Bukit View Secondary School

Secondary 4 Express

Preliminary Examination 2021

CANDIDATE NAME

CLASS

INDEX NUMBER

Physics

Paper 1 Multiple Choice

6091/01

16 Sept 2021

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, register number and class on the Answer Sheet in the spaces provided.
Do not open this booklet until you are told to do so.

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.

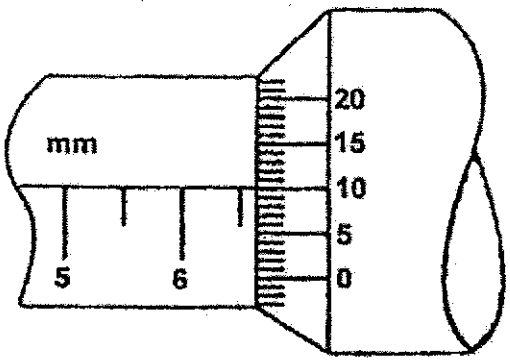
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

Setter: Mr Ng Wuay Boon

Parent's Signature:_____

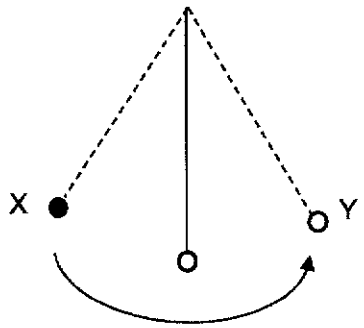
This question paper consists of **15** printed pages.

1 The reading of the micrometer screw gauge shown in the figure is _____.



A 6.10 mm
B 6.11 mm
C 6.51 mm
D 6.60 mm

2 The pendulum shown below takes 0.65 s to move from the point X to Y.



What is the period of the pendulum?

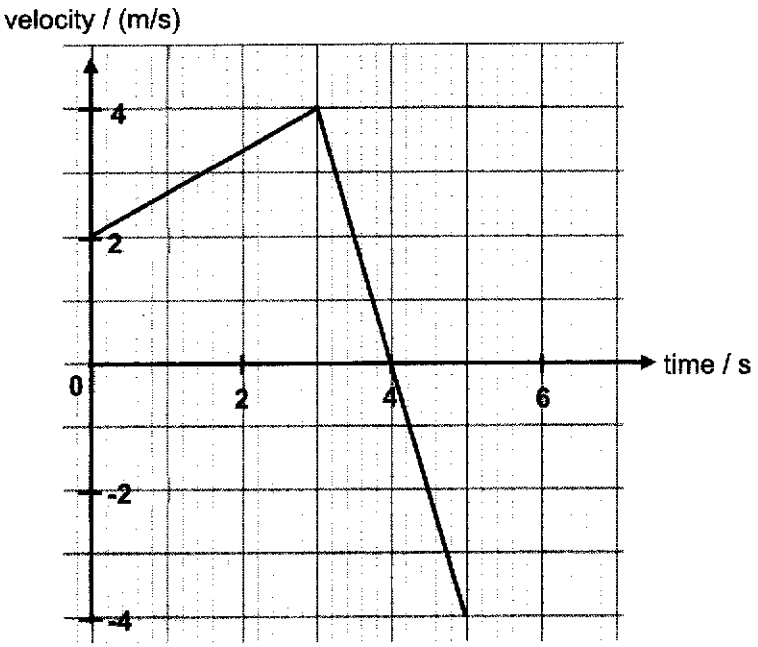
A 0.33 s
B 0.65 s
C 1.3 s
D 2.6 s

3 A piece of rock was taken from the surface of the Earth to the surface of the Moon.

Which of the following shows the correct changes for the mass, density and weight of the piece of rock?

	mass	density	weight
A	decreases	no change	decreases
B	increases	increases	decreases
C	no change	increases	no change
D	no change	no change	decreases

4 The graph below shows the motion of a body.

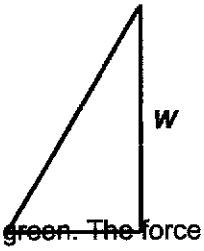


What is the displacement in the first 5.0 s?

A 4.0 m
B 6.0 m
C 9.0 m
D 13.0 m

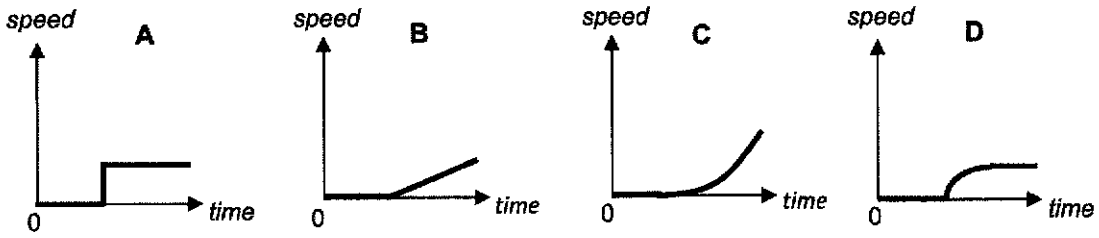
5 A heavy sack of weight *W* hangs from the end of a rope. The sack is pulled sideways by a horizontal force *F* and is held stationary. The tension in the rope is *T*.

Which force diagram gives the correct value and direction for the tension *T*?

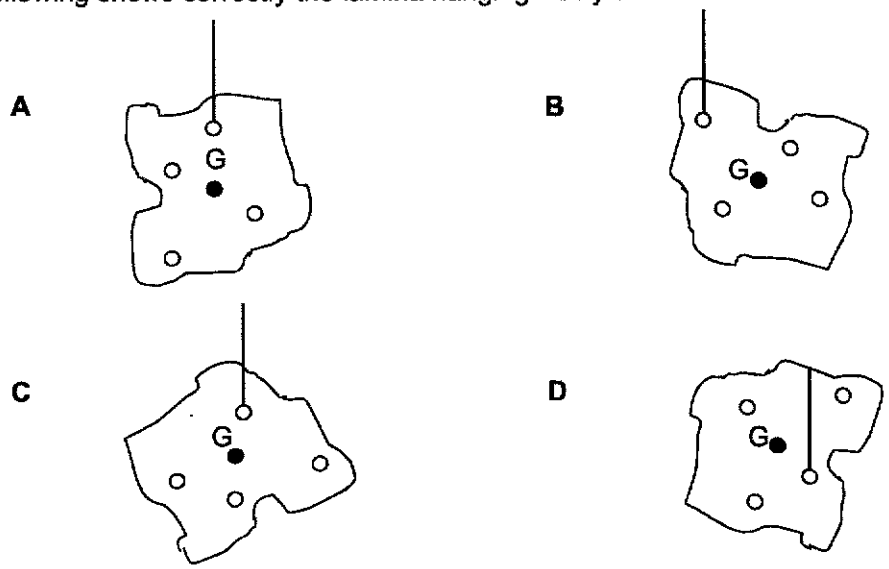


6 A car driver presses the accelerator sharply when the traffic lights turn green. The force applied on the car varies with time as shown in the graph below.

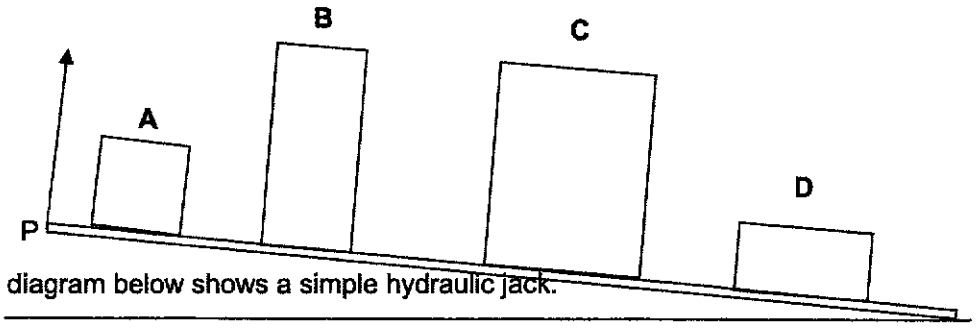
Which graph shows the variation with time of the car's speed?



7 Four holes are made on a uniform lamina. The centre of gravity of the lamina is at G. Which of the following shows correctly the lamina hanging freely about one of the holes?

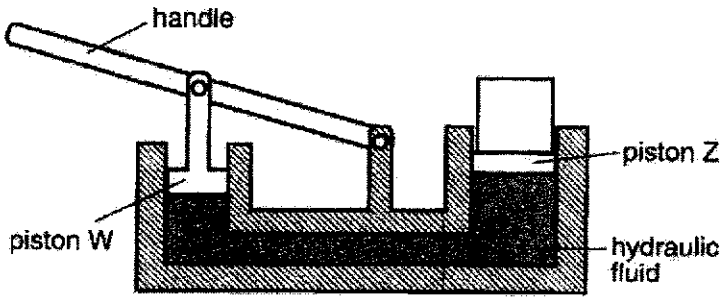


8 Four wooden blocks are placed on a plank. The end P of the plank is then slowly raised. If the blocks do not slip on the plank, which block would be the first to topple over?



9 The diagram below shows a simple hydraulic jack.

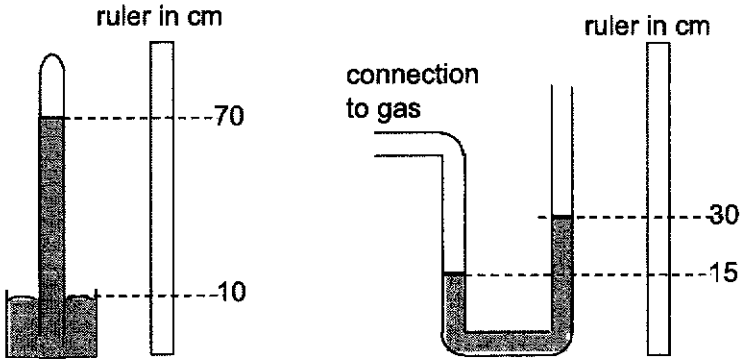
5



Which of the following modifications will enable heavier loads to be lifted?

	diameter of W	diameter of Z
A	doubled	remains the same
B	doubled	halved
C	halved	doubled
D	remains the same	halved

10 The diagrams below show a mercury barometer and a mercury manometer placed in the same room.



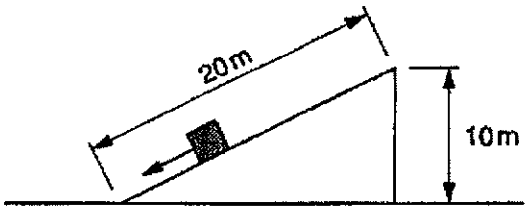
What is the pressure of the gas?

A 15 cm Hg
B 40 cm Hg
C 75 cm Hg
D 90 cm Hg

11 A car of total mass 850 kg slows down from 25 m/s to 12 m/s with a constant deceleration in 5 s. What is the work done against the braking force?

A 11 kJ
B 110 kJ
C 204 kJ
D 266 kJ

12 A block of mass 2 kg slides from rest through a distance of 20 m down a frictionless slope, as shown.



What is the kinetic energy of the block at the bottom of the slope?
[The acceleration of free fall is 10 m/s^2.]

A 20 J
B 40 J
C 200 J
D 400 J

13 A hydroelectric power station has a capacity of 400 MW. This means that the power station is able to produce _____.

A 400 J of energy in 1 s.
B 400 J of energy in 1 min.
C 400 J of energy in 1 ms.
D 400 J of energy in 1 μs.

14 The resistance of a piece of platinum wire in pure melting ice is 800 Ω. The resistance of the wire in steam is 910 Ω. What would the temperature be when the wire has a resistance of 1000 Ω?

A 55°C
B 110°C
C 182°C
D 222°C

15 Illuminated smoke particles, suspended in air, are seen to move about randomly and continually when viewed with a microscope. This is because the smoke particles are _____.

A able to move about by themselves.
B bombarded continually by air molecules.
C moved about by convection currents.
D supplied with energy by the light illuminating them.

16 In very cold weather, ice can form on the surface of puddles of water because the air temperature is below that of the water. If the ice layer is found to be thickening at its lower surface, then thermal energy must be mostly _____.

A conducted away from the ice through the air.
B conducted from the upper to the lower surface of the ice.
C convected away from the ice through the water.
D convected towards the ice through the air.

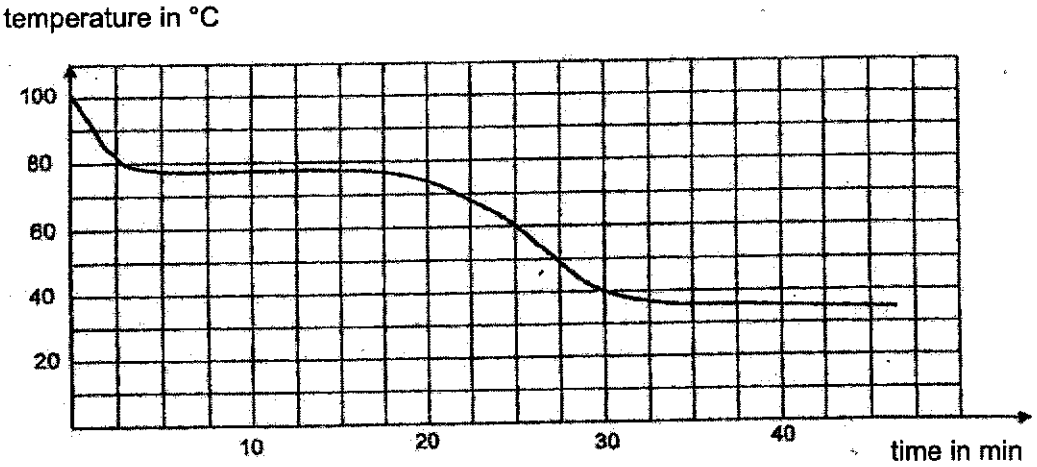
17 A piece of ordinary kitchen aluminum foil is used to wrap around food to be cooked in a barbecue fire. The foil has a shiny side and a dull side. Which side should be on the outside and why?

A The dull side should be on the outside because it absorbs heat radiation faster.
B The dull side should be on the outside because it is a better emitter of heat radiation.
C The shiny side should be on the outside because it is a better absorber of heat radiation.
D The shiny side should be on the outside because it is a better conductor of heat.

18 Which of these statements is **not** true?

A An increase in temperature of a body is accompanied by an increase in internal energy of the body.
B Heat flow is always from low temperature to high temperature.
C Objects at high temperatures have molecules inside moving around at higher speed than objects at lower temperatures.
D The temperature of an object is its hotness compared to others.

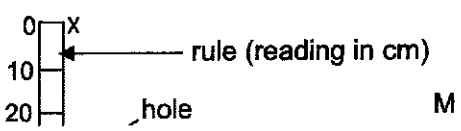
19 A liquid M was allowed to cool in a room at 29°C. The cooling graph of substance M is as shown below.



Which of the following statements is true about M?

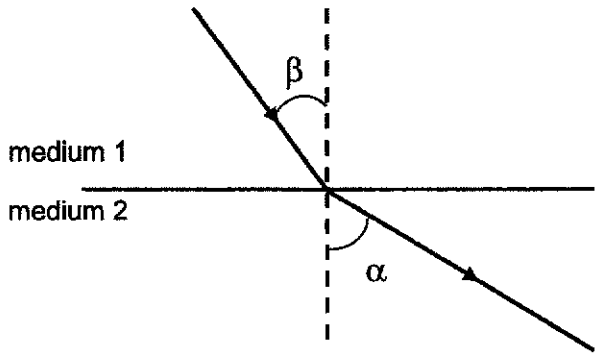
A Substance M was a mixture of 2 states between the time of 5 and 15 min.
B Substance M was not losing any energy to the surroundings between the time of 5 and 15 min.
C The specific heat capacity of M in the liquid state is equal to its specific heat capacity in the solid state.
D The specific latent heat of fusion of M increases when a greater mass of M is used.

20 The diagram shows a metre rule XY with a small hole drilled at the 30 cm 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, the extent to which he can see the metre rule is between the _____.



A 0 cm and 90 cm mark.
B 10 cm and 70 cm mark.
C 20 cm and 50 cm mark.
D 20 cm and 60 cm mark.

21 The figure shows a ray of light crossing the boundary from medium 1 to medium 2.



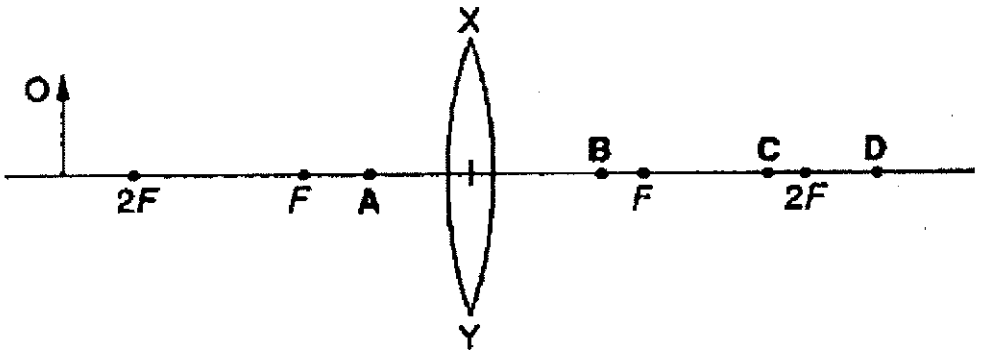
If the two media are glass and air, which of the following is correct?

	medium 1	medium 2	refractive index of glass
A	air	glass	$\sin \beta / \sin \alpha$
B	air	glass	$\sin \alpha / \sin \beta$
C	glass	air	$\sin \beta / \sin \alpha$
D	glass	air	$\sin \alpha / \sin \beta$

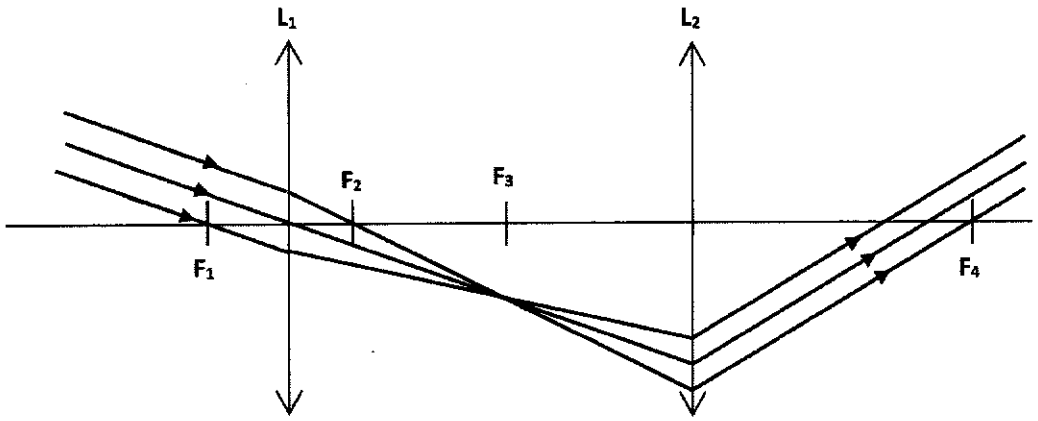
22 In the diagram, XY is a converging (convex) lens.

Points labelled *F* are one focal length from the lens and points labelled 2*F* are two focal lengths from the lens.

If an object is placed at O, at which point is the image of its base formed?



23 The figure below represents parallel rays from a distant object passing through lenses L_1 and L_2. The rays emerging from L_2 are parallel.



The principal foci of L_1 and L_2 are respectively _____.

A F_1 and F_2
B F_1 and F_3
C F_1 and F_4
D F_3 for both lenses

24 A wave generator which makes 5 oscillations in one second is used to produce waves in a ripple tank.

Which of the following values of frequency, wavelength and speed could the waves have?

	frequency / Hz	wavelength / cm	speed / (cm/s)
A	0.5	12	6
B	5	3	15
C	5	12	60
D	20	3	60

25 When water waves in a ripple tank move from a shallow region to a deeper region, which of the following will happen?

A The wavelength decreases; the velocity decreases.
B The wavelength decreases; the velocity increases.
C The wavelength increases; the velocity decreases.
D The wavelength increases; the velocity increases.

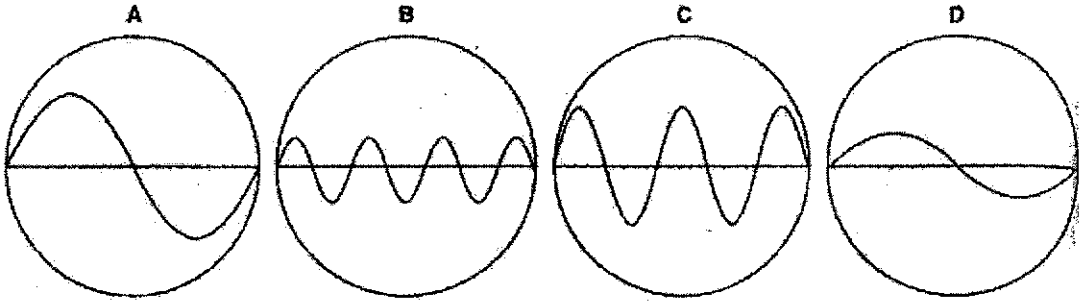
26 Which of the following properties applies to ultra-violet, infra-red and gamma radiations?

A They are affected by magnetic fields.
B They can be detected by photographic plates.
C They cause damage to living tissue.
D They have the same velocity in a vacuum.

27 Radio waves, visible light and X-rays are all part of the electromagnetic spectrum. What is the correct order of increasing wavelength?

	shortest ⟶ *longest*		
A	radio waves	visible light	X-rays
B	radio waves	X-rays	visible light
C	X-rays	radio waves	visible light
D	X-rays	visible light	radio waves

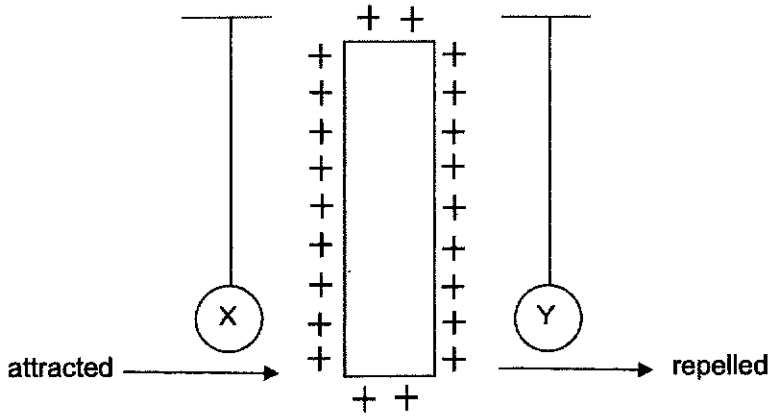
28 The diagrams represent sound waves displayed on an oscilloscope. Assuming the controls of the oscilloscope remain the same for each sound, which diagram represents the quietest sound with the highest pitch?



29 Sonar waves are emitted from a surface vessel to determine the depth of the sea. The time interval between its emitted signal and its reflection from the sea is 2.75 seconds. The speed of sound in water is 1200 m/s. What is the depth of the sea?

A 436 m
B 1650 m
C 3300 m
D 6600 m

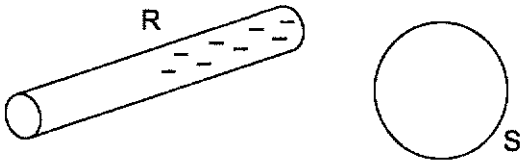
30 X and Y are two lightweight metal balls suspended using nylon thread. When a positively-charged rod was placed between these two balls, the ball X was attracted towards the charged rod but the ball Y was repelled away from the rod.



Which of these is the correct conclusion about the charge on each ball?

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

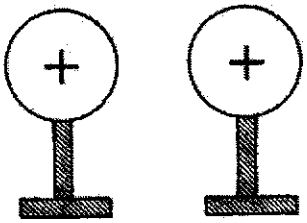
31 An insulated charged rod R is to be used to give a permanent charge to an isolated conducting sphere S by induction.



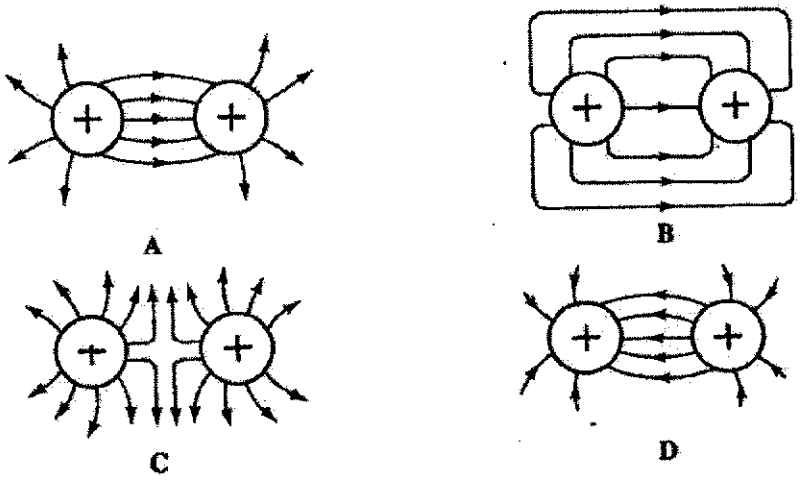
What is the required sequence of events?

A Move R closer to S; connect S to earth; remove earth connection from S; remove R.
B Move R closer to S; connect S to earth; remove R; remove earth connection from S.
C Move R to make contact with S; connect S to earth; remove R; remove earth connection from S.
D Move R to make contact with S; remove R.

32 Two identical metal spheres are both positively-charged and have equal amounts of charge.



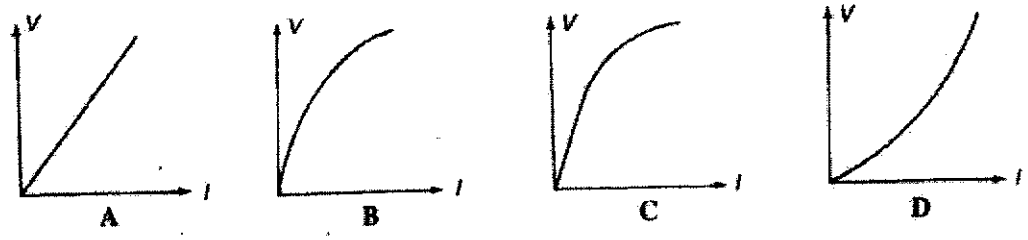
Which of the following best shows the lines of electric force around these metal spheres?



33 A dry cell of e.m.f. 3.0 V has a wire connected to its terminals. If 12 C of charge passes through the circuit, what amount of chemical energy is transformed into electrical energy?

A 0.25 J
B 3.6 J
C 4.0 J
D 36 J

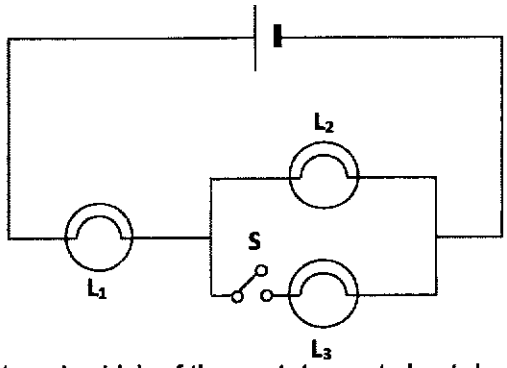
34 In general, the resistance of metals increases as the temperature increases and therefore they do **not** obey Ohm's law exactly. Which of these graphs best illustrates this?



35 A wire of length, *L* and diameter, *D* will have the same resistance as a wire made of the same material with dimensions:

	length	diameter
A	2*L*	*D*/4
B	2*L*	*D*/2
C	2*L*	2*D*
D	4*L*	2*D*

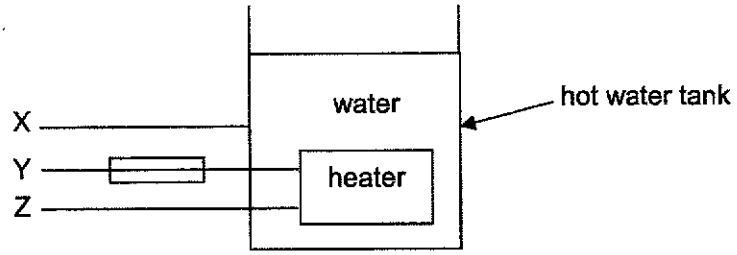
36 The diagram shows a circuit which contains three identical lamps.



When the switch S is closed, which of these statements best describes what happens to the brightness of lamp L_1 and lamp L_2?

A L_1 and L_2 both become brighter than before.
B L_1 and L_2 both become dimmer than before.
C L_1 is brighter but L_2 is dimmer than before.
D L_1 is dimmer but L_2 is brighter than before.

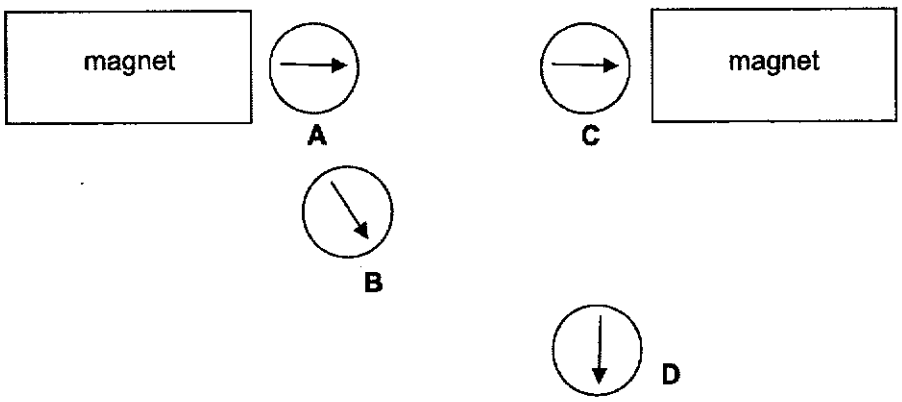
37 The diagram shows the electrical wiring connected to a hot water tank.



What should the voltages applied to the three wires be so that the water tank can work normally?

	X	Y	Z
A	0 V	240 V	0 V
B	0 V	240 V	240 V
C	240 V	240 V	0 V
D	240 V	240 V	240 V

38 Two magnets are brought close to each other and four compasses are placed near to the poles as shown.



Which compass does **not** seem to indicate the direction of the magnetic field?

39 Which of the following is an example of induced magnetism?

A A bar magnet loses its magnetism if repeatedly dropped.
B A freely swinging magnet comes to rest pointing North-South.
C A north pole of a magnet attracts a south pole of another magnet.
D An iron paper clip is attracted to a bar magnet.

40 Figure (i) shows a compass needle pointing to the magnetic north when there is no other magnet around. It is then placed at a point P near to a magnet surrounded by a soft iron ring as shown in Figure (ii). Which diagram shows the orientation of the compass needle when it is at P?

Figure (i)

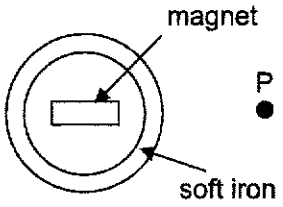
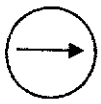
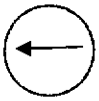


Figure (ii)

A



B



C

D

~ End of Paper ~

Bukit View Secondary School

Secondary 4 Express
Preliminary Examination 2021

CANDIDATE NAME

CLASS

INDEX NUMBER

Physics **6091/02**
Paper 2 Theory **15 Sep 2021**
1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your candidate name, class and number in the spaces at the top of this page.
Write in dark blue or black pen.
You may use a HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.

Do not open this booklet until you are told to do so.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 12 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	
Section A	/50
Section B	/30
Total	/80

Setter: Mr Ng Wuay Boon **Parent's Signature:**_____

This question paper consists of **25** printed pages.
Section A (50 marks)

Answer **all** questions in this section.

1 A skier slides down a slope, as shown in Fig. 1.1. The values of the time t when the skier passes points A, B, C and D are marked on Fig. 1.1.

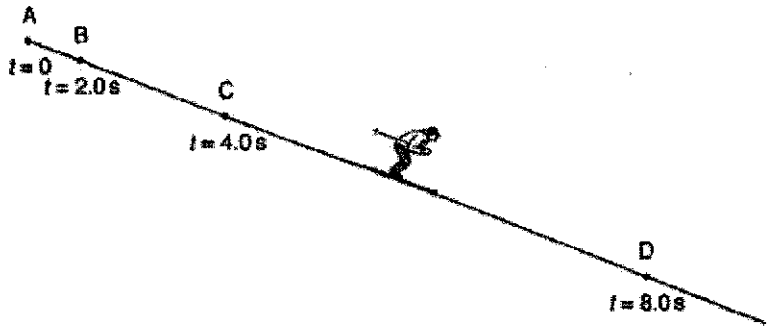


Fig. 1.1 (not to scale)

Fig. 1.2 shows the velocity-time graph of the motion with four points plotted.

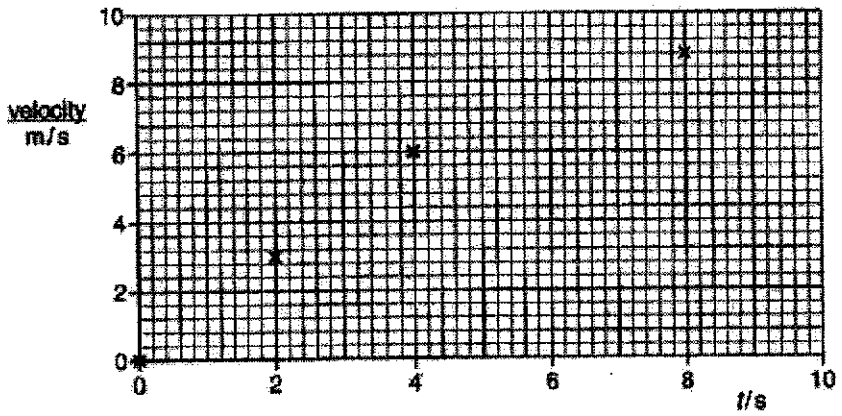


Fig. 1.2

Between A and C the acceleration is uniform. After D, the velocity of the skier is constant.

(a) On Fig. 1.2, draw a line to complete the velocity-time graph from $t = 0$ to $t = 10$ s. [1]

(b) Calculate the distance between

(i) points A and B,

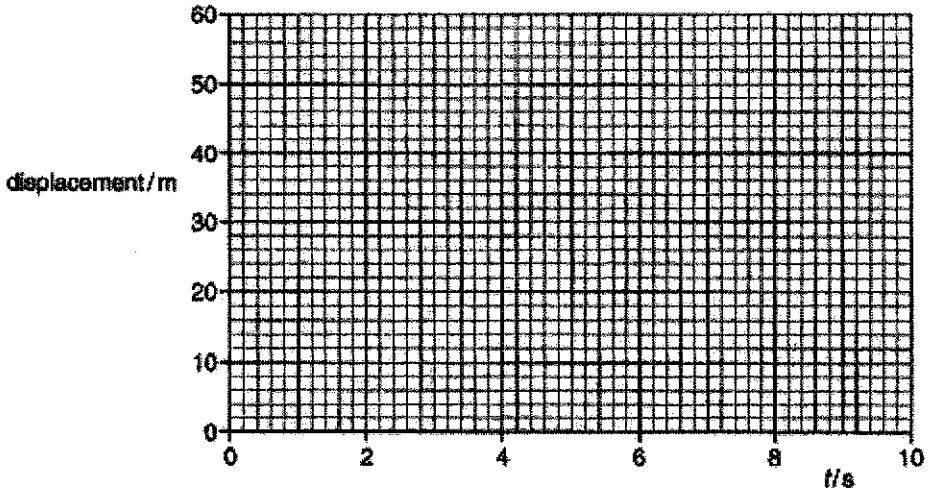
distance = ... [2]

(ii) points B and C.

distance = ... [1]

(c) The distance between A and D is 44 m. The displacement of the skier is zero at point A.

(i) On Fig. 1.3, draw a displacement-time graph for the motion.



[1]

Fig. 1.3

(ii) State how your displacement-time graph shows that the velocity is constant after D.

..... [1]

(d) Fig. 1.4 shows the skier at one point in the motion.

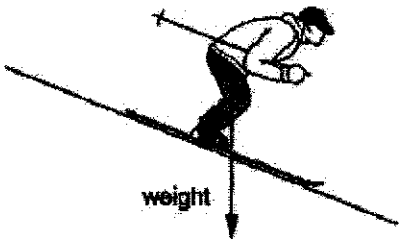


Fig. 1.4

One force, the weight of the skier, is shown on Fig. 1.4. On Fig. 1.4, draw and label two other forces that act on the skier. [2]

2 Fig. 2.1 shows a school bag being pulled along a table with a force *P*. When the bag is moving, there is a frictional force of 0.5 N acting as shown.

Fig. 2.1

Fig. 2.2 shows how the acceleration *a* of the bag varies with *P*.

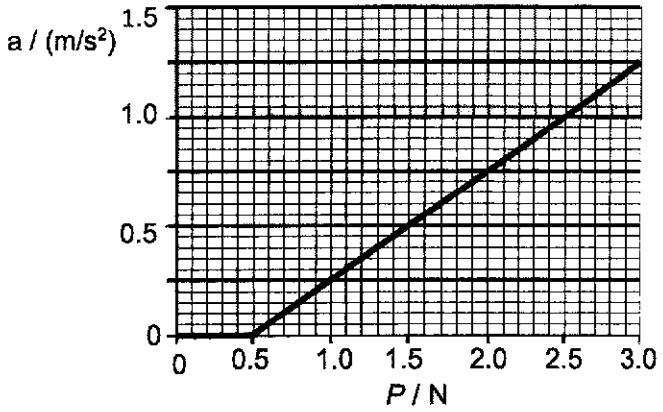


Fig. 2.2

(a) Explain why *P* must be greater than 0.5 N for the bag to accelerate.

.....

..... [1]

(b) **(i)** State the equation that relates the resultant force *F*, the mass *m* of the bag and the acceleration *a*.

..... [1]

(ii) Using both Fig. 2.1 and Fig. 2.2, calculate the value of *m*.

m = ...[2]

3 A window cleaner of mass 80 kg is standing on a uniform horizontal platform of weight 150 N. This platform is stationary and suspended by two ropes, P and Q, as shown in Fig. 3.1. The window cleaner is standing 1.0 m from rope P.

5

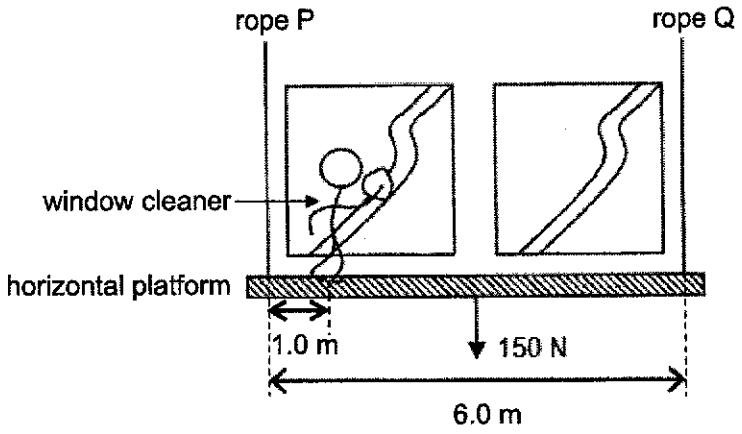


Fig. 3.1

(a) Calculate the weight of the window cleaner.

weight = ... [1]

(b) Calculate the tension acting in rope Q.

tension in Q = ... [2]

(c) Calculate the tension acting in rope P.

tension in P = ... [1]

4 The roof of a bungalow is constructed using ceramic tiles. One tile of mass 300 g starts to slide down the roof from rest as shown in Fig. 2.1. It experiences a constant frictional force of 0.40 N and slides for 3.5 m before reaching and falling off the edge of the roof.

6

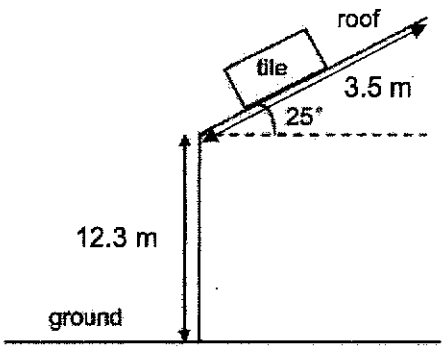


Fig. 4.1

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

.....

.....

.....

..... [2]

(b) Find the speed of the tile just before it falls off the edge of the roof.

speed = ... [3]

5 Fig. 5.1 shows a student sitting on a chair. Fig. 5.2 shows the same student tipping his chair back.

centre of

(a) State and explain how the pressure exerted by the chair on the floor in Fig. 5.1 compares with the pressure exerted by the chair in Fig. 5.2.

.....

.....

.....

.....

..... [2]

(b) **(i)** State what is meant by *centre of gravity*.

.....

..... [1]

(ii) State and explain if the student on the chair in Fig. 5.2 will topple forward or backward.

.....

.....

.....

.....

..... [2]

6 Fig. 6.1 shows an air pump being used to inflate a rubber boat. The air in the vertical cylinder of the pump is at atmospheric pressure.

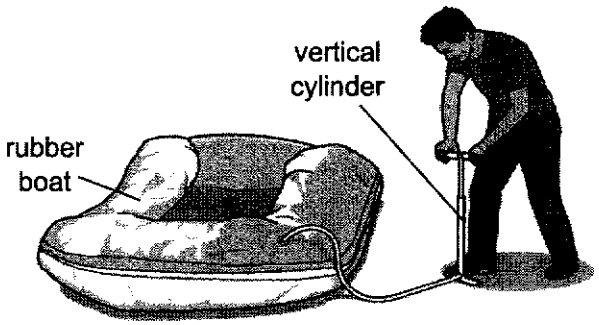


Fig. 6.1

(a) Explain, in terms of molecules, how the air inside the cylinder exerts a pressure.

.....

.....

.....

.....

.....

..... [2]

(b) When the boat is fully inflated, the air pump is disconnected and the boat is sealed tightly. The man sits on the side of the boat. The volume of the boat decreases while the temperature of the air stays constant.

Explain, in terms of molecules, how the pressure of the air in the boat changes.

.....

.....

.....

.....

.....

..... [3]

7 A boy throws a pebble into a lake and observes that the ripples caused by the pebble becomes closer as they moves towards the edge of the lake, as shown in Fig. 7.2.

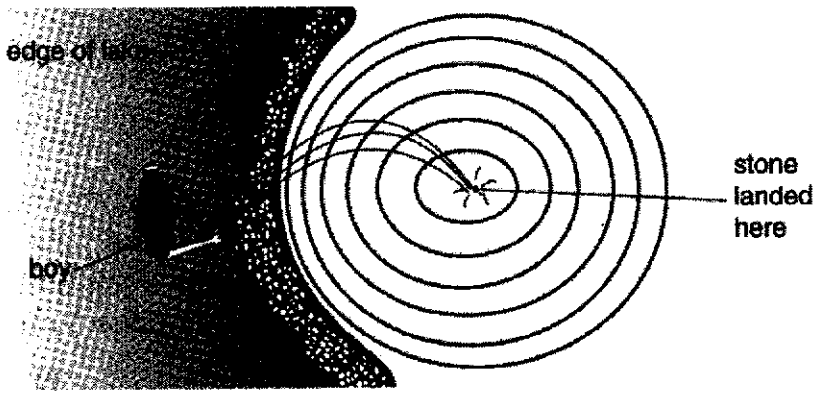


Fig. 7.2

(a) The boy concluded that 'the wavelength of the wave approaching the edge of the lake is smaller'.
Based on your observation of the diagram, comment on the boy's conclusion and state a possible reason for his observation.

.....

.....

.....

.....

..... [2]

(b) Describe one similarity and one difference between water waves and radio waves.

.....

.....

.....

.....

..... [2]

8 Fig. 8.1 shows the positions of particles of a medium at a particular instant when a 15 Hz wave, travelling from left to right, passes through the medium. Before the wave arrived, the particles were equally spaced at their original undisturbed positions as shown by the vertical lines.

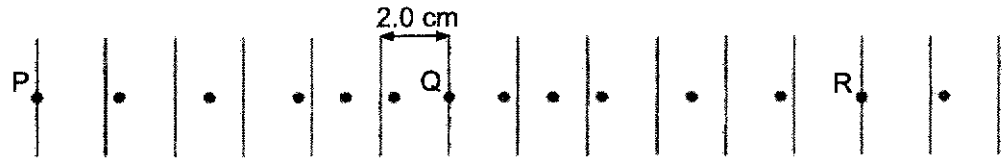


Fig. 8.1

(a) State the type of wave formed in Fig. 8.1. Explain your answer.

.....

.....

.....

..... [2]

(b) The distance between each pair of vertical lines is 2.0 cm.

Calculate the speed of the wave.

speed = ... [2]

9 Fig. 9.1 shows the wiring in a typical plug and Fig. 9.2 shows the electrical wiring in a table lamp.

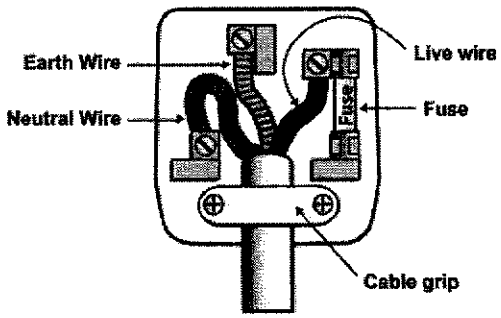


Fig. 9.1

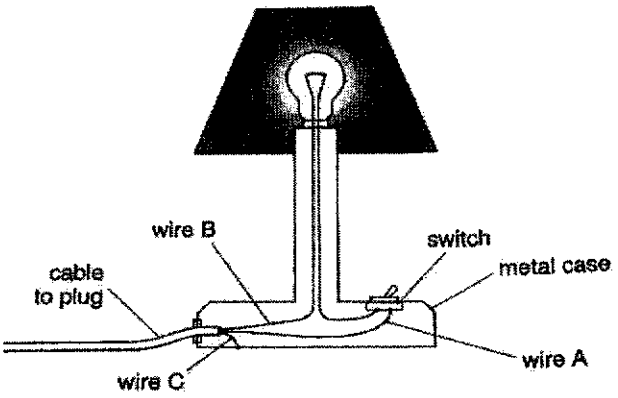


Fig. 9.2

(a) Explain why wire A rather than wire B is connected to the live terminal in the plug.

.....

.....

.....

.....

..... [2]

(b) The plug contains a fuse. Explain the purpose and operation of a fuse.

.....

.....

.....

.....

..... [2]

10 Fig. 10.1 shows a circuit containing a variable resistor and two identical lamps each of resistance 10.0 Ω.

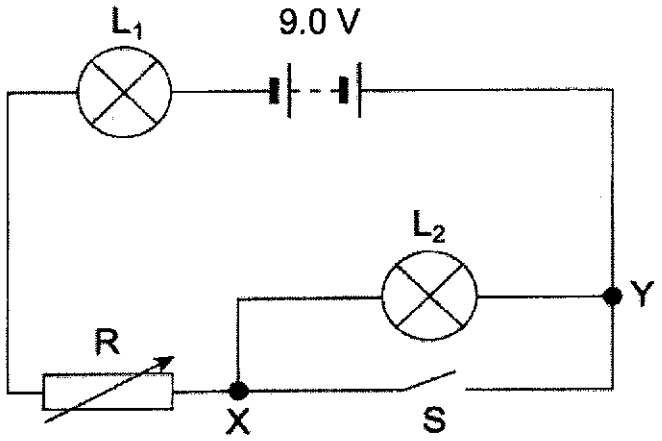


Fig. 10.1

(a) The switch S is open and the resistance of the variable resistor is gradually reduced to the minimum setting.

State and explain what happens to the brightness of both lamps.

.....

.....

.....

..... [2]

(b) Switch S is now closed with the variable resistor at its minimum setting.

(i) State the value of the potential difference across XY.

..... [1]

(ii) State what happens to the brightness of lamp L_1.

..... [1]

11 A circuit was set up as shown in Fig. 11.1.

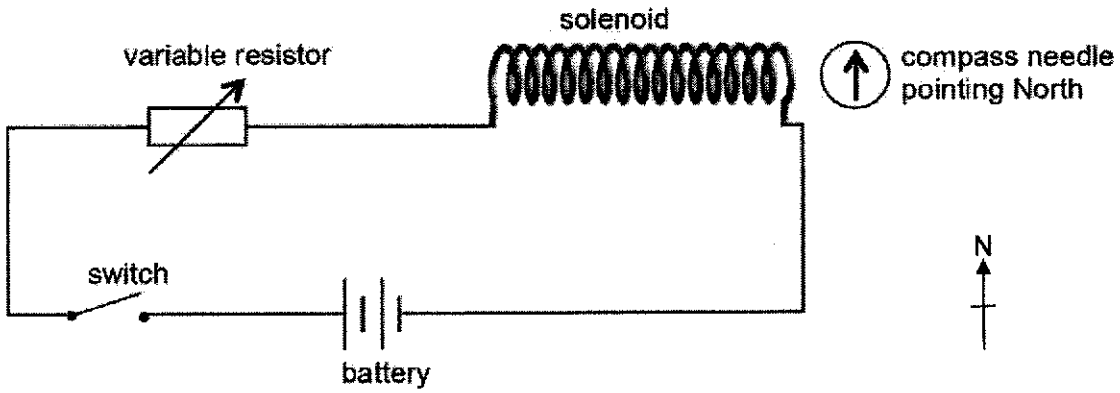


Fig. 11.1

(a) Explain what happens to the compass needle when the switch is closed.

.....

.....

.....

.....

..... [2]

(b) Besides increasing the current flow, suggest another way to increase the strength of the electromagnet.

.....

..... [1]

Section B (30 marks)

Answer **all** questions in the spaces provided.
Answer only one of the two alternative questions in **Question 14**.

12 A watch company wanted to test a new design of their watch in pure water and sea water for water resistance under high pressures.

Table 12.1 gives data on the depth of pure water and sea water and the corresponding pressures exerted by the pure and sea waters.

depth / m	pressure exerted by pure water / MPa	pressure exerted by sea water / MPa
0	0	0
500	5.10	5.20
1000	10.1	10.3
1500	15.1	15.5
2000	20.1	20.7
2500	25.1	25.9
3000	30.1	31.1
3500	35.1	36.3
4000	40.1	41.5

Table 12.1

(a) Define *pressure*.

..... [1]

(b) For the range of depths shown in the table, state

(i) a similarity in the pressure exerted by pure water and sea water,

.....

.....

..... [1]

(ii) a difference between the pressure exerted by pure water and sea water.

.....

.....

..... [1]

(c) Using the data from Table 12.1, determine the density of sea water at a depth of 2000 m. Assume the gravitational field strength of 10 N/kg remains constant at all depths and atmospheric pressure is 1.03×10^5 Pa.

density = ... [3]

(d) The watch has a surface area of 2.0×10^{-3} m^2 that is in contact with the sea water and can withstand a maximum force of 85 kN.

Determine if the watch can be submerged 4000 m under the sea water without being damaged. Show the working for your answer.

.....

.....

..... [2]

(e) The density of sea water increases with depth. Provide a possible explanation.

.....

.....

.....

..... [2]

13 Fig. 13.1 shows how the resistance of a thermistor varies with temperature.

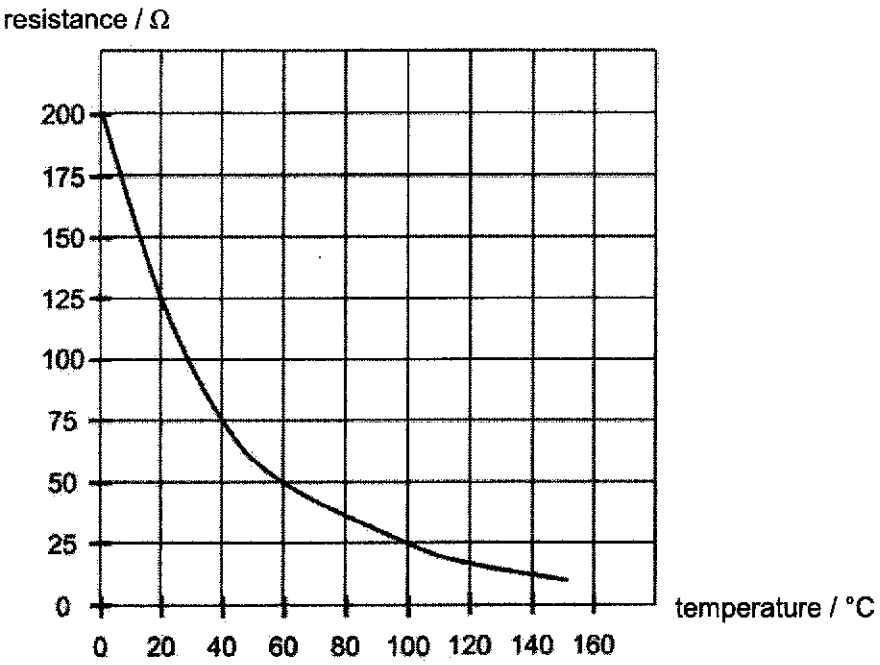


Fig. 13.1

The thermistor is connected in a circuit with a heating element as shown in Fig. 13.2.

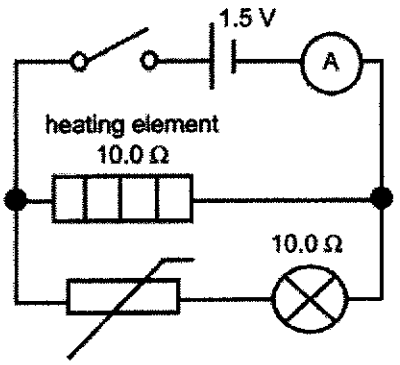


Fig. 13.2

(a) Describe how the resistance of the thermistor changes with temperature.

.....

.....

..... [1]

(b) Initially, the thermistor is cold. Explain what can be observed for the lamp when the switch is closed.

.....

.....

.....

.....

.....

..... [2]

(c) When the lamp first lights up, the current flowing through it is 20.0 mA. Assuming that the resistances of the lamp and the heating element remain constant throughout the experiment,

(i) calculate the potential difference (p.d.) across the lamp, and hence, the p.d. across the thermistor when the lamp first lights up.

p.d across lamp = ...

p.d across thermistor = ... [2]

(ii) determine the current reading in the ammeter.

current = ...[1]

(d) Thermistors are used in infra-red toasters. An infra-red toaster operates with two infra-red lamps positioned above and below the holding trays as shown in Fig. 13.3. It is capable of emitting infra-red radiation of different frequencies to cook the surface and the interior of the food concurrently.

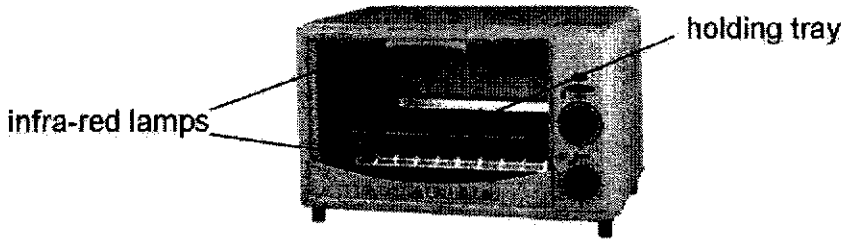


Fig. 13.3

Fig. 13.4 shows a convection oven. The convection oven uses a heater to warm up the air and a fan to circulate the hot air within the oven in order to cook food.

convection oven (side view)

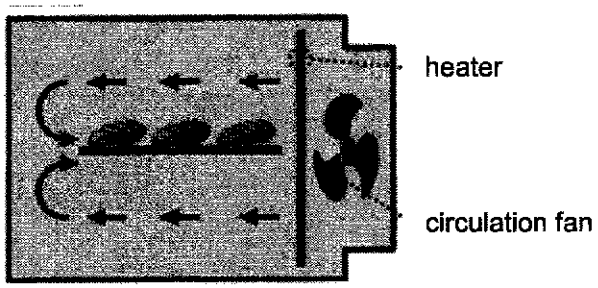


Fig. 13.4

(i) Explain why the interior of the infra-red toaster is silver-coloured and smooth.

.....

.....

..... [1]

(ii) Discuss why the infra-red toaster may cook the same type and amount of food faster than the convection oven.

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

EITHER

14 Fig. 14.1 shows a relay switch. It consists of a solenoid with a soft iron core. The solenoid is connected to a cell via a switch S. A movable L-shaped iron armature is positioned near one end of the soft iron. A secondary contact point (A and B) is positioned above the iron armature.

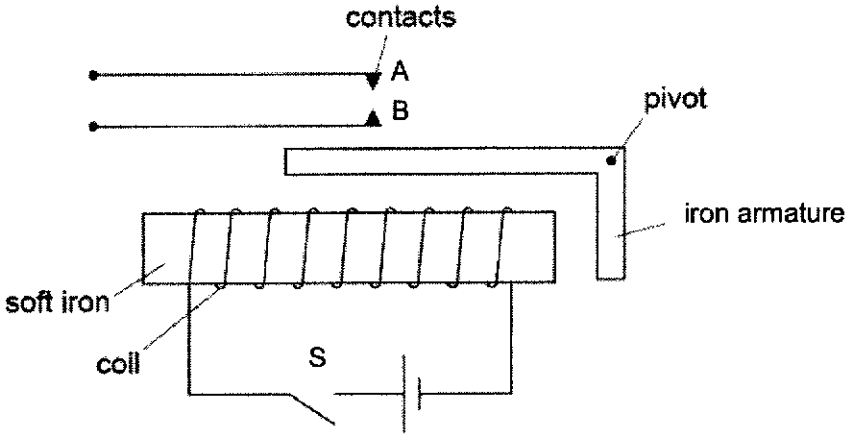


Fig. 14.1

(a) Explain how the circuit works to close the contacts A and B.

.....

.....

.....

.....

.....

.....

.....

..... [3]

21

The relay switch is used to power up a d.c. motor as shown in Fig. 14.2.

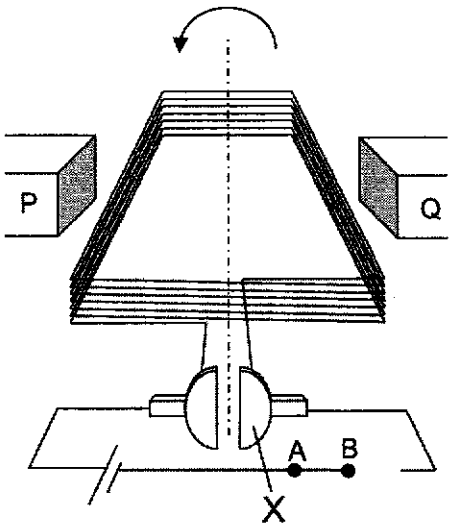


Fig. 14.2

(b) Identify the magnetic poles P and Q which causes the coil to rotate in an anticlockwise direction.

..... [1]

(c) Name the component X and explain its function.

.....

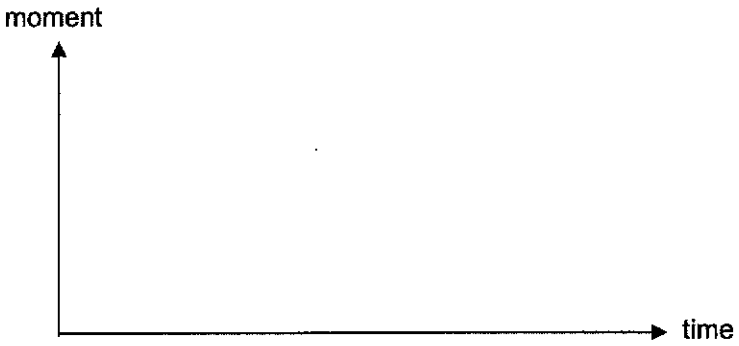
.....

.....

.....

..... [2]

(d) Sketch and explain how the moment acting on the coil varies with time for one revolution. Assume the time taken for one revolution is T and the coil is initially in the horizontal position shown in Fig. 14.2.



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.....

..... [4]

OR

14 Two coils, A and B, are placed one on top of the other, as shown in Fig. 14.3.
Coil A is connected in series with a battery and a switch. A millivoltmeter is connected across the terminals of coil B.

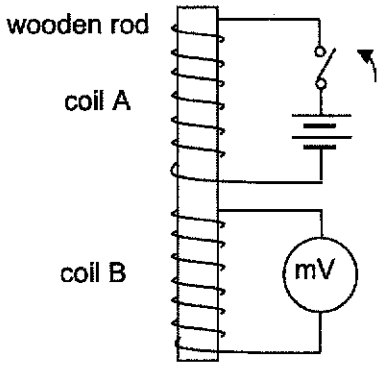


Fig. 14.3a

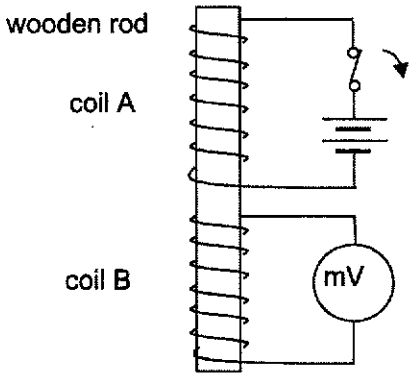


Fig. 14.3b

(a) Explain why, when the current in coil A is switched on, the millivoltmeter indicates an induced e.m.f. for a short period of time and then reduces to zero rapidly in Fig. 14.3a.

.....

.....

.....

.....

..... [2]

(b) **(i)** On Fig. 14.3b, draw an arrow on coil B to show the direction of the induced current in coil B when the switch was just opened. [1]

(ii) Explain the direction drawn in **(b)(i)**.

.....

.....

.....

.....

..... [2]

Fig. 14.4 shows two coils of insulated wire wound on an iron core to make a transformer.

One coil is connected to a 16 V a.c. supply. The other coil is connected to a lamp, which is rated 12 V, 24 W.

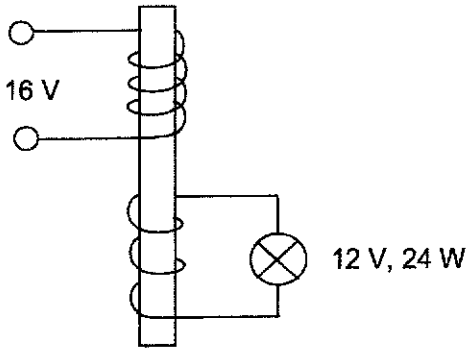


Fig. 14.4

(c) The lamp is operating at its correct rating.
Calculate the minimum current drawn from the 16 V supply.

minimum current = ... [2]

(d) However the current drawn from the supply is found to be 1.7 A.

(i) Calculate the input power to the transformer.

input power = ... [1]

(ii) Calculate the electrical energy lost by the transformer each second.

electrical energy lost = ... [1]

(iii) State one reason why a transformer is **not** 100% efficient.

.....

..... [1]

~ End of Paper ~

BUKIT VIEW SECONDARY
SEC 4 EXPRESS PRELIMINARY EXAM 2021
PHYSICS (6091)

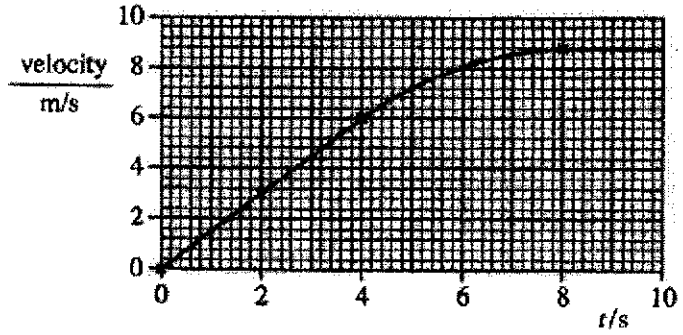
PAPER 1

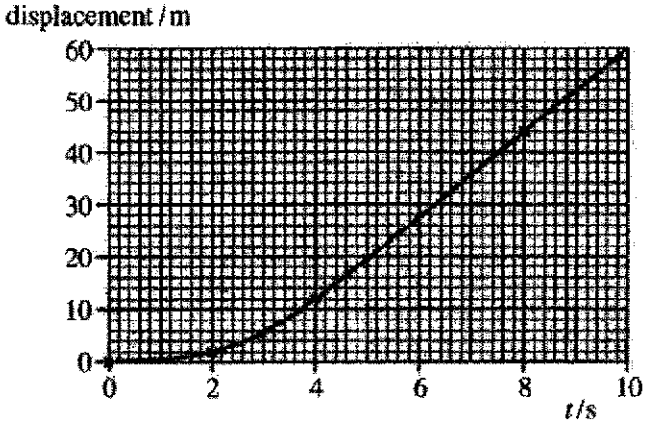
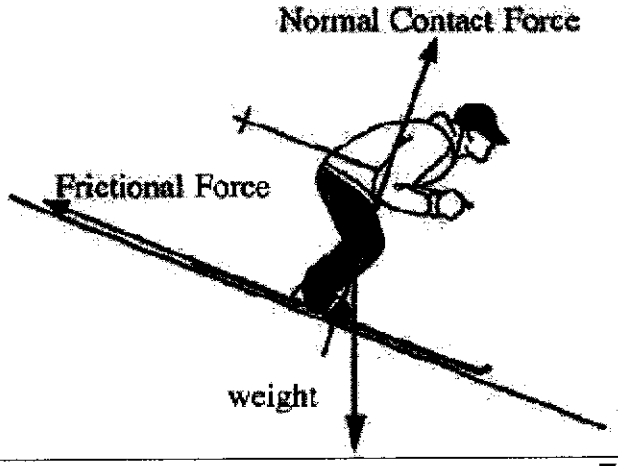
1	D	11	C	21	D	31	A
2	C	12	C	22	C	32	C
3	D	13	D	23	D	33	D
4	C	14	C	24	B	34	D
5	C	15	B	25	D	35	D
6	B	16	C	26	D	36	C
7	A	17	A	27	D	37	A
8	B	18	B	28	B	38	D
9	C	19	A	29	B	39	D
10	C	20	C	30	C	40	C

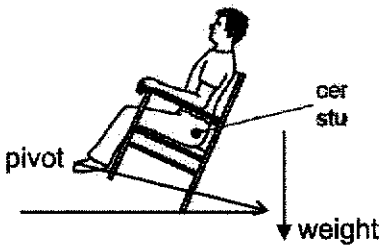
PAPER 2
-1m for every missing/wrong unit (no cap)
-1m for every sf/dp error (no cap)

General marking notes:
Do not penalize for carry forward errors. Award full marks for subsequent parts if both method and units are correct.
Do not penalize for spelling errors but do highlight them to the students.
Remind students to show formulae, working and units for all calculations.
Answers must not be more than 3.s.f. if accuracy is not specified.

SECTION A

Qn	SECTION A [Workings / Calculations / Methods] + [Examiner's Comments]	Marks / Remarks
1a		B1
1bi	Distance between A and B = area under graph from A to B = ½ (2.0)(3.0) = 3.0 m	 M1 A1
1bii	Distance between B and C = area under graph from B to C = ½ (3.0+6.0)(4.0-2.0) = 9.0 m	 A1

ci		B1
cii	The displacement-time graph has a constant gradient after D.	B1
d		B1 – normal contact force w arrow perpendicular to surface B1 – frictional force along the surface, opposite direction to motion
	Total =	**8 m**
2a	Require positive resultant force to act on the bag, for it to accelerate *P* must be **more than 0.5 N to overcome frictional force**	B1
2bi	resultant force = mass x acceleration OR $F = ma$	B1
2bii	P = 1.5 N, a = 0.5 m/s^2 ma = P – f m = (1.5–0.5) / 0.5 m = 2 kg	M1 A1
3a	W = mg = 80 x 10 = 800 N	 B1
3b	Taking moments about P, Total Clockwise Moments about P = Total Anti-Clockwise Moments abt p (800 x 1) + (150 x 3) = T_Q x 6 T_Q = 208 N	 M1 A1
3c	Tension in rope P = 800 + 150 - 208 = 742 N	B1
4a	The principle of conservation of energy states that energy cannot be created or destroyed, but can only be	B1

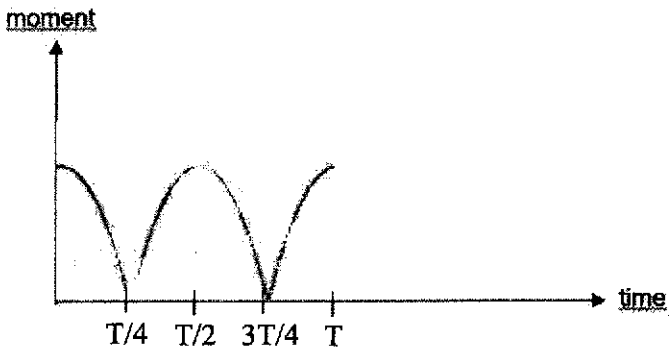
	converted from one form to another. The total energy in an isolated system is constant.	B1
4b	Loss in GPE = Gain in KE + WD against friction $mgh = \frac{1}{2}mv^2 + Fd$ $(0.300)(10)(3.5 \times \sin 25°) = (\frac{1}{2})(0.300)(v^2) + (0.40)(3.5)$ $v = 4.50\ m\ s^{-1}$	 M1 M1 A1
5a	The pressure exerted by the chair on the floor in Fig. 2.1 is lesser than that of Fig. 2.2. This is because in Fig. 2.1, the force (weight of student and chair) is distributed over a larger base area (4 legs of chair instead of 2 legs) resulting in a smaller force per unit area (pressure).	B1 B1
bi	The centre of gravity (C.G.) is the point through which the entire weight of the body appears to act regardless of orientation.	B1
bii	The student on the chair in Fig. 5.2 will topple backward.  The line of action of weight (which passes through the C.G.) lies on the right side of the pivot resulting in a clockwise moment causing the student on the chair to topple backward.	B1 B1
6a	The air molecules move randomly at high speed. The air molecules collide with the inner walls of the cylinder. These collisions exert an average force on the inner walls of the cylinder. Since pressure is defined as the force acting per unit area, the moving air molecules exert a pressure inside the cylinder.	B1 B1 B1
6b	When the volume of the boat decreases, the number of air molecules per unit volume increases. This increases the frequency of collision between the air molecules and the inner walls of the rubber boat. Hence the air pressure in the rubber boat increases.	B1 B1 B1

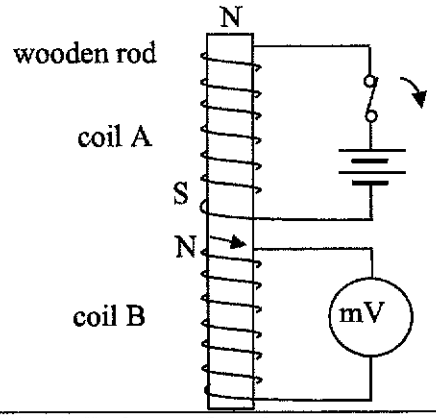
7a	From the diagram, the wavefronts are narrower indicating that the wavelength is shorter. The lake is getting shallower.	B1 B1
7b	(1) Both are transverse waves (2) They have different frequencies/wavelengths/speed.	B1 B1
8a	It is a longitudinal wave. It consists of a series of compressions and rarefactions.	B1 B1
8b	speed = freq x wavelength = 15 x 24 = 360 cm/s = 3.6 m/s	 B1 A1
9a	If wire B is connected to live terminal, the lamp **will be at live potential when the switch is open.** This may **cause electric shocks to user.** If wire A is connected to live terminal, the lamp will **not be at live potential when the switch is open,** hence **protecting the user from electric shocks.**	B1 B1
9b	The purpose of a fuse is to **protect the appliance** from **high current which may cause damage**. (or to prevent **overheating of the circuit/ appliance**.) The fuse will melt and **break the circuit** when current is **higher than the rated value.**	B1 B1
10a	Both lamps have the **same brightness** and they are **gradually brighter** as the variable resistor is gradually reduced to minimum. As the variable resistance reduces, the **total circuit resistance will drop**, leading to **higher current flow so the bulbs will become brighter.**	B1 B1
10bi	p.d. = 0 V	B1
10bii	The brightness will increase	B1
11a	When the switch is closed, **current flows through the solenoid and it becomes an electromagnet** with the **North magnetic pole formed at the end nearer to the compass.** The compass needle will deflect 90 degree clockwise and **point to the right (East direction)** as **like poles repel.**	B1 B1
11b	Place a soft iron as the core in the solenoid. OR Increase the number of turns in the solenoid.	A1

Section B

Qn	SECTION A [Workings / Calculations / Methods] + [Examiner's Comments]	Marks / Remarks
12a	Pressure is the force per unit area.	B1

bi	At 0 m, pressure exerted by both pure and sea water is the same. OR From 0 m onwards, pressure exerted by sea water and pure water are increasing.	B1
bii	There is a greater increase in pressure exerted by sea water than pure water.	B1
c	$P = h\rho g + P_{atm}$ $20\ 700\ 000 = 2000 \times \rho \times 10 + 103000$ $\rho = 1030\ kg/m^3$	B2 A1
d	$P = F/A$ $P = 85\ 000 / 2.0 \times 10^{-3}$ $P = 42\ 500\ 000\ Pa = 42.5\ MPa$ Since watch can withstand 42.5 MPa which is greater than pressure at 4000m, watch can be submerged 4000 m under sea water.	B1 B1
e	The volume of sea water decreases due to lower temperatures of deeper sea waters, since density is the measure of mass per unit volume, the density will be higher in deeper sea. **OR** There are more salt particles / content / impurities at the bottom of the sea, which causes the sea water to have a greater mass, since density is the measure of mass per unit volume, the density will be higher in deeper sea.	B1 B1 B1 B1
	Total	**10 m**
13a	As the temperature increases, the resistance of the thermistor falls with decreasing gradient.	B1
b	When it is cold, the thermistor has a much **higher resistance** compared to the heating element. The lamp will **not light up as the current flowing through is very little.** As the thermistor **warms up, the resistance will drop and the current flowing through will increase** and the lamp will start to **brighten up.**	B1 B1
ci	p.d across lamp = I R = $20 \times 10^{-3} \times 10 = 0.2$ V p.d across thermistor = 1.5 – 0.2 = 1.3 V	A1 A1
cii	Current through heating element = 1.5/10 = 0.15 A Total current = 0.15 A + 0.02 A = 0.17 A	 A1
di	Silver-coloured and smooth surface is a **poor absorber of heat radiation**. It helps to **reflect the radiation and keep the interior of the toaster hot** to cook food faster.	B1
dii	In the convection oven, the **heater warms up the surrounding air** then the **circulation fan circulates the hot air to the food**. Heat is transferred from the **hot air to the food via conduction. Air is a poor conductor of heat** so the whole process takes longer.	B1 B1

	In the toaster, heat is **transferred directly to the food** using **infra-red radiation at high speed**. Therefore the toaster will be able to cook the same type and amount of food faster. Bonus: (if student is able to compare that convection cooking **heats up only the surface** while infrared radiation can **heat the food from internal**, we can award 1 mark)	B1
	Total	**10 m**
E 14a	When switch is closed, current flows through the coil. The soft iron becomes an electromagnet. The iron armature end will be attracted towards the right end of the soft iron due to induced magnetism. The iron armature rotates about the pivot and the left end will move up to close the contacts AB.	 B1 B1 B1
b	P – North, Q - South	A1
c	X is split-ring commutator. It reverses the direction of current in the coil every half a revolution to ensure the coil continues to turn in one direction.	B1 B1
d	 When the coil is **horizontal**, the **moment is greatest** as the **perpendicular distance between the force and the pivot is largest.** As the coil rotates, the **perpendicular distance reduces so the moment decreases.** When the coil is in **vertical position** after a quarter revolution, the **moment is zero as the force passes through the pivoting axis (or the perpendicular distance from the pivot is zero).** As it continues to rotate to the next horizontal position, the **moment increases towards maximum again at T/2.** The cycle repeats itself for another half revolution and form the graph as drawn above.	B1 - drawing B1 B1 B1
	Total	**10 m**
OR 14a	When current is switched on, **coil A will become an electromagnet**. There is a **sudden change in**	B1

	magnetic flux linkage to coil B which induces an emf. When the **magnetic field in coil A is stable,** there will be **no more changes in magnetic flux linkage to coil B** so there will be no more induced emf.	B1
bi		B1
bii	**Coil A initially has a S pole nearest to coil B.** When the **switch is opened, the change in magnetic field** causes the **coil B to have a N pole induced at the end closer to coil A** to oppose the change. **Using right-hand grip rule**, we can determine the direction of the induced current drawn in b (i).	B1 B1
c	Current in lamp = 24 / 12 = 2 A $V_s/V_p = I_p/I_s$ $12/16 = I_p/2$ $I_p = 1.5$ A	 M1 A1
di	Input power = VI = 16 x 1.7 = 27.2 W	A1
dii	Energy loss per sec = 27.2 – 24 = 3.2 J	A1
diii	There will be some energy loss in the form of heat due to resistance.	A1
	Total	**10 m**