Name | Reg. No | Class

4EX/5NA

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

Physics Component

Paper 1 Multiple Choice [20 Marks]

PRELIMINARY EXAMINATION TWO

August 2016

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 **8** printed pages.

Setter: Ms Mok Pei Jiun Vetter: Mr Johnson Tay

[Turn over

Section A: MCQ

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

1 **Fig. 1.1** shows the reading obtained on a pair of vernier calipers used to measure the thickness of a dictionary.

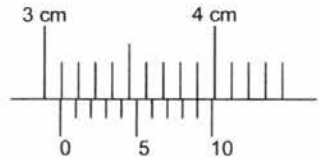


Fig. 1.1

What is the thickness of the dictionary?

A 3.09 cm **B** 3.19 cm **C** 3.90 cm **D** 3.99 cm

2 **Fig. 2.1** shows a speed-time graph of a moving car.

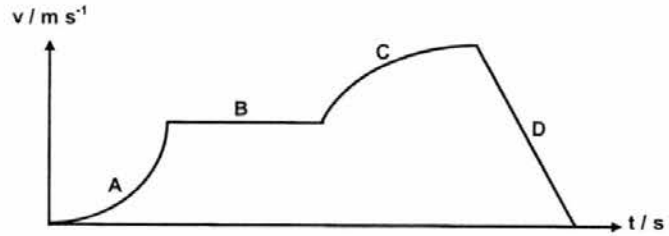


Fig. 2.1

Which section of the graph indicates that the car is moving with a decreasing acceleration?

3 When a book of mass 2 kg was pushed along the horizontal surface of the table with a constant force of 9 N, it experienced a frictional force of 5 N.

Which of the following describes the motion of the book?

A The book moves with a speed of 2.0 m s^{-1}.

B The book moves with a speed of 2.5 m s^{-1}.

C The book moves with an acceleration of 2.0 m s^{-2}.

D The book moves with an acceleration of 25 m s^{-2}.

4 **Fig. 4.1** shows a speed-time graph for a moving car.

Which segment(s) of the graph indicate(s) that the resultant force acting on car is zero?

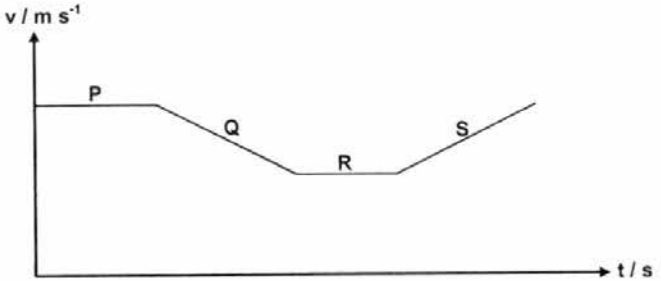


Fig. 4.1

A P and R **B** Q and S **C** Q only **D** S only

5 Four girls **A**, **B**, **C**, and **D** each stand on one heel of their shoes.

Fig. 5.1 shows the girls' weight and the area of the heels of their shoes.

Girl	Weight	Area of heel of shoe
A	400 N	1 cm^2
B	400 N	4 cm^2
C	600 N	1 cm^2
D	600 N	2 cm^2

Fig. 5.1

Which of the girls is exerting the highest pressure on the floor?

6 An astronaut has a mass of 80 kg on Earth. He can jump 1.50 m high on the surface of Earth.

Which of the following correctly states the distance he can jump on the Moon and the corresponding reason?

	Distance he can jump on the Moon	Reason
A	Higher than 1.50 m	He has a smaller mass on the Moon
B	Higher than 1.50 m	He has a smaller weight on the Moon
C	Lower than 1.50 m	He has a greater mass on the Moon
D	Lower than 1.50 m	He has a greater weight on the Moon

[Turn over

7 The measuring cylinder in **Fig. 7.1** contains 50 cm^3 of water.

When a metallic object of mass 118 g is lowered into the water as shown in **Fig. 7.2**, the volume goes up to 68 cm^3.

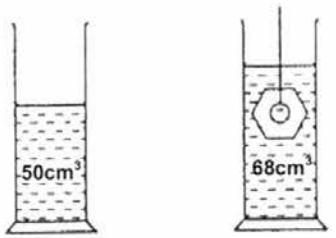


Fig. 7.1 **Fig. 7.2**

What is the density of the metallic object?

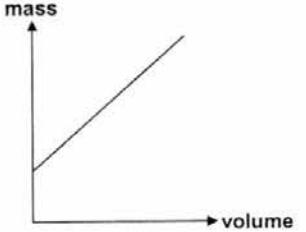
A 1.7 g cm^{-3} **B** 2.4 g cm^{-3} **C** 4.3 g cm^{-3} **D** 6.6 g cm^{-3}

8 Pamela conducted an experiment to determine the density of a type of wood.

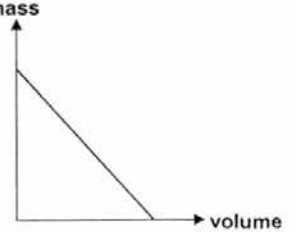
She measured the mass and volume of different sized samples of the wood, and plotted a graph of mass against volume.

Which of the following shows her results?

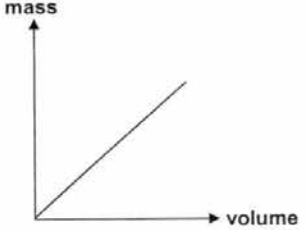
A



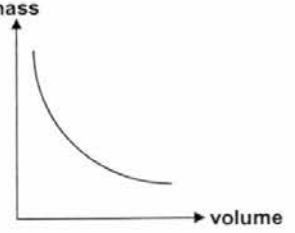
C



B



D



9 **Fig. 9.1** shows force **F** being applied to a box to move it from the bottom of the slope to the top of the slope.

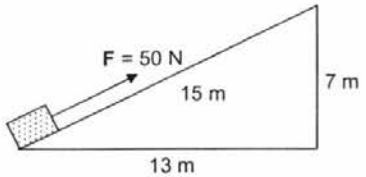


Fig. 9.1

Calculate the work done by force **F**.

A 150 J **B** 350 J **C** 550 J **D** 750 J

10 Jason held a sack of rice on top of his head for 30 minutes. Kenneth held another sack of rice half as heavy as Jason's on top of his head for 1 hour.

Which statement best describes the above situation?

A Both of them did not do any work.

B Jason did more work.

C Kenneth did more work.

D Kenneth did some work and Jason did the same amount of work as Jason.

11 Thermal processes of conduction and convection are methods through which heat is transferred between regions in contact. When will these thermal processes stop?

A When there is no more heat in the regions in contact.

B When the regions in contact are colder than room temperature.

C When the regions in contact are hotter than room temperature.

D When the regions in contact are in thermal equilibrium.

12 Sarah walked bare-footed into a room with polished marble floor. She then quickly stepped onto a piece of carpet in the middle of the room and exclaimed, "The marble floor is so cold! My feet feel warmer on the carpet."

Why did Sarah's feet feel cold on the marble floor but warmer on the carpet?

A The marble floor is a better absorber of radiant heat than the carpet.

B The marble floor is a better conductor of heat than the carpet.

C The marble floor is a better emitter of radiant heat than the carpet.

D The marble floor is at a lower temperature than the carpet.

[Turn over

13 A lump of ice is placed in a pail of water at room temperature as shown in **Fig. 13.1**.

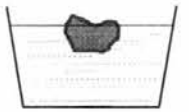
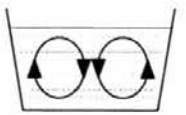


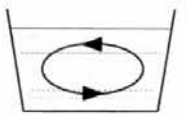
Fig. 13.1

Which one of the following diagrams shows correctly the convection currents in the pail of water?

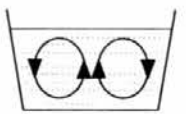
A



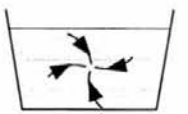
C



B



D



14 **Fig. 14.1** shows the melting point of four different metals.

Metal	Copper	Iron	Platinum	Rhodium
Melting Point / °C	1064	1535	1773	1966

Fig. 14.1

How many of the above four metals will remain as a solid at a temperature of 1500 °C?

A 2 **B** 3 **C** 4 **D** None

15 **Fig. 15.1** shows the path of a ray of light incident on the boundary between a liquid and air. What is the refractive index of the liquid?

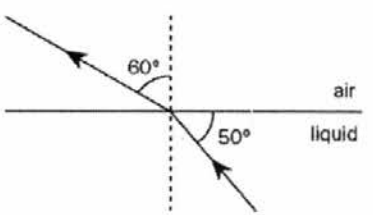


Fig. 15.1

A $\frac{\sin 30°}{\sin 50°}$ **B** $\frac{\sin 40°}{\sin 60°}$ **C** $\frac{\sin 60°}{\sin 40°}$ **D** $\frac{\sin 60°}{\sin 50°}$

16 **Fig. 16.1** shows a point light source **P** placed in front of a thin converging lens **L**.

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

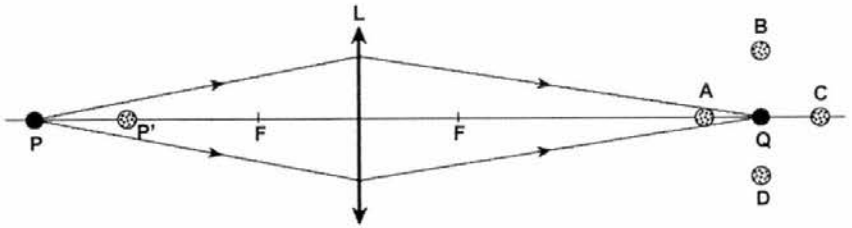


Fig. 16.1

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

17 Which of the following statements about electromagnetic waves is **false**?

A They are transverse waves.

B They can be refracted and reflected.

C They require a transparent medium in order to be transmitted.

D They travel through vacuum at the speed of 3.00×10^8 m s^{-1}.

18 **P**, **Q**, **R** and **S** are small rubber balls held close to one another.

It is observed that **P** attracts **Q** and repels **R**, and **Q** repels **S**.

If **R** is positively charged, which of the following statements is **true**?

A **P** is negatively charged.

B **Q** is negatively charged.

C **Q** is positively charged.

D **S** is positively charged.

19 Four different resistors are connected in the circuit shown in **Fig. 19.1**.

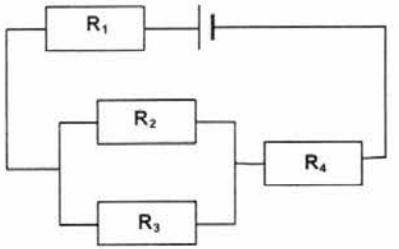


Fig. 19.1

If R_2 and R_4 are both replaced with short low-resistance wires, what will be the total resistance of the circuit?

A R_1 **B** $R_1 + R_3$ **C** $\dfrac{1}{\frac{1}{R_1}+\frac{1}{R_3}}$ **D** Zero

20 **Fig. 20.1** shows the top view of a magnet placed in a magnetic field.

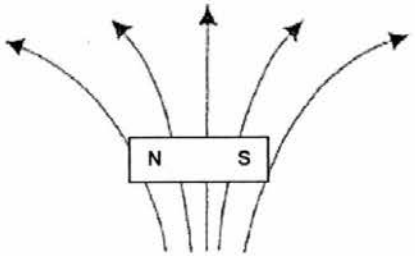


Fig. 20.1

What will happen to the magnet if it is suspended freely?

A It will move to the left.

B It will move to the right.

C It will rotate in the anti-clockwise direction.

D It will rotate in the clockwise direction.

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

Name | Reg. No | Class

4EX/5NA

SCIENCE (PHYSICS, CHEMISTRY) **5076/02**

Physics Component

Paper 2 Theory [65 Marks]

PRELIMINARY EXAMINATION TWO

August 2016

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 **17** printed pages.

Setter: Ms Mok Pei Jiun Vetter: Mr Johnson Tay

[Turn over

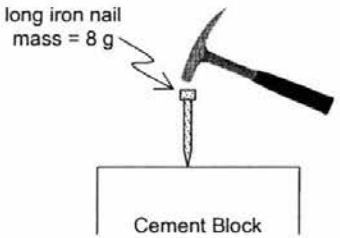
Section A

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

1 A hammer is used to drive a nail vertically into a cement block as shown in **Fig. 1.1**.

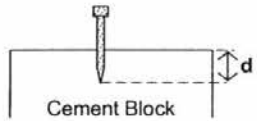
During the first hit by the hammer, the nail enters the cement block with an initial velocity of 5.5 m s^{-1} and decelerated at 375 m s^{-2} to a stop.

Fig. 1.2 shows the position of the nail after the first hit by the hammer.



before hammering

Fig. 1.1



after the first hit by hammer

Fig. 1.2

(a) Calculate the resistive force experienced by the nail as it enters the cement block.

resistive force = ...N [1]

(b) Find **d**, the depth of penetration of the nail.

depth, **d** = ...m [3]

2 **Fig. 2.1** shows the densities of two blocks **X** and **Y** that are made of different materials.

Block	X	Y
Density / g cm^{-3}	2.00	5.00

Fig. 2.1

The side of block **X** resting on a flat horizontal surface has an area of 2 cm^2.

The height of block **X** is 10 cm and g = 10 N kg^{-1}.

(a) Calculate the weight of block **X**.

weight = ... N [2]

(b) Calculate the pressure exerted by block **X** on the horizontal surface.

pressure = ... Pa [2]

(c) Block **Y** has the same dimensions as Block **X** and is also placed on the same side on the same flat horizontal surface.

Discuss how the pressure exerted on the surface by Block **Y** differs from your answer in Part **(b)**.

.....

.....

.....

.....

..... [2]

[Turn over

3 **Fig. 3.1** shows a horizontal beam pivoted close to one end. The weightless beam is supported by a force **F** and is loaded with weights of 4.0 N and 10.0 N as shown. All dimensions are marked on the diagram

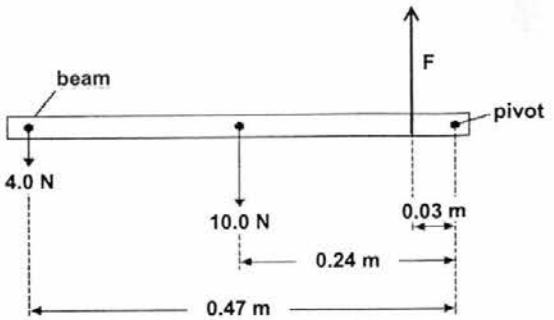


Fig. 3.1

(a) Explain the expression '*moment of a force about a pivot*'.

.....

..... [1]

(b) By taking moments about the pivot, calculate the magnitude of force **F** which helps keep the beam horizontal.

force, **F** = ... N [3]

4 **Fig. 4.1** shows the path taken by an iron ball dropped from a height of 140 m.

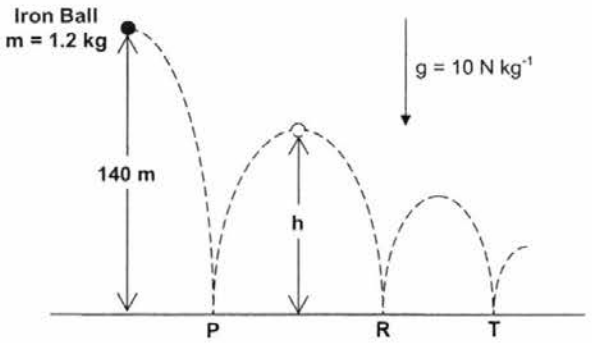


Fig. 4.1

(a) What is the gravitational potential energy possessed by the iron ball just before its release?

gravitational potential energy = ... J [2]

(b) Using the answer you have derived in part **(a)**, calculate the impact velocity of the iron ball at position **P**?

impact velocity = ... m s^{-1} [2]

(c) Assuming 23% of the total energy possessed by the iron ball is lost on each impact, find **h**, the maximum height which the ball reached after the first impact.

height, **h** = ... m [1]

[Turn over

5 **Fig. 5.1** shows a force of 280 N being applied to a box to accelerate it up an inclined plane with rough surface.

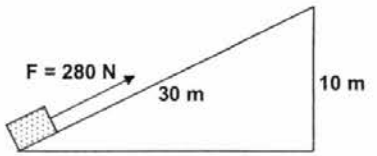


Fig. 5.1

(a) State and explain the changes in kinetic energy and gravitational potential energy as the box moves up the inclined plane.

.....

.....

..... [2]

(b) A frictional force of 110 N is experienced by the box as it moves up the inclined plane.

Draw and label this frictional force in **Fig. 5.1**. [1]

(c) Calculate the work done against friction as the box is moved up the full length of the inclined plane.

work done against friction = ... J [2]

(d) It takes 8 s for the box to move up the full length of the inclined plane.

Calculate the power of force **F** in moving the box.

power = ... W [2]

6 An experiment is carried out to determine which material, **A** or **B**, is a better material for making a vacuum flask.

Two containers, one made of material **A** and the other of material **B**, are filled with water at 100 °C and allowed to cool to room temperature.

Fig. 6.1 shows the cooling curve obtained.

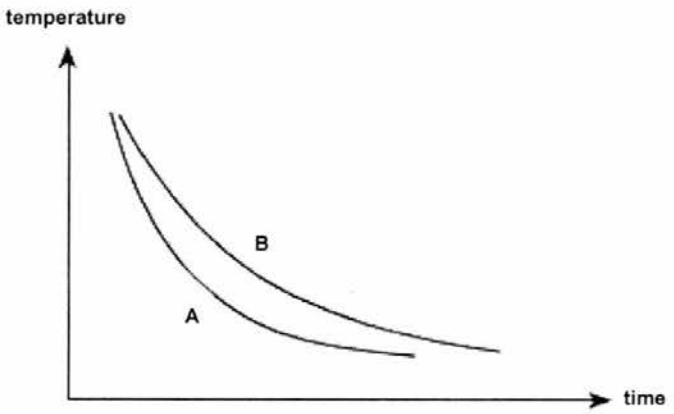


Fig. 6.1

Discuss, with reference to the cooling curve(s), which of the two materials is more suitable for making a vacuum flask.

.....

.....

.....

.....

.....

.....

[2]

7 Water initially at 25 °C is heated using a 1 kW heater.

The graph in **Fig. 7.1** shows how the mass of the water changes over time.

The water starts to boil at **X** and the heater is switched off at **Y**.

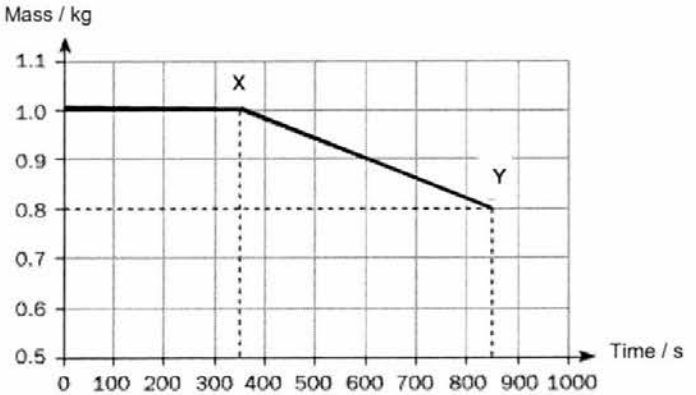
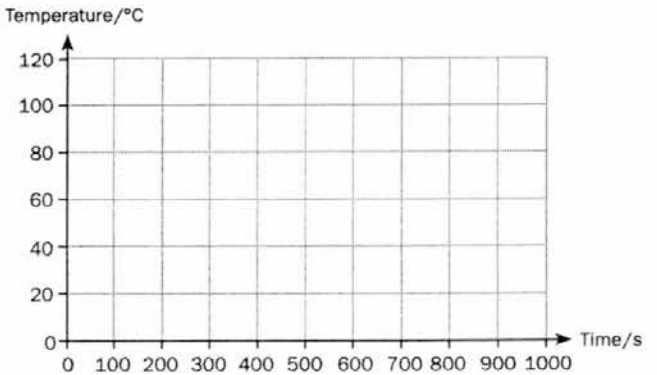


Fig. 7.1

In **Fig. 7.2** below, draw the corresponding temperature-time graph of the water.



[2]

Fig. 7.2

8 **Fig. 8.1** shows a fixed mass of air trapped in a cylinder with a smooth piston. The initial temperature of the air is 25 °C.

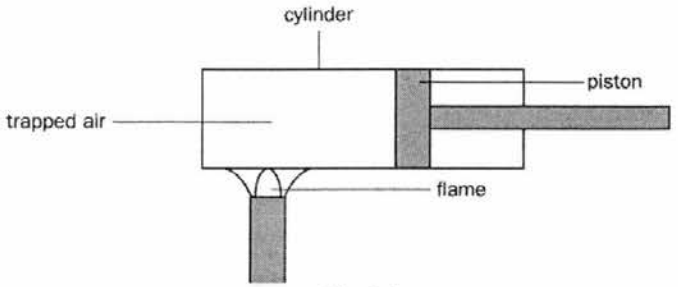


Fig. 8.1

The cylinder is heated and the temperature of the trapped air rises. The piston is observed to move outwards.

Using the kinetic model of gases, account for the movement of the piston.

.....

.....

.....

..... [2]

9 **Fig. 9.1** shows an incorrect electromagnetic spectrum drawn by a student. The parts of the spectrum and the wavelengths are in the wrong order. The values of the wavelengths do not match the correct parts of the spectrum.

Shortest Wavelength						Longest Wavelength
microwaves	radio waves	ultraviolet	infra-red	gamma rays	X-rays	Visible Light
10^{3} m	10^{-14} m	10^{-10} m	10^{-8} m	10^{-2} m	10^{-6} m	10^{-5} m

Fig. 9.1

(a) Re-write **Fig. 9.1** in **Fig. 9.2** with the correct wave components and wavelengths. [2]

Shortest Wavelength						Longest Wavelength

Fig. 9.2

[Turn over

(b) State one use of infra-red radiation.

.....

..... [1]

10 **Fig. 10.1** shows the displacement-time graph of the wave of sound **P**.

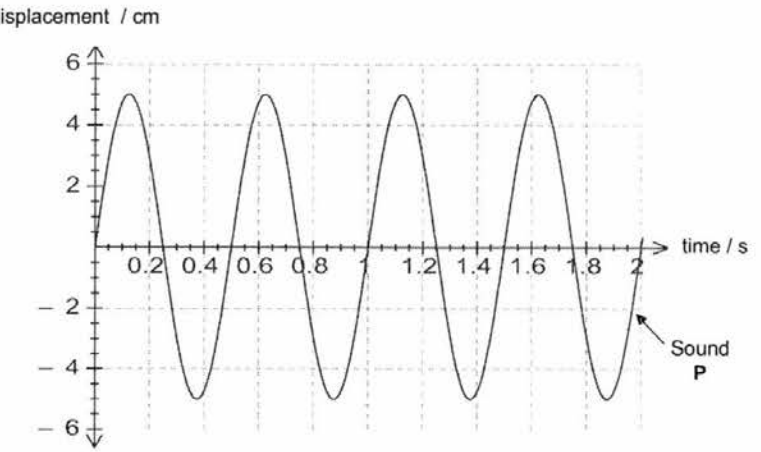


Fig. 10.1

(a) State the amplitude of the wave.

..... [1]

(b) Define frequency of a wave.

.....

..... [1]

(c) Determine the frequency of the transverse wave in **Fig. 10.1**.

frequency = ... Hz [1]

(d) Sound **Q** is half the volume and half the pitch of sound **P**.
Sketch the waveform of sound **Q** in **Fig. 10.1** and label it as "sound **Q**".

[2]

11 Spheres **A** and **B** are isolated positively charged copper spheres.

Fig. 11.1 shows how the charges are distributed when the two spheres are placed near each other.

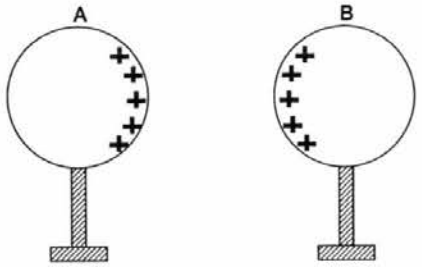


Fig. 11.1

(a) On **Fig. 11.1**, draw the electric field pattern between the two spheres. [1]

(b) Describe the force between the two spheres.

.....
[1]

12 **Fig. 12.1** shows a wire **XY** resting on a top-pan balance between the two poles of a horseshoe magnet **AB**.

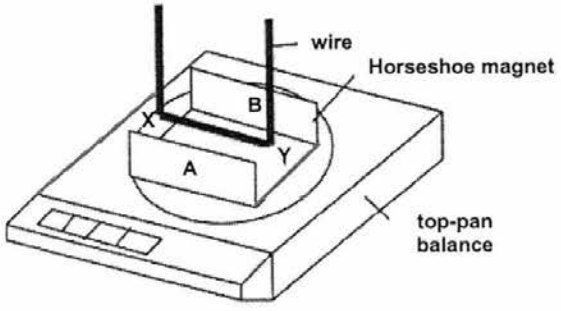


Fig. 12.2

A current is passed through the wire and the readings were recorded in **Fig. 12.2**.

Current / A	Direction of Current	Reading on balance / g
0.0	Nil	142.0
2.0	X to Y	144.6
3.0	Y to X	138.1

Fig. 12.2

(a) Deduce the polarity of **A** and **B**.

.....
[1]

(b) Explain how the differences in the readings came about.

.....

.....

.....

.....
[2]

- End of Section A -

Section B

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

Write your answers in the spaces provided.

13 **Fig 13.1** shows a graph which represents the motion of two vehicles travelling along the same straight stretch of road.

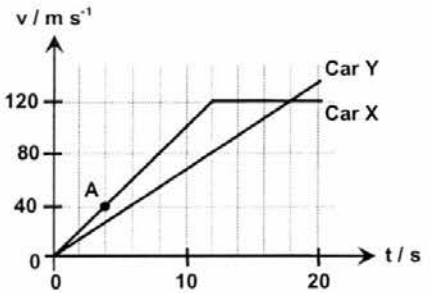


Fig. 13.1

(a) What is the instantaneous speed of **Car X** at the point marked **A** on the graph?

instantaneous speed = ... m s^{-1} [1]

(b) What is the acceleration of **Car X** in the first 10 s?

acceleration = ... m s^{-2} [2]

(c) What is the distance travelled by **Car Y** in the first 18 s?

distance travelled = ... m [2]

[Turn over

(d) What is the average speed of **Car Y** in the first 18 s?

average speed = ... m s^{-1} [2]

(e) Jacklyn said, "**Car X** was ahead of **Car Y** from the beginning of the journey but **Car Y** overtook **Car X** at **t** = 18 s." Jennifer said, "**Car Y** did not overtake **Car X** at **t** = 18 s. Something else happened."

State and explain who you think is correct.

.....

.....

.....

.....

.....

.....

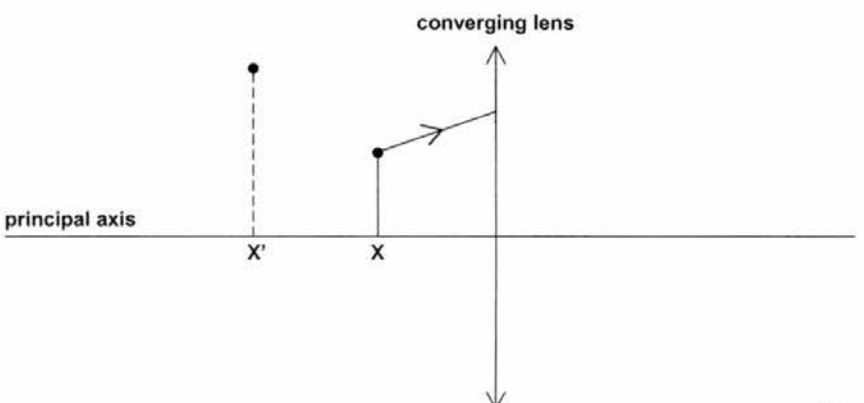
[3]

14 **(a) (i)** **Fig. 14.1** below shows a thin converging lens being used to produce an image **X'** of an object **X**.

Complete the diagram to locate the position of the principal focus **F**.

Indicate the position of the principal focus **F** and the observer clearly on **Fig. 14.1**.

Indicate, also, the focal length **f** of the converging lens on **Fig. 14.1**.



[4]

Fig. 14.1

(a) (ii) Give one common application for the lens set-up in **Fig. 14.1**.

.....

[1]

(b) **Fig. 14.2** shows the path of a light ray in a glass prism, **ABC**. The refractive index of the glass prism is 1.81.

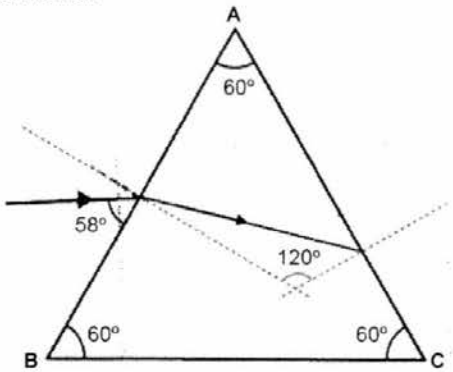


Fig. 14.2

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

angle of refraction = ... ° [2]

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

.....

.....

.....

[1]

(iii) Calculate the critical angle of the glass prism

critical angle = ... ° [1]

(iv) Sketch the ray that exit from surface **AC**.

[1]

[Turn over

15 **(a)** **Fig. 15.1** shows the relationship between the potential difference across the filament of a lamp and the current flowing through it.

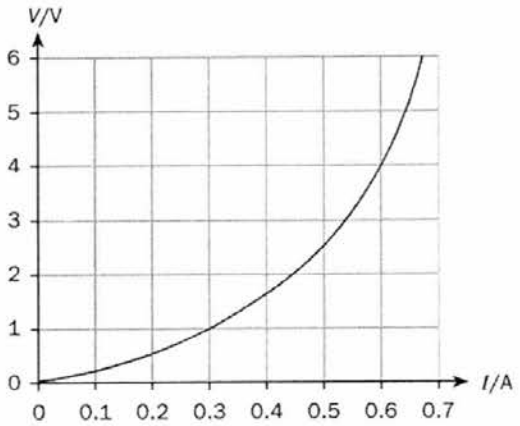


Fig. 15.1

(i) Calculate the resistance of the filament lamp when the current is 0.3 A.

resistance = ... Ω [2]

(ii) Calculate the resistance of the filament lamp when the current is 0.6 A.

resistance = ... Ω [1]

(iii) An Ohmic conductor's resistance does not change with varying current. Explain the difference in your answers in part **(i)** and part **(ii)**.

.....

.....

.....

.....

[2]

(b) An electric kettle designed to be operated from a 240 V supply has a power rating of 1680 W.

(i) Calculate the current which flows when the kettle is being used.

current = ...A [2]

(ii) 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 used with this kettle.

fuse rating = ...A [1]

(iii) In normal operation what would be the size of the voltage and current in the live wire, the neutral wire and the earth wire? Indicate your answers in **Fig. 15.2**.

	Live Wire	Neutral Wire	Earth Wire
Voltage			
Current			

[2]

- End of Section B -

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

Name | Reg. No | Class

4EX/5NA

SCIENCE (PHYSICS, CHEMISTRY) **5076/05**

Physics Component

Paper 5 Practical [15 Marks]

PRELIMINARY EXAMINATION TWO

August 2016

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

[Turn over

1 In this experiment, you will investigate how the time taken by a wooden cylinder to roll down a wooden inclined plane varies with the height of the wooden inclined plane, and thus derive an approximate value for g, the acceleration of free fall.

You are provided with the following pieces of apparatus.

- One(1) wooden plane
- One(1) retort stand with boss and clamp
- One(1) metre-rule
- One(1) digital stop-watch
- One(1) plastic basket
- One(1) wooden cylinder

(a) Measure the full length of the wooden inclined plane provided.

Record your measurement below.

Length of wooden inclined plane = ... [1]

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

h, the height of the release point of wooden cylinder should be adjusted to 5.0 cm.

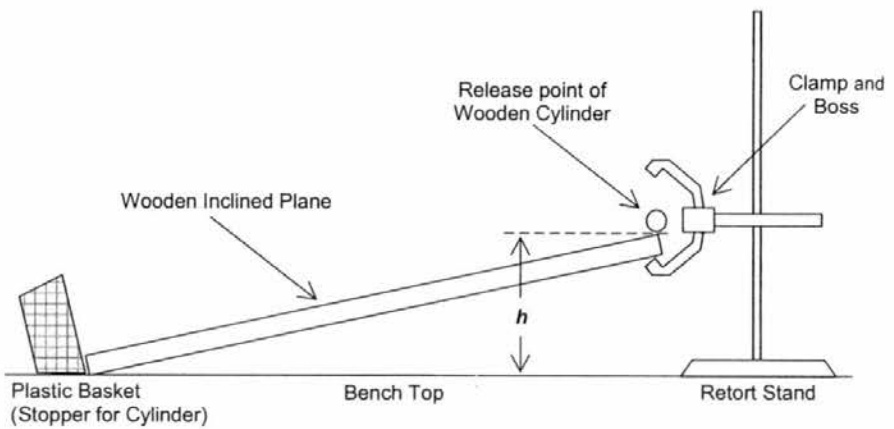


Fig. 1.1

(c) Gently place the wooden cylinder at the release point on the wooden inclined plane and determine t_1, the time taken for the wooden cylinder to roll down the full length of the plane.

You need to ensure that the length of the wooden cylinder is parallel to the shorter edge of the wooden plane before release, and the full length of the wooden cylinder stays on the top of the wooden plane during the whole decent.

Repeat the procedure three more times to obtain t_2, t_3, and t_4.

(d) In the space below, record your values of h, t_1, t_2, t_3, and t_4, and show clearly how you obtain $< t >$, the average time taken for the wooden cylinder to roll down the wooden plane from the height h = 5.0 cm.

[2]

(e) By altering height h, obtain a series of 6 set of values of h, t_1, t_2, t_3, t_4, and $< t >$.

Record your readings in the table provided in **Fig. 1.2**.

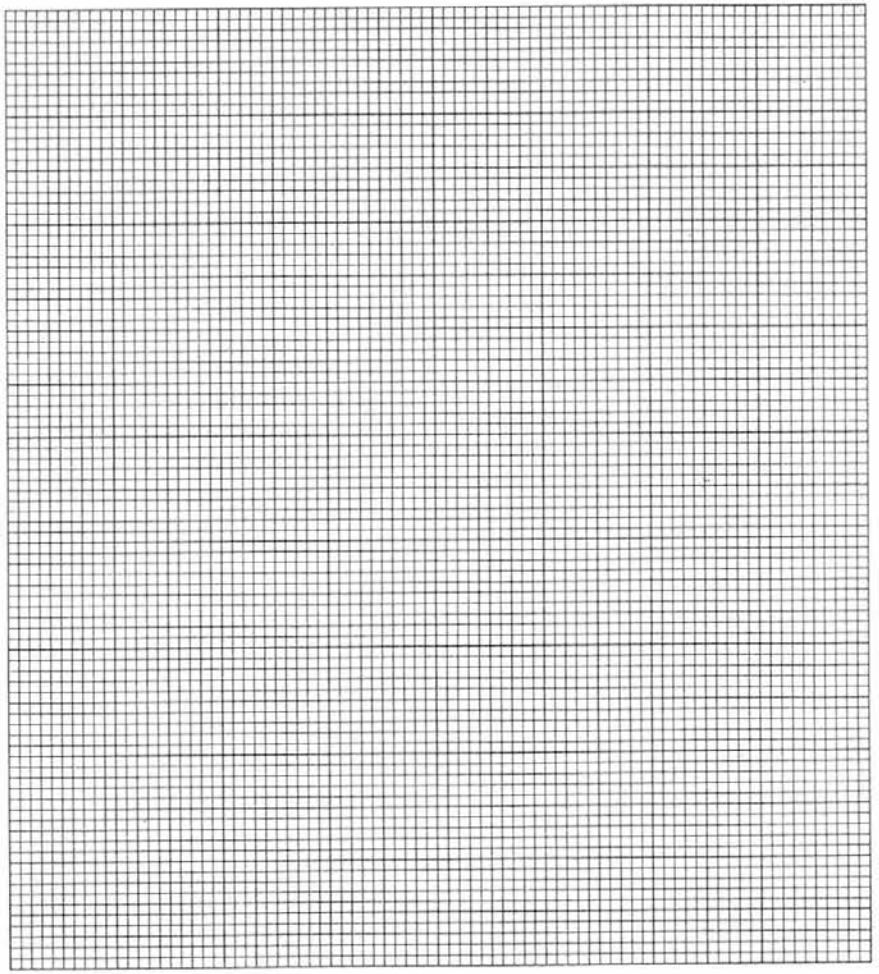
h / cm	time taken for cylinder to roll down the inclined plane				
	t_1 / s	t_2 / s	t_3 / s	t_4 / s	$< t >$ / s
5.0					
15.0					
25.0					
35.0					
45.0					
55.0					

[2]

Fig. 1.2

(f) Plot the graph of $< t >$ / s against h / cm in **Fig. 1.3**.

The graph is a **curve that tends towards a constant value** as h increases.



[4]

Fig. 1.3

(g) When h for the given wooden inclined plane reaches its **maximum**, the time which the wooden cylinder will take to roll down the slope is t_M. Show on the graph paper how you deduced the value t_M. Record the value of t_M with its correct S.I. unit below.

t_M = ...

[2]

(h) Calculate the value for g, the acceleration of free fall, from the equation

$$g = 5.000 \div t_M^2$$

Give your answer in the correct S.I. unit.

g = ... [1]

(i) Give a reason why the experiment is repeated to obtain four readings of time (t_1, t_2, t_3, t_4) for each height.

.....

.....

..... [1]

(j) Identify **one** possible source of error in this experiment.

Suggest an improvement that would reduce this error.

Source of error: .....

.....

.....

..... [1]

Improvement: .....

.....

.....

..... [1]

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

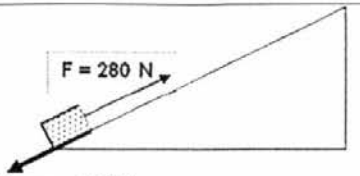
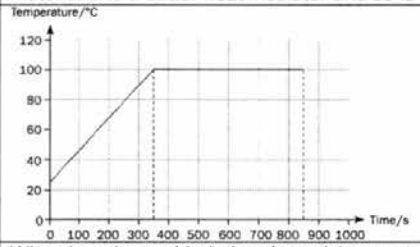
ANSWER SCHEME FOR 2016 PRELIM 2 4E5N 50765 SCIENCE-PHYSICS

Paper 1: Multiple Choice Questions (20 Marks)

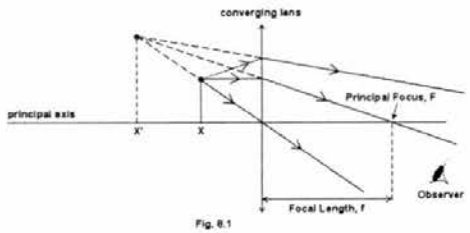
1	2	3	4	5	6	7	8	9	10
A	C	C	A	C	B	D	B	D	A
11	12	13	14	15	16	17	18	19	20
D	B	A	B	C	C	C	B	A	D

Paper 2 Section A: Structured Questions (45 Marks)

1a	$F = m \times a$ $F = 0.008\ kg \times (-375\ m\ s^{-2})$ $F = -3.00\ N$	[1]
1b	$a = (v - u) / t$ $-375\ m\ s^{-2} = (0\ m\ s^{-1} - 5.5\ m\ s^{-1}) / t$ $t = -5.5 / -375\ s = 0.0147s$ d = area under v-t graph $d = \frac{1}{2} \times 0.0147s \times 5.5\ m\ s^{-1} = 0.0404m$	[1] [1] [1]
2a	$m = \rho \times V = 2.00\ g\ cm^{-3} \times 2\ cm^2 \times 10\ cm = 40\ g = 0.04\ kg$ $W = m \times g = 0.04\ kg \times 10\ N\ kg^{-1} = 0.4\ N$	[1] [1]
2b	P = F / A or W / A $P = 0.4\ N / 2\ cm^2 = 0.4\ N / 0.0002\ m^2 = 2000\ N\ m^{-2} = 2000\ Pa$	[1] [1]
2c	Both blocks are of the same dimensions so Block Y with a greater density will have a larger mass and thus larger weight. With the same area of contact with the surface, Block Y of larger weight will exert a higher pressure than that exerted by Block X calculated in part (b).	[1] [1]
3a	It is the turning effect about the pivot created by the force.	[1]
3b	According to the Principle of Moments, when an object is balanced, Total clockwise moment = Total anticlockwise moment $F_1 \times d_1 = F_2 \times d_2 + F_3 \times d_3$ $F \times 0.03\ m = 10\ N \times 0.24\ m + 4.0\ N \times 0.47\ m$ $F = 4.28\ Nm / 0.03\ m = 142.6667\ N = 142\ N$	[1] statement [1] formula [1] answer
4a	$E_P = m \times g \times h$ $E_P = 1.2\ kg \times 10\ N\ kg^{-1} \times 140\ m = 1680\ J$	[1] [1]
4b	According to the Principle of Conservation of Energy, E_P of ball at release = E_K of ball on impact $1680\ J = \frac{1}{2} \times m \times v^2$ $1680\ J = \frac{1}{2} \times 1.2\ kg \times v^2$ $v = \sqrt{\frac{1680 \times 2}{1.2}}\ m\ s^{-1} = 52.9\ m\ s^{-1}$	[1] statement [1] answer
4c	E_P at height h = (100% - 23%) x E_P at height 140 m E_P at height h = 77% x E_P at height 140 m = 0.77 x 1680 J = 1293.6 J $h = 1293.6\ J / (1.2\ kg \times 10\ N\ kg^{-1}) = 107.8\ m = 108\ m$ OR $h = 77\% \times 140\ m = 0.77 \times 140\ m = 107.8\ m = 108\ m$	[1]
5a	Velocity of block is increasing (*because it is accelerating – this is not required in answer for award of mark*) and so kinetic energy is increasing. Height of block is increasing (*because it is moving up the slope – this is not required in answer for award of mark*) and so gravitational potential energy is increasing.	[1] [1]

5b		[1] correct arrow + labelling of frictional force absence of 110 N allowed
5c	Work done against friction = friction x distance moved $W = 110\ N \times 30\ m = 3300\ J$	[1] [1]
5d	$P = W / t$ $P = (280\ N \times 30\ m) / 8\ s = 8400\ J / 8\ s = 1050\ w$	[1] [1]
6	Cooling curve of material B has a gentler slope and so indicates that heat is lost to the surrounding at a slower rate. Material B is a better heat insulator and so is a more suitable material.	[1] [1]
7		[1] for straight line joining (0,25) and (350,100) [1] for straight line joining (350,100) and (850,100)
8	When heat is provided, the air particles trapped in the cylinder gain kinetic energy and move faster. The particles will collide more vigorously and frequently with the cylinder walls and piston, and so the piston is pushed outwards. *Reference to Pressure increase is not required for award of mark.*	[1] [1]
9a	Shortest Wavelength … Longest Wavelength gamma rays; X-rays; ultraviolet; Visible Light; infra-red; microwaves; radio waves 10^{-14} m; 10^{-10} m; 10^{-8} m; 10^{-6} m; 10^{-5} m; 10^{-2} m; 10^{3} m	[1] wavelength in correct order [1] component in correct order
9b	Cooking, Thermal Imaging, Short-range Communication, Optical Fibres, Remote Controls, Security Systems	[1] any one
10a	5 cm	[1]
10b	It is the number of wave formed at the source every second. OR It is the number of wave passing by a fixed point every second.	[1]
10c	$f = 1 / T = 1 / 0.5\ s = 2\ Hz$	[1]
10d	A smooth sinusoidal graph with amplitude 2.5 cm and period 0.25 s	[1] [1]
11a	Electric field lines drawn in correct pattern with correct directional arrows.	[1]
11b	It is a force of repulsion.	[1]
12a	A: south, B: north	[1]
12b	When current flows from X to Y a downwards force is produced according to Fleming's Left Hand Rule and the reading increases. When current flows from Y to X an upwards force is produced according to Fleming's Left Hand Rule and the reading decreases.	[1] [1]

Paper 2 Section B: Long Questions (20 Marks) – Choose 2 out of 3 Questions

13a	$40\ m\ s^{-1}$	[1]
13b	$a = \triangle v / \triangle t$ $a = (120 / 12)\ m\ s^{-2} = 10\ m\ s^{-2}$	[1] [1]
13c	Distance Travelled = Area under v-t graph from 0 s to 18 s $d = ½ \times 18\ s \times 120\ m\ s^{-1}$ $d = 1080\ m$	[1] [1]
13d	<v> = Total Distance / Total Time <v> = 1080 m / 18 s <v> = $60\ m\ s^{-1}$	[1] [1]
13e	Jennifer is correct. Distance travelled is given by area under v-t graph. The area under v-t graph for Car X is larger than that of Car Y at t = 18 s. Therefore, Car X has overtaken Car Y as it travelled a further distance than Car Y.	[1] [1] [1]
14ai	 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. Position of observer drawn and labelled. Focal Length f correctly indicated and labelled.	[1] [1] [1] [1]
14aii	Magnifying Glass	[1]
14bi	$n = \sin i / \sin r$ $1.81 = \sin(90°-58°) / \sin r$ $\sin r = \sin 32° / 1.81$ $r = \sin^{-1}(0.292773074) = 17.0°$	[1] [1]
14bii	When light travels from air (the less dense medium) to glass (the denser medium), it slows down and bends towards the normal.	[1]
14biii	$n = 1 / \sin c$ $c = \sin^{-1}(1/1.81) = 33.5°$	[1]
14biv	Light ray is drawn with directional arrow and bending away from normal. No indication of angle is needed.	[1]
15ai	$R = V / I$ $R = 1\ v / 0.3\ A = 3.33\ \Omega$	[1] [1]
15aii	$R = V / I = 4\ v / 0.6\ A = 6.67\ \Omega$	[1]
15aiii	A non-ohmic conductor's resistance will increase as it heats up. So when the filament lamp, a non-ohmic conductor, operates at higher voltage and current, greater heat is dissipated resulting in an increase in electrical resistance.	[1] [1]
15bi	$P = I \times V$ $I = P / V = 1680\ W / 240\ V = 7\ A$	[1] [1]
15bii	10 A	[1]
15biii		[1] [1]

	Live Wire	Neutral Wire	Earth Wire
Voltage	240 V	0 V	0 V
Current	7 A	7 A	0 A

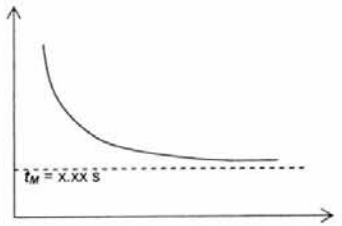
Paper 5: Practical (15 Marks)

1a	Length = 100.0 cm or 1.000 m	[1]
1d	Values of all 4 times recorded and calculated between 3.30 s and 4.04 s Calculation of $< t >$ shown clearly	[1] [1]
1e		[1] [1]

h / cm	time taken for cylinder to roll down the inclined plane				
	t_1 / s	t_2 / s	t_3 / s	t_4 / s	<t> / s
5.0	3.47	3.54	3.79	3.88	3.67
15.0	1.62	1.62	1.64	1.67	1.64
25.0	1.31	1.27	1.21	1.18	1.24
35.0	0.97	1.05	1.01	1.04	1.02
45.0	0.97	0.95	0.96	0.97	0.96
55.0	0.89	0.84	0.83	0.84	0.85

Correctly recorded reading in 2 d.p. for t_1, t_2, t_3, and t_4

Correctly calculated average $<t>$ in 2 d.p.

1f	Vertical Axis labelled as $< t > / s$ + Horizontal Axis labelled as h / cm Scale is stated correctly + Appropriate scale chosen, no odd scale No empty portion on axes + Correct d.p. for axes markers + Axes markers properly placed & labelled Points plotted correctly and well-spaced + "X" is at least 4 small boxes sized and clearly imprinted + Best fit smooth curve is drawn + Clear line, not feathery, crooked or faint	[1] [1] [1] [1]
1g	 A horizontal dotted line is drawn to indicate the constant value which the curve is tending towards. Value of t_M is indicated for the drawn dotted line in 2 d.p. and S.I. unit of "s".	[1] [1]
1h	g is calculated with given formula and presented in 3 s.f. and correct S.I. unit of "$m\ s^{-2}$"	[1]
1i	The time for each drop is very short and so there is significant error caused by human reaction time accumulated on the stop-watch at the start and end of the drop. So obtaining an average from more repeated readings reduces this error.	[1]
1j	Source of error: The value found for g will not be accurate due to the high friction between the wooden plank and the wooden cylinder. Improvement: The wooden plank and cylinder can be polished to reduce friction and increase accuracy. **OR** We can replace the wooden plank with a smooth plank of any material and replace the wooden cylinder with one of smooth surface but same dimension and mass.	[1] [1]