Candidate Name	Class	Register Number

CHANGKAT CHANGI SECONDARY SCHOOL

Preliminary Examination 2019

Subject	:	**Science (Physics / Chemistry)**
Paper No	:	**5076/01**
Level	:	**Secondary 4 Exp/5 Normal Academic**
Date	:	**4th September 2019**
Duration	:	**1 Hour**
Setter	:	**Mr Hong KK / Ms Ling GK**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your name, class and register number in the spaces provided at the top of this page.
Do not use staples, paper clips, glue or correction fluid.

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 OTAS sheet.

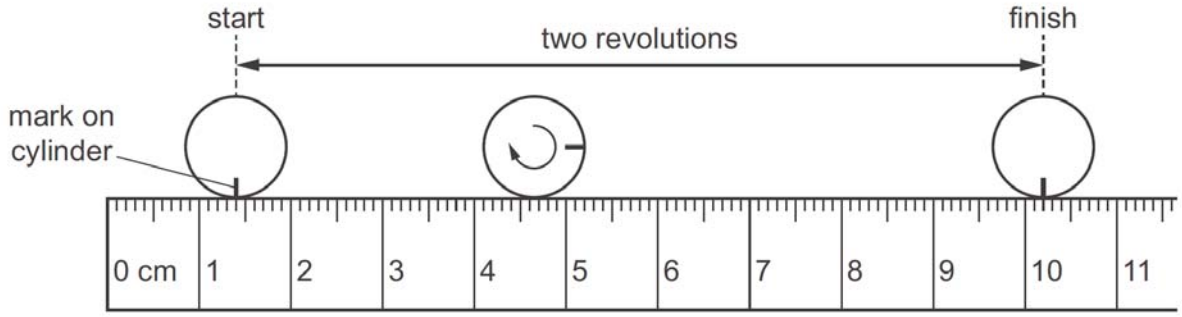
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

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

For Examiners' Use	Marks
Paper 1	/ 40
Personal Target	Actual Grade
Parent's / Guardian's Signature	

This Question Paper consists of **9** printed pages.

1 A small cylinder is rolled along a ruler and completes two revolutions.

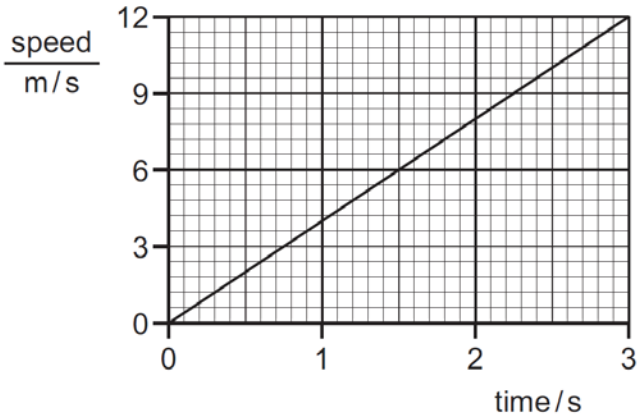


The circumference is the distance around the outside of a circle.

What is the circumference of the cylinder?

A 4.4 cm **B** 5.2 cm **C** 8.8 cm **D** 10.2 cm

2 The graph shows the speed of a car as it moves from rest.



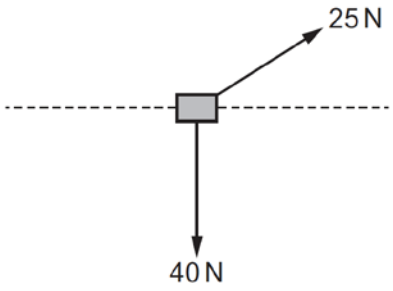
What is the average speed of the car during the first 3 s?

A 4 m/s **B** 6 m/s **C** 18 m/s **D** 36 m/s

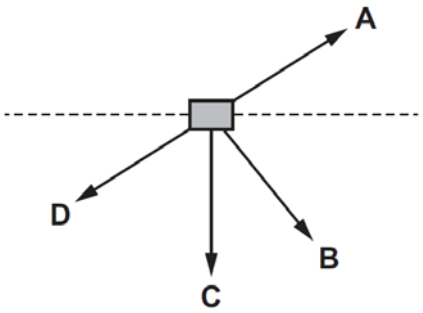
3 When a heavy coin falls a short distance towards the ground it does not reach terminal velocity.
Which of the following explains this observation correctly?

A The coin has not hit the ground.
B The weight of the coin equals the air resistance.
C The weight of the coin increases as air resistance increases.
D The weight of the coin is always more than air resistance.

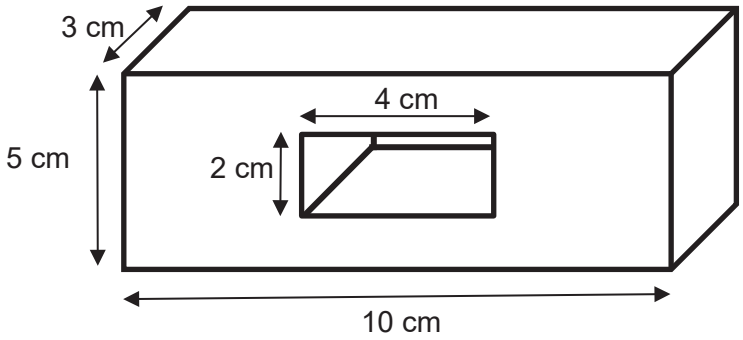
4 Forces of 25 N and 40 N act on an object in the directions shown.



Which arrow shows the direction of the resultant force on the object?



5 A hollow rectangular metal block has the dimensions shown.

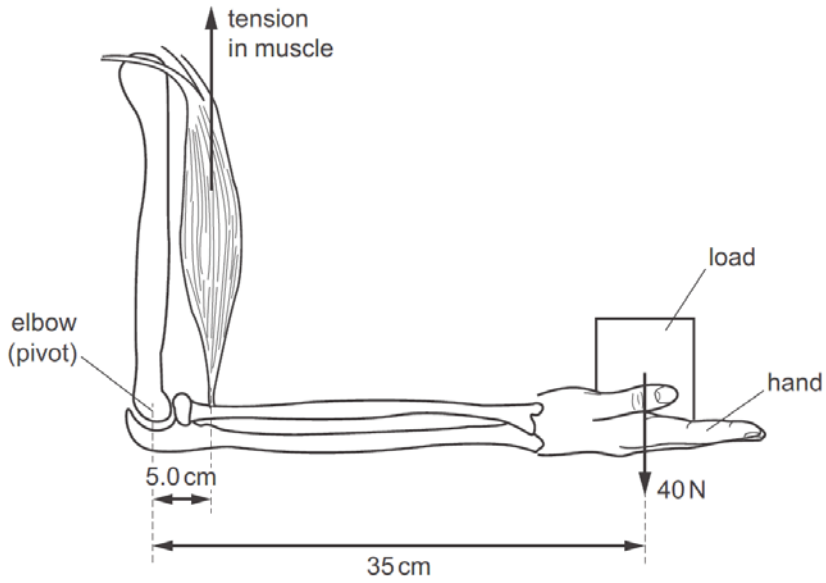


The hole in the middle goes all the way through the block.
The density of the metal is 10 g/cm^3.

What is the mass of the block?

A 12.6 g **B** 540 g **C** 1260 g **D** 1500 g

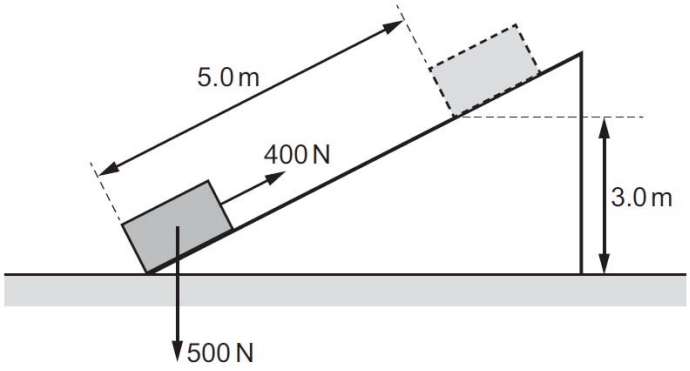
6 The diagram shows a muscle and bones in a person's arm. The hand holds a load of weight 40 N. The elbow acts as a pivot and the tension in the muscle keeps the lower part of the arm horizontal.



What is the tension in the muscle due to the load?

A 200 N **B** 240 N **C** 280 N **D** 1400 N

7 Work is done when a force of 400 N pulls a crate of weight 500 N at a constant speed along a ramp, as shown.



Part of the work done increases the gravitational potential energy E of the crate and the rest is work done W against friction.

What are the values of E and W?

	E/J	W/J
A	1500	500
B	1500	2000
C	2000	2500
D	3500	500

8 A parachutist has opened his parachute and is falling to Earth at constant speed.

What is the principal energy conversion taking place as he falls?

A kinetic energy → potential energy

B kinetic energy → thermal energy (heat)

C potential energy → kinetic energy

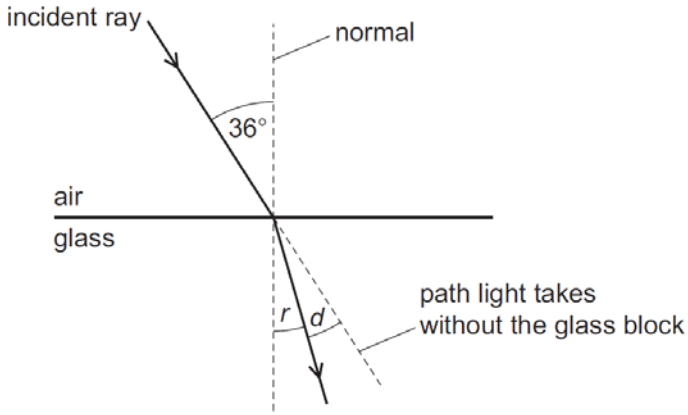
D potential energy → thermal energy (heat)

9 Water is poured into four dishes. In two of the dishes the water has a small surface area and in the other two it has a large surface area. The water in two of the dishes is cool and the water in the other two is warm.

From which dish does the water evaporate the quickest?

	surface area	temperature
A	large	cool
B	large	warm
C	small	cool
D	small	warm

10 A ray of light is incident on the surface of a glass block. The diagram is not drawn to scale. The refractive index of the glass is 1.5.

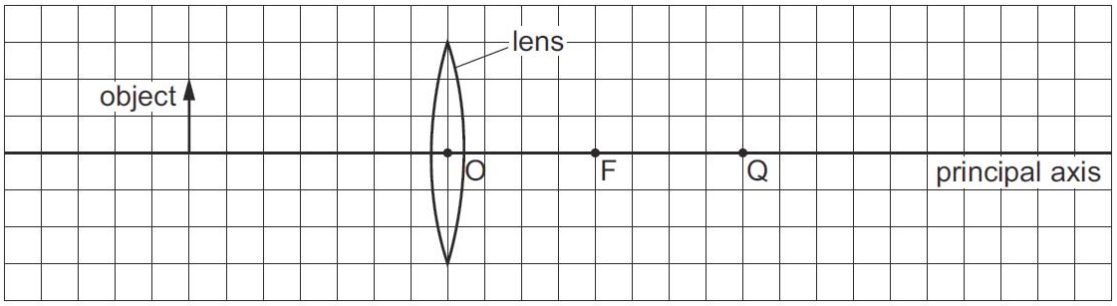


The angle of refraction is *r*. The angle between the refracted ray and the path the light takes without the glass block is *d*.

What are *r* and *d* ?

	r / °	*d* / °
A	23	12
B	24	12
C	23	13
D	24	13

11 The diagram shows an object on the principal axis of a converging (convex) lens. A principal focus of the lens is at F.

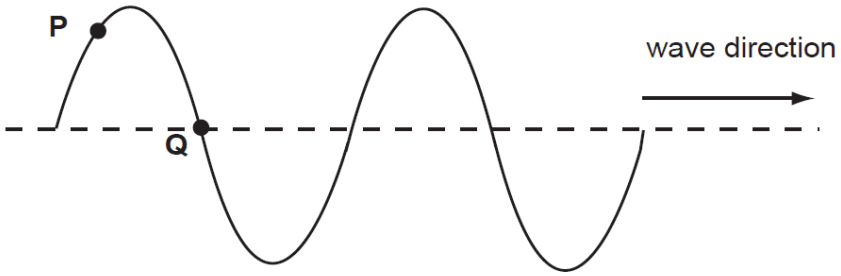


Where is the image formed by the lens?

A between O and F
B between F and Q
C at Q
D to the right of Q

12 The diagram shows a wave on a string with two points P and Q marked.

The wave is moving in the direction shown.

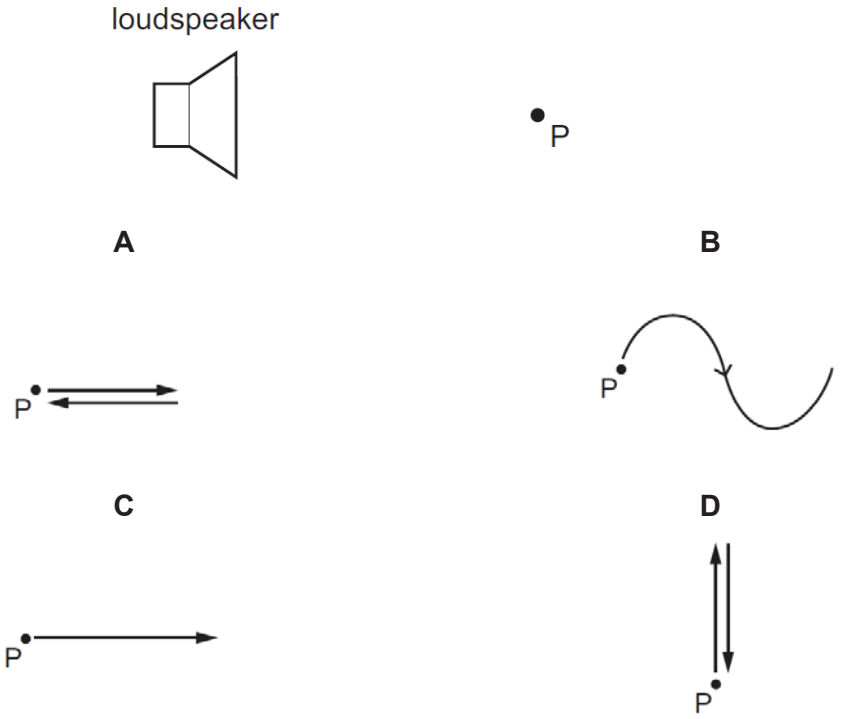


What will happen next?

A P will move to the right.
B P will move up.
C Q will not move.
D Q will move up.

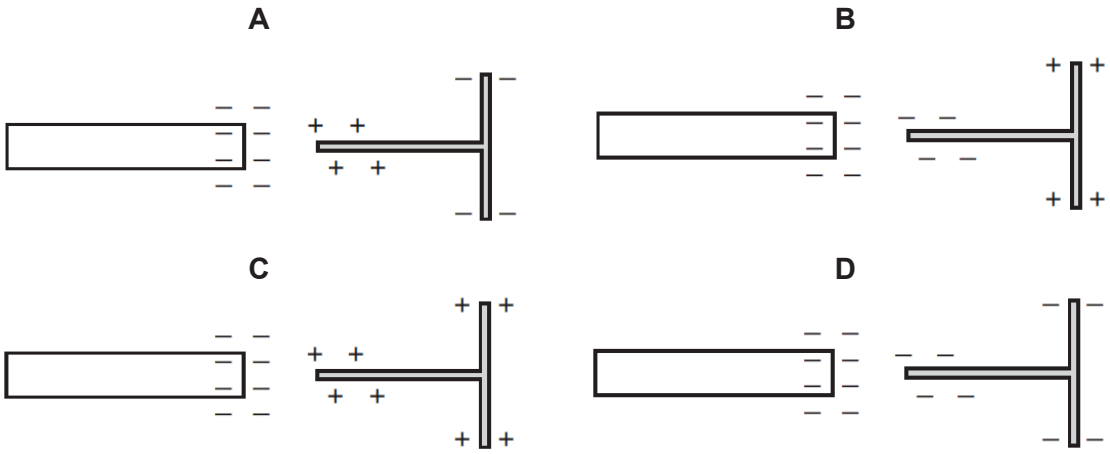
13 The diagram shows a loudspeaker that is producing a continuous sound wave of frequency 200 Hz in air.

Which diagram best shows how the sound wave causes a molecule at P to move during 0.0050 s?



14 A negatively-charged rod is brought close to an isolated T-shaped piece of metal. Initially, the metal is uncharged.

Which diagram shows the induced charge on the metal?



15 A television controller emits an infra-red beam.

Which statement about infra-red radiation in the television controller is correct?

A It causes ionisation.
B It consists of longitudinal waves.
C It has a higher frequency than ultra-violet light.
D It travels at the speed of light.

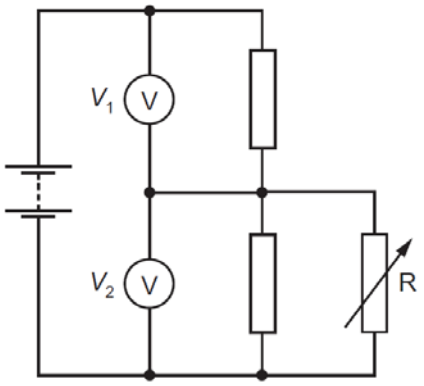
16 Many electrical appliances have metal cases.

To prevent the case from becoming 'live', the earth wire of the electric cable is attached to the case.

How does the earth wire prevent an electric shock?

A It allows a current to flow to earth, so that the appliance continues working.
B It allows a large current to flow to earth, blowing the fuse.
C It prevents the fuse from blowing.
D It reduces the current to a safe level.

17 The diagram shows a circuit with two equal fixed resistors with a variable resistor R connected in parallel to one of them.

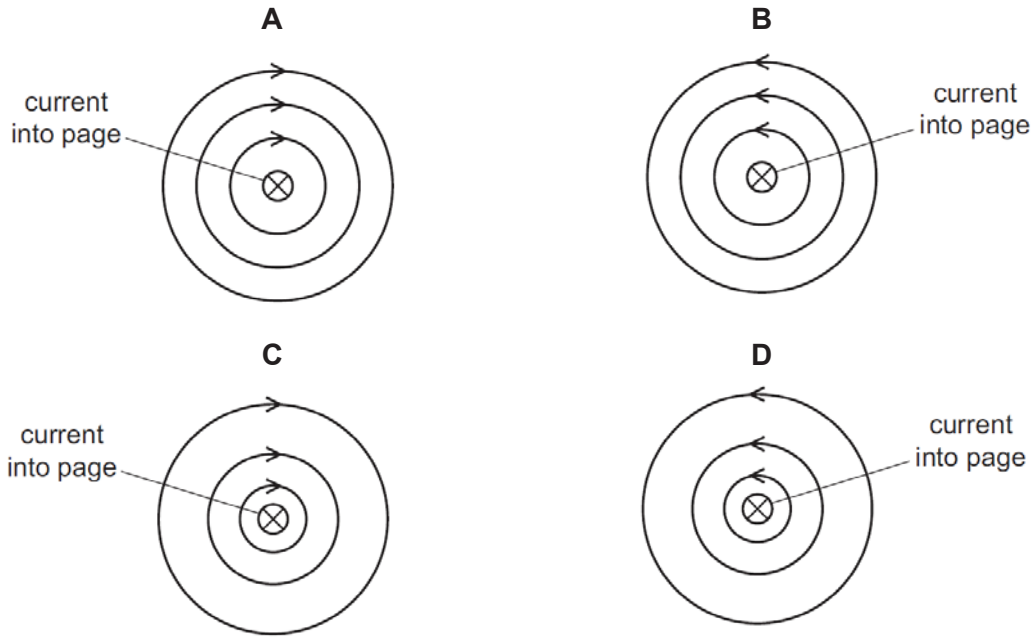


The resistance of R increases.

What happens to the two voltmeter readings?

	V_1	V_2
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

18 An electric current in a wire is into the page.
Which diagram shows the shape and direction of the magnetic field around the wire?



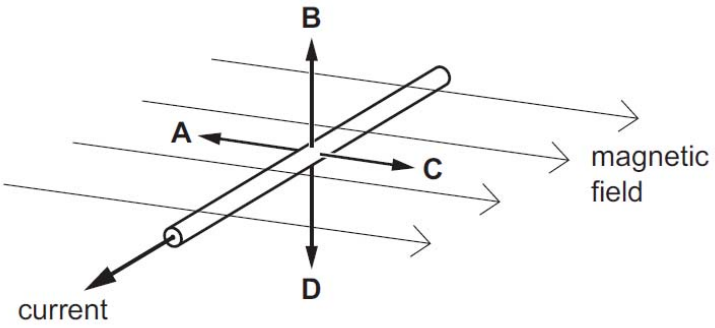
19 It costs $0.20 for 1 kWh of electrical energy.

How much will it cost to run an electrical fan of 90 W for 10 hours?

A $0.05 **B** $0.18 **C** $3.00 **D** $18.00

20 The diagram shows a current-carrying wire in a horizontal magnetic field.

Which arrow shows the direction of the force experienced by the wire?



End of Paper

Candidate Name	Class	Register Number

CHANGKAT CHANGI SECONDARY SCHOOL

Preliminary Examination 2019

Subject	:	**Science (Physics)**
Paper No	:	**5076/02**
Level	:	**Secondary 4 Express/5 Normal Academic**
Date	:	**29th August 2019**
Duration	:	**1 hour 15 minutes**
Setter	:	**Mr Hong K K**

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.
Write your name, class and register number in the spaces at the top of this page.

Answer **all** questions in Section A and any **two** questions in Section B.

In calculations, you should show all the steps in your working, giving your answer at each stage.
Enter the numbers of the Section B questions you have answered in the grid below.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiners' Use	Marks
Section A	/ 45
Section B	
	/ 10
	/ 10
Total	/ 65
Personal Target	Actual Grade
Parent's / Guardian's signature	

This Question Paper consists of **18** printed pages.

[Turn Over

Section A [45 marks]
Answer all the questions in the spaces provided.

1. A girl of mass 35 kg, on a bicycle, accelerates from rest and travels down a slope in a straight line. The girl does not use the pedals.
Fig. 1.1 shows that the gradient of the slope is constant.

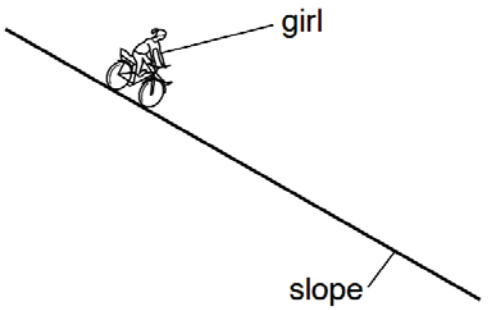


Fig. 1.1

(a) Calculate the resultant force on the girl when she is accelerating at 2.6 m/s^2.

resultant force = ... N [2]

(b) At first, her acceleration is constant. At time t_1, her acceleration starts to decrease gradually until she is travelling at a constant speed in a straight line.

On Fig. 1.2, sketch a speed-time graph for the girl from when she starts moving until she is travelling at a constant speed. [3]

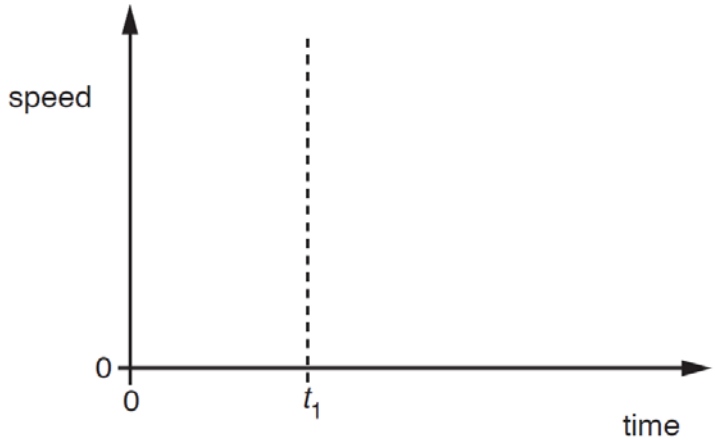


Fig. 1.2

2. Fig. 2.1 shows the dam and reservoir of a hydroelectric power station.

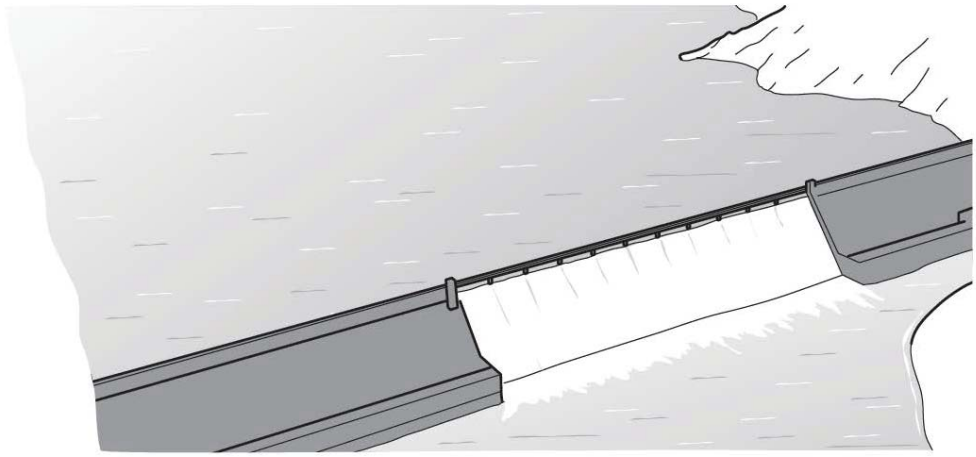


Fig. 2.1

A hydroelectric power station uses a renewable energy source.

(a) The water surface in the reservoir of the hydroelectric power station is at a vertical height of 170 m above the turbines.
In one hour, 1.6×10^{10} kg of water flows from the reservoir through the turbines.
The gravitational field strength *g* is 10 N/kg.

Calculate the loss in gravitational potential energy of the water in one hour.

loss in gravitational potential energy =…… [2]

(b) When the power station operates at full capacity, the electrical power output is 6.8×10^9 W.

Calculate the electrical energy output in one hour when the power station operates at full capacity.

electrical energy output =…… [2]

(c) Calculate the total amount of other forms of energy produced in one hour.

other forms of energy =…… J [2]

(d) Calculate the efficiency of the power station operating at full capacity, given that

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{energy input}} \times 100\% \ .$$

efficiency =…….. [1]

3. A lamp is positioned at the bottom of a small pool of water.
The critical angle for light passing from water into air is 49°.

(a) Explain what is meant by the term *critical angle*.

……

……

……

……

……

…… [2]

(b) The lamp sends rays of light towards the surface of the pool.
Fig. 3.1 shows three rays of light that are at 30°, 60° and 90° to the horizontal.

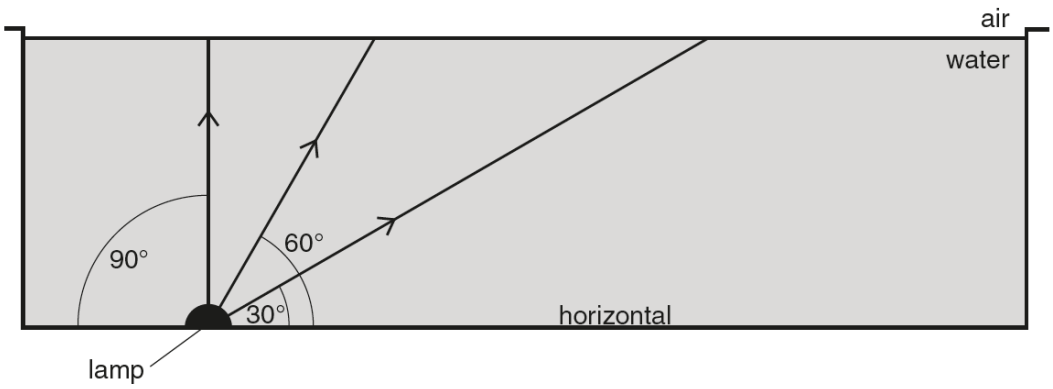


Fig. 3.1

On Fig. 3.1, draw the path taken by each of the three rays after they strike the surface of the water. [3]

4. Fig. 4.1 shows a girl standing at a distance in front of a large building.

Fig. 4.1

The girl uses a sound generator and a loudspeaker to send a short pulse of sound towards the building. The sound has a frequency of 3700 Hz.

A short time later, the girl hears an echo.

(a) Besides the hard flat surface of the building, state another important condition for the girl to be able to hear the echo clearly.

……

…… [1]

(b) The pitch of the echo is the same as that of the original sound but the echo is not as loud.
State the changes, if any, on

(i) the amplitude of the echo,

…… [1]

(ii) the frequency of the echo.

…… [1]

(c) The speed of sound in air is 330 m/s.

Calculate the wavelength of this sound.

wavelength = ……m [2]

5. Fig. 5.1 shows a metal coffee cup on a metal warming plate.

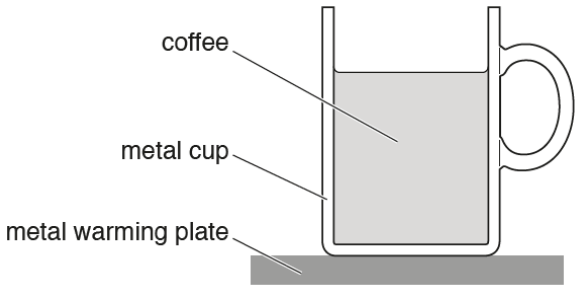


Fig. 5.1

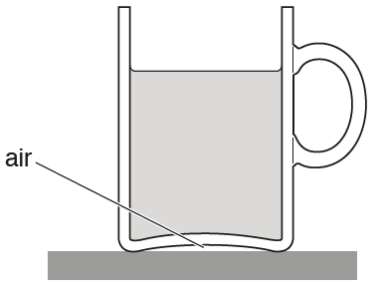


Fig. 5.2

There is a small electrical heater inside the warming plate that keeps the plate hotter than the coffee.

(a) Heat is transferred through the metal by conduction to the liquid.

Describe how heat is then transferred to all the liquid in the cup.

.....

.....

.....

.....

.....

.....

.....

..... [2]

(b) A cup of a different shape is placed on the same heater, as shown in Fig. 5.2.
The two cups are made of the same metal and contain the same amount of coffee.

Explain why the coffee in the cup in Fig. 5.2 is not kept as warm as the coffee in the cup in Fig. 5.1.

.....

.....

.....

.....

..... [2]

(c) The outside surface of the cup can be either black or white and can be either dull or shiny.

(i) State a suitable choice of colour and texture for the outside surface of the cup.

……..... [1]

(ii) Explain your answer to **(c)(i)**.

.....

..... [1]

6. Two flexible iron strips, WX and YZ, are placed close to each other inside a solenoid (long coil). The end W of WX and the end Z of YZ are held firmly in position.

Fig. 6.1 shows that the solenoid is connected to a d.c. power supply and a switch.

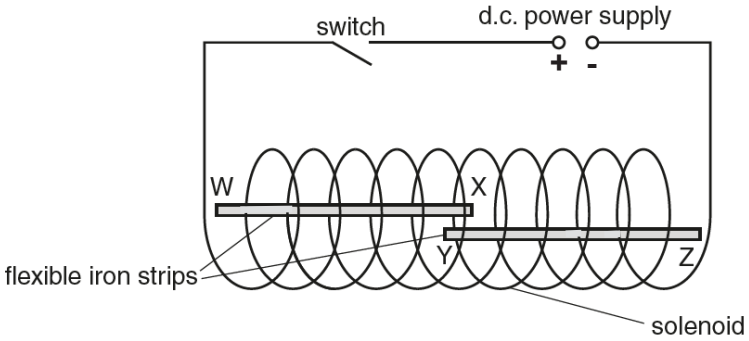


Fig. 6.1

The switch is closed and there is an electric current in the solenoid.

(a) **(i)** On Fig. 6.1, mark with an arrow the direction of current flowing in the solenoid at the turns near W and Z. [1]

(ii) State the type of magnetic pole produced at W, X, Y and Z.

1. W .....-pole
2. X .....-pole
3. Y .....-pole
4. Z .....-pole

[2]

(b) State and explain what happens to X and Y because the flexible iron strips are magnetised.

.....

.....

.....

..... [1]

7. (a) Measurements of the current and the potential difference (p.d.) across a metal wire A are made.

Fig. 7.1 shows a graph of the current against the p.d. for the wire.

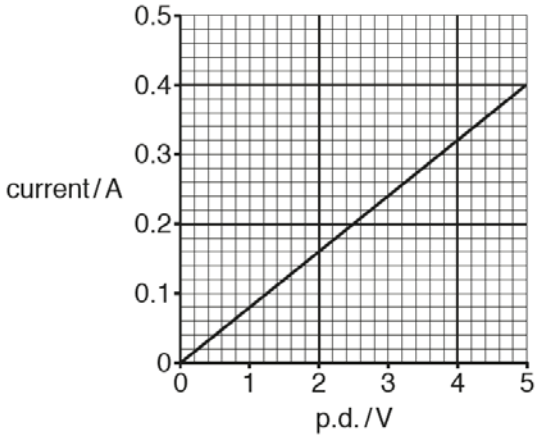


Fig. 7.1

(i) State and explain whether wire A is an ohmic or non-ohmic component.

.....

..... [1]

(ii) State how the graph shows that the temperature of the wire does not change in the experiment.

.....

..... [1]

(iii) Determine the resistance of the wire A.

resistance of wire A = ... Ω [2]

(b) Another wire B of the same material has the same length as the original wire A but has only half the cross-sectional area.

(i) Determine the resistance of the new wire B.

resistance of wire B = ... Ω [1]

(ii) On Fig. 7.1, draw the graph for the new wire B. [1]

8. A student sets up the circuit shown in Fig. 8.1.

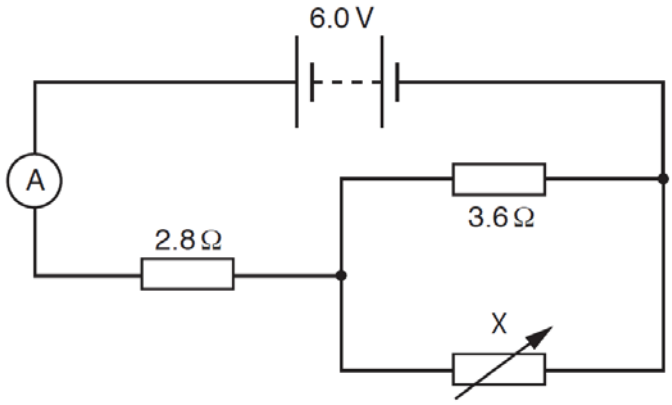


Fig. 8.1

The electromotive force (e.m.f.) of the battery is 6.0 V.

(a) The resistance of the variable resistor X is set to 1.8 Ω.

Determine

(i) the total resistance of the circuit,

total resistance = ... Ω [2]

(ii) the current measured by the ammeter.

current = ... A [2]

(b) **(i)** State what is meant by the potential difference (p.d.) across a component in a circuit.

.....

.....

..... [1]

(ii) The resistance of X is increased.

State what happens, if any, to the p.d. across the 2.8 Ω resistor. Explain your answer.

.....

.....

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..... [2]

Section B [20 MARKS]
Answer any two questions in the spaces provided.

9. Fig. 9.1 shows a satellite in orbit around the Earth.

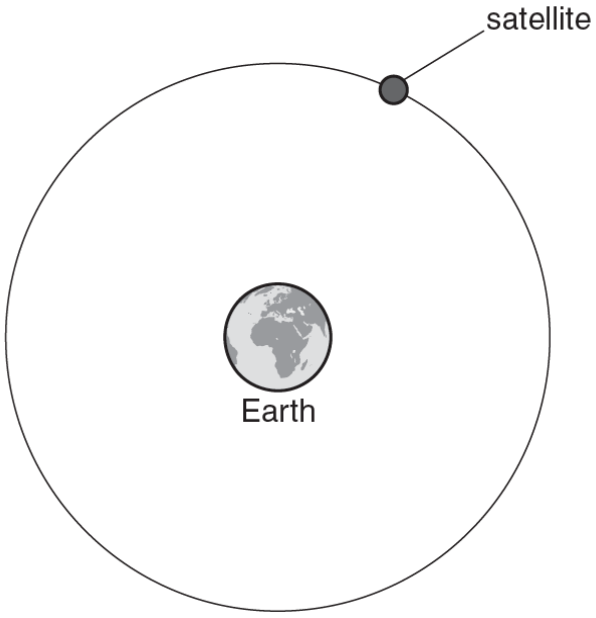


Fig. 9.1 (not to scale)

The satellite travels at a constant speed in a circular orbit.

(a) **(i)** State what is meant by velocity.

……

……

…… [1]

(ii) Explain why the velocity changes.

……

……

…… [1]

(iii) Indicate the direction of the force acting on the satellite by drawing an arrow to represent it on Fig. 9.1. [1]

(b) The satellite is placed into orbit by a rocket.

Fig. 9.2 shows the rocket as it takes off.

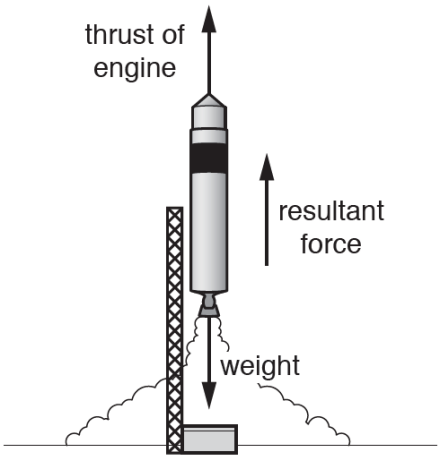


Fig. 9.2

The rocket and fuel have a total mass of 40 000 kg and a total weight of 400 000 N.
The resultant force acting upwards on the rocket is 50 000 N.

(i) Calculate the thrust produced by the rocket engine.

thrust = ……..… [2]

(ii) Calculate the acceleration of the rocket.

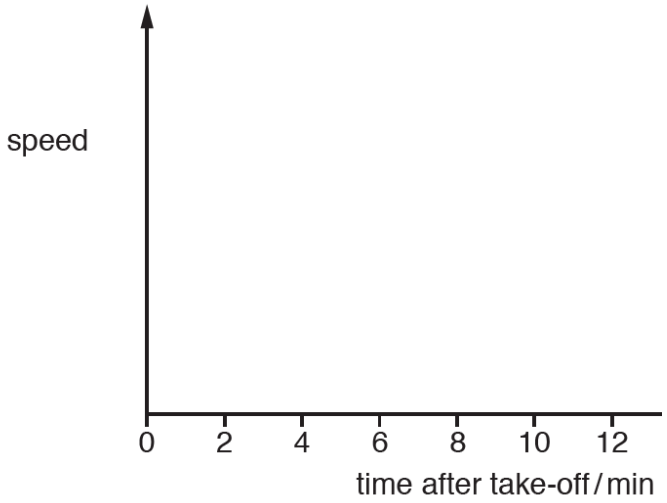
acceleration = …… [2]

(iii) The table in Fig. 9.3 describes the motion of the rocket in the first 12 minutes.

time / minutes	motion of rocket
0 to 4	uniform acceleration
4 to 6	increasing acceleration
6 to 10	decreasing acceleration
10 to 12	constant speed

Fig. 9.3

On Fig. 9.4, sketch the speed-time graph of the rocket for the first 12 minutes. You do not need to give values for the speed.



[3]

Fig. 9.4

10. Fig. 10.1 shows the brake pedal of a car which is connected to a master cylinder.

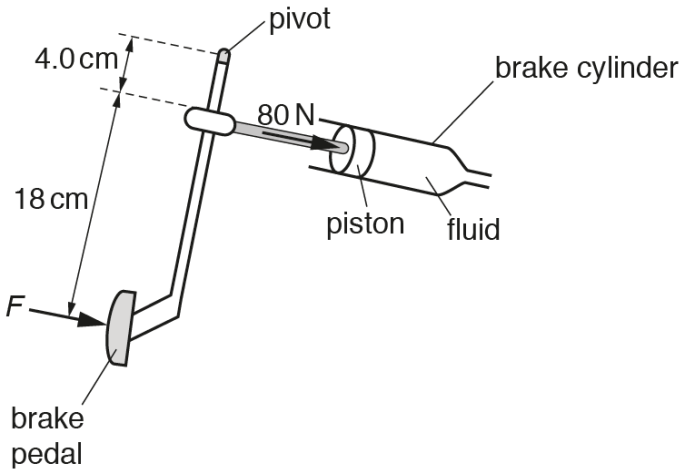


Fig. 10.1 (not to scale)

The brake is pressed with a force *F*. This force produces a moment about the pivot.

Pressing the brake causes a force of 80 N to act on the fluid in the brake cylinder.

(a) (i) State what is meant by the *moment of a force* about the pivot.

……

……

……

…… [1]

(ii) The magnitude of the force exerted on the piston by the fluid is 80 N and is acting in the opposite direction as indicated in Fig. 10.1.

Explain why this claim is correct.

……

……

…… [1]

(b) **(i)** Calculate the moment of the force acting on the piston.

moment of the force = …… [2]

(ii) Calculate the value of *F*.

force *F* = …… [2]

(iii) The cross-sectional area of the piston is 0.0012 m^2.

Calculate the pressure exerted by the brake piston on the fluid.

pressure = …… [2]

(c) Fig. 10.2 shows how the master cylinder (in Fig. 10.1) is connected to the car's braking system. The brake drum rotates with the wheel of the car.

.

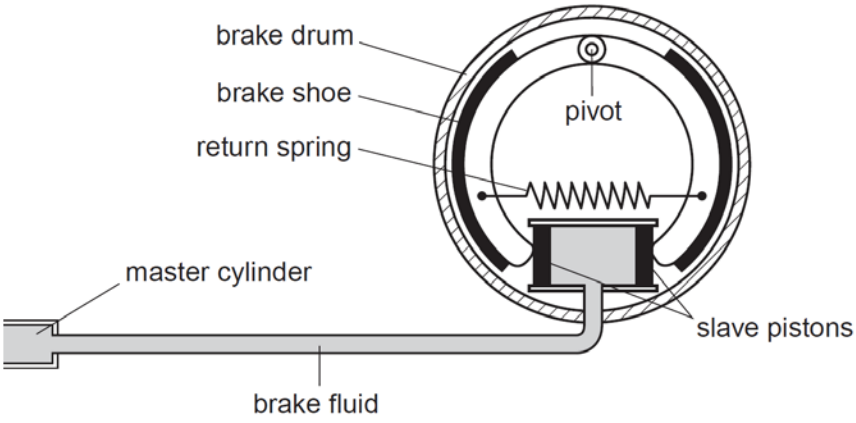


Fig. 10.2

The total cross-sectional area of the two slave pistons is 0.0040 m^2.

Calculate the total force exerted on the slave pistons by the brake fluid.

total force = ... [2]

11. (a) Fig. 11.1 shows a vertical solenoid (long coil) with an iron core held in a wooden clamp above a laboratory bench.
The solenoid is connected in series with a battery, a switch S, an ammeter and a variable resistor.
There is a voltmeter in parallel with the solenoid.

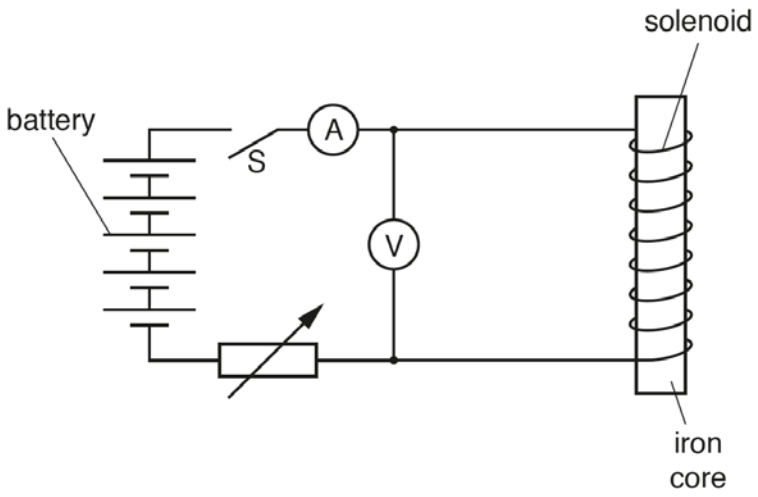


Fig. 11.1

The battery consists of five 1.5 V cells in series.

When the switch S is closed a reading of 4.0 A is shown in the ammeter.

(i) State the size of the electromotive force (e.m.f.) of the battery.

electromotive force (e.m.f.) of the battery = ... [1]

(ii) Calculate the total resistance of the circuit.

total resistance = ... [2]

(iii) The reading on the voltmeter is 6.5 V.

Calculate the power dissipated in the solenoid.

power dissipated = ... [2]

(iv) The solenoid is made of copper and the student notices that, as time passes, the solenoid becomes extremely warm.

State and explain the effect of this temperature increase on the ammeter reading.

.....

.....

.....

.....

[2]

(b) The current in the solenoid magnetises the iron core. When a iron nail is brought very near (but not touching) the magnetised core, the iron nail jumps up towards it.

(i) Explain the changes in the iron nail that causes it to be attracted to the magnetised core.

.....

.....

.....

.....

.....

..... [2]

(ii) The switch S is opened.

State and explain whether the iron nail remains in contact with the iron core.

.....

.....

.....

..... [1]

End of Paper

Candidate Name	Class	Register Number

CHANGKAT CHANGI SECONDARY SCHOOL

Preliminary Examination 2019

Subject	:	**Science (Physics / Chemistry)**
Paper No	:	**5076/01**
Level	:	**Secondary 4 Exp/5 Normal Academic**
Date	:	**4th September 2019**
Duration	:	**1 Hour**
Setter	:	**Mr Hong KK / Ms Ling GK**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your name, class and register number in the spaces provided at the top of this page.
Do not use staples, paper clips, glue or correction fluid.

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 OTAS sheet.

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.

For Examiners' Use	Marks
Paper 1	/ 40
Personal Target	Actual Grade
Parent's / Guardian's Signature	

This Question Paper consists of **9** printed pages.

1	2	3	4	5	6	7	8	9	10
A	B	D	B	C	C	B	D	B	C
11	12	13	14	15	16	17	18	19	20
D	D	A	A	D	B	B	C	B	B

Candidate Name	Class	Register Number

CHANGKAT CHANGI SECONDARY SCHOOL

Preliminary Examination 2019

Subject	:	**Science (Physics)**
Paper No	:	**5076/02**
Level	:	**Secondary 4 Express/5 Normal Academic**
Date	:	**29th August 2019**
Duration	:	**1 hour 15 minutes**
Setter	:	**Mr Hong K K**

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.
Write your name, class and register number in the spaces at the top of this page.

Answer **all** questions in Section A and any **two** questions in Section B.

In calculations, you should show all the steps in your working, giving your answer at each stage.
Enter the numbers of the Section B questions you have answered in the grid below.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiners' Use	Marks
Section A	/ 45
Section B	
	/ 10
	/ 10
Total	/ 65
Personal Target	Actual Grade
Parent's / Guardian's signature	

This Question Paper consists of **18** printed pages.

[Turn Over

Section A [45 marks]
Answer all the questions in the spaces provided.

1. A girl of mass 35 kg, on a bicycle, accelerates from rest and travels down a slope in a straight line. The girl does not use the pedals.
Fig. 1.1 shows that the gradient of the slope is constant.

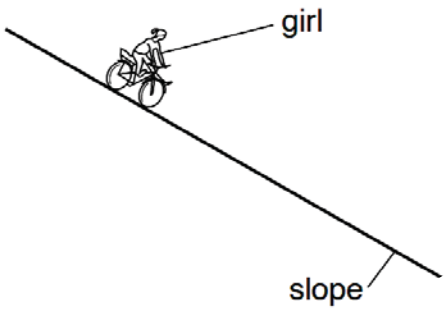


Fig. 1.1

(a) Calculate the resultant force on the girl when she is accelerating at 2.6 m/s^2.

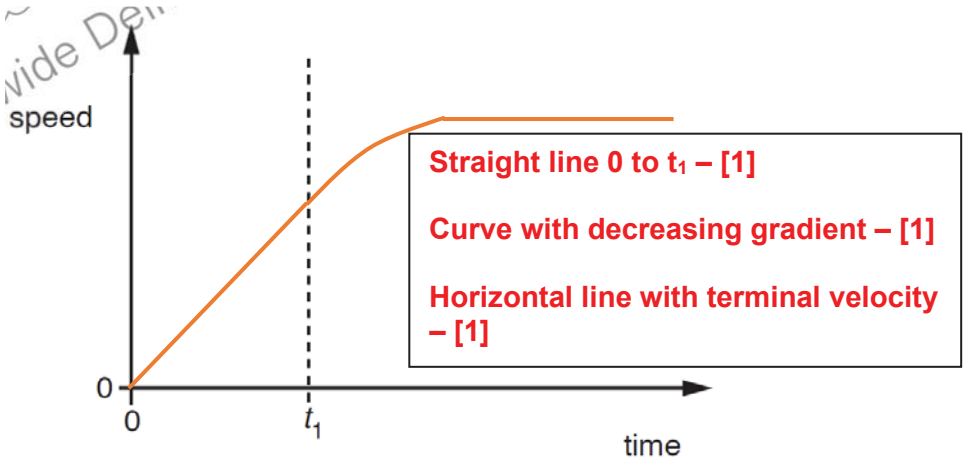
F = ma = 35 x 2.6 [1]

= 91 N [1]

resultant force = ... N [2]

(b) At first, her acceleration is constant. At time t_1, her acceleration starts to decrease gradually until she is travelling at a constant speed in a straight line.

On Fig. 1.2, sketch a speed-time graph for the girl from when she starts moving until she is travelling at a constant speed. [3]



Straight line 0 to t_1 – [1]

Curve with decreasing gradient – [1]

Horizontal line with terminal velocity – [1]

Fig. 1.2

2. Fig. 2.1 shows the dam and reservoir of a hydroelectric power station.

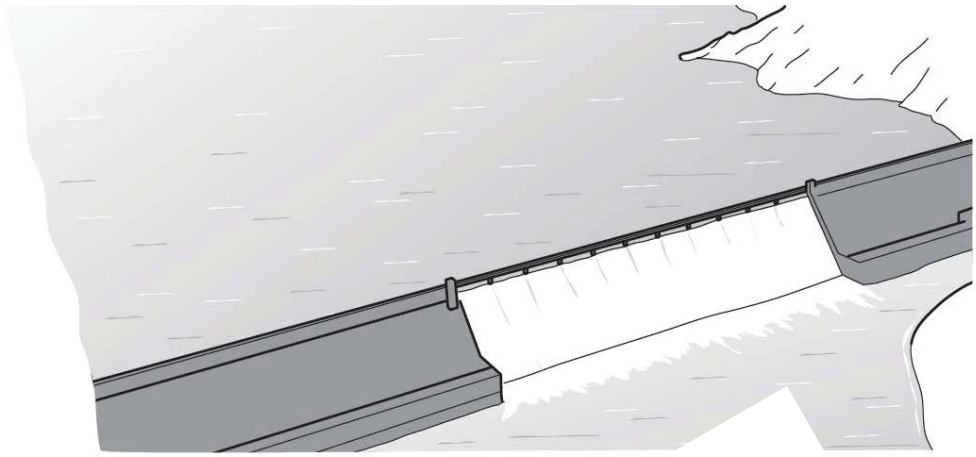


Fig. 2.1

A hydroelectric power station uses a renewable energy source.

(a) The water surface in the reservoir of the hydroelectric power station is at a vertical height of 170 m above the turbines.
In one hour, 1.6×10^{10} kg of water flows from the reservoir through the turbines.
The gravitational field strength g is 10 N/kg.

Calculate the loss in gravitational potential energy of the water in one hour.

gpe = mgh = $(1.6 \times 10^{10})(10)(170)$ [1]

= 2.72×10^{13} J [1 - 2 or 3 sf]

loss in gravitational potential energy =..... [2]

(b) When the power station operates at full capacity, the electrical power output is 6.8×10^9 W.

Calculate the electrical energy output in one hour when the power station operates at full capacity.

Energy, E = P x t = (6.8×10^9) (60 x 60) [1]

= 2.45×10^{13} J [1 - 2 or 3 sf]

electrical energy output =..... [2]

(c) Calculate the total amount of other forms of energy produced in one hour.

loss in gpe = electrical energy + other forms of energy
other forms of energy = $2.72 \times 10^{13} - 2.45 \times 10^{13}$ J [1]

= 2.72×10^{12} J [1 - 2 or 3 sf]

other forms of energy =..... J [2]

(d) Calculate the efficiency of the power station operating at full capacity, given that

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{energy input}} \times 100\% .$$

Efficiency = $(2.45 \times 10^{13}) / (2.72 \times 10^{13}) \times 100\%$

= 90% [1]

efficiency =..... [1]

3. A lamp is positioned at the bottom of a small pool of water.
The critical angle for light passing from water into air is 49°.

(a) Explain what is meant by the term *critical angle*.

Critical angle is the angle of incidence for a ray travelling from an optically denser medium [1] to a less medium and the angle of refraction is 90°. [1]

..... [2]

(b) The lamp sends rays of light towards the surface of the pool.
Fig. 3.1 shows three rays of light that are at 30°, 60° and 90° to the horizontal.

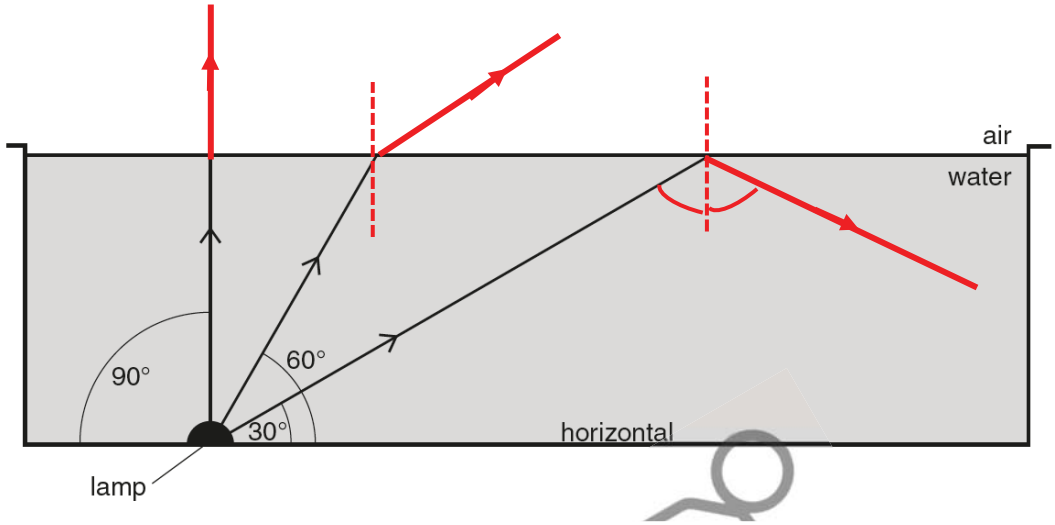


Fig. 3.1

On Fig. 3.1, draw the path taken by each of the three rays after they strike the surface of the water. [3]

4. Fig. 4.1 shows a girl standing at a distance in front of a large building.

Fig. 4.1

The girl uses a sound generator and a loudspeaker to send a short pulse of sound towards the building. The sound has a frequency of 3700 Hz.

A short time later, the girl hears an echo.

(a) Besides the hard flat surface of the building, state another important condition for the girl to be able to hear the echo clearly.

Distance of building must be at least 200 m [1] so the will be heard after 1.3 seconds later.

..... [1]

(b) The pitch of the echo is the same as that of the original sound but the echo is not as loud.
State the changes, if any, on

(i) the amplitude of the echo,

Smaller [1]

..... [1]

(ii) the frequency of the echo.

Unchanged [1]

..... [1]

(c) The speed of sound in air is 330 m/s.

Calculate the wavelength of this sound.

$\lambda = v / f = 330 / 3700$ **[1]**

$= 0.089$ m **[1]**

wavelength = ...m [2]

5. Fig. 5.1 shows a metal coffee cup on a metal warming plate.

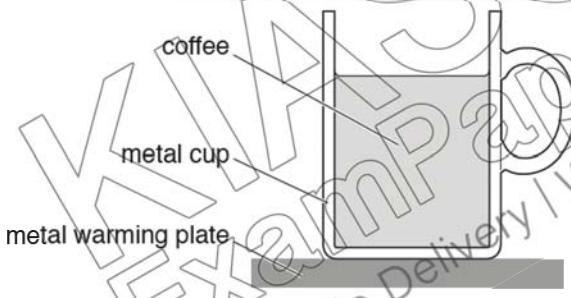


Fig. 5.1

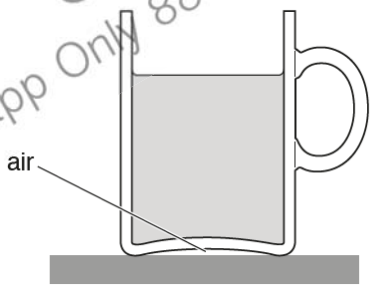


Fig. 5.2

There is a small electrical heater inside the warming plate that keeps the plate hotter than the coffee.

(a) Heat is transferred through the metal by conduction to the liquid.

Describe how heat is then transferred to all the liquid in the cup.

Liquid at the bottom of the cup is heated up and becomes less dense and rises. [1]

Colder liquid at the top is denser and sinks and a convection current is set up. [1]

.....

.....

.....

..... [2]

(b) A cup of a different shape is placed on the same heater, as shown in Fig. 5.2.
The two cups are made of the same metal and contain the same amount of coffee.

Explain why the coffee in the cup in Fig. 5.2 is not kept as warm as the coffee in the cup in Fig. 5.1.

For cup in Fig. 5.2, there is an air gap between the warming plate and the bottom of the cup. [1]

Air is a very poor conductor and reduce the heat transfer by conduction to cup. [1]

..... [2]

(c) The outside surface of the cup can be either black or white and can be either dull or shiny.

(i) State a suitable choice of colour and texture for the outside surface of the cup.

White and smooth surface. [1] [1]

(ii) Explain your answer to **(c)(i)**.

White and smooth surface is a poor emitter of heat so reduces the heat loss from the cup. [1]

[1]

6. Two flexible iron strips, WX and YZ, are placed close to each other inside a solenoid (long coil). The end W of WX and the end Z of YZ are held firmly in position.

Fig. 6.1 shows that the solenoid is connected to a d.c. power supply and a switch.

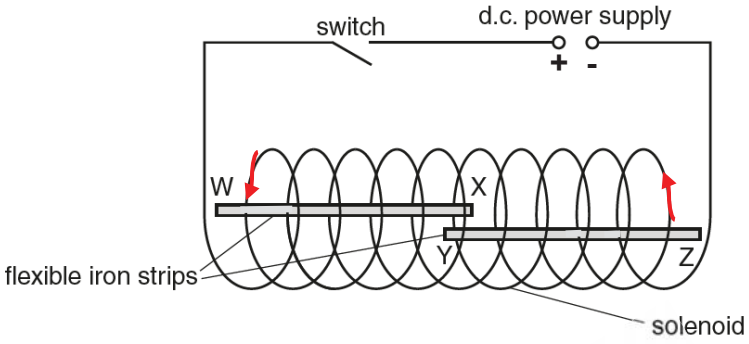


Fig. 6.1

The switch is closed and there is an electric current in the solenoid.

(a) **(i)** On Fig. 6.1, mark with an arrow the direction of current flowing in the solenoid at the turns near W and Z.

See above diagram - arrows. [1]

(ii) State the type of magnetic pole produced at W, X, Y and Z.

1. W ..... **North** -pole
2. X ..... **South** -pole
3. Y ..... **North** -pole
4. Z ..... **South** -pole

[2]

(b) State and explain what happens to X and Y because the flexible iron strips are magnetised.

As X and Y are unlike poles, they will attract. [1]

.....

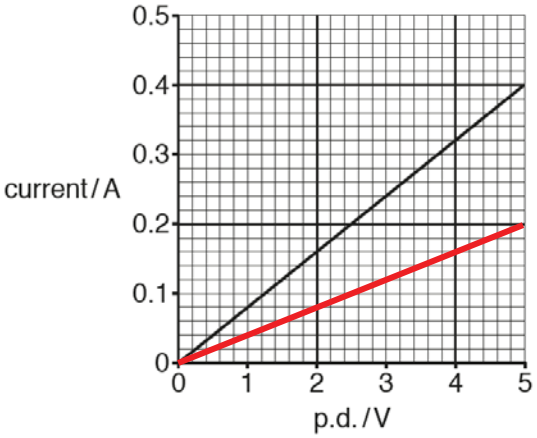
.....

.....

[1]

7. **(a)** Measurements of the current and the potential difference (p.d.) across a metal wire A are made.

Fig. 7.1 shows a graph of the current against the p.d. for the wire.



(b)(ii) straight line with as shown. [1]

Fig. 7.1

(i) State and explain whether wire A is an ohmic or non-ohmic component.

Wire A is ohmic as the graph is a straight line that passes through the origin OR the current is directly proportional to the p.d. [1]

..... [1]

(ii) State how the graph shows that the temperature of the wire does not change in the experiment.

Graph shows a constant gradient and thus a constant resistance so temperature is constant. [1]

..... [1]

(iii) Determine the resistance of the wire A.

R = 1/gradient or V/I = 5/0.4 [1]

= 12.5 Ω. [1]

resistance of wire A = ... Ω [2]

(b) Another wire B of the same material has the same length as the original wire A but has only half the cross-sectional area.

(i) Determine the resistance of the new wire B.

As cross-sectional area is halved, its resistance is doubled, R = 2 x 12.5 = 25 Ω. [1]

resistance of wire B = ... Ω [1]

(ii) On Fig. 7.1, draw the graph for the new wire B. [1]

8. A student sets up the circuit shown in Fig. 8.1.

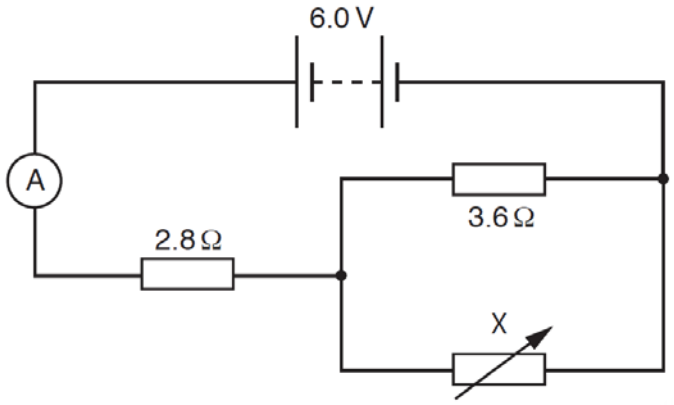


Fig. 8.1

The electromotive force (e.m.f.) of the battery is 6.0 V.

(a) The resistance of the variable resistor X is set to 1.8 Ω.

Determine

(i) the total resistance of the circuit,

1/r = 1/3.6 + 1/1.8 = 3/3.6
r = 1.2 Ω [1]

R = 1.2 + 2.8 = 4.0 Ω. [1]

total resistance = ... Ω [2]

(ii) the current measured by the ammeter.

I = V/R = 6 / 4 [1]

= 1.5 A [1]

current = ... A [2]

(b) **(i)** State what is meant by the potential difference (p.d.) across a component in a circuit.

Potential difference is the work done is driving a unit charge across the component. [1]

..... [1]

(ii) The resistance of X is increased.

State what happens, if any, to the p.d. across the 2.8 Ω resistor. Explain your answer.

When X increases, the resistance of the two resistors in parallel increases. [1]

Current in the circuit decreases and causes the p.d. across the 2.8 Ω to decrease. [1]

..... [2]

Section B [20 MARKS]
Answer any two questions in the spaces provided.

9. Fig. 9.1 shows a satellite in orbit around the Earth.

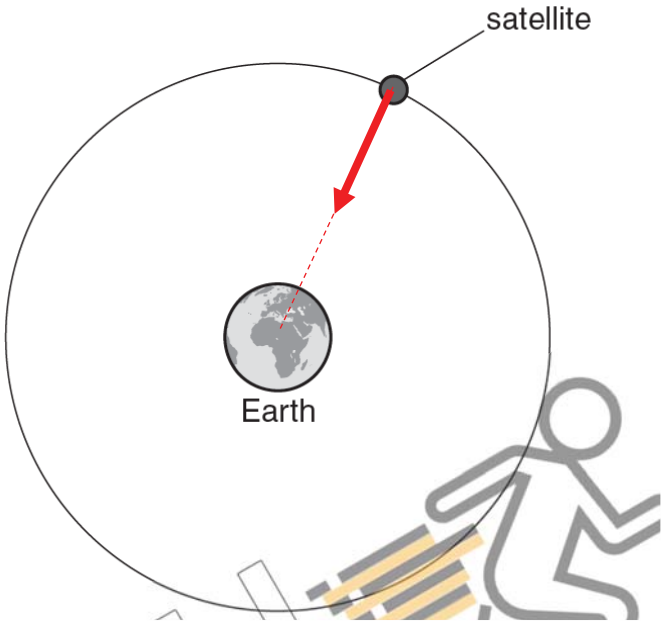


Fig. 9.1 (not to scale)

The satellite travels at a constant speed in a circular orbit.

(a) **(i)** State what is meant by velocity.

Velocity is the rate of change of speed in a specified direction OR Velocity is the rate of change of displacement. [1]

..... [1]

(ii) Explain why the velocity changes.

As the direction of motion of the satellite is constantly changing, its velocity changes [1] as a constant velocity requires both the speed and direction to be constant.

..... [1]

(iii) Indicate the direction of the force acting on the satellite by drawing an arrow to represent it on Fig. 9.1. [1]

Direction of force is towards the centre of the Earth [1].

(b) The satellite is placed into orbit by a rocket.

Fig. 9.2 shows the rocket as it takes off.

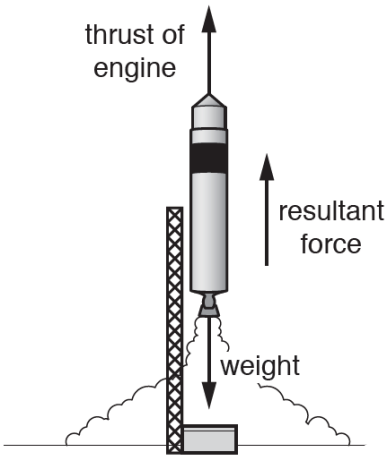


Fig. 9.2

The rocket and fuel have a total mass of 40 000 kg and a total weight of 400 000 N.
The resultant force acting upwards on the rocket is 50 000 N.

(i) Calculate the thrust produced by the rocket engine.

Resultant force, F = thrust – weight

50 000 = T - 400000 [1]

➔ T = 450 000 N [1]

thrust = ... N [2]

(ii) Calculate the acceleration of the rocket.

Resultant force, F = ma

a = F/m = 50000 / 40000 [1]

= 1.25 m/s^2 [1]

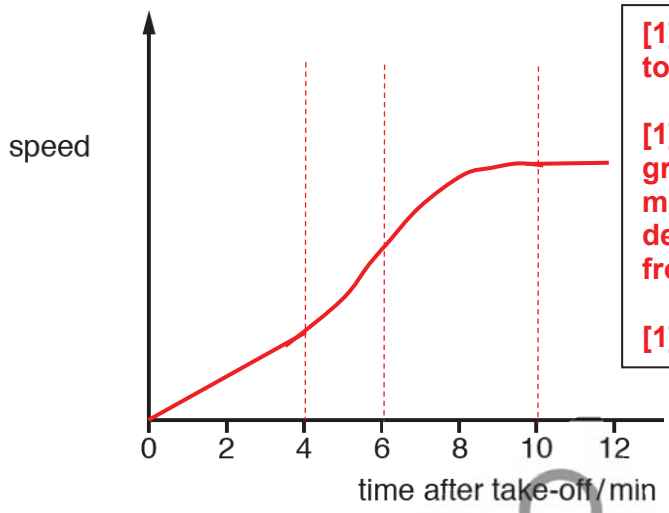
acceleration = ... m/s^2 [2]

(iii) The table in Fig. 9.3 describes the motion of the rocket in the first 12 minutes.

time / minutes	motion of rocket
0 to 4	uniform acceleration
4 to 6	increasing acceleration
6 to 10	decreasing acceleration
10 to 12	constant speed

Fig. 9.3

On Fig. 9.4, sketch the speed-time graph of the rocket for the first 12 minutes.
You do not need to give values for the speed.



[1] – str line from 0 to 4 min;

[1] – increasing gradient from 4 to 6 min & then decreasing gradient from 6 to 10 min;

[1] – horizontal line

[3]

Fig. 9.4

10. Fig. 10.1 shows the brake pedal of a car which is connected to a master cylinder.

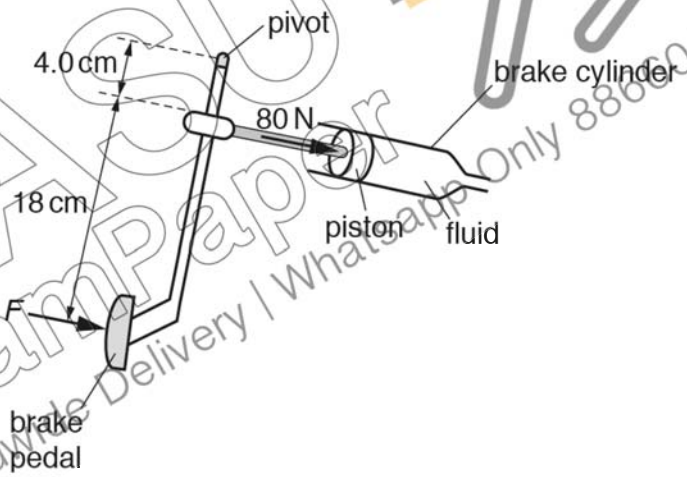


Fig. 10.1 (not to scale)

The brake is pressed with a force *F*. This force produces a moment about the pivot.

Pressing the brake causes a force of 80 N to act on the fluid in the brake cylinder.

(a) (i) State what is meant by the *moment of a force* about the pivot.

The moment of the force is turning effect produced
OR
The moment of the force is given by the product of the force and the perpendicular distance from the pivot. [1]

..... [1]

(ii) The magnitude of the force exerted on the piston by the fluid is 80 N and is acting in the opposite direction as indicated in Fig. 10.1.

Explain why this claim is correct.

Based on Newton's third law [1], which states that there is an equal but opposite force acting on the two bodies – the piston and the fluid.

..... [1]

(b) **(i)** Calculate the moment of the force acting on the piston.

moment = F x d = 80 N x 4 cm OR 80 N x 0.04 m [1]

= 320 N cm OR 3.20 N m [1]

moment of the force = ... [2]

(ii) Calculate the value of *F*.

***F* x 22 cm = 80 N x 4 cm OR *F* x 0.22m = 80 N x 0.04 m [1]**

***F* = 14.5 N [1]**

force *F* = ... [2]

(iii) The cross-sectional area of the piston is 0.0012 m^2.

Calculate the pressure exerted by the brake piston on the fluid.

P = F/A = 80 / 0.0012 [1]

= 67 000 Pa [1]

pressure = ... [2]

(c) Fig. 10.2 shows how the master cylinder (in Fig. 10.1) is connected to the car's braking system. The brake drum rotates with the wheel of the car.

.

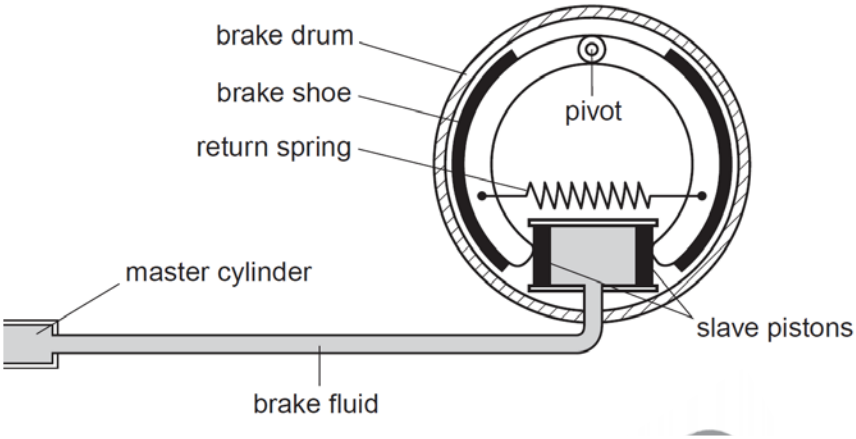


Fig. 10.2

The total cross-sectional area of the two slave pistons is 0.0040 m^2.

Calculate the total force exerted on the slave pistons by the brake fluid.

F / 0.0040 = 80 / 0.0012 [1]

F = 267 N [1]

total force = ... [2]

11. (a) Fig. 11.1 shows a vertical solenoid (long coil) with an iron core held in a wooden clamp above a laboratory bench.
The solenoid is connected in series with a battery, a switch S, an ammeter and a variable resistor.
There is a voltmeter in parallel with the solenoid.

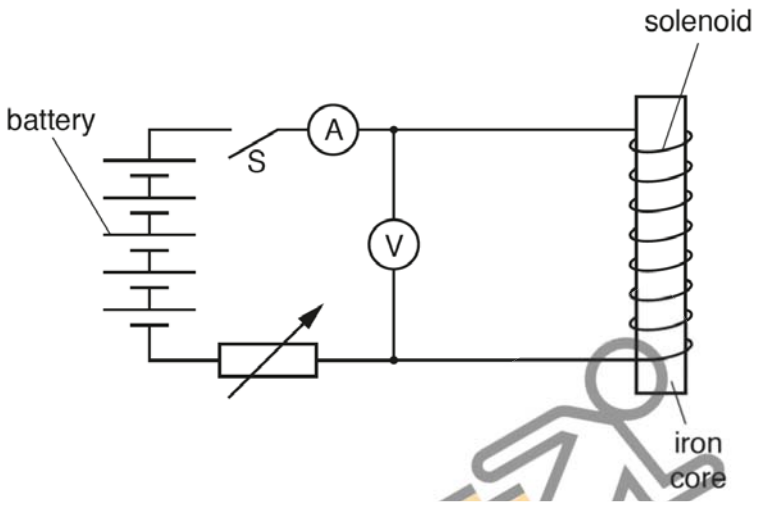


Fig. 11.1

The battery consists of five 1.5 V cells in series.

When the switch S is closed a reading of 4.0 A is shown in the ammeter.

(i) State the size of the electromotive force (e.m.f.) of the battery.

electromotive force (e.m.f.) of the battery = 5 x 1.5 = 7.5 V [1] [1]

(ii) Calculate the total resistance of the circuit.

R = V/I = 7.5 / 4.0 [1]

= 1.88 Ω [1]

total resistance = ... [2]

(iii) The reading on the voltmeter is 6.5 V.

Calculate the power dissipated in the solenoid.

P = V I = 6.5 x 4.0 [1]

= 26 W [1]

power dissipated = ... [2]

(iv) The solenoid is made of copper and the student notices that, as time passes, the solenoid becomes extremely warm.

State and explain the effect of this temperature increase on the ammeter reading.

Increased in temperature in wire increases its resistance. [1]

Total resistance increases and the current, thus ammeter reading decrease. [1]

.....

.....

[2]

(b) The current in the solenoid magnetises the iron core. When a iron nail is brought very near (but not touching) the magnetised core, the iron nail jumps up towards it.

(i) Explain the changes in the iron nail that causes it to be attracted to the magnetised core.

Magnetic induction occurs in the nail with the end of the nail nearer to the core being an unlike pole. [1]

Since unlike poles attract, the nail will be attracted by the core. [1]

.....

.....

..... [2]

(ii) The switch S is opened.

State and explain whether the iron nail remains in contact with the iron core.

Iron loses all its magnetism and thus the iron nail will not be attracted by the unmagnetised core. [1]

.....

.....

..... [1]

End of Paper

1	2	3	4	5	6	7	8	9	10
A	B	D	B	C	C	B	D	B	C
11	12	13	14	15	16	17	18	19	20
D	D	A	A	D	B	B	C	B	B