Name | Reg. No | Class

MAYFLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL MAYFLOWER

4EX/5NA

SCIENCE (PHYSICS,) **5076/01**

Physics Component

Paper 1 Multiple Choice [20 Marks]

PRELIMINARY EXAMINATION TWO

August 2017

1 hour

(with Chemistry component)

Additional Materials:
Approved calculator
Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS TO CANDIDATES:

Do not start reading the questions until you are told to do so.

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, class, and index number on the OTAS provided.

INFORMATION FOR CANDIDATES:

You are advised not to spend more than 30 minutes on this paper.

There are **twenty** 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 **OTAS**.

Read the instructions on the OTAS 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.

This question paper consists of **9** printed pages.

Setter: Ms Mok Pei Jiun

Vetter: Mr Johnson Tay

Section A: MCQ

Answer **all** the questions on the **OTAS** form provided

1 **Fig. 1.1** shows the reading on a micrometer screw gauge when it is used to measure the thickness of a sheet of metal.

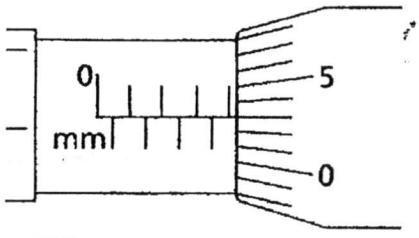


Fig. 1.1

Assuming there is no zero error on the micrometer screw gauge, what is the thickness of the sheet of metal?

A 4.03 mm **B** 4.07 mm **C** 8.03 mm **D** 43.00 mm

2 **Fig. 2.1** shows a distance-time graph that represents the motion of two cars, **P** and **Q**, travelling along the same straight road.

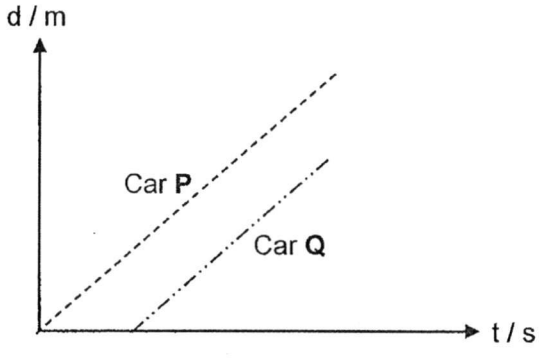


Fig. 2.1

Which of the following statements describe the motion of the two cars correctly?

I Both cars are travelling at the same constant speed.

II Car **P** maintains a constant distance from Car **Q** throughout the journey.

III Car **Q** started the journey earlier than Car **P**.

A I and II **B** I and III **C** II and III **D** None

3 Various horizontal forces can act on a moving car.

In which situation are the horizontal forces acting on the car balanced?

A The car accelerates in a straight line.

B The car changes direction at constant speed.

C The car slows down and finally stops.

D The car travels at constant speed in a straight line.

4 **Fig. 4.1** shows two skateboarders **P** and **Q** standing on a smooth and rough floor respectively.

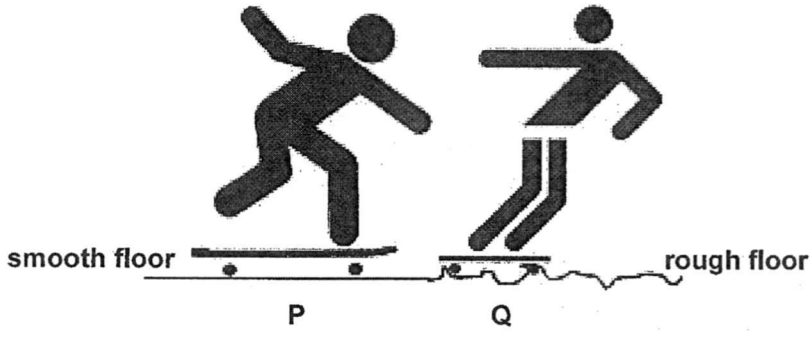


Fig. 4.1

Skateboarder **Q** pushes skateboarder **P** away with a momentary horizontal force.

Which of the following describes their motions after the push?

	Motion of P	Motion of Q
A	constant speed	decelerating
B	constant speed	zero acceleration
C	increasing speed	decelerating
D	increasing speed	zero acceleration

5 **Fig. 5.1** shows a hydraulic system.

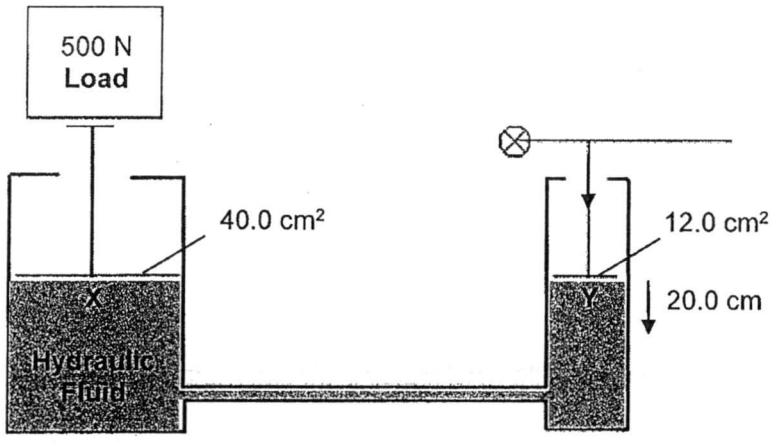


Fig. 5.1

Piston **X** of the hydraulics system is used to lift a 500 N load up at constant speed by pushing piston **Y** 20.0 cm downward.

The cross sectional area of pistons **X** and **Y** are 40.0 cm^2 and 12.0 cm^2 respectively.

The pressure in the hydraulic fluid remains the same throughout the motion.

Calculate the push force at piston **Y**.

A 150 N **B** 250 N **C** 1000 N **D** 1670 N

6 **Fig. 6.1** shows four objects that are uniformly made of the same material but of different shapes.

Fig. 6.1

Which object has the lowest stability?

7 **Fig. 7.1** shows a uniform metre rule of mass 54 kg pivoted at the 0.0 cm mark and kept horizontal by a string attached at the 75 cm mark.

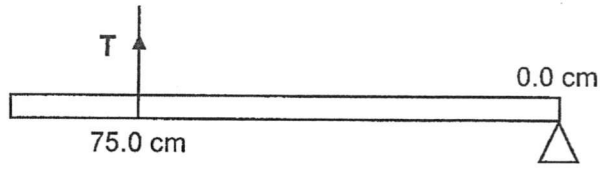


Fig. 7.1

Calculate the tension **T** in the string.

A 18 N **B** 36 N **C** 180 N **D** 360 N

8 **Fig. 8.1** shows force **F** being applied to a box of mass 10 kg to move it from the bottom of the slope to the top of the slope.

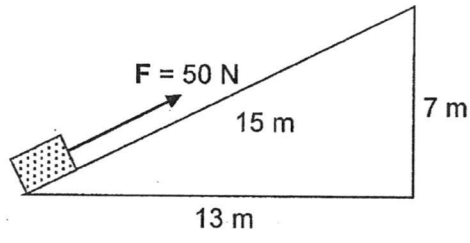


Fig. 8.1

Calculate the work done against gravity.

A 350 J **B** 650 J **C** 700 J **D** 750 J

9 Heat transfer can happen in various states of matter.

Which of the following is correct?

A Conduction of heat can happen in liquids and gases only.

B Conduction of heat can happen in solids and liquids only.

C Conduction of heat can happen in solids, liquids and gases.

D Conduction of heat can happen in solids only.

10 **Fig. 10.1** shows a slice of bread being toasted under a red-hot electric grill.

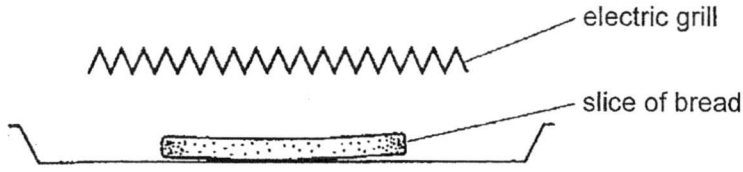


Fig. 10.1

Which statement explains how heat energy reaches the bread?

A The heat energy reaches the bread by conduction and convection.

B The heat energy reaches the bread by conduction only.

C The heat energy reaches the bread by convection and radiation.

D The heat energy reaches the bread by radiation only.

11 The following table shows the comparison of average speed of molecules and total internal energy of water at 100 °C and steam at 100 °C.

Which of the comparisons is correct?

	Average speed of molecules	**Total internal energy**
A	100°C steam higher than 100°C water	100°C steam higher than 100°C water
B	100°C steam higher than 100°C water	100°C steam same as 100°C water
C	100°C steam same as 100°C water	100°C steam higher than 100°C water
D	100°C steam same as 100°C water	100°C steam same as 100°C water

12 A solid is heated but does not melt.

What happen to the molecules of the solid?

A Molecules move randomly with constant speed during this process.

B Molecules move randomly with increasing speed during this process.

C Molecules start to break intermolecular bonds and change state.

D Molecules vibrate about more vigorously about their fixed positions.

13 When water evaporates, what happens to its molecules?

A The water molecules changes into gas molecules.

B The water molecules escape from the surface into the air.

C The water molecules form new bonds with each other.

D The water molecules were compressed into smaller molecules.

14 Sophia stands in front of a plane mirror.

There are four objects, **I**, **II**, **III** and **IV**, placed around her as shown in **Fig. 14.1**.

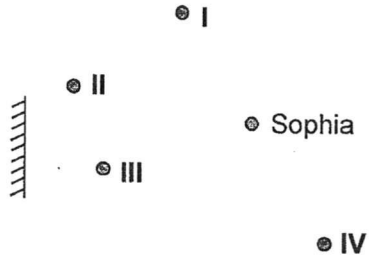


Fig. 14.1

Which object(s) can Sophia see in the plane mirror?

A All 4 objects **B** **I** and **II** **C** **III** and **IV** **D** None

15 **Fig. 15.1** shows a point light source **P** placed in front of a thin converging lens **L**.

It forms an image at point **Q**.

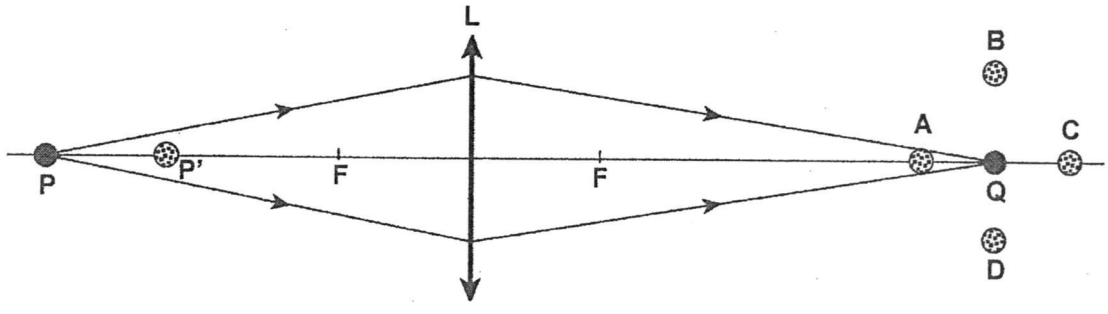


Fig. 15.1

If the light source **P** is moved to **P'**, at which point, **A**, **B**, **C**, or **D**, will the image be likely to form?

16 Five balls are floating in the sea.

Fig. 16.1 shows the positions of the balls from above.

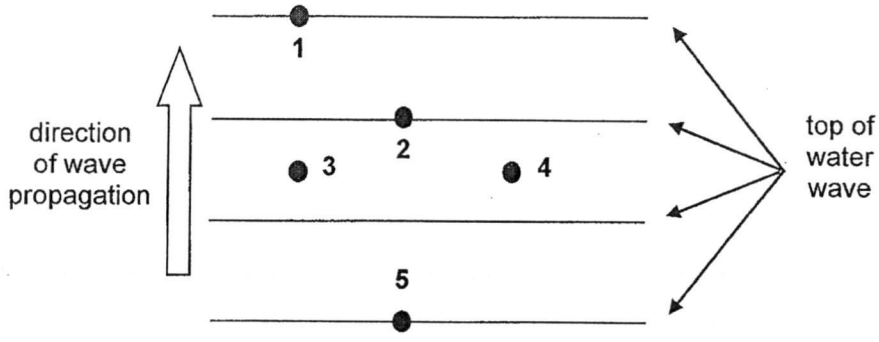


Fig. 16.1

Which balls are on the same wavefront?

A 1, 2 and 5 **B** 1 and 3 **C** 2 and 5 **D** 3 and 4

17 Sound waves from a violin and a flute are compared.

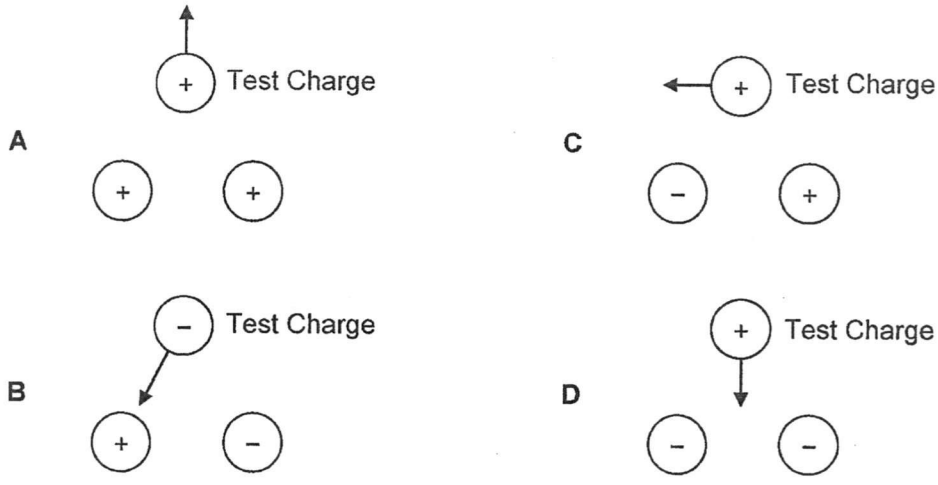
The sound wave from the violin has a smaller amplitude and smaller period than that from the flute.

Which of the following shows the comparison of loudness and pitch for the flute and the violin?

	Louder Sound	Higher Pitch
A	Flute	Flute
B	Flute	Violin
C	Violin	Flute
D	Violin	Violin

18 A positive test charge is placed in the immediate region of two point charges.

Which of the following does not show the correct direction of the resultant electrostatic force acting on the positive test charge?



19 A battery is connected to a length of resistance wire. Which of the following changes will increase the current in the battery?

A Increasing the cross-sectional area of the wiree.

B Increasing the length of the wire.

C Lowering the e.m.f. of the battery.

D Replacing the wire to one with a higher resistivity.

20 **Fig. 20.1** shows a plotting compass placed above a current carrying wire.

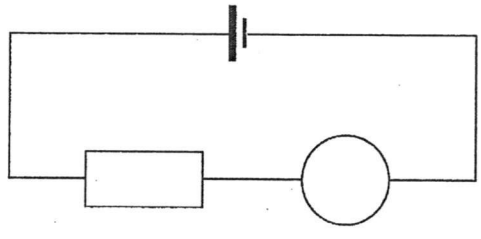


Fig. 20.1

Ignoring effects of the Earth's magnetic field, which of the following shows the direction which the compass needle will point towards?

- - - - - End of Paper - - - - -

Name | Reg. No | Class

MAYFLOWER SECONDARY SCHOOL

4EX/5NA

SCIENCE (PHYSICS)

Physics Component

Paper 2 Theory [65 Marks]

5076/02

PRELIMINARY EXAMINATION TWO

August 2017

1 hour 15 minutes

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

INSTRUCTIONS TO CANDIDATES

Do not start reading the questions until you are told to do so.

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

You may use a soft pencil for any diagrams, graphs, tables or rough working.

Write in dark blue or black pen.

Do not use staples, paper clips, glue or correction fluid.

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

You may lose marks if you do not show your working or if you do not use appropriate units.

Section A

Answer **all** questions.

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

Section B

Answer **any two** questions.

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

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

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

FOR EXAMINER'S USE		
Paper		Marks
Paper 1 (MCQ)		/ 20
Paper 2		
A		/ 45
B	Q ___	/ 10
	Q ___	/ 10
Paper 5		/ 15
Total		/ 100

This question paper consists of **14** printed pages.

Setter: Ms Mok Pei Jiun

Vetter: Mr Johnson Tay

[Turn over

Section A

Answer **all** the questions in the spaces provided.

1 Richard wants to find out how much frictional force his 1500 kg truck experiences while travelling on a level road.

He drives his truck along the level road and turns off his engine when the truck reaches the speed of 8.0 m / s, and finds that the truck was able to slow down to 7.0 m / s over a distance of 15 m.

(a) Find the time taken for the truck to slow down from 8.0 m / s to 7.0 m / s.

time taken = ... s [2]

(b) Calculate the deceleration of the truck.

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

(c) Find the frictional force acting on the truck.

frictional force = ... N [2]

2 **Fig. 2.1** shows a person flying a kite in an open field.

Fig. 2.2 shows the side view of the same flat kite, **XY**, of weight 5.0 N.

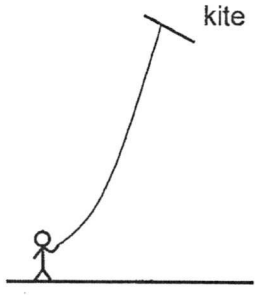


Fig. 2.1

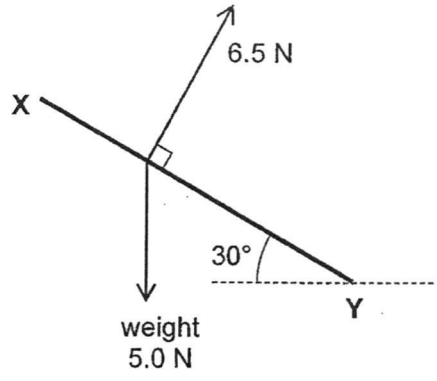


Fig. 2.2

At a particular time, the kite is inclined at 30° to the horizontal and the wind exerts a steady force of 6.5 N perpendicular to **XY** so that the kite flies freely.

Using a scaled diagram, determine the magnitude of the resultant force acting on the kite.

scale: 2 cm represents ..... N

magnitude of resultant force: ..... N

[4]

3 **Fig. 3.1** shows a 100-cm ruler pivoted at the 65-cm mark. It is balanced by a solid block of mass 120 g positioned at a distance ***d*** away from the pivot.

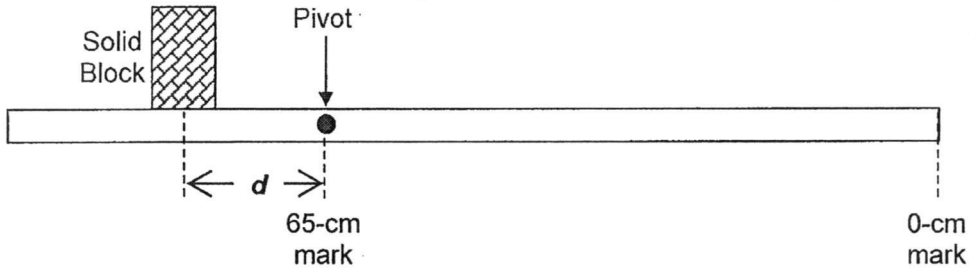


Fig. 3.1

(a) The ruler has a mass of 80 g. Given that the gravitational field strength, g, of the location is 10 N / kg. Calculate the weight of the ruler.

weight = ... N [2]

(b) Assuming that the ruler is uniformly made, mark on **Fig. 3.1**, the position of the centre of gravity of the ruler with an "**X**".

[1]

(c) Draw on **Fig. 3.1**, the line of weight of the ruler, and label it with "**W**".

[1]

(d) Find ***d***, the distance of the solid block from the pivot.

distance ***d*** = ... m [2]

(e) The solid block has a volume of 8.8 cm^3. Find the density of the solid block.

density = ... g / cm^3 [2]

4 **Fig. 4.1** shows the path taken by a smoke particle, as seen in a Brownian motion experiment.

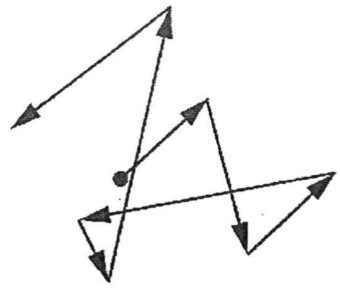


Fig. 4.1

(a) Explain why the smoke particle moved in the manner shown in **Fig. 4.1**.

.....

.....

.....

[2]

(b) State and explain what happens to the motion of the smoke particle when temperature increases.

.....

.....

.....

[2]

5 Shirley warms a cup of frozen milk at −8 °C by placing it into a container filled with hot water at 100 °C as shown in **Fig. 5.1**.

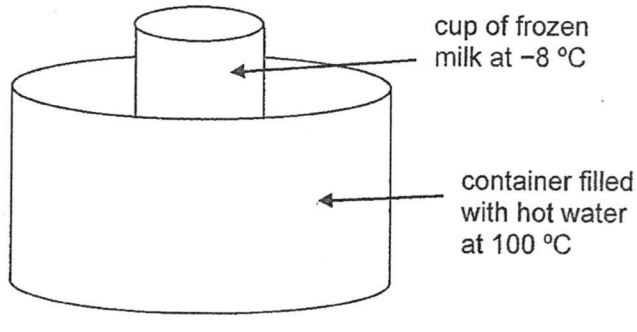


Fig. 5.1

(a) Explain how heat is transferred from the hot water to the frozen milk initially.

.....

.....

.....

[2]

(b) Temperature of the frozen milk rises steadily till −2 °C and remains at the same temperature for a few minutes although heat is transferred from the hot water to the frozen milk continually.

What is happening to the frozen milk during which the temperature remains constant.

.....

[1]

(c) Explain your answer in part **(b)** with reference to energy changes.

.....

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.....

.....

.....

[2]

6 **Fig. 6.1** below shows a thin converging lens being used to produce an image **X'** of an object **X**.

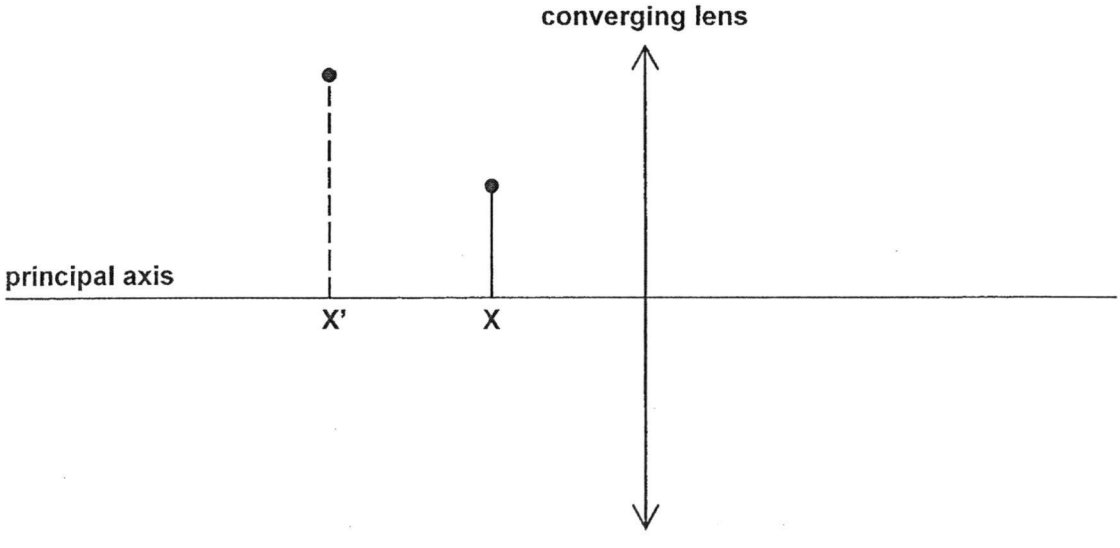


Fig. 6.1

Complete the diagram to locate the position of the principal focus **F**.
Indicate the principal focus **F** clearly on **Fig. 6.1**. [2]

7 A sound wave of speed 330 m /s in air has a wavelength of 120 m.

Calculate the period of this sound wave.

period = ... s [2]

8 **(a)** The list below contains three components of the electromagnetic spectrum.

infra-red **gamma rays** **visible light**

Arrange the components in order of increasing wavelength.

.....

[1]

(b) Satellites are used in the transmission of some television signals.

Fig. 8.1 shows a satellite above the television station where a television signal is generated. The satellite is orbiting at a distance of 36 000 km from the television station.

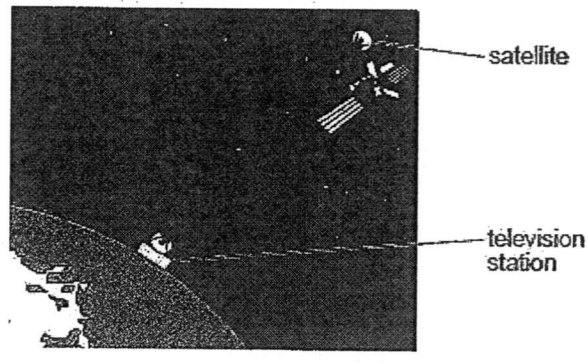


Fig. 8.1

(i) State which component of the electromagnetic spectrum is used to transmit the television signal to the satellite.

.....

[1]

(ii) Given that the component in part **(i)** travels at a speed of 3.00×10^8 m / s, calculate the time the television station takes to send a signal to the satellite.

time = ... s [2]

9 A positive point charge is propelled into a region of electric field as shown in **Fig. 9.1**.

Ignore the effects of gravity on the positive point charge for all parts of this question.

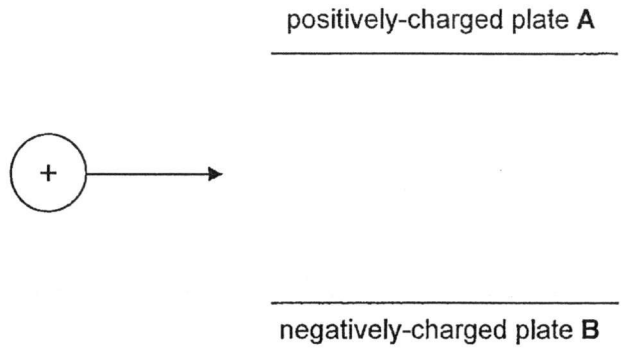


Fig. 9.1

(a) Draw on **Fig. 9.1**, a possible path that the positive point charge will take as it passes through the region of electric field between positively-charged plate **A** and negatively-charged plate **B**. [1]

(b) Account for the **forces** acting on the positive point charge when it is in the region of electric field between electric field between positively-charged plate **A** and negatively-charged plate **B**.

.....

.....

.....

.....

..... [3]

10 **Fig. 10.1** shows a wire **ABCD** positioned between the two poles of a horseshoe magnet which is resting on a top-pan balance.

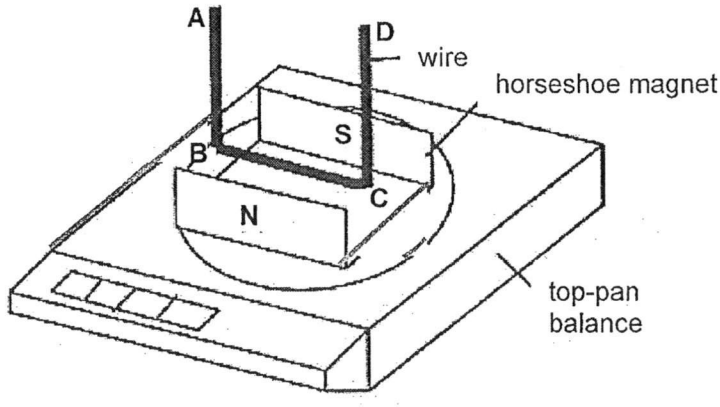


Fig. 10.1

(a) When there is no current flowing through wire **ABCD**, the top-pan balance registers only the mass of the horseshoe magnet.

The reading on the top-pan balance changes when a current flows through wire **ABCD**.

Discuss how the reading on the top-pan balance will change when the current direction in wire **ABCD** changes.

.....

.....

.....

.....

.....

.....

[3]

(b) (i) A current of 12.0 A flows through wire **ABCD** when the potential difference across points **A** and **D** is 8.00 V. Calculate the resistance of wire **ABCD**.

resistance = ... Ω [1]

(ii) If the potential dfference between points **A** and **D** is fixed at 8.00 V, and wire **ABCD** is replaced by another piece of wire of the same length and material but double the thickness, what will happen to the current flowing through wire **ABCD**? Explain your answer.

.....

.....

.....

.....

[2]

- End of Section A -

Section B

Answer any **two** questions in this section.

Write your answers in the spaces provided.

11 **Fig. 11.1** shows a ball of mass 2 kg accelerating down a rough slope from a high point.

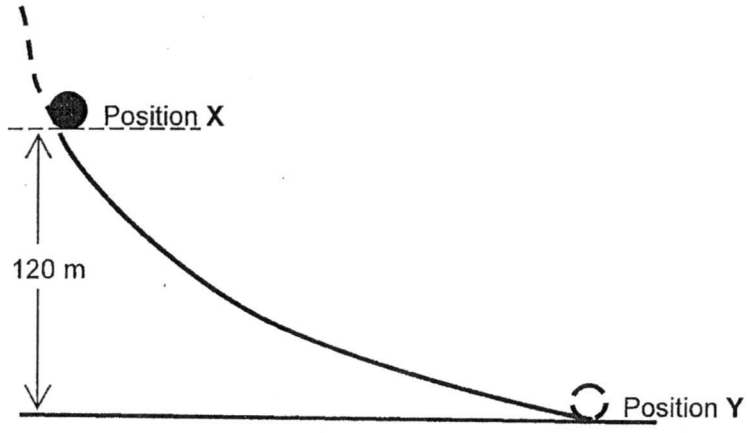


Fig. 11.1

(a) Describe and explain how the gravitational potential energy of the ball changes as it moves from Position **X** to Position **Y**.

.....

.....

.....

[2]

(b) Describe and explain how the kinetic energy of the ball changes as it moves from Position **X** to Position **Y**.

.....

.....

.....

[2]

Use the following information for subsequent parts of this question:

*Take total energy of the ball at Position **X** to be 3900 J.*

Take gravitational field strength, g, to be 10 N/kg

(c) Show that the gravitational potential energy of the ball at position **X** is 2400 J

[1]

(d) Derive the kinetic energy of the ball at position **X** and thus calculate the speed of the ball at this position.

kinetic energy = ... J [1]

speed = ... m /s [2]

(e) As the ball moves down the slope, it is experiencing irregular frictional force.

(i) Suggest a reason why the frictional force experienced by the ball is irregular.

.....

.....

[1]

(ii) A part of the ball's mechanical energy is lost to the surround due to the frictional force. Account for this loss.

.....

.....

[1]

12 **Fig. 12.1** shows the path of a light ray in a glass prism, **ABC**. The refractive index of the glass prism is 1.81.

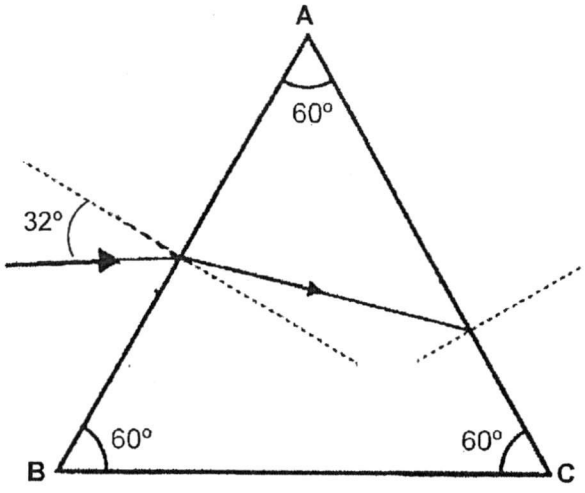


Fig. 12.2

(a) Calculate the angle of refraction of the light ray on surface **AB**.

angle of refraction = ... ° [2]

(b) Find the speed of light in the glass prism.

speed = ... m / s [2]

(c) Explain why the light ray bends in such a manner at the surface **AB**.

.....

.....

..... [2]

(d) The ray exits the prism through surface **AC**. Sketch the possible path of the emergent ray.

[1]

(e) Calculate the critical angle of the glass prism

critical angle = ... ° [1]

(f) Explain why the light ray exits the prism through surface **AC** instead of going through total internal reflection.

.....

.....

.....

.....

..... [2]

13 An air conditioner and a television are both connected to the same electrical circuit with a 240 V a.c. power supply.

Fig. 13.1 gives the normal rating and daily usage for the two electrical appliances.

	Normal Rating		Daily Usage
Electrical Appliance	Power	Voltage	
Air Conditioner	2300 W	240 V	8 hours
Television	280 W	240 V	4 hours

Fig. 13.1

(a) Calculate the total current through the main branch of the electrical circuit.

Total current = ... A [2]

(b) Fuses are normally rated at 1 A, 2 A, 5 A, 10 A, and 13 A. Suggest a suitable rating for the fuse to be fitted to the main branch of the electrical circuit. Explain your choice.

.....

.....

.....

[2]

(c) Describe a possible electrical hazard when the main branch of the electrical circuit is not fitted with a fuse.

.....

.....

[1]

(d) Given that the use of electricity is charged at \$0.12 per unit, calculate the weekly cost incurred by the two electrical appliances.

cost = ...[2]

(e) State the circumstance in which the Earth Wire would not be necessary in an electric appliance. Explain your answer.

.....

.....

.....

.....

.....

[3]

- End of Section B -

- - - - - End of Paper - - - - -

Name | Reg. No | Class

MAYFLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL MAYFLOWER

4EX/5NA

SCIENCE (PHYSICS)

5076/05

Physics Component

Paper 5 Practical [15 Marks]

PRELIMINARY EXAMINATION TWO

August 2017

1 hour 30 minute

(with Chemistry component)

Additional Materials:
Approved calculator
Soft clean eraser
Soft pencil (type B or HB is recommended)
Ruler
Curve ruler
Apparatus as listed.

READ THESE INSTRUCTIONS FIRST

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

Write your answers in the spaces provided.

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

Write in dark blue or black pen.

Answer all questions. 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.

You are advised to spend 45 minutes on the Physics Section and 45 minutes on the Chemistry Section.

For Examiner's Use	
Total	

This document consists of **5** printed pages.

Setter: Ms Mok Pei Jiun

Vetter: Mr Johnson Tay

1 In this experiment, you are going to confirm the mass of a ruler and obtain a value for the acceleration due to gravity, ***g***. To do this, you will use the apparatus shown in **Fig. 1.1** below.

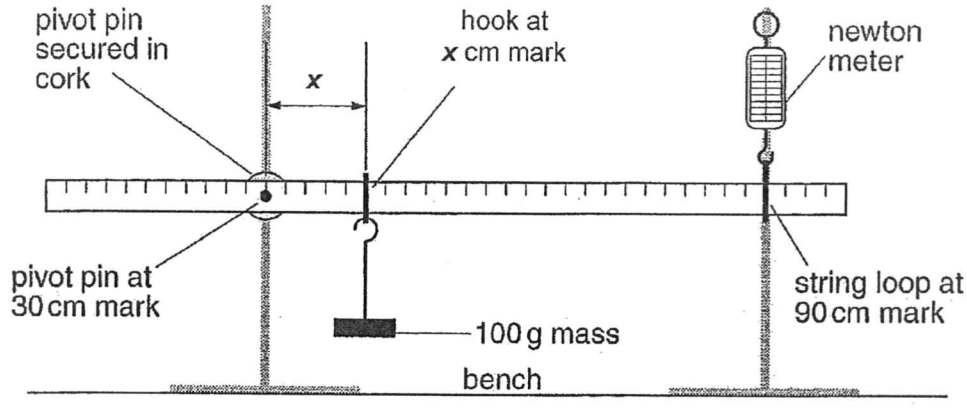


Fig. 1.1

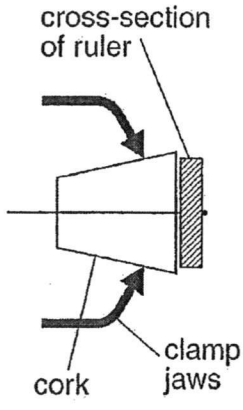


Fig. 1.2

(a) Copy the true mass of the ruler, ***M***, from the side of your ruler, in the space provided below.

true mass, ***M***, of ruler = ...g [1]

(b) (i) Set up your apparatus as shown in **Fig. 1.1**.

- Place the pivot pin in the hole at the 30 cm mark on the metre ruler. Carefully push the pin through the centre of the cork and clamp the cork firmly to the retort stand, as shown in **Fig. 1.2**. Ensure that the pin is horizontal and that the metre ruler is free to rotate.

- Use the string loop to suspend the ruler, at the 90 cm mark of the ruler, from the newton meter. Adjust the retort stand on the right hand side so that the newton meter hangs vertically and the ruler is approximately horizontal.

(ii) Hang the 100 g mass from the hook, and position it at the 65 cm mark on the ruler. In this position, the value of distance ***x*** is 35 cm.

- When all parts of the apparatus are stationary, read the value of the force on the newton meter. Record the value of this force, to 0.01 N, in the column headed F_1 in **Fig. 1.3**.

  Note: If the newton meter appears to be sticking, tap it gently on the side to release it before you try to read the force.

- Move the slotted mass so that it is at the 55 cm mark on the ruler. The value of the distance ***x*** is now 25 cm. Read the value of the force on the newton meter and record its value, to 0.01 N, in the column headed F_1 in **Fig. 1.3**.

- Repeat the experiment using values of distance ***x*** of 15 cm, 5 cm, −5 cm, and −10 cm. In each case, read and record the value of the force on the newton meter, to 0.01 N, in the column headed F_1 in **Fig. 1.3**.

  Note: when the values of distance ***x*** are negative, you will need to position the slotted mass to the left of the pivot.

- Repeat all six of the experiments in part **(b)(ii)**. Read and record the value of each force, to 0.01 N, in the column headed F_2 in **Fig. 1.3**.

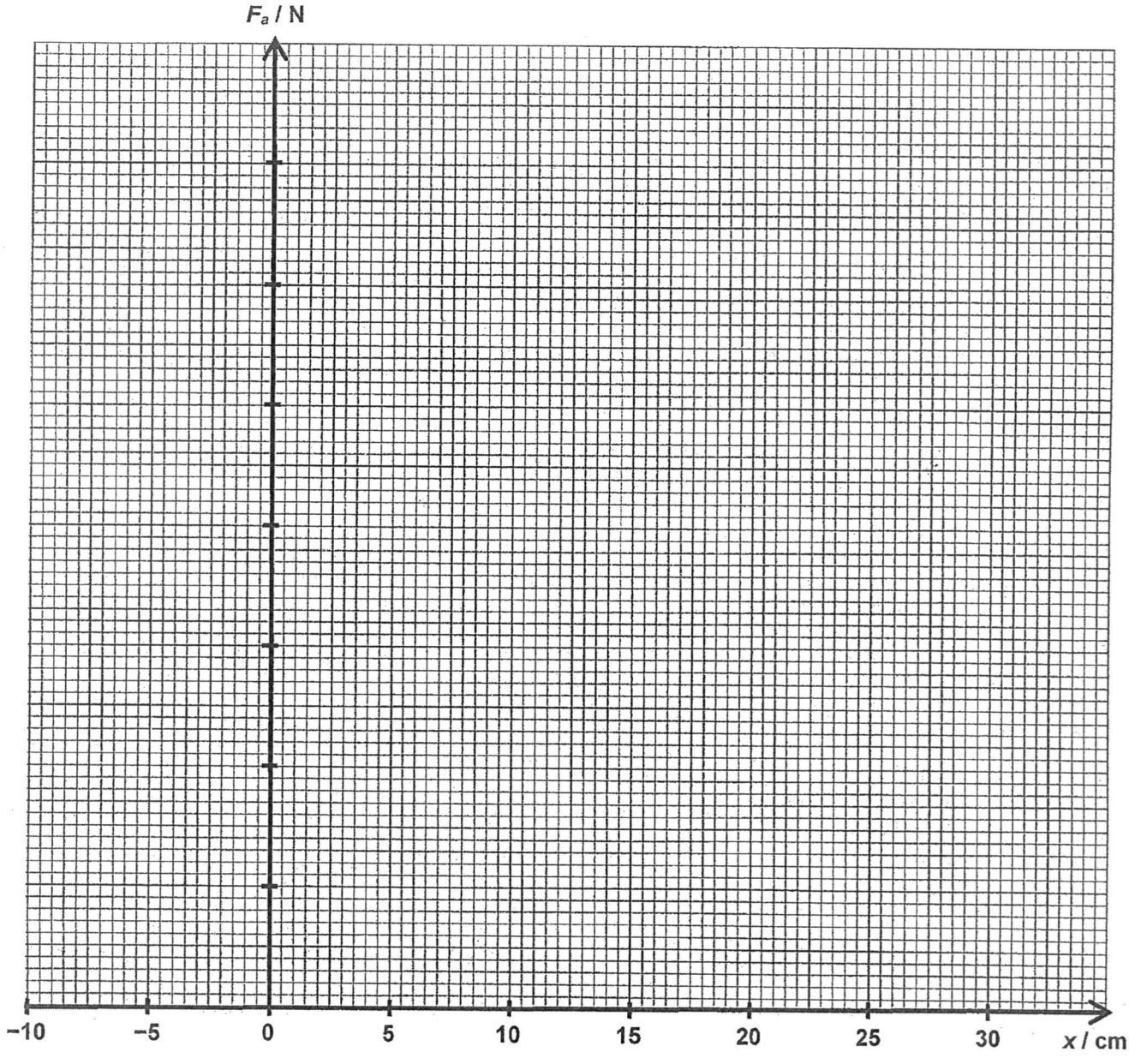
- Complete **Fig. 1.3** for each set of data by calculating the average force, F_a, giving your answers to the nearest 0.01 N.

distance ***x*** / cm	first force F_1 / N	second force F_2 / N	average force F_a / N
35			
25			
15			
5			
−5			
−10			

[3]

Fig. 1.3

(c) Plot a graph of average force, F_a, against distance, x, on **Fig. 1.4**. Draw the best-fit straight line.



[4]

Fig. 1.4

(d) Calculate the gradient of the line, showing clearly on your graph how you did this.

value of the gradient = ... N / cm [2]

(e) Using your value for the gradient found in part **(d)**, and the formula below, calculate a value for the acceleration due to gravity, ***g***.

$$g = \frac{\text{gradient x } 60}{0.100}$$

value of g = ... m / s^2 [1]

(f) **(i)** Read the value of the average force where your graph line crosses the vertical axis. Use this value (intercept), and the formula below, to calculate a value, ***W***, for the mass of your ruler.

W = intercept x 305.8

value of W = ... g [1]

(ii) Using the true mass of your ruler, ***M***, recorded in part **(a)** and your experimental value for the mass of the ruler, ***W***, calculate the percentage error in your experiment.

$$\text{Percentage error} = \frac{M - W}{M} \text{ x } 100\ \%$$

percentage error = ... % [1]

(iii) Suggest what could have caused this error.

.....

.....

..... [1]

(iv) How could you improve this experiment to reduce the error?

.....

.....

..... [1]

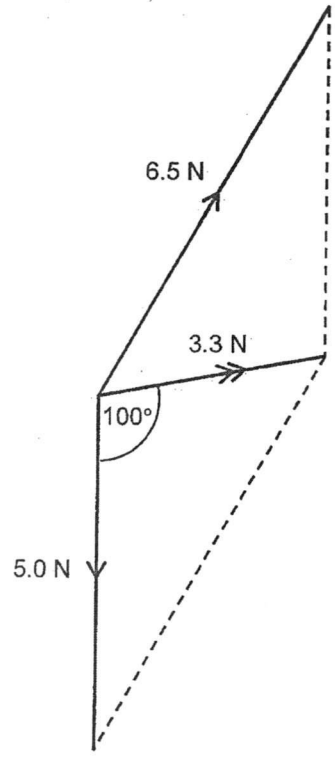
- - - - - End of Physics Component - - - - -

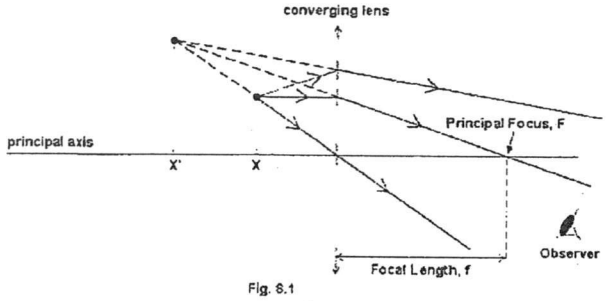
ANSWER SCHEME FOR 2017 PRELIM 2 4E5N 50765 SCIENCE-PHYSICS

Paper 1: Multiple Choice Questions (20 Marks)

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

Paper 2 Section A: Structured Questions (45 Marks) **Accept 2 or 3 s.f. + Award for e.c.f.**

1a	Distance Travelled = Area under graph (award mark if student is able to state formula for area) 15 m = ½ x (7.0 m / s + 8.0 m / s) x t t = 2.0 s	[1] [1]
1b	a = △v / △ t (do not accept d = −△v / △ t) a = (7.0 m / s - 8.0 m / s) / 2.0 s a = - 1.0 m / s / 2.0 s a = - 0.50 m / s^2 deceleration = 0.50 m / s^2	[1] [1]
1c	Frictional Force = mass x deceleration (accept F = m x a) F = m x a F = 1500 kg x 0.5 m / s^2 F = 750 N	[1] [1]
a2	 scale: 1 cm represents 1 N (accept any reasonable scale) addition of 5.0 N force and 6.5 N force as well as the resultant force are formed in a proper shape (either by parallelogram or triangle method) with correct angles between them all lines are drawn to scale + correct directional arrows + correct labelling resultant force = 3.3 N (accept 3.2 N to 3.4 N)	[1] [1] [1] [1]
3a	W = m x g W = (80/1000) kg x 10 N/kg W = 0.800 N	[1] [1]
3b	X drawn in the middle of the ruler (estimated – no need to indicate 50-cm mark)	[1]
3c	Downwards arrow from X labelled with W.	[1]

3d	According to the Principle of Moments, for an object that is balance, Total Clockwise Moment = Total Anti-clockwise Moment $F_1 \times d_1 = F_2 \times d_2$ 0.800 N x 0.15 m = 1.20 N x ***d*** OR 80 g x 15 cm = 120 g x ***d*** ***d*** = 0.100 m ***d*** = 10.0 cm	[1] Statement + Formula [1]
3e	$\rho = m / V$ ρ = 120 g / 8.8 cm^3 ρ = 13.6 g / cm^3	[1] [1]
4a	Air molecules around the smoke particle are moving randomly at high speed. They bombard with the smoke particle and cause the smoke particle to move randomly at high speed.	[1] [1]
4b	When temperature increases, air molecules will move at higher speed. (accept "kinetic energy of particles increase") There is a higher rate of collision between air molecules and the smoke particle and the smoke particle will move around randomly at even higher speed.	[1] [1]
5a	Heat is transferred through conduction from the hot water to the cup containing the frozen milk. Heat is then transferred from the cup to the frozen milk through conduction.	[1] [1]
5b	The frozen milk is undergoing the process of melting.	[1]
5c	At melting point (−2°C), temperature remains the same and thus kinetic energy of milk particles remains the same. Heat provided is used to overcome intermolecular bonding to change the state of the milk from solid to liquid thus increasing the average potential energy of the milk particles.	[1] [1]
6	 Fig. 8.1 Completing the existing ray with correct dotted and solid portions and direction. Principal Focus F correctly positioned using two light rays with correct dotted and solid portions and directions, and labelled.	 [1] [1]
7	$v = f \times \lambda = \lambda / T$ $T = \lambda / v$ T = 120 m / 330 m/s T = 0.364 s	[1] [1]
8a	Gamma Rays, Visible Light, Infra-red Rays	[1]
8bi	Microwave	[1]
8bii	d = v x t 36000000 m = 300000000 m/s x t t = 0.120 s	[1] [1]
9a	Path is drawn neatly in a trajectory that is downwards and rightwards.	[1]
9b	The positive point charge is experiencing a downwards repulsion by the positively-charged plate A because similarly charged objects repel. It is also experiencing a downwards attraction by the negatively-charged plate B because oppositely charged objects attract. (stating of similarly charged objects repel and oppositely charged objects attract)	[1] [1] [1]

10a	When current flows in the direction from B to C, an upwards force is exerted on the wire creating a repulsion between the wire and the magnet. Therefore, the reading on the scale will increase. When the current is flowing in the reversed direction, a downwards force is exerted on the wire creating an attraction between the wire and the magnet. This will cause the reading on the scale to reduce.	[1] [1] [1]
10bi	$V = I \times R$ $R = V / I = 8.00\ V / 12.0\ A = 0.667\ \Omega$	[1]
10bii	Since $R = \rho L / A$, resistance between B and C will reduce by half (accept reduce). And as V=IR, when resistance is reduced by half (accept reduced) with the same potential difference applied, current will increase. (no need to specify that current is doubled).	[1] [1]
Paper 2 Section B: Long Questions (20 Marks) – Choose 2 out of 3 Questions		
11a	The ball is reducing in height when it moves down the slope. Since GPE = mgh, the gravitational potential energy of car is reducing.	[1] [1]
11b	The speed of ball is increasing as it is accelerating down the slope. Since $KE = \frac{1}{2} mv^2$, the kinetic energy of the ball is increasing.	[1] [1]
11c	$E_P = m\ g\ h = 2\ kg \times 10\ N/kg \times 120\ m = 2400\ J$	[1]
11d	$E_K = E_T - E_P = 3900\ J - 2400\ J = 1500\ J$ $E_K = \frac{1}{2} m v^2$ $1500\ J = \frac{1}{2} \times 2\ kg \times v^2$ $v = \sqrt{\frac{2 \times 1500}{2}}\ m/s = 38.7\ m/s$	[1] [1] [1]
11ei	The roughness of the slope is not uniform throughout.	[1]
11eii	Some energy is converted to heat and sound due to friction between the ball and the slope.	[1]
14a	$n = \sin i / \sin r$ $1.81 = \sin 32° / \sin r$ $\sin r = \sin 32° / 1.81$ $r = \sin^{-1}(0.292773074) = 17.0°$	[1] [1]
14b	$n = c / v$ $1.81 = 3.00 \times 10^8\ m/s / v$ $v = 1.66 \times 10^8\ m/s$	[1] [1]
14c	When light travels from air (the less dense medium) to glass (the denser medium), it slows down and bends towards the normal.	[1] [1]
14d	Light ray is drawn with directional arrow and bending away from normal. No indication of angle is needed.	[1]
14e	$n = 1 / \sin c$ $c = \sin^{-1}(1/1.81) = 33.5°$	[1]
14f	In order to go through total internal reflection, the light ray needs to be incident from the denser medium and angle of incidence needs to be larger than critical angle. Although the light ray is incident from the denser medium, the angle of incidence at surface AC is smaller than critical angle. Hence, the ray goes through refraction instead of total internal reflection.	[1] [1]
15a	$P = IV$ or $I = P / V$ $I_{AC} = 2300\ W / 240\ V = 9.58\ A$ $I_{TV} = 280\ W / 240\ V = 1.17\ A$ Total Current = 9.58 A + 1.17 A = 10.75 A = 10.8 A	[1] [1]

15b	The fuse rating should be slightly higher than the total current in the circuit. Therefore, a suitable fuse rating would be 13A.	[1] [1]
15c	When there is a short circuit, the main branch will carry a high current which will cause over-heating and possible electrical fire.	[1]
15d	Cost = Rate x Energy Used = Rate x Power x Time Cost = (\$0.12 / kWh) x [(2.3 kW x 8 h) + (0.28 kW x 4 h)] / day x 7 days Cost = (\$0.12) (18.4 + 1.12) x 7 = \$16.40	[1] [1]
15e	Earth wire would not be necessary when the electric appliance has **double insulation**. With double insulation, even if the wiring loosens, the **live wire cannot touch the external casing**. This will **prevent the external casing from becoming live** and so **protects the user of the appliance from electrical shock**.	[1] [2]

Paper 5: Practical (15 Marks)

1a	True mass ***M*** = 89.8 g (according to individual student's given mass on ruler)	[1]
1b	<table><tr><th>x / cm</th><th>F_1 / N</th><th>F_2 / N</th><th>F_a / N</th></tr><tr><td>35</td><td>0.88</td><td>0.88</td><td>0.88</td></tr><tr><td>25</td><td>0.72</td><td>0.72</td><td>0.72</td></tr><tr><td>15</td><td>0.55</td><td>0.55</td><td>0.55</td></tr><tr><td>5</td><td>0.39</td><td>0.37</td><td>0.38</td></tr><tr><td>-5</td><td>0.22</td><td>0.21</td><td>0.22</td></tr><tr><td>-10</td><td>0.14</td><td>0.13</td><td>0.14</td></tr></table> Correctly recorded reading in 2 d.p. for F_1 Correctly recorded reading in 2 d.p. for F_2 Correctly calculated average F_a in 2 d.p.	 [1] [1] [1]
1c	Markers on F_a/N-Axis labelled clearly and appropriately Scale is stated correctly + Appropriate scale chosen, no odd scale Points plotted correctly and clearly imprinted Best fit straight line is drawn + clear, smooth line, not feathery, crooked or faint	[1] [1] [1] [1]
1d	Gradient triangle shown with coordinates of two chosen points. Gradient formula is shown with correct calculation (within 20% of 0.0170 N/cm) and presented in 3 s.f. (0.0136 N/cm – 0.0204 N/cm)	[1] [1]
1e	***g*** is calculated with given formula (within 20% of 10.2 m/s^2)and presented in 3 s.f. (8.16 m/s^2 – 12.2 m/s^2)	[1]
1fi	***W*** is calculated with given formula (within 20% of 91.7 g) and presented in 3 s.f. (73.4 g – 110.0 g)	[1] Allow ecf
1fii	% error is calculated with given formula (within 20% of 2.12%) and presented in 3 s.f. (1.70% – 2.54%)	[1] Allow ecf
1fiii	Source of error: The hook used for the 100g mass is not able to hang properly at a specific mark as it does not sit on the ruler properly. It has a tendency to tilt which affects the actual distance ***x***. Improvement: Use a string instead of the hook. It will allow distance **x** to be obtained and fixed properly.	[1] For Source
	Source of error: The height of the newton meter cannot be adjusted with minute movements. And so the actual height needed to keep the ruler straight is difficult to obtain. Improvement: Using a retort stand that allows small adjustments of height will be able to give a more accurate height.	[1] For Improvement
	Weight of metal hook – change to a lighter hook	