Class:	Register No:	Name:

CRESCENT GIRLS' SCHOOL
SECONDARY FOUR
PRELIMINARY EXAMINATION

PHYSICS **6091/02**
Paper 2

17 Sep 2019

1 hr 45 min

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces provided at the top of this page and on all separate answer sheets used.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluids.

Section A (50 marks)
Answer **all** questions.

Section B (30 marks)
Answer **all** questions.
Question 10 has a choice of parts, answer **either one**.

At the end of the examination, fasten all your work securely together.
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	

This paper consists of 14 printed pages (including the cover page).

Section A (50 marks)
Answer **all** questions. Write your answers in the spaces provided in the question paper.

1 A wheel F on an axle is free to rotate about a horizontal axis as shown in Fig. 1. The diameter of the wheel is 50.0 cm while the diameter of the axle is 10.0 cm.

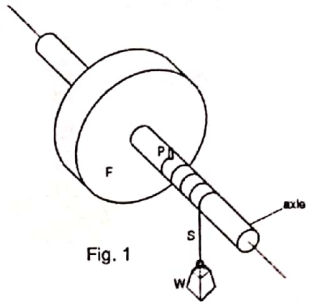

Fig. 1

String S has a loop on one end, which is hooked over peg P on the axle. The string is coiled several times around the axle, and has a weight W attached to the other end. W is released and both the wheel and the axle rotate.

(a) Draw on Fig. 1, the direction of the force that should be applied on wheel F to stop the rotation. [1]

(b) Given that the mass of W is 80.0 g, find the moments due to W. The gravitational field strength is 10 N/kg. [2]

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(c) Determine the smallest force that should be applied on the wheel F to stop its rotation. [2]

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(d) The weight W is hung now from peg P without coiling several times around the axle. Without further calculations, explain any changes to your answer in (c). [2]

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2 A mercury barometer is used to measure atmospheric pressure as shown in Fig. 2. The atmospheric pressure is equal to 75 cm of mercury.

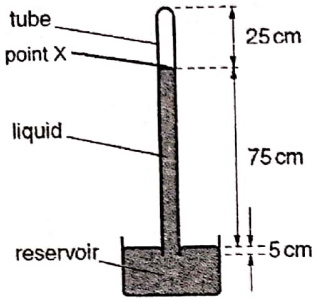

Fig. 2

(a) Define pressure. [1]

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(b) State the pressure at point X in the tube, in terms of height of mercury. [1]

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(c) Determine the atmospheric pressure shown in Fig. 2, in terms of Pascal. The density of mercury is 13600 kgm^{-3}. The gravitational field strength is 10 N/kg. [2]

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(d) The tube is accidentally knocked at the top, so that a small crack appears at the top of the tube. Some air leaks in through the crack. State and explain how this affects the liquid level in the tube. [3]

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3 Water waves are moving from the deep region to the shallow region as shown in Fig. 3. Fig. 3 is drawn to scale.

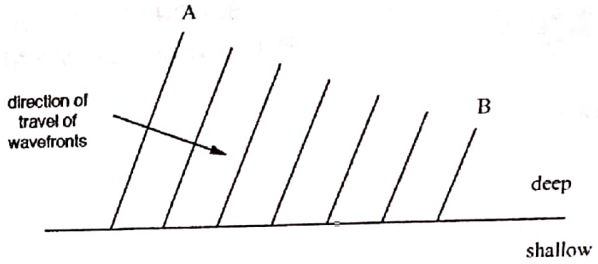

Fig. 3

(a) State what is meant by wavefront. [1]

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(b) Draw the wavefronts of the refracted waves in Fig. 3. [2]

(c) The wavefront shown at position A takes 4.0 s to travel to position B. Determine

(i) the wavelength of the wave, [2]

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(ii) the speed of the wave. [2]

4 A negatively charged plastic rod is brought towards a positively charged plastic ball as shown in Fig. 4.

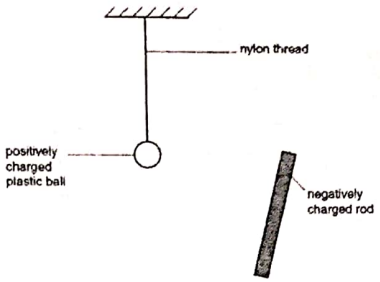

Fig. 4

(a) Draw the electric field pattern between the rod and the ball in Fig. 4. [2]

(b) There is an electric field in the space between the ball and the rod. Describe how you could determine the direction of the electric field. [2]

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(c) Describe and explain what happens to the ball as the rod is brought near it. [2]

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(d) The rod touches the ball and remains in contact for some time. Describe any movement of charges between the rod and the ball. [1]

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5 Fig. 5 shows a room heater used during winter in some countries.

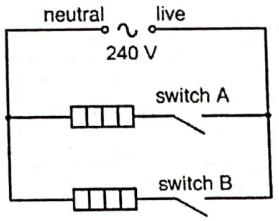

Fig. 5

(a) On Fig. 5, draw the symbol of the fuse in the correct position. [1]

(b) A fuse with a much higher rating than the normal working current is placed in the circuit. Explain why this presents a risk of damage to the appliance. [3]

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(c) The earth wire reduces the chance of an electric shock if a fault develops in the heater.

(i) State one fault that causes an electric shock when a person uses the heater without an earth wire. [1]

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(ii) Explain how using an earth wire prevents an electric shock. [2]

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6 Fig. 6 shows an iron rod AB resting in a magnetic field and connected to a circuit. The rod can move freely in the magnetic field. PQ is a variable resistor with a sliding contact J.

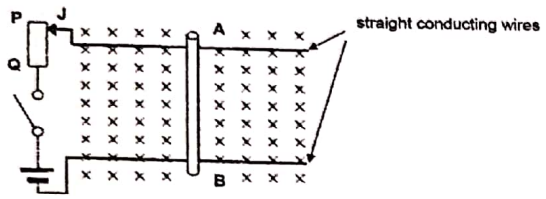

Fig. 6

(a) The switch is closed. State the direction of current flow in the rod and hence state the direction which the rod will move. [2]

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(b) Explain why the rod moves. [3]

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(c) When the switch is closed, the jockey J is moved toward Q. State and explain any changes to the forces acting on the rod. [3]

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7 Fig. 7 shows a wind-up torch which does not contain batteries.

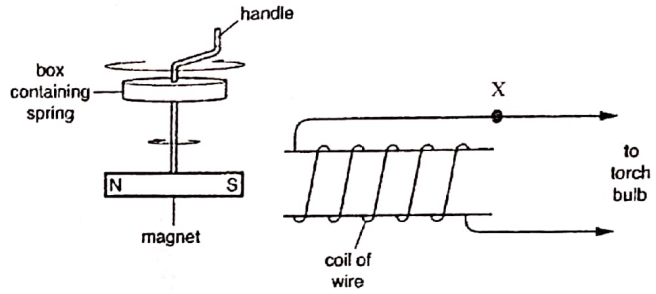

Fig. 7

To use the torch, the handle is first rotated to wind a spiral spring in a box. When the switch of the torch is turned on, the spring unwinds and a current flows in the coil.

(a) The South Pole of the magnet is rotating away from the coil. Label on Fig. 7, the direction of the current at point X. [1]

(b) Explain why there is a current in the coil. [2]

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(c) As the spring unwinds, the force in the spring decreases. Explain how this causes a decrease in intensity of the light produced. [3]

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(d) Suggest one modification to the design of the torch in order to produce a larger current. [1]

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Section B (30 marks)

Question 10 has a choice of parts, answer **either one.**

Write your answers in the spaces provided in the question paper.

8 A wind turbine uses a renewable energy source to generate electricity.

(a) State one disadvantage of using wind turbine to produce a high proportion of the electricity in Singapore. [1]

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(b) Fig. 8.1 shows how the power output of a wind turbine varies with speed.

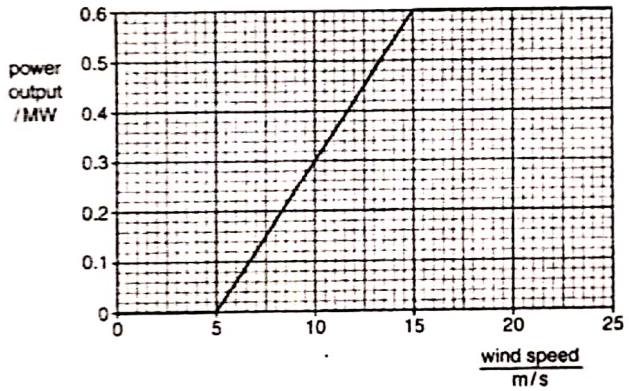

Fig. 8.1

(i) Using Fig. 8.1, describe how the power output varies with wind speed. [3]

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(ii) The wind speed is recorded at one minute intervals, as shown in Fig. 8.2.

time / min	wind speed / ms^{-1}
0	2
1	3
2	16
3	16
4	0
5	0
6	20
7	22
8	10
9	10

Fig. 8.2

Use the data in Fig. 8.1 and 8.2 to estimate the total energy produced in the ten minute interval. Give your answer in Joules. [3]

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(iii) Explain why your data to (ii) is only an estimate. [1]

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(c) A wind turbine produces an alternating voltage of 600 V. Electric cables connect the wind turbine to houses some distance away. Energy is wasted within the cables. State and explain how a transformer is used to reduce the amount of energy that is wasted. [2]

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9 Fig. 9 shows the temperature-time graph of a substance that is allowed to cool. The substance has a mass of 200 g and is in liquid state when the temperature is 220 °C.

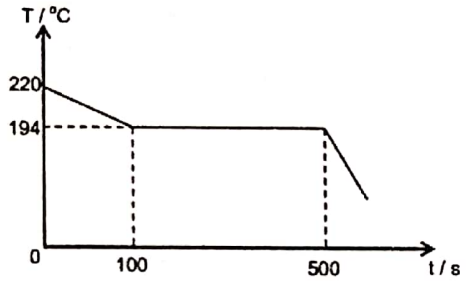

Fig. 9

(a) Define specific latent heat of fusion. [1]

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(b) Explain why the liquid is losing thermal energy to the surrounding. [1]

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(c) During the 100 s to 500 s period, the temperature of the substance is constant. Explain why the internal energy of the substance is decreasing. [2]

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(d) State whether the specific heat capacity of the substance is higher when it is in liquid state or in solid state. Use Fig. 9 to explain your answer. [2]

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(e) The substance loses heat at a constant rate of 400 W. Calculate the specific latent of fusion of the substance. [2]

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(f) 150 g of water at 30 °C is added to the substance when its temperature is 190 °C. Given that the specific heat capacity of the substance is 2.1 $Jg^{-1}°C^{-1}$ and the specific heat capacity of water is 4.2 $Jg^{-1}°C^{-1}$, find the final temperature of the substance. Assume that there is no heat loss to the surroundings. [2]

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10 Either

Fig. 10 shows a circuit with two ammeters, a resistor and a lamp.

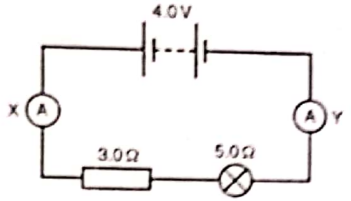

Fig. 10

(a) Define current flow. [1]

(b) Determine the reading on ammeter X. [2]

(c) Explain why the readings on ammeter X and ammeter Y are the same. [1]

(d) Calculate the potential difference across the lamp. [2]

(e) Explain why the current flowing through the lamp changes when the circuit is switched on for some time. [2]

(f) The ammeter Y is replaced with a voltmeter. Explain why the reading on ammeter X becomes very low. [2]

10 Or

Fig. 11 shows the speed-time graph of a car.

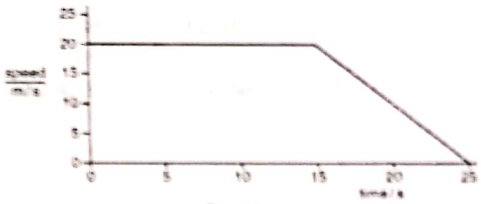

Fig. 11

(a) State how the graph shows that the speed of the car is constant during the first 15 s. [1]

(b) Calculate the deceleration of the car from 15 s to 25 s. [2]

(c) Describe the net force acting on the car from 15 s to 25 s. [2]

(d) Find the total distance travelled by the car in 25 s. [2]

(e) Sketch the distance-time graph of the car. Indicate the values of the distance at 15 s and 25 s on your graph. [3]

End of paper

Class:	Register No:	Name: MS

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SECONDARY FOUR
PRELIMINARY EXAMINATION

PHYSICS 6091/02
Paper 2

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1 hr 45 min

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Information for marker

Numerical final answer not rounded to 2/3 sf OR without unit, deduct max 1m per question.

Marking load

Q1 – Q5 : SG
Q6 – Q9 : TY
Q10 E : Kim
Q10 O : WK

For Examiner's Use	
Section A	/50
Section B	/30
TOTAL	

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B

Section A (50 marks)
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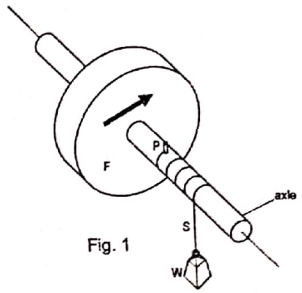


Fig. 1

String S has a loop on one end, which is hooked over peg P on the axle. The string is coiled several times around the axle, and has a weight W attached to the other end. W is released and both the wheel and the axle rotate.

(a) Draw on Fig. 1, the direction of the force that should be applied on wheel F to stop the rotation. [1]

Force shown in correct direction. Results in clockwise moments. [1]

(b) Given that the mass of W is 80.0 g, find the moments due to W. The gravitational field strength is 10 N/kg. [2]

Moments = F x d
= ((80.0 / 1000) x 10) x (10.0 / 2)
= 4.0 Ncm

(c) Determine the smallest force that should be applied on the wheel F to stop its rotation. [2]

4.0 = F x d
= F x (50.0 / 2)
F = 0.16 N

(d) The weight W is now hung from peg P without coiling several times around the axle. Without further calculations, explain any changes to your answer in (c). [2]

No change in answer for (c).

There is no change in the perpendicular distance between F and pivot.

Hence no change in the moment by W and no change in the force.

2 A mercury barometer is used to measure atmospheric pressure as shown in Fig. 2. The atmospheric pressure is equal to 75 cm of mercury.

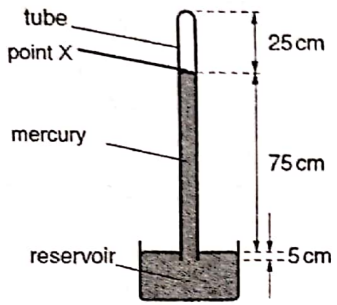


Fig. 2

(a) Define pressure. [1]

Pressure is the force acting (perpendicularly) per unit area.

(b) State the pressure at point X in the tube, in terms of height of mercury. [1]

0 cm Hg

(c) Determine the atmospheric pressure shown in Fig. 2, in terms of Pascal. The density of mercury is 13600 kgm^{-3}. The gravitational field strength is 10 N/kg. [2]

P = pgh
= 13600 x 10 x 0.750
= 102 000 Pa OR 100 000 Pa

(d) The tube is accidentally knocked at the top, so that a small crack appears at the top of the tube. Some air leaks in through the crack. State and explain how this affects the liquid level in the tube. [3]

The air above the mercury results in pressure acting downwards / on the mercury.

Since the atmospheric pressure is now the sum of air pressure and mercury pressure, the pressure due to the mercury is less.

Hence the height of the mercury drops.

3 Water waves are moving from the deep region to the shallow region as shown in Fig. 3. Fig. 3 is drawn to scale.

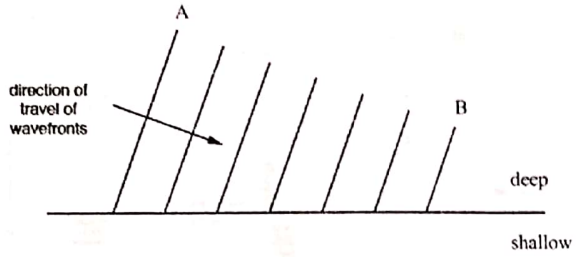
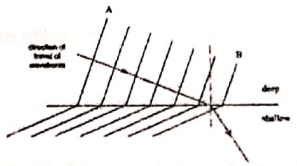


Fig. 3

(a) State what is meant by wavefront. [1]

A wavefront is an imaginary line that join all adjacent points on a wave that are in phase.

(b) Draw the wavefronts of the refracted waves in Fig. 3. [2]



(c) The wavefront shown at position A takes 4.0 s to travel to position B. Determine

(i) the wavelength of the wave, [2]

wavelength = 6.3 / 6
= 1.0 cm (accept 0.9 cm to 1.1 cm)

(ii) the speed of the wave. [2]

Speed = distance / time
= 6.3 / 4.0
= 1.575
= 1.6 cms^{-1}

OR

T = 4/6 s
F = 1 / T = 1.5 Hz

v = fλ
= 1.5 x 1.0
= 1.5 cm^{-1}

4 A negatively charged plastic rod is brought towards a positively charged plastic ball as shown in Fig. 4.

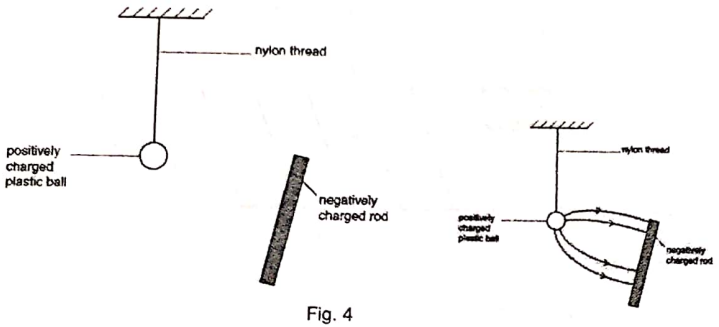


Fig. 4

(a) Draw the electric field pattern between the rod and the ball in Fig. 4. [2]

Field lines perpendicular to surface

Arrows from ball to rod.

(b) There is an electric field in the space between the ball and the rod. Describe how you could determine the direction of the electric field. [2]

Place a positive (test) charge in the electric field.

The direction which the charge moves is the direction of the electric field.

(Allow for answers that describes a negative charge)

(c) Describe and explain what happens to the ball as the rod is brought near it. [2]

The ball moves / is attracted towards the rod.

The ball and the rod have unlike charges and unlike charges attract.

(d) The rod touches the ball and remains in contact for some time. Describe any movement of charges between the rod and the ball. [1]

No movement of charges (as they are both insulators).

5 Fig. 5 shows a room heater used during winter in some countries.

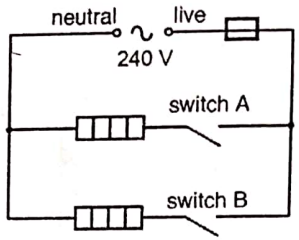


Fig. 5

(a) On Fig. 5, draw the symbol of the fuse in the correct position. [1]

Correct symbol AND symbol on any part of live wire.

(b) A fuse with a much higher rating than the normal working current is placed in the circuit. Explain why this presents a risk of damage to the appliance. [3]

A higher than normal working current could flow through the heater (due to faulty wiring).

The fuse will not blow to open the circuit.

This could start electrical fire / heater could overheat.

(c) The earth wire reduces the chance of an electric shock if a fault develops in the heater.

(i) State one fault that causes an electric shock when a person uses the heater without an earth wire. [1]

The live wire touches the metal casing of the heater.

(ii) Explain how using an earth wire prevents an electric shock. [2]

The earth wire provides a path of lower resistance from the metal casing to the earth.

This allows the current to flow from the casing to the earth instead of through the person. OR

The results in a higher current and causes the fuse to blow and open the circuit.

6 Fig. 6 shows an iron rod AB resting in a magnetic field and connected to a circuit. The rod can move freely in the magnetic field. PQ is a variable resistor with a sliding contact J.

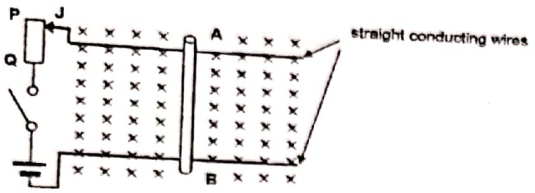


Fig. 6

(a) The switch is closed. State the direction of current flow in the rod and hence state the direction which the rod will move. [2]

A to B (accept clockwise / downwards)
To the right (using LHR)

(b) Explain why the rod moves. [3]

The current flow in the rod generates a magnetic field that interacts with the magnetic field below the rod.
There is a difference between the magnetic field strength (along the left and right side of the rod). (accept description of stronger / weaker field)
This results in a (net) force acting on the wire.

(c) When the switch is closed, the jockey J is moved toward Q. State and explain any changes to the forces acting on the rod. [3]

When the jockey is moved towards Q, the resistance decreases.
The current flow in the rod increases.
The force acting on the rod increases.

7 Fig. 7 shows a wind-up torch which does not contain batteries.

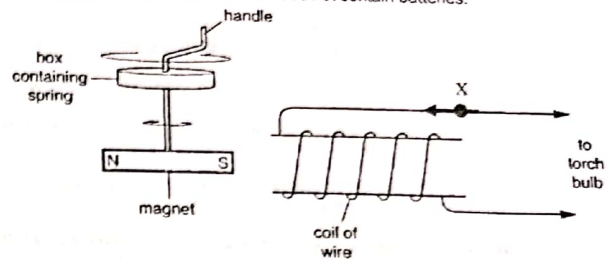


Fig. 7

To use the torch, the handle is first rotated to wind a spiral spring in a box. When the switch of the torch is turned on, the spring unwinds and a current flows in the coil.

(a) The South Pole of the magnet is rotating away from the coil. Label on Fig. 7, the direction of the current at point X. [1]

Arrow pointing to the left as shown.

(b) Explain why there is a current in the coil. [2]

When the magnet rotates it results in a changing magnetic field that cuts the coil / cause a change in magnetic flux linkage (in the coil).

This induced an emf and hence current in the coil.

(c) As the spring unwinds, the force in the spring decreases. Explain how this causes a decrease in intensity of the light produced. [3]

The smaller force results in a slower rotation / movement of the magnet.
Hence the rate which the magnetic field cuts the coil decreases / smaller change.
The results in a smaller induced emf / current and so the intensity of light decreases.

(d) Suggest one modification to the design of the torch in order to produce a larger current. [1]

Any one:
Increase the number of turns of the coil /
Use a stronger magnet /
Insert a soft iron core in the coil /
Bring the magnet closer to the coil
Longer handle / more elastic spring.

Section B (30 marks)
Question 10 has a choice of parts, answer either one.
Write your answers in the spaces provided in the question paper.

8 A wind turbine uses a renewable energy source to generate electricity.

(a) State one disadvantage of using wind turbine to produce a high proportion of the electricity in Singapore. [1]

There might not be sufficient wind / wind speed throughout to generate sufficient electrical energy.

(accept wind turbines requires large amount of space and Singapore has limited spaced)

(b) Fig. 8.1 shows how the power output of a wind turbine varies with speed.

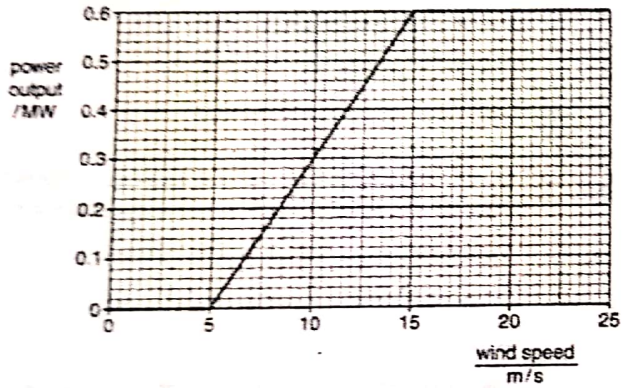


Fig. 8.1

(i) Using Fig. 8.1, describe how the power output varies with wind speed. [3]

When wind speed is 0 m/s to 5 m/s, the power output is 0 MW
When wind speed is 5 m/s to 15 m/s, the power output increase from 0 MW to 0.6 MW at a constant rate.
When wind speed is 15 m/s to 25 m/s, the power output is constant at 0.6 MW

(ii) The wind speed is recorded at one minute intervals, as shown in Fig. 8.2.

time / min	wind speed / ms^{-1}
0	2
1	3
2	16
3	16
4	0
5	0
6	20
7	22
8	10
9	10

Fig. 8.2

Use the data in Fig. 8.1 and 8.2 to estimate the total energy produced in the ten minute interval. Give your answer in Joules. [3]

Total energy = Power output at that wind speed x time period for that wind speed
= (0.6 x 60) + (0.6 x 60) + (0.6 x 60) + (0.6 x 60) + (0.3 x 60) + (0.3 x 60)

= 180 MJ

(output for wind speed below 5m/s is 0MW)

(iii) Explain why your data to (ii) is only an estimate. [1]

As the wind speed is recorded at one minute intervals, there could be variations in the speed between each recording that is not reflected in the table.

(Fig 8.1 values have accounted for power loss / turbine inefficiencies)

(c) A wind turbine produces an alternating voltage of 600 V. Electric cables connect the wind turbine to houses some distance away. Energy is wasted within the cables. State and explain how a transformer is used to reduce the amount of energy that is wasted. [2]

Use a step-up transformer to increase the voltage of the power output from wind turbine.
Since power output is constant, the current from the turbine would decrease (P = IV). A lower current flow will result in a lower energy loss ($P_{loss} = I^2R$)

9 Fig. 9 shows the temperature-time graph of a substance that is allowed to cool. The substance has a mass of 200 g and is in liquid state when the temperature is 220 °C.

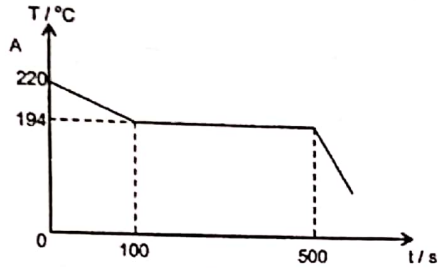


Fig. 9

(a) Define specific latent heat of fusion. [1]

Specific latent heat of fusion is the amount of energy required to change unit mass of a substance from solid to liquid state without a change in temperature.

(b) Explain why the liquid is losing thermal energy to the surrounding. [1]

The liquid is at a higher temperature compared to the surrounding.

(c) During the 100 s to 500 s period, the temperature of the substance is constant. Explain why the internal energy of the substance is decreasing. [2]

The liquid is changing from liquid to a solid.

During solidification, (potential) energy decreases / is released / is lost to the surrounding.

Hence the internal energy (potential + kinetic) is decreasing.

(d) State whether the specific heat capacity of the substance is higher when it is in liquid state or in solid state. Use Fig. 9 to explain your answer. [2]

Specific heat capacity is higher when it is in liquid state.

In liquid state, the gradient of the graph is smaller. OR

Within the same time period, the change in temperature is less.

(e) The substance loses heat at a constant rate of 400 W. Calculate the specific latent of fusion of the substance. [2]

$P \times t = m\ell_f$

$400 \times (500 - 100) = 200 \times \ell_f$

$\ell_f = 800\ J/g$

(f) 150 g of water at 30 °C is added to the substance when its temperature is 190 °C. Given that the specific heat capacity of the substance is 2.1 $Jg^{-1}°C^{-1}$ and the specific heat capacity of water is 4.2 $Jg^{-1}°C^{-1}$, find the final temperature of the substance. Assume that there is no heat loss to the surroundings. [2]

Let the final temperature be T

Heat loss by substance = heat gain by water

$200 \times 2.1 \times (190 - T) = 150 \times 4.2 \times (T - 30)$

$79\,800 - 420T = 630T - 18\,900$

$98\,700 = 1050\,T$

**$T = 94\ °C$

10 Either

Fig. 10 shows a circuit with two ammeters, a resistor and a lamp.

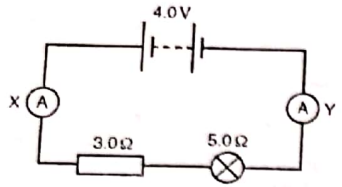


Fig. 10

(a) Define current flow. [1]

Current flow is the rate of flow of electric charge (through a given point of a conductor).

(b) Determine the reading on ammeter X. [2]

V = IR
4.0 = I x (3.0 + 5.0)
I = 0.50 A

(c) Explain why the readings on ammeter X and ammeter Y are the same. [1]

Current in a series circuit is the same throughout the circuit. OR
Current is not used up in the circuit.

(d) Calculate the potential difference across the lamp. [2]

V = IR
= 0.50 x 5.0
= 2.5 V

(e) Explain why the current flowing through the lamp changes when the circuit is switched on for some time. [2]

After some time, the lamp heats up and its resistance increases.
Since the total resistance for the circuit changes (increase), the current through the lamp changes / decreases.

(f) The ammeter Y is replaced with a voltmeter. Explain why the reading on ammeter X becomes very low. [2]

The resistance of the voltmeter is very high.
Hence the current flow in the circuit will be very low.

10 Or

Fig. 11 shows the speed-time graph of a car.

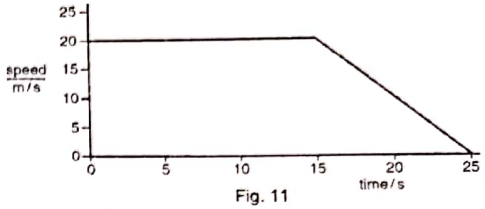


Fig. 11

(a) State how the graph shows that the speed of the car is constant during the first 15 s. [1]

Graph is a horizontal straight line / gradient of graph is 0.

(b) Calculate the deceleration of the car from 15 s to 25 s. [2]

a = v – u / t
= (0 – 20) / 10
= - 2.0 ms^{-2}

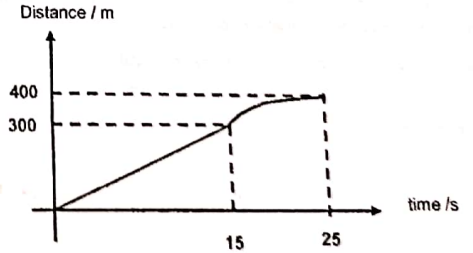
(c) Describe the net force acting on the car from 15 s to 25 s. [2]

A constant net force.
The net force acts in opposite direction to the direction which the car is moving / net force is in the direction opposing the motion of the car.

(d) Find the total distance travelled by the car in 25 s. [2]

Total distance = area under graph
= ½ x (15 + 25) x 20
= 400 m

(e) Sketch the distance-time graph of the car. Indicate the values of the distance at 15 s and 25 s on your graph. [3]



End of paper