direction* *1m for the correct emergent ray buts ide the glassblock with correct direction* Some candidated lost one mark unnecessenrly for not drawing the ray out of the glass block
11	EITHER Majority of candidates choose 11 Either. Those who choose 11OR did well as well.		
	(a)	(i)	Principle of conservation of energy states that energy cannot be created or destoyed and energy can be converted from one form to another form, [1] and the totalenergy of an isolated system is constant. [1] Generaly well-done. Those candidates who lost the mark , did not list the last point
		(ii)	As the object drops, the gravitational potential energy (GPE) is converted to kinetic energy (KE). Hence, loss in GPE = gain in KE, $mgh = \frac{1}{2} mv^2$ Or $v = \sqrt{(2gh)}$ [1] The value is only an approximate as some of the GPE is converted to thermal energy (heat) or kinetic energy of the air. [1] Generally well-done. Those candidates who lost the mark , did not describe how to use the formula to get v.

	(b)	(i)	Amount of kinetic energy converted to thermal energy = 40/100 [1/2 (10/1000) (300)^2 = 180J [1] $Q = mc\Delta\theta$ 180 = (10/1000) (130) $\Delta\theta$ [1] $\Delta\theta$ = 140°C or 138°C [1] Majority of the candidates can do this question.
		(ii)	When the pellet comes to a rest inside the steel plate, thermal energy is transferred from the heated pellet (high temperature) to the steel plate (low temperature) via conduction. [1] The molecules of the steel plate gain internal kinetic energy [1] and move faster. [1] Candidates are advised to use "internal" to describe energy possessed by particles. Most candidates did not write down the first point on how energy of the pellet is transferred to the steel plate.
OR			
	(a)		With an electronic balance, measure the mass of the kettle with water and record the mass as m_1. [1] Insert a thermometer inside the kettle and switch on the kettle. Start the stopwatch when temperature of water reaches 100°C. [1] Stop the stopwatch when the kettle automatically switches off. Record the time as t. Weigh the kettle again and record the mass as m_2. The difference in the mass ($m_1 - m_2$) is the mass of water changed to vapour. [1] To calculate, first find $L_v = (m_1 - m_2) \times (2.36 \times 10^6)$, [1] and then $P = L_v / t$ [1] Those candidates who attempted 11OR found this part the hardest, tend to miss out on the 2nd and 3rd point on starting the stopwatch and finding the mass difference after the temperature of water reaches 100°C.
	(b)		Cost = no. of kWh × cost per kWh = (2000/1000) (15/60) × 28cents [1m for correct kWh] = 14 cents [1] Generally well-done
	(c)	(i)	I= P/V = 2000/ 250 [1] = 8.0A [1] Generally well-done
		(ii)	Accept one: [1] • A circuit breaker can be reset after it trips but a fuse must be replaced after it blows. • Circuit breaker operates at a quicker speed as compared to a fuse. Generally well-done