BEATTY SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2023
SECONDARY FOUR EXPRESS

CANDIDATE NAME			
CLASS		REGISTER NUMBER	

PHYSICS

6091/01

Paper 1 Multiple Choice
Setter: Mdm Lim Yi Wen

28 August 2023
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, class and register number on the Multiple Choice Answer Sheet 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 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 booklet.
The use of an approved scientific calculator is expected, where appropriate.

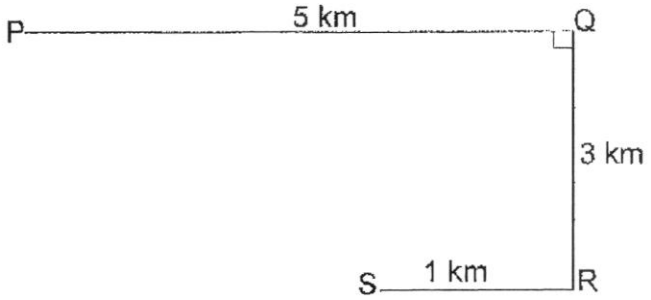
1 Which is the likely estimate of the radius of a hydrogen nucleus?

A 10^{-8} m **B** 10^{-10} m **C** 10^{-12} m **D** 10^{-15} m

2 Which pair contains two vector quantities?

A acceleration and time
B displacement and temperature
C force and displacement
D velocity and work done

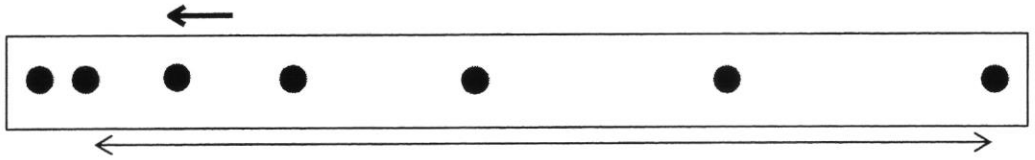
3 The diagram shows the path travelled by a car starting from P and ending the journey at S.



What is the displacement of the car?

A 1 m **B** 4 m **C** 5 m **D** 9 m

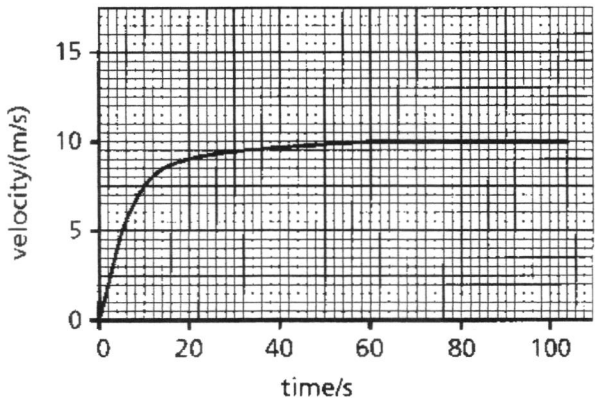
4 Chloe used a ticker tape timer to investigate the acceleration of a remote control car. The ticker tape timer is set to vibrate at 50 Hz and a portion of the tape obtained is shown below.



What is the average speed of the remote control car during the portion shown?

A 0.4 cm/s **B** 2.0 cm/s **C** 200 cm/s **D** 1000 cm/s

5 The diagram below shows the velocity-time graph of a falling object.



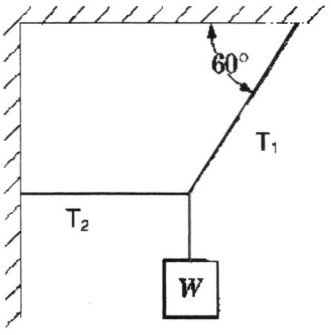
Which statement is true?

A Air resistance caused the object to decelerate.
B The acceleration due to gravity decreases with time.
C The acceleration of the object was initially 10 m/s^2.
D The object was experiencing Newton's First Law after 60 s.

6 Which two forces forms an action-reaction pair?

A driving force acting on a car and air resistance acting on the same car
B force pulling a rope and tension in the same rope
C upward force (lift) acting on a plane and weight acting on the same plane
D weight of a book and reaction force acting on the same book

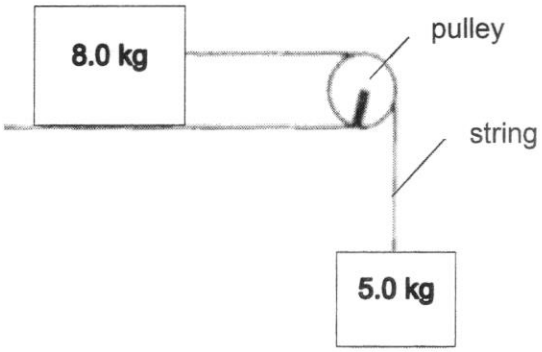
7 The diagram shows a system in equilibrium. It consists of an object of weight W that hangs from two ropes. The tensions in the ropes are T_1 and T_2.



Which of the following are correct values of T_1 and T_2?

	T_1	T_2
A	W / cos 60°	T_1 cos 60°
B	W / sin 60°	T_1 cos 60°
C	W / cos 60°	T_1 sin 60°
D	W / sin 60°	T_1 sin 60°

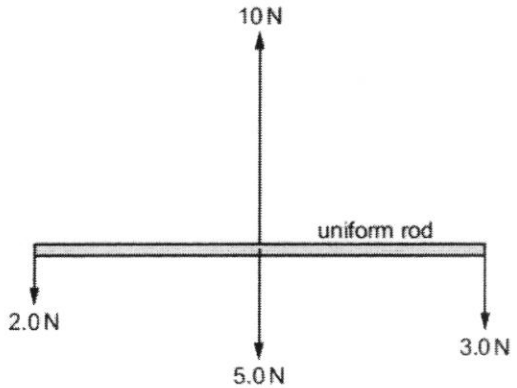
8 An 8.0 kg block is placed on a smooth table and attached to a 5.0 kg block with a string. The string runs over a frictionless pulley as shown in the diagram below.



Ignoring air resistance, determine the acceleration of the 5 kg mass.

A 0.63 ms^{-2} **B** 1.6 ms^{-2} **C** 3.8 ms^{-2} **D** 16 ms^{-2}

9 The diagram shows the forces acting on the rod when it is released.



What happens to the rod when it is released?

A It does not move.
B It moves to the right.
C It moves upwards.
D It starts to rotate.

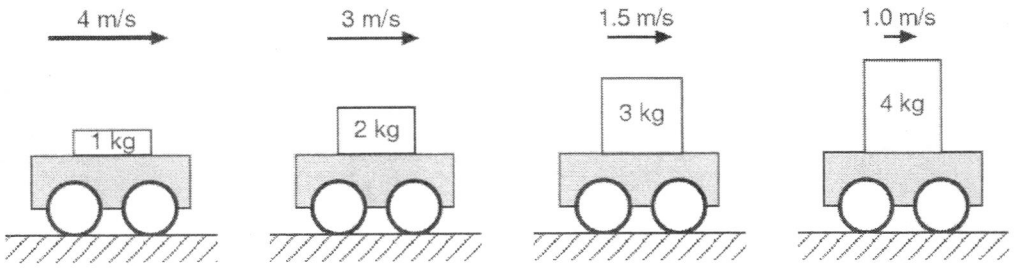
10 An unknown object found on Planet Z weighs 40 N.

If the gravitational field strength of Planet Z is half that of Earth's, what is the weight of the object on Earth?

A 4 N **B** 20 N **C** 40 N **D** 80 N

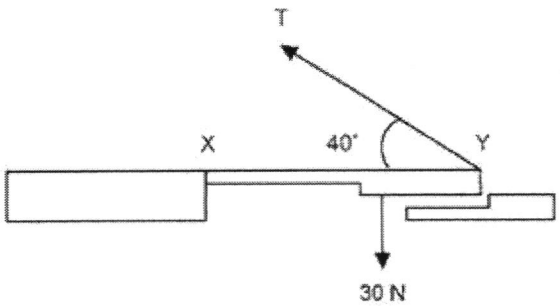
11 A lab cart is loaded with different masses and moved at various velocities.

Which diagram shows the cart-mass system with the greatest inertia?



A **B** **C** **D**

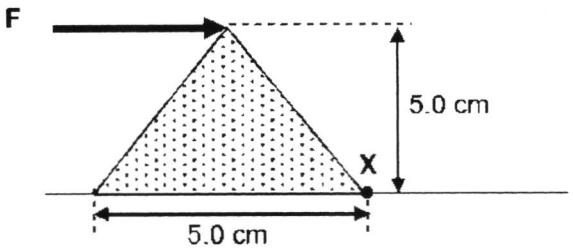
12 A trap door XY of length 1.00 m and weighing 30 N is hinged at the end X. It is opened by pulling a string inclined at an angle 40° to the horizontal.



Given that the centre of gravity of the trap door is 70 cm from X, what is the tension T in the string required to just lift the trap door?

A 21 N **B** 30 N **C** 33 N **D** 100 N

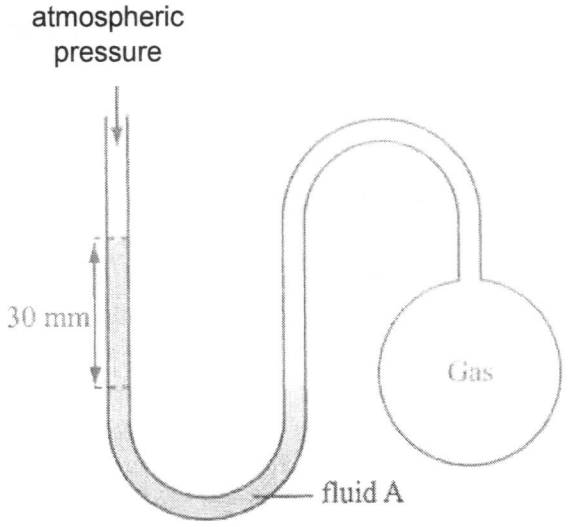
13 The diagram below shows the cross-section of a uniform pyramid of weight 10.0 N



What is the minimum value of the force F that is required to just tilt the pyramid about X?

A 2.5 N **B** 5.0 N **C** 10.0 N **D** 20.0 N

14 The diagram shows a manometer used to measure the pressure of gas.



If atmospheric pressure is 1×10^5 Pa and the density of fluid A is 1000 kg/m^3, what is the gas pressure?

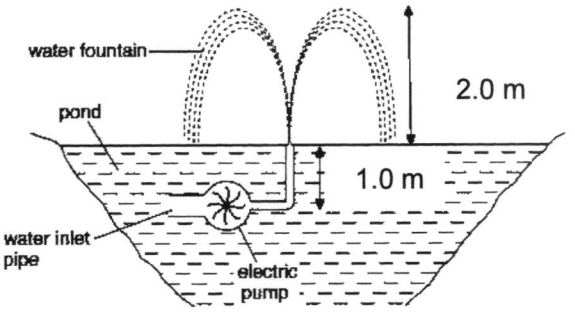
A 0.3 kPa **B** 100.3 kPa **C** 300 kPa **D** 400 kPa

15 Liquids X and Y are stored in large open tanks. Liquid X has a density of 800 kg / m^3 and liquid Y has a density of 1200 kg / m^3.

At which depths are the pressure exerted by liquid X and Y equal?

	depth of liquid X / m	depth of liquid Y / m
A	8	18
B	10	15
C	15	10
D	18	8

16 A water fountain has an electric pump installed 1.0 m below the surface. 0.60 m^3 of water flows through the pump every hour and this water is shot 2.0 m into the air. Take the density of water to be 1000 kg/m^3.



Calculate the work done by the pump every hour.

A 600 J **B** 1 800 J **C** 12 000 J **D** 18 000 J

17 A 6 N force is exerted on an object R along a rough surface of 10 m.

What is the gain in kinetic energy of object R if the force of friction is 2 N?

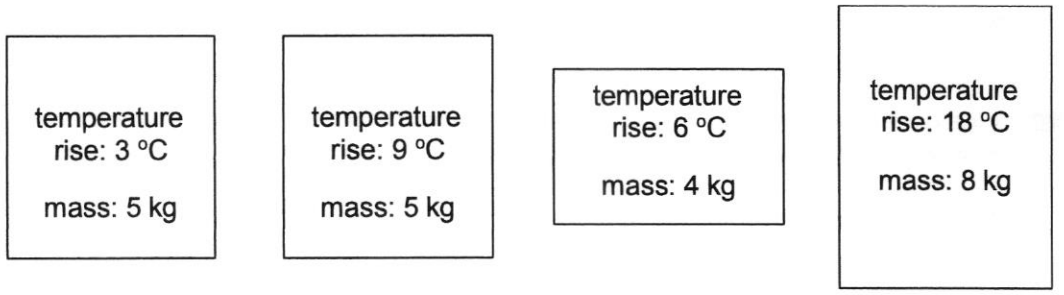
A 20 J **B** 40 J **C** 60 J **D** 80 J

18 Which cup will have the greatest rate of drop in temperature?

	exposed surface area/cm^3	texture
A	20	dull
B	30	dull
C	20	shiny
D	30	shiny

19 The same quantity of thermal energy is supplied to four blocks of different masses. The temperature rise and the mass is shown on each block.

Which block has the lowest specific heat capacity?

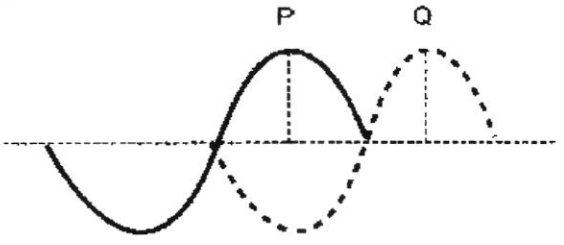


A **B** **C** **D**

20 What is a possible frequency of an ultrasound wave?

A 2 Hz **B** 10 Hz **C** 200 Hz **D** 100 kHz

21 A radio wave of wavelength 10 m long travels from position P to position Q in a special medium as shown.



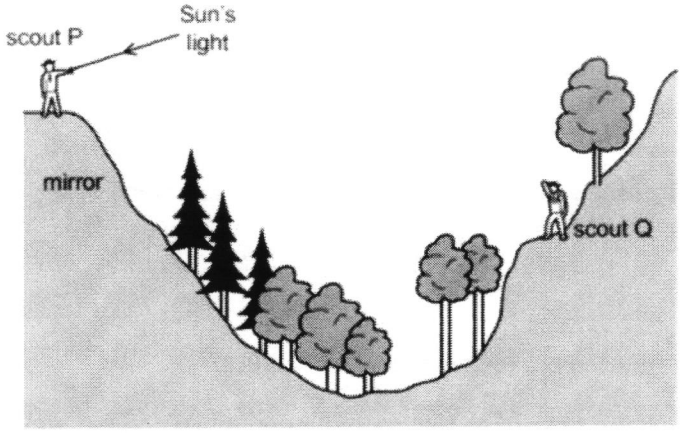
Given that the frequency of this radio wave is 10 MHz, what is the time taken for the wave to move from P to Q?

A 2.5×10^{-8}s **B** 5.0×10^{-8} s **C** 1.0×10^{-7} s **D** 5.0×10^{-7} s

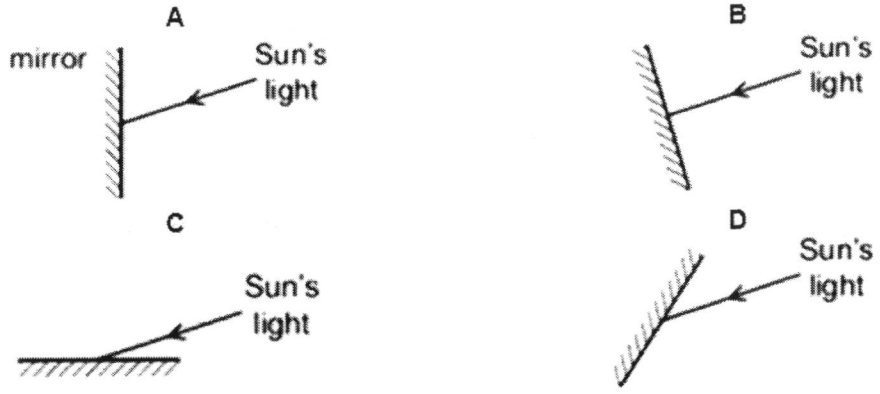
22 Which statement about total internal reflection is correct?

A The larger the refractive index of a medium, the larger is the critical angle.
B Total internal reflection will always occur when light travels from an optically denser to an optically less dense medium.
C When total internal reflection occurs, the angle of incidence is equal to the angle of reflection.
D When total internal reflection occurs, the angle of incidence is less than the critical angle.

23 Scout P signals to scout Q on the other side of a valley by using a mirror to reflect the Sun's light.



Which mirror position allows the Sun's light to be reflected to scout Q?

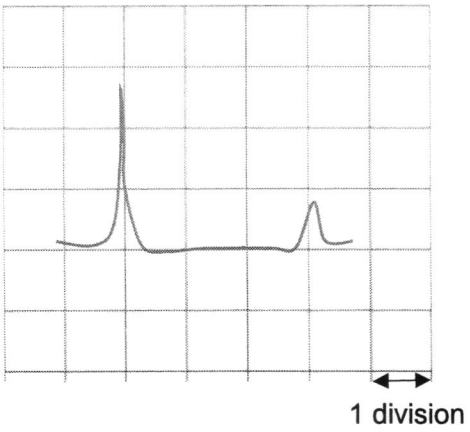


24 Which statement about electromagnetic waves is false?

A Blue light has higher frequency than green light.
B Microwaves have longer wavelengths than infra-red waves.
C Radio waves travel at the same speed as gamma rays.
D X-rays have shorter wavelengths than gamma rays.

25 A man shouts on a mountain and detects the sound at the nearest neighbouring mountain using a microphone attached to a cathode ray oscilloscope (CRO). The following CRO screen shows the original sound and trace. Sound travels at 330 m/s in air.

The time-based setting of the CRO is set to 2 s/div.



What is the distance between the man and the mountain?

A 30 m **B** 495 m **C** 990 m **D** 1980 m

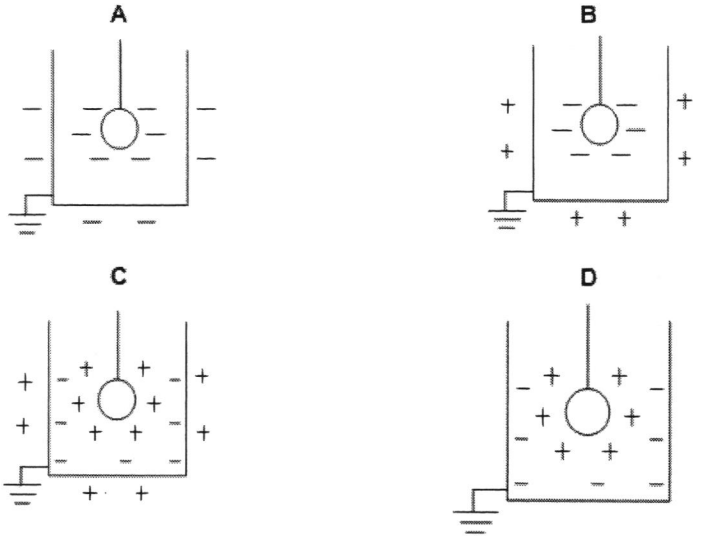
26 Which statement about electric field are correct?

1 An electron experiences a force when it is placed in an electric field.
2 Field lines point from a positively charged object to a negatively charged object.
3 Field lines show the direction where a charge will move with constant speed.

A 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

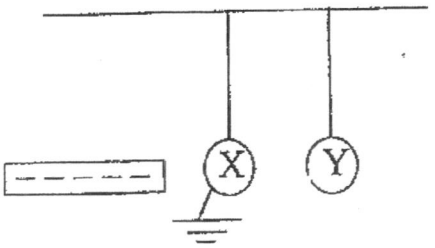
27 A charged sphere is suspended by an insulating thread inside a metal can. The outside of the can is earthed.

Which diagram shows the resulting charges on the sphere and on the can?



28 A negatively charged rod is brought near one of the two uncharged metal balls X and Y.

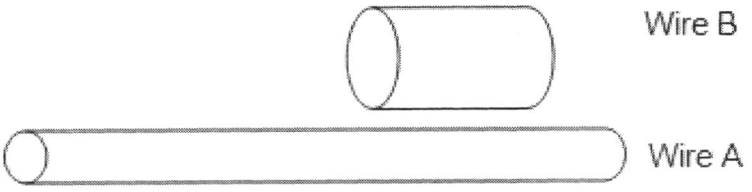
X is then earthed as shown below.



If the rod is then removed after earthing, how would the balls be charged?

	ball X	ball Y
A	positive	neutral
B	positive	negative
C	neutral	neutral
D	negative	positive

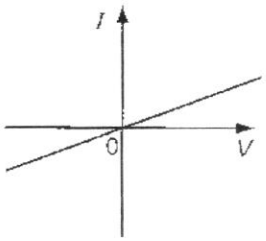
29 Two pieces of copper wire, A and B, have the same volume. The length of A is 2.0 times the length of B.



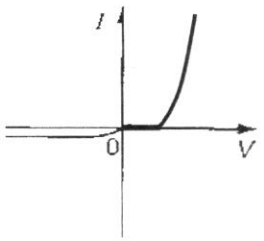
What is the value of $\frac{R_A}{R_B}$ where R_A and R_B are the resistances of wires A and B respectively?

A 0.25 **B** 0.50 **C** 2.0 **D** 4.0

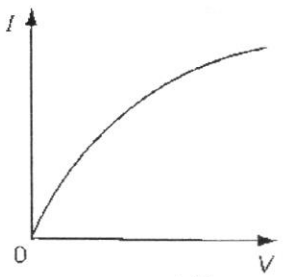
30 The three graphs X, Y and Z show the *I/V* characteristics for three different components.



graph X



graph Y

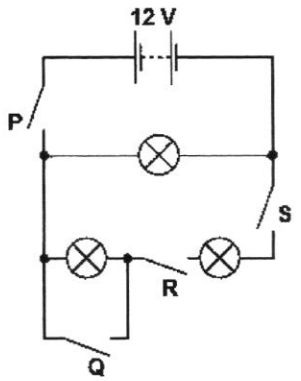


graph Z

To which components do these characteristics correspond?

	Graph X	Graph Y	Graph Z
A	filament lamp	metallic conductor	semiconductor diode
B	metallic conductor	semiconductor diode	filament lamp
C	semiconductor diode	metallic conductor	filament lamp
D	metallic conductor	filament lamp	semiconductor diode

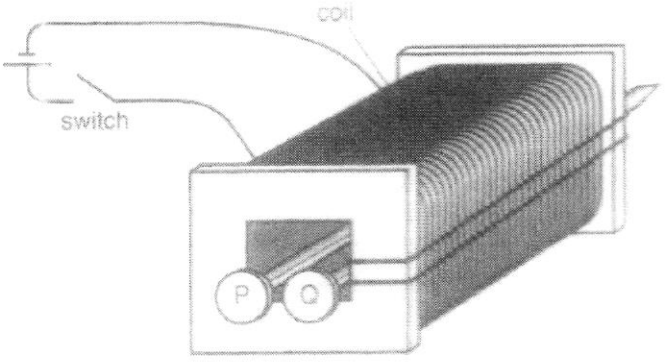
31 The circuit shown consists of three identical lamps. The lamps are rated at 5 W, 12 V.



Which switches need to be closed for two lamps to be operating at normal brightness?

A P, R and S
B P, Q, R and S
C Q, R and S
D R and S

32 Two nails P and Q are placed inside a coil, as shown in the diagram below. P is free to move but Q is fixed. The coil is joined to a battery and a switch.



When the switch is closed, what will happen to P?

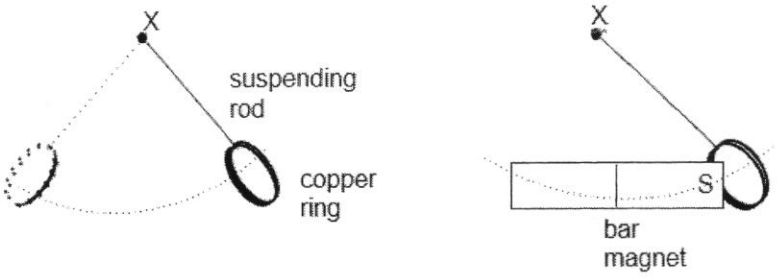
A moves away from Q.

B moves to and fro.

C moves towards Q.

D shoots out of the coil.

33 The diagram on the left shows a copper ring suspended by a long, light rod which is pivoted at X. When the copper ring is released from the position as shown, it begins to oscillate like a pendulum.



A bar magnet is placed near the copper ring as shown in the diagram on the right. When the magnet passes through the copper ring, there is an induced electromotive force in the copper ring. Which of the following statements correctly describes the motion of the copper ring when it is released?

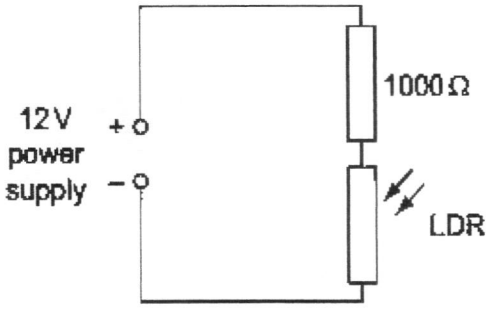
A The amplitude of oscillation will gradually decrease.

B The amplitude of oscillation will gradually increase.

C The copper ring will be brought to rest with the rod resting parallel to the bar magnet.

D The period of oscillation will decrease.

34 In a darkened room, a 1000 Ω resistor and a light-dependent resistor (LDR) are connected in series with a 12 V power supply.



The curtains are opened and light falls on the LDR. What happens to the voltage across the LDR?

A becomes zero
B decreases
C increases
D remains unchanged

35 An air-conditioner has a rating of 240 V, 1500 W, The cost of operating the air-conditioner came up to $45 for a particular month. What is the duration of time that the air-conditioner was switched on for the month if one unit of electricity costs $0.20?

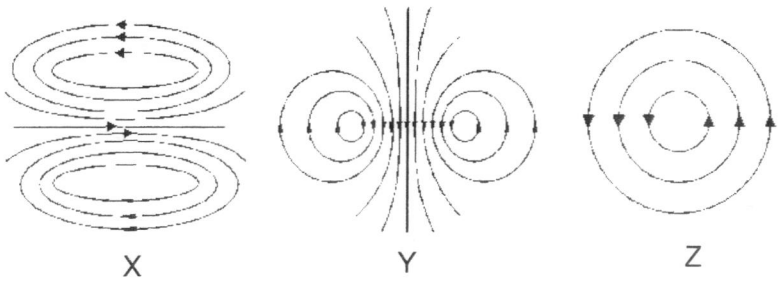
A 9 min **B** 150 hrs **C** 744 hrs **D** 938 hrs

36 An electric iron is connected to the mains supply of 110 V by a cable.

Which row shows a possible combination of the potential and current of the respective wires under normal operating conditions?

	live wire		neutral wire		earth wire	
	current/A	Potential	current/A	potential	current/A	potential
A	1.0	High	0.0	Low	0.0	Low
B	1.0	High	1.0	Low	0.0	Low
C	1.0	Low	1.0	High	1.0	High
D	0.0	Low	1.0	High	1.0	Low

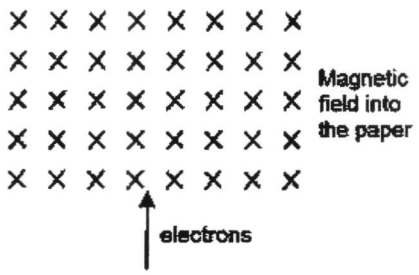
37 Three sets of magnetic fields obtained are shown below.



Which row correctly lists the origins of the magnetic fields illustrated?

	X	Y	Z
A	a pair of like poles permanent magnets facing each other	current flowing opposite direction in two straight wires	current flowing in a circular coil of wire
B	a pair of like poles permanent magnets facing each other	current flowing same direction in two straight wires	current flowing in a straight wire
C	current flowing in a solenoid	current flowing opposite direction in two straight wires	current flowing in a straight wire
D	current flowing in a solenoid	current flowing same direction in two straight wires	current flowing in a circular coil of wire

38 In the diagram, a beam of electrons is moving across a magnetic field. The direction of the magnetic lines of force is going into the paper.



What is the direction of deflection of the beam of electrons?

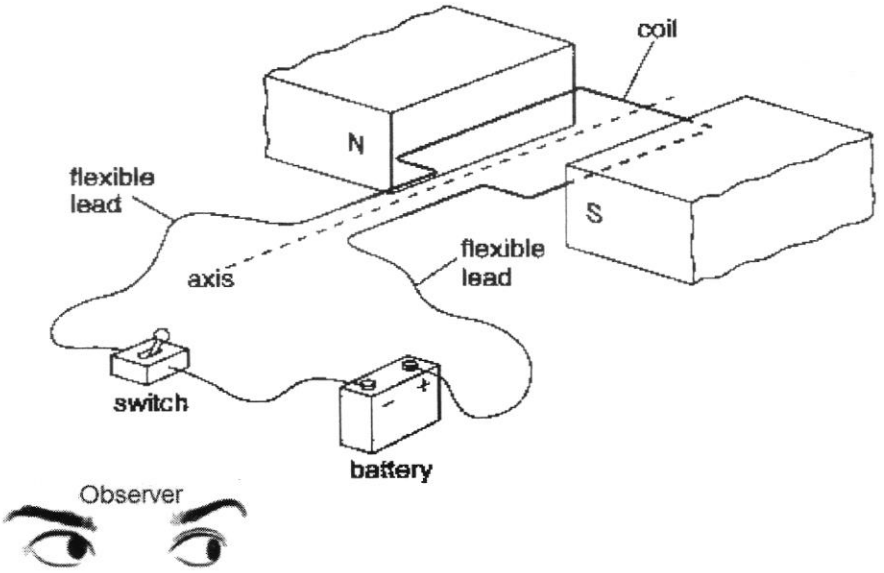
A It will deflect into the paper.

B It will deflect out of the paper.

C It will deflect to the left.

D It will deflect to the right.

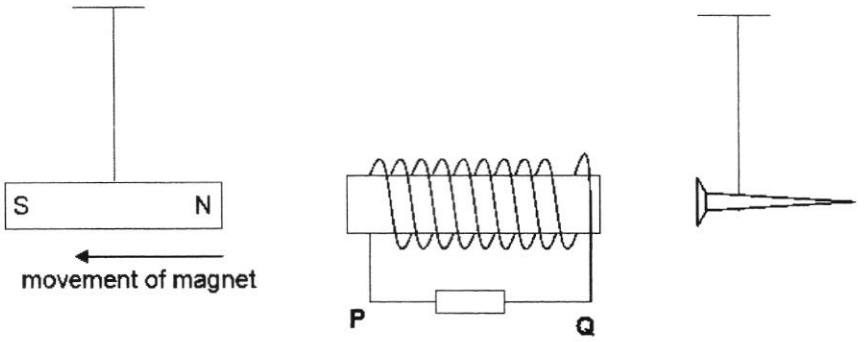
39 The figure shows a coil in a closed circuit and connected to a battery. The coil is placed between the poles of a magnet.



From the observer's point of view, which statement best describes the motion of the coil?

A The coil rotates anticlockwise 90° and comes to a stop.
B The coil rotates anticlockwise 180° and comes to a stop.
C The coil rotates clockwise 90° and comes to a stop.
D The coil rotates clockwise 180° and comes to a stop.

40 A solenoid is placed in between a magnet and an iron nail that are freely suspended from the ceiling, as shown in the diagram. The magnet is then moved away from the solenoid.



What is the direction of the current flowing through the resistor and the direction that the iron nail moves when the magnet is moved away from the solenoid?

	direction of current flowing through the resistor	direction of movement of iron nail
A	from **Q** to **P**	towards solenoid
B	from **Q** to **P**	away from solenoid
C	from **P** to **Q**	towards solenoid
D	from **P** to **Q**	away from solenoid

BEATTY SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2023
SECONDARY FOUR EXPRESS

CANDIDATE NAME			
CLASS		REGISTER NUMBER	

PHYSICS

6091/02

Paper 2 Theory
Setter: Mdm Lim Yi Wen

23 August 2023
1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
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 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.

For Examiner's Use	
A	/50
B.....	/10
B.....	/10
B.....	/10
Total	/80

This document consists of **21** printed pages and **1** blank page.

[Turn over

Section A

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

1 Fig. 1.1 shows a lift in the Takashimaya shopping mall.

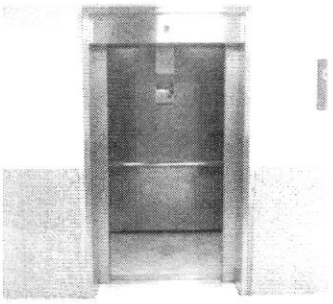


Fig. 1.1

It moves up from the ground to the 7th level and then descends down to the 5th level. The velocity-time graph of the motion is shown in Fig. 1.2.

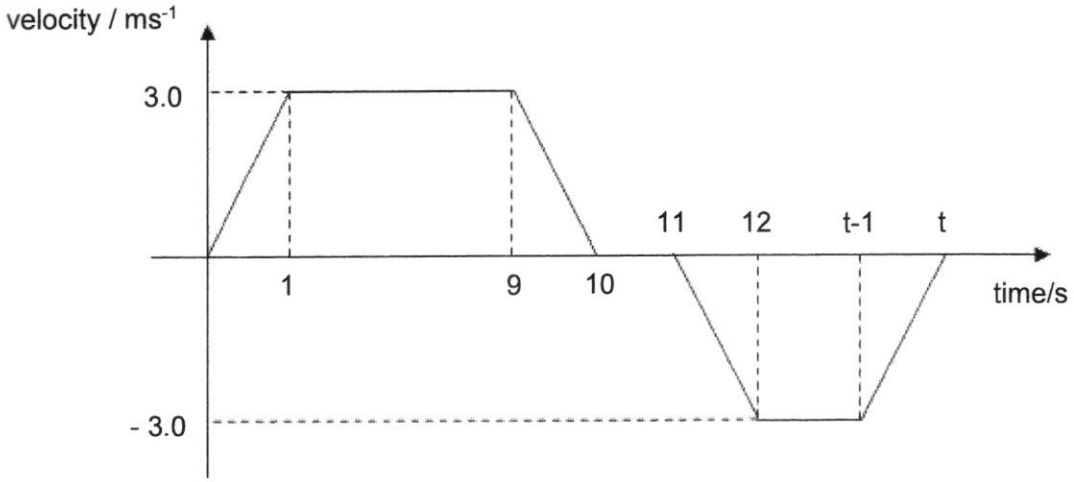


Fig. 1.2

(a) Calculate the height of the 7th level from the ground.

height of the 7th level from the ground = ... [2]

(b) Assume the height of each level is the same, calculate the time taken for the entire journey.

time taken = ... [3]

(c) Sketch the corresponding acceleration-time graph for the entire motion of the lift in Fig. 1.3.

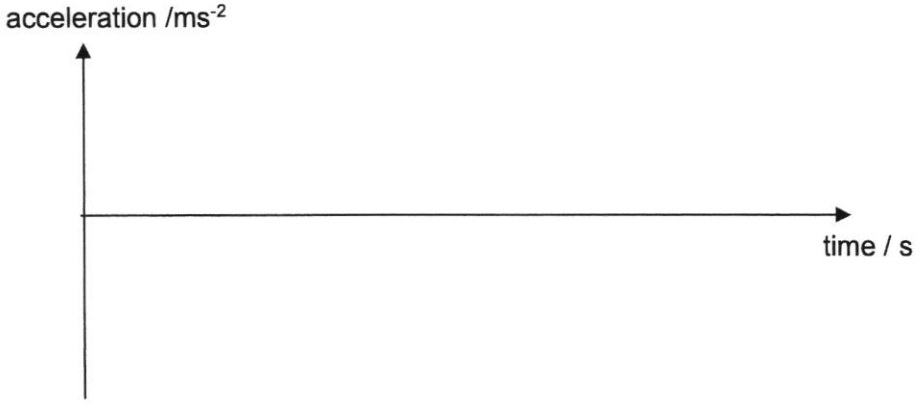


Fig. 1.3 [3]

(d) The lift moves upwards with a constant speed of 1.5 m/s when an upward force of 3000 N provided by its attached cables is acting on it. Calculate

(i) the mass of the lift,

mass of lift = ... [2]

(ii) the upward force acting on it when the lift is decelerating between the 9th and the 10th second.

upward force = ... [2]

2 Strong winds amid a thunderstorm saw trees toppling in various parts of Singapore. Fig. 2.1 shows six to several trees fallen along a road.

Fig. 2.1

In order to protect the trees, a lightning protection system (LPS) which is similar to the lightning conductor installed on top of the buildings is installed to prevent damage of the trees. Fig. 2.2 shows a photo of a LPS.

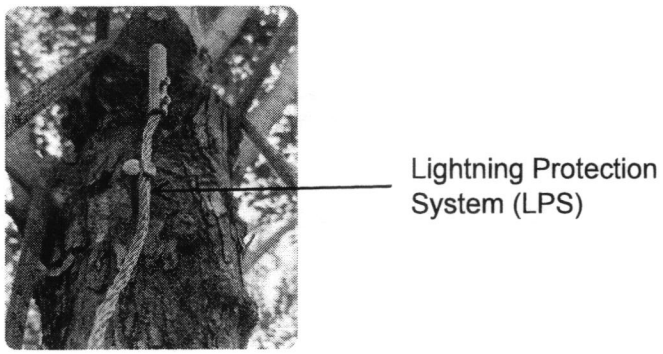


Fig. 2.2

(a) Describe and explain how the LPS can protect the trees during a thunderstorm.

.....

.....

.....

.....

.....

..... [3]

(b) Fig. 2.3 shows a fallen tree of mass 120 kg, length 10.0 m resting on a rough floor and leaning against a frictionless wall. The forces F_M and F_N indicated in the diagram are the reaction force acting on the tree due to the frictionless wall and the floor respectively. Assume the center of gravity of the tree is located at its mid-point.

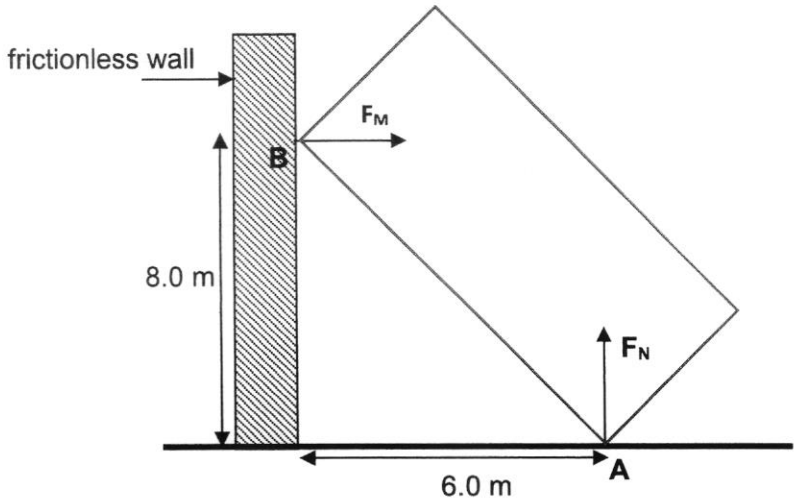


Fig. 2.3

(i) On Fig. 2.3, add in two other forces acting on the fallen tree, indicating their direction and position (state the horizontal distance from point A in Fig. 2.3). [2]

(ii) Using the principle of moments, calculate the force, F_M.

F_M = ... [3]

(iii) If the fallen tree is leaning on a rough wall instead, state and explain if the force F_M will be increase, decrease or remains the same.

.....

.....

.....

.....

.....

..... [3]

3 Fig. 3.1 shows a track for a model car.

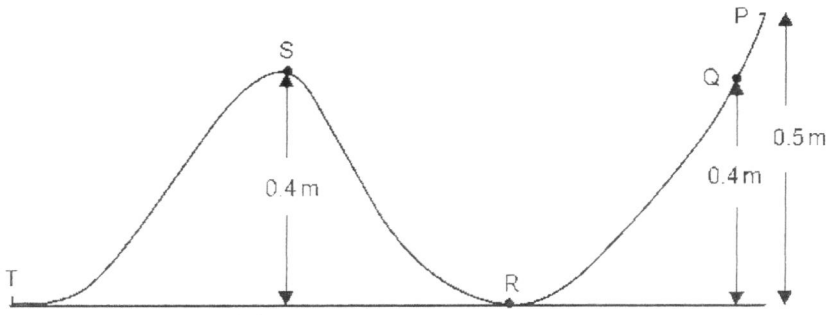


Fig. 3.1

The car moved down a sloping track due to its weight.
The car is released at Q. It comes to rest just before it reaches S and rolls back.

(a) Explain in terms of energy conversion why the car, if released at Q, cannot move past S.

.....

.....

..... [2]

(b) A second car, of mass 0.12 kg, is released from P. It continues until it runs off the track at T.
Calculate the maximum speed that the car could have at T assuming friction in the car is negligible.

maximum speed = ... [2]

4 The electrons in the beam of a cathode-ray tube are accelerated from rest by a potential difference of 5000 V. Each electron carries a charge of 1.6×10^{-19} C. If the current carried by the electron beam is 3.0×10^{-3} A, calculate

(a) the number of electrons reaching the screen per second,

no. of electrons = ... [1]

(b) the energy carried per second by the electron beam.

energy carried per second by the electron beam = ... [2]

5 Fig. 5.1 shows two conducting spheres. Sphere B is connected to earth through a sensitive ammeter. Sphere A has a very large positive charge on it. When sphere B is brought near to sphere A, the ammeter needle moves rapidly up the scale and then back to zero.

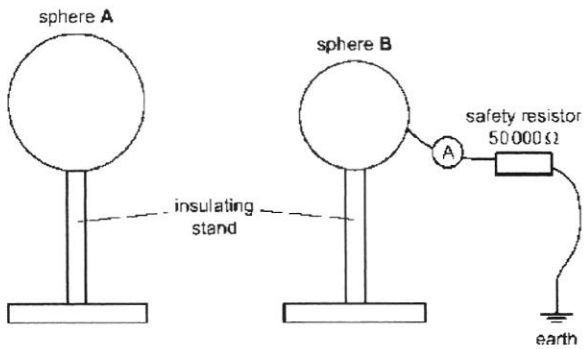


Fig. 5.1

(a) Explain why the ammeter needle moves.

.....

.....

.....

..... [2]

(b) The current through the ammeter is 0.0010 mA.
Calculate the potential difference across the safety resistor.

potential difference = ... [2]

6 Relays allow a low current circuit to control one or more higher current circuits. Relays allows thinner cables to be used to connect the control switch to the relay thereby saving weight, space and cost. Relays allow power to be routed to a device over the shortest distance, thereby reducing voltage loss.

Fig. 6.1 shows a reed relay being used to switch on an electric motor when a variable resistor is adjusted.

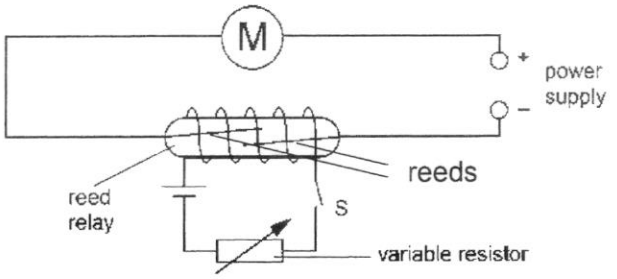


Fig. 6.1

Fig. 6.2 shows how the current in the coil changes with time.

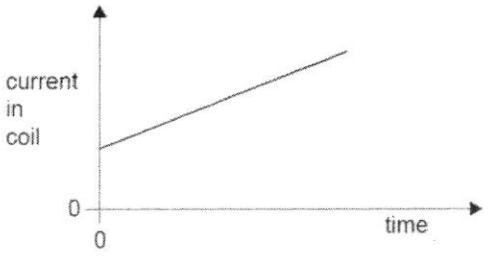


Fig. 6.2

(a) Suggest and explain a suitable material to be used for the reed relay.

.....

.....

.....

..... [2]

(b) The variable resistor is set at its greatest resistance and then switch S is closed. The reeds in the reed relay do not close when this is done. The resistance of the variable resistor is slowly decreased. The reeds in the reed relay close and comes into contact.
Explain how the reeds in the reed relay come into contact when the resistance of the variable resistor decreased.

.....

.....

.....

.....

..... [3]

(c) On Fig. 6.3, draw a line that might show how the current in the motor changes with time as the variable resistor is adjusted.

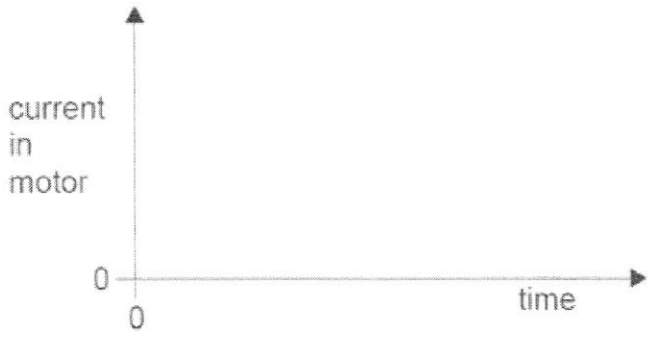


Fig. 6.3

[1]

7 A student built a temperature probe with the circuit as shown in Fig. 7.1.

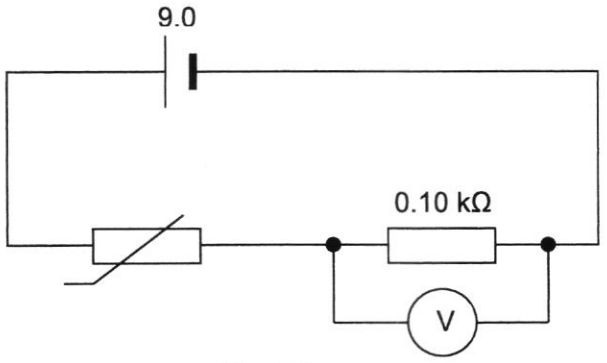


Fig. 7.1

The battery has e.m.f. 9.0 V and negligible internal resistance and the voltmeter has infinite resistance. The calibration curve for the thermistor is shown in Fig. 7.2.

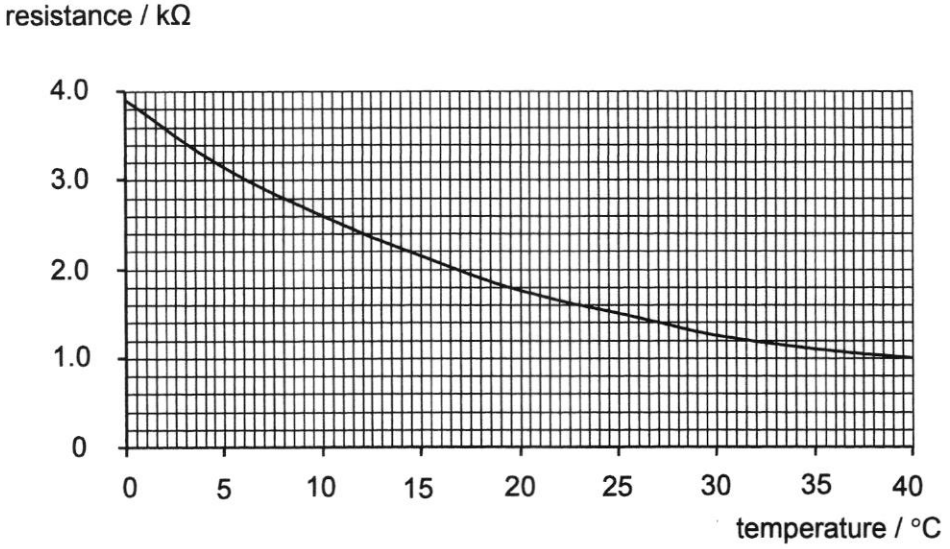


Fig. 7.2

Another student decided to modify the temperature probe in Fig. 7.1 and set up the circuit shown in Fig.7.3. She replaced the battery with an a.c. supply of 50 Hz which has a peak voltage 9.0 V. The circuit also includes a diode and the voltage output V_0 across the terminals M, N are connected to the Y-plates of a cathode ray oscilloscope (CRO).
As the same thermistor is used, the calibration curve in Fig. 7.2 is still valid.

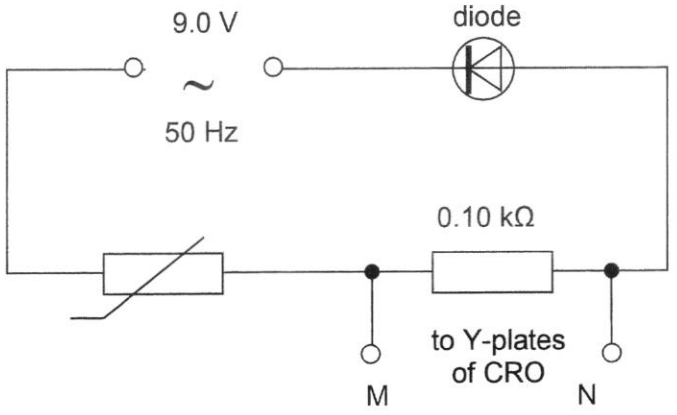


Fig. 7.3

Before using the probe to measure temperature, the student investigated theoretically the results. A spreadsheet is used to make the calculations as shown in Fig. 7.4.
She inputs: the temperature (T),
the corresponding resistance (R_T) of the thermistor,
the resistance I of the fixed resistor and
the peak voltage (V_P) of the supply.

A	B	C	D	E	F
temperature of thermistor	resistance of thermistor	resistance of fixed resistor	peak voltage of supply	current through thermistor	voltage output to CRO
T/ °C	R_T / k Ω	R / k Ω	V_P / V	I / mA	V_0 / V
0	3.90	0.10	9.0	2.3	0.23
5	3.15	0.10	9.0	2.8	0.28
10	2.60	0.10	9.0	3.3	0.33
15	2.15	0.10	9.0	4.0	0.40
20	1.75	0.10	9.0	4.9	0.49
25	1.50	0.10	9.0	5.6	0.56
30	1.25	0.10	9.0	6.7	0.67
35	1.10	0.10	9.0	7.5	0.75

Fig. 7.4

(a) State how the values in column B are obtained?

.....

..... [1]

(b) With reference to Fig. 7.4, explain with a sample data how the calculations are performed to find

(i) the current values in column E,

[2]

(ii) the voltage output values in column F.

[2]

(c) The student dipped the probe into water at 15 °C and the output voltage is connected to the CRO.

The setting of the CRO are as follows:

Time base: 5.0 ms cm^{-1}
Y – sensitivity: 0.20 V cm^{-1}

Draw the trace (for 2 cycles) seen on the CRO screen in Fig. 7.5.

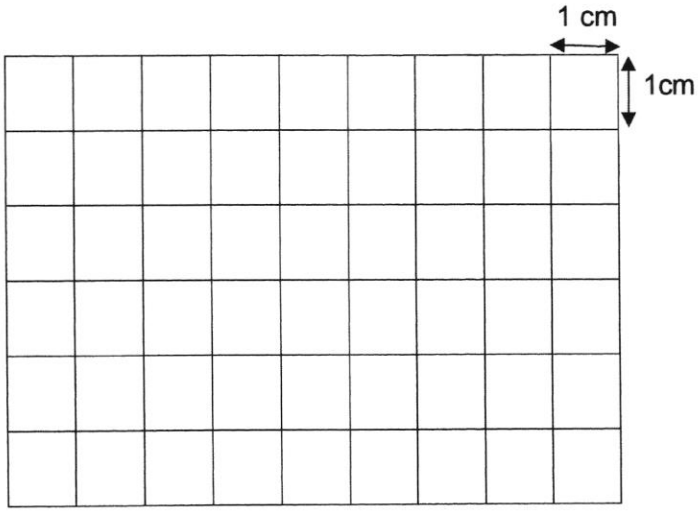


Fig. 7.5

[2]

8 The transformer in Fig. 8.1 is connected to a 240 V mains supply, and is being used to light a 6.0 V lamp connected between A and B.

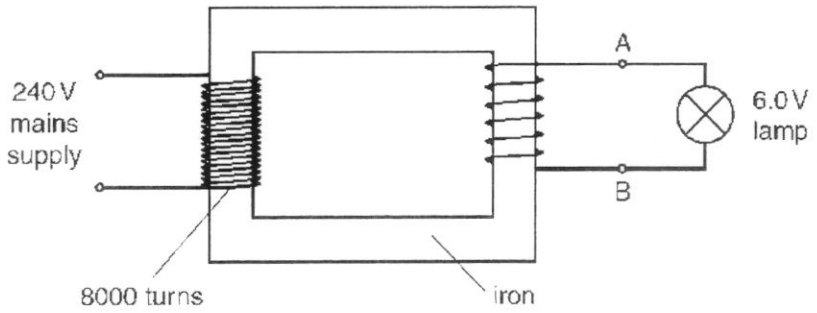


Fig. 8.1

The primary coil has 8000 turns.

(a) Calculate the number of turns needed on the secondary coil in order to provide 6.0 V between A and B.

number of turns = ... [2]

(b) Suggest one difference that is seen in the appearance of the lamp when the mains supply voltage is reduced to 120 V.

.....

..... [1]

Section B

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 11**.

9 A thin converging lens is used in an overhead projector to produce real and inverted images of different sizes on the screen. Fig. 9.1 shows the information gathered based on different object distances, u.

data set	object distance (u) / cm	image distance (v) / cm	object height (H) / cm	image height (I) / cm	magnification (M)
1	30.0	30.0	5.0	5.0	1.0
2	24.0	40.0	5.0	8.3	1.7
3	45.0	22.5	5.0	2.5	0.50
4	60.0	20.0	5.0	1.7	0.34

Fig. 9.1

(a) Using values from data set (1), draw a scaled diagram to determine the focal length of the converging lens being used.

scale = ...

focal length = ... [3]

(b) With the aid of another converging lens, a ***real*** and ***upright*** image can be produced on the screen. Draw the answer on Fig. 9.2 and complete the path of the two light rays.

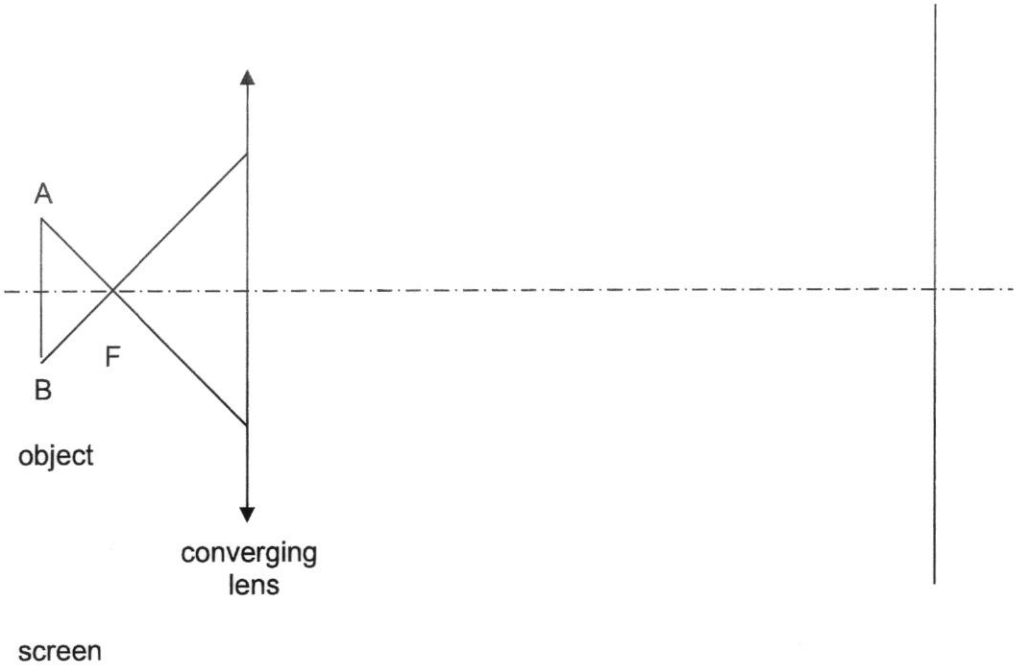


Fig. 9.2

[2]

(c) A pupil wants to investigate the variation of the magnitude of the force on a wire with the current flowing through it under the action of a magnetic field. He sets up the apparatus as shown in Fig. 9.3. One end of the wire is pivoted at the joint while its other end is placed in contact with a small tank of mercury.

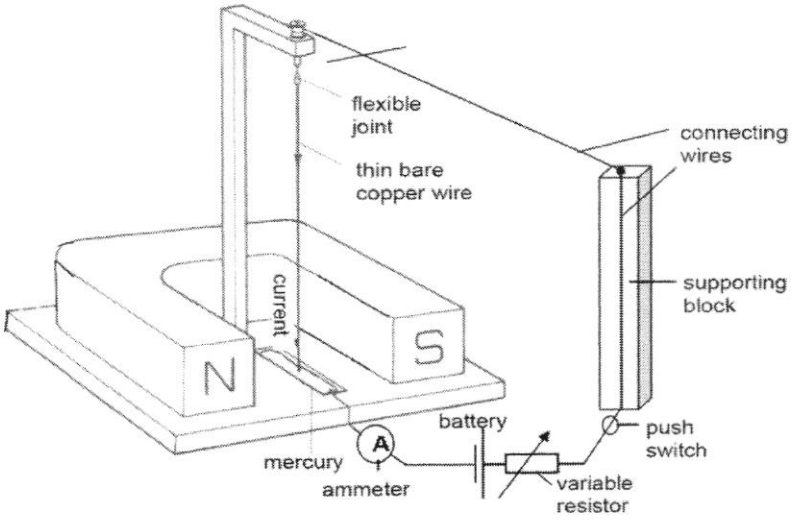


Fig. 9.3

When the push switch is closed, the thin bare copper wire appears to move. The maximum angle of deflection θ of the deflection is measured using the protractor.

(i) State the purpose of using mercury in the set-up.

.....

..... [1]

(ii) State and explain the direction in which the thin wire will move.

.....

.....

.....

..... [2]

The pupil varies the current by adjusting the resistance of the variable resistor. Fig. 9.3 shows the variation of the maximum angular displacement of the wire, θ, from the vertical with the current in the thin wire, I.

When the current I is 0.70 A, the angle of angular displacement of the wire is 15°.

(iii) Given that the wire is 20 g and the length of wire 15 cm, use a vector diagram to determine the magnitude of the horizontal force that cause the wire to move when the current is 0.70 A.

magnitude of horizontal force = ... [2]

10 A Maglev or magnetically levitated train, shown in Fig. 10.1 below, uses magnetism to hover above the ground thus allowing it to travel faster than a regular train.

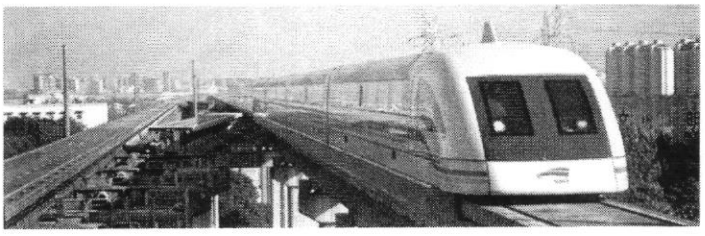


Fig. 10.1

A Maglev train uses superconducting electromagnets which are cooled to extremely cold temperatures so they can conduct electricity with zero resistance. The magnets are placed at the bottom of the train. As the train moves, current is induced in the wire coils placed in the guideway or train tracks. The magnetic force between the magnets and the induced currents lifts the train. A medium-sized Maglev has a mass of 30000 kg. With an power consumption of 1.7 kW per tonne, the train is able to travel at 450 km/h. (1 tonne = 1000 kg)

(a) Using the principles of electromagnetic induction, explain how the magnetic force between the magnets and the induced currents lifts the train.

.....

.....

.....

..... [2]

(b) Convert 450 km/h into m/s.

speed = ... [1]

(c) Suggest why the Maglev can travel at such high speed.

.....

..... [1]

(d) The distance from Pudong Airport in Shanghai to Shanghai city is 30 km. Calculate the energy consumption, in joules, of a medium-sized Maglev travelling from the airport to the city in a single-trip if it travels at 450 km/h throughout the journey?

energy consumption = ... [3]

(e) A similar levitation system is shown in Fig. 10.2 where there are two horizontal wires A and B of the same length. Wire A is rigidly fixed a distance 5 mm vertically above wire B. Wire B lies on a surface with light flexible connecting wires attached to it.

Fig. 10.2

A fixed current flow in wire A. The current in wire B is gradually increased until B just starts to lift off the surface.

(i) For wire B to lift, state if the currents in A and B should be in the same or opposite direction.

.....

..... [1]

(ii) Explain why wire B lift off the surface as current in the wire is gradually increased.

.....

.....

.....

..... [2]

11 EITHER

Fig. 11.1 shows a sealed steel cylinder filled with high pressure steam.

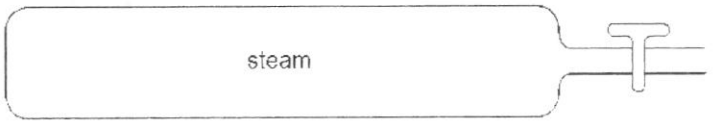


Fig. 11.1

Fig. 11.2 shows the same cylinder just after all the steam has condensed.

Fig. 11.2

(a) (i) Explain how the molecules in the steam exert a high pressure on the inside walls of the cylinder compared to water at the same temperature.

.....

.....

.....

..... [2]

(ii) Describe, in terms of particles, the process by which heat is transferred from the steam through cylinder wall to the surrounding.

.....

.....

.....

.....

..... [2]

(iii) Explain why the temperature of the water remains at constant temperature during condensation.

.....

.....

.....

..... [2]

(iv) When all the steam has condensed, 100 g of water is in the cylinder.
Under these conditions, the specific latent heat of vaporisation of steam is 3200 J/g.
Calculate the energy lost by the steam as it condenses.

energy = ... [2]

(b) Fig. 11.3 shows two examples of footwear being worn by people of equal weight at the Winter Olympics competition.

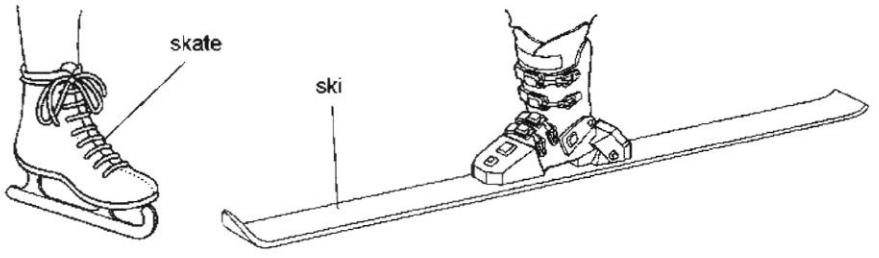


Fig. 11.3

Explain how a pair of skis rather than skates enable the athlete to ski down a slope covered with snow.

.....

.....

.....

..... [2]

11 OR

A microphone is connected to a cathode ray oscilloscope (CRO). Fig. 11.4 below shows the pattern on the CRO. when the string on the guitar is struck.

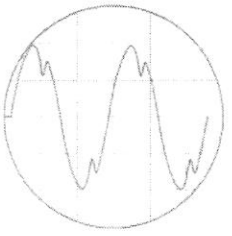


Fig. 11.4

(a) Describe how the sound from the guitar reach the other end of the laboratory as a longitudinal wave.

.....

.....

.....

.....

.....

..... [3]

(b) State how the speed and frequency changes if a note of higher pitch is played.

.....

.....

.....

..... [2]

(c) State and explain how the speed and wavelength of the sound changes as the sound passes from the air through a wooden door.

.....

.....

.....

.....

.....

..... [3]

(d) Bats navigate by emitting high pitched sounds above the threshold of human hearing. A bat emits a pulse of sound and hears the echo from a wall 0.070 s later.

Sound travels at 330 m/s in air.

Calculate the distance from the bat to the wall.

distance from the wall = ... [2]

BEATTY SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2023
SECONDARY FOUR EXPRESS

CANDIDATE NAME	ANSWER		
CLASS		REGISTER NUMBER	

PHYSICS

6091/02

Paper 2 Theory
Setter: Mdm Lim Yi Wen

23 August 2022
1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
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 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.

For Examiner's Use	
A	/50
B.....	/12
B.....	/8
B.....	/10
Total	/80

Paper 1

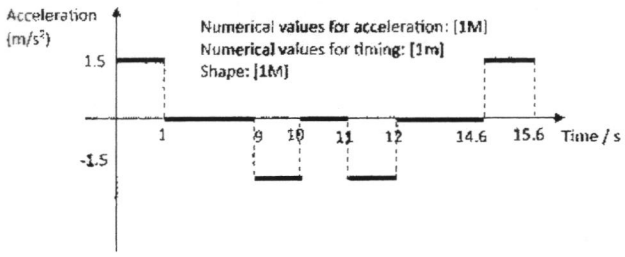
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
B	C	C	C	D	B	B	C	D	D

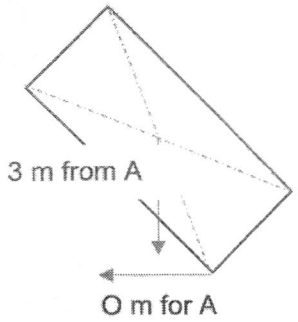
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
D	C	B	B	C	D	B	B	D	C

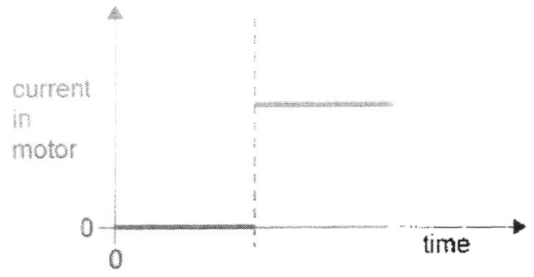
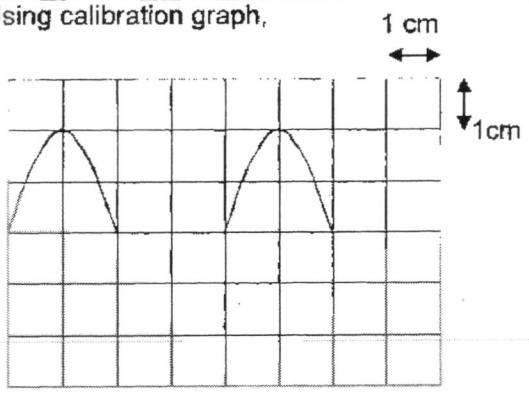
Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
D	C	A	D	D	A	D	A	D	B

Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40
B	A	B	B	B	B	A	D	D	A

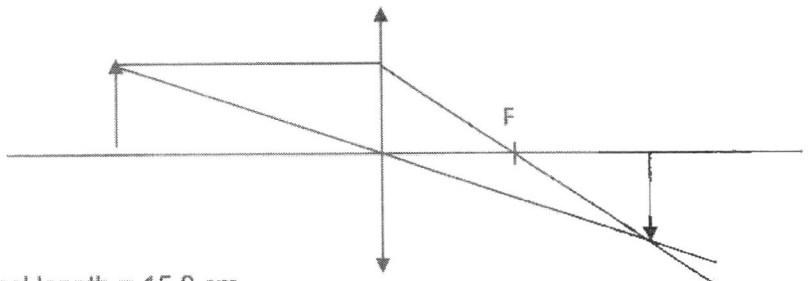
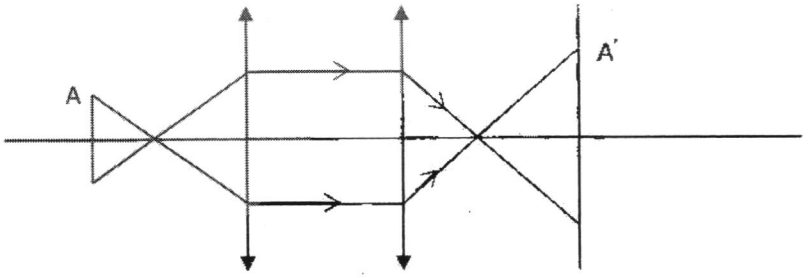
Paper 2
Section A (50 marks)

1a	Distance = area under graph = area of trapezium = ½ X3X(10+8) = 27 m	1 1	
1b	Distance moved = 27/5 X 2 = 10.8 m Area under graph = ½ X 3 X [(t-11)+(t-1-12)] 10.8 = ½ X 3 X [t-11+t-13] 10.8 = ½ X 3 X (2t-24) 10.8 = 3X(t-12) 3.6 = t-12 t = 15.6 s total time = 11 + 15.6 s = 26.6 s	1 1 1	
1c		1 1 1	
1di	Upward force = weight = 3000N W = mg 3000 = m x 10 m = 300kg	1 1	
1dii	F_{upward} - 3000 = ma F_{upward} - 3000 = 300 x (-1.5) F_{upward} = 2550N	1 1	
2a	A thundercloud becomes electrically charged due to friction between water molecules in the thundercloud and air particles in the atmosphere. The negatively charged underside of the cloud repels the electrons near the surface of the Earth. The surface of the Earth becomes positively charged. When the accumulation of charges is large enough on LPS, it can ionize the air particles nearby.	1 1 1	

	The ionized air particles provide a conducting path for the electrons in the cloud to reach the Earth. Electrons that follow this discharge path to the Earth form lightning. / providing path of least resistance to earth.		
2bi	 1 m for each force with correct distance from A	1 1	
2bii	Taking moment about A, using the principle of moment, hence or otherwise, calculate the force F_M. Using principle of moment, (taking moment about point A) ACM = CWM F_M x 8.0 = 1200 x 3.0 F_M = 450 N	 1 1	
2biii	FM will be smaller. The friction force acting on the fallen tree would create a clockwise moment. Hence, the clockwise moment requires by the force, F_M will be smaller since the friction force already provide the additional clockwise moment in maintaining the equilibrium.	1 1 1	
3a	Loss of gravitational potential energy in Q is converted to kinetic energy which will in turn be converted to gravitational potential energy at S. Thus, since energy cannot be created, energy at S must be lesser than GPE at Q. / work done against friction causes energy loss to surroundings.	1 1	
3b	$mgh = ½ mv^2$ $10 X0.5=½ Xv^2$ $v^2=10$ v=3.17 m/s	 1 1	
4a	No. of electrons = $3.0 X 10^{-3} / 1.6 X 10^{-19}$ $=1.875 X 10^{-16}$	1	
4b	$E=\varepsilon Q$ $= 5000X3.0X10^{-3}$ =15 J	 1 1	
5a	electrons moves from earth to A. Since current is the movement of charge, it will cause a deflection in ammeter.	1 1	
5b	V = IR $= 0.001X10^{-3} X 50000$ =0.05 V	 1 1	
6a	Iron As it is a soft magnetic material which will magnetise and demagnetise quickly	1 1	

6b	When the resistance decreased, the current increased, the reeds will get magnetised more strongly. For both reeds, the north pole will be at the right end and the left end will be south pole. As the right end of the top reed will be north, the left end of the second reed will be south pole. As opposite poles attract, the reeds will attract and thus completing the circuit.	1 1 1	
6c		1	
7a	Use the calibration graph	1	
7b	Use $I = \frac{V_P}{R_T + R}$ e.g. $E_3 = D_3 / (B_2 + C_2)$ The calculation is repeated down the column.	1 1	
	Use $V_0 = \frac{R}{R_T + R} \times V_P$ or $V_0 = IR$ e.g. $F_3 = (C_3 / (B_2 + C_2)) * D_3$ or $F_3 = E_3 * C_3$ The calculation is repeated down the column.	1 1	
7c	Using calibration graph,  shape positive part the curve is shown, negative part is not shown vertical height = 2 cm (because voltage = 0.40 V) horizontal length = 4 cm (because time = 1 / 50 Hz = 0.02 s = 20 ms)	 1 1	
8a	Vs/Vp=Ns/Np 6/240 = Ns/8000 Ns=200 turns	 1 1	
8b	Light bulb will be dim.	1	

Section B

9a	Min acceptable scale: 1 cm represent 5 cm  Focal length = 15.0 cm		
9b	 1 mark for showing parallel rays after the 1st converging lens 1 mark for showing the rays converge after the 2nd lens	1 1	
9ci	Mercury is a good conductor of electricity.	1	
9cii	Wire will move outwards. Circular magnetic field from wire and the magnetic field from the magnet interacts and a force is induced causing the wire to move outwards.	1 1	
9ciii	W = mg = 0.020 X 10 = 0.200 N When I = 0.70 A, θ = 15°  Horizontal force = 0.056 N 1 mark for general shape 1 marks for precise answer in horizontal force	1 1	
10a	Superconducting electromagnets produces magnetic field which changes as the train moves. This changing magnetic field linkages caused an induced current. By Lenz law, the direction of induced current always opposed the change the produces it, so the train and the track repel.	1 1	
10b	450 km/h = 450 X 1000 / 3600 = 125 m/s	1	

10c	Reduced friction with lesser moving parts as train is levitated/ streamline shape	1	
10d	Energy consumption for train per sec = 1.7 kW x 30 = 5.1 kW Time of travel = 30 / 450 = 0.067 h = 240 s Total energy consumption = 5100 x 240 = 1224000 J = 1.22 x 10^6 J	1 1 1	
10ei	same direction		
10eii	parallel current-carrying wire exert attractive force between them, so current increases, the force increases until it is more than the weight of the wire	1 1	
	11 EITHER		
11ai	Steam molecules move at higher speeds in random directions compared to water molecules. / lesser molecules in gaseous state. When they collide with the walls of the container, it exerts a greater force on the wall and the frequency of collision is also greater compared to liquid.	1 1	
11aii	The particles at a higher temperature will move more vigorously. When they vibrate, they will collide with the neighbouring particles and the particles will also start moving more vigorously. The electrons at the warmer end will also move at a higher speed. When the warmer electrons move across the container, the electrons will collide into the other atoms and these molecules will start moving faster also, passing any thermal energy by collision of particles.	1 1	
11aiii	Thermal energy is taken in for the particles to overcome their strong forces of attraction. This increases the internal potential energy and not the average kinetic energy. Thus, there is no change in temperature.	1 1	
11aiv	Latent heat of vapourisation = ml_v = 100 X 3200 = 320 000 J	1 1	
11b	Skis provides a larger contact surface area than skate. Thus, the weight is distributed over a larger area which reduces pressure on the snow and thus not sinking into the snow.	1 1	
	11 OR		
11a	When the strings vibrates, it sets up a series of rarefaction and compression in the air. Sound travels parallel to the direction of vibration of particles as a longitudinal wave. The sound energy is transferred to the other end of the room without the net movement of the medium.	1 1 1	
11b	Speed remains the same and Frequency increases	1 1	
11c	Speed increases as the particles in a door are more closely packed. Thus propagation of compression and rarefaction can be faster. Frequency remains unchanged as it depends on the source, wavelength will increase as v=fλ.	1 1 1	
11d	V = 2d/t 330 = 2d/0.070 2d = 23.1 d = 11.6 m	1 1	