NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
END-OF-YEAR EXAMINATIONS 2017

SUBJECT :	SCIENCE PHYSICS 5076	DATE :	6 OCT 2017
LEVEL :	SECONDARY 3 EXPRESS	DURATION :	1 H 30 MIN

INSTRUCTIONS TO CANDIDATES

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. Write your name, class and index number on the **Question Paper** and the **Optical Answer Sheet** in the spaces provided. **It is also required that you WRITE and SHADE your index number on the Optical Answer Sheet.**
2. Answer **ALL** questions in **Section A** in the **Optical Answer Sheet** provided.
3. Answer **ALL** questions in **Section B** in the spaces provided.
4. Answer **TWO FULL** questions in **Section C** in the spaces provided.
5. Throughout the paper, the **acceleration due to gravity on Earth** is taken as 10 N/kg **unless stated otherwise.**
6. Calculators may be used where necessary. **For numerical values, give answers to THREE (3) significant figures.**
7. **DO NOT DETACH** any sections from this paper.
7. At the end of the examination, submit the **Question Paper** and the **Optical Answer Sheet SEPARATELY.**

For Examiner's Use Only

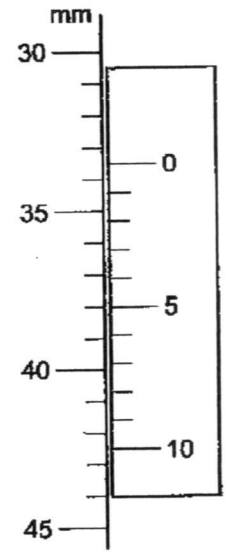
Section	A [20 m]	B [40 m]	C [20 m]	Total [80 m]	Grade
Score					

This question paper consists of **21** *printed pages.*

SECTION A : [20 marks]

*Each question is provided with **four** possible answers (**A**, **B**, **C** and **D**). Select the most appropriate answer and **shade** your choice in the **Optical Answer Sheet** provided.*

1 The diagram shows part of a vernier scale.



What is the length measured?

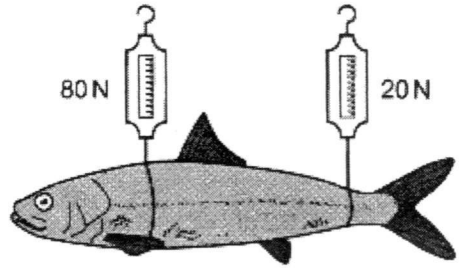
A 30.5 mm
B 33.5 mm
C 33.6 mm
D 34.5 mm

2 Which of the following affects the period of a pendulum?

I The mass of the bob.
II The length of the string.
III The acceleration due to gravity.

A **I** only
B **II** only
C **II** and **III** only
D **I**, **II** and **III**

3 A student weighs a fish using two spring balances as shown in the diagram.



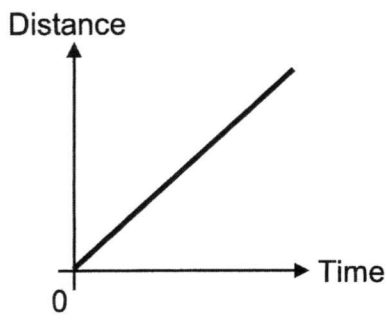
The spring balances read 80 N and 20 N.

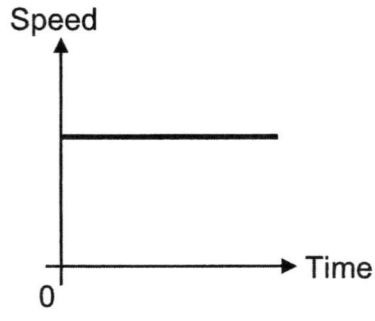
What is the weight of the fish?

A 50 N
B 60 N
C 80 N
D 100 N

4 Which one of the following pair of graphs represents the same motion?

A





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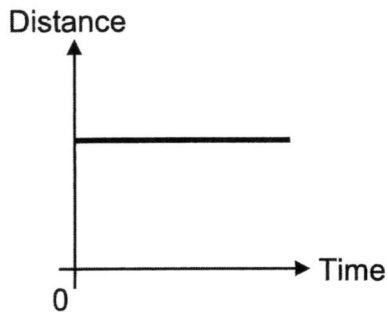

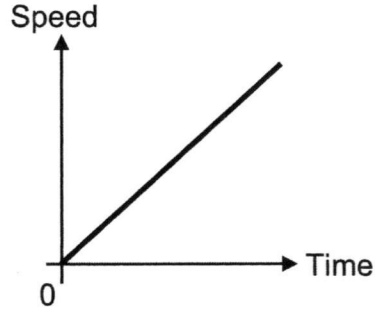

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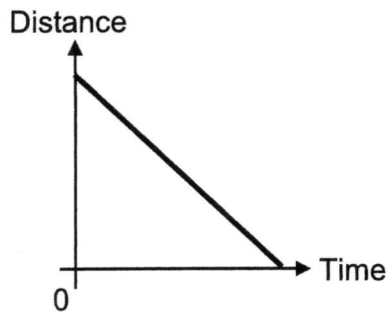

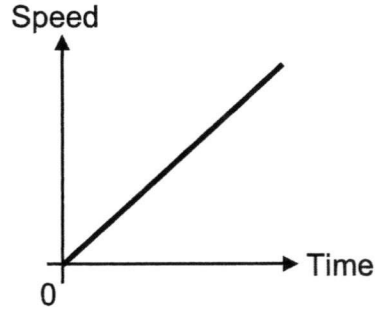

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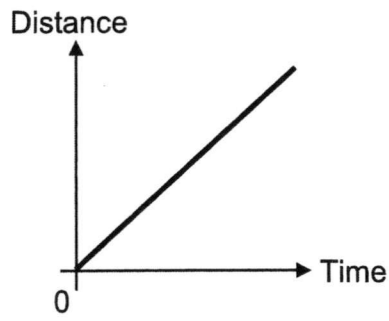
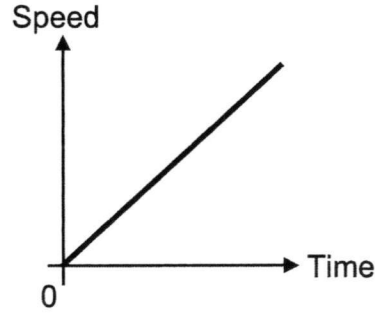
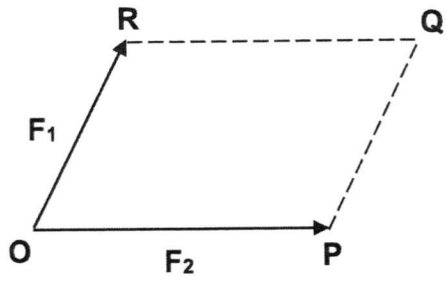




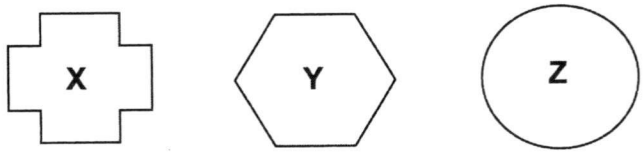
5 Two forces, F_1 and F_2, act in the direction as shown in the diagram.



What is the direction of the resultant force of the forces?

A QO
B OQ
C PR
D RP

6 Three objects are cut from the same sheet of metal as shown in the diagram.

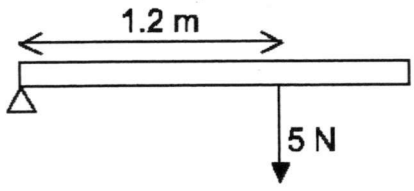


Which object has the greatest density?

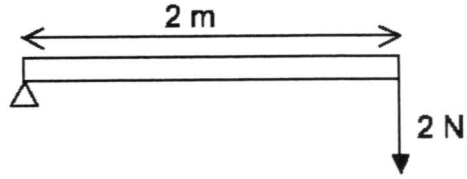
A X
B Y
C Z
D All have the same density.

7 Which one of the following would give the largest turning effect?

A



B



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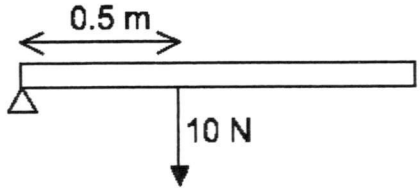

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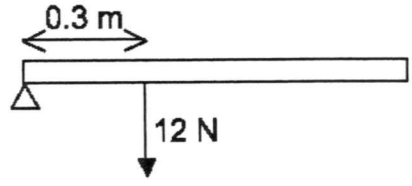
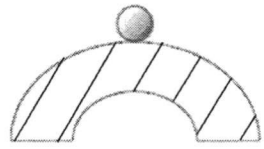


8 Which one of the following diagrams shows a sphere in stable equilibrium?

A

B



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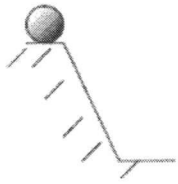
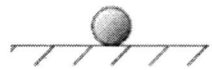


D

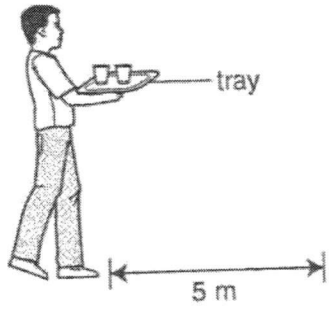


9 A car travels along a level road which has a rough surface. When the engine is turned off, the car starts to slow down.

Which one of the following shows the main change in energy that has taken place?

A From heat energy to kinetic energy.
B From kinetic energy to heat energy.
C From gravitational potential energy to heat energy.
D From kinetic energy to gravitational potential energy.

10 The diagram shows a waiter carrying a tray of food that weighs 10 N and walking a distance of 5 m.



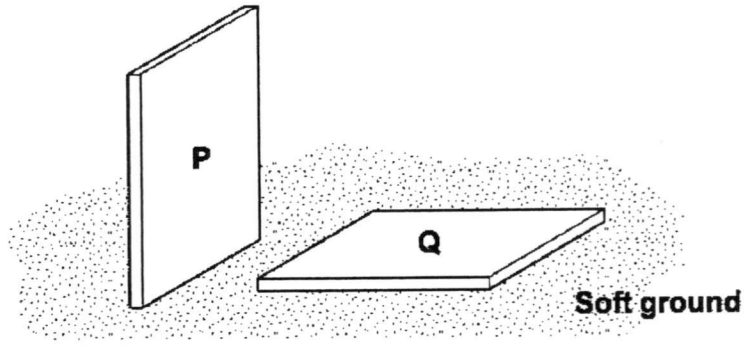
What is the work done by the waiter in carrying the tray?

A 0 J
B 5 J
C 10 J
D 50 J

11 A construction worker wants to lift some tiles from the ground floor to the sixth floor, which is 16 m from the ground. What is the time taken for a motor with a power rating of 1.50 kW to lift the tiles, which have a combined mass of 300 kg, to the sixth floor?

A 3.2 s
B 32 s
C 3200 s
D 32000 s

12 **P** and **Q** are two identical and heavy stone tiles. A builder leaves them resting on soft ground as shown in the diagram.



Tile **P** is vertical and tile **Q** is horizontal.

After a few hours, tile **P** started to sink into the soft ground, but tile **Q** does not. Which one of the following correctly compares the forces and the pressures that the tiles exert on the ground?

	Forces on ground	Pressures on ground
A	Different	Tile **P** is greater
B	Different	Tile **Q** is greater
C	Same	Tile **P** is greater
D	Same	Tile **Q** is greater

13 Which one of the following correctly states the properties of solids, liquids and gases?

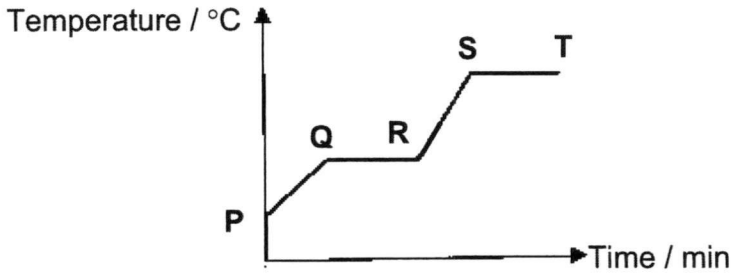
	Solids	Liquids	Gases
A	Fixed shape	Fixed shape	No fixed shape
B	Easily compressed	Easily compressed	Hard to compress
C	Do not flow	Flow easily	Flow easily
D	No fixed volume	Fixed volume	No fixed volume

14 The forces of attraction between particles in solids, liquids and gases are F_S, F_L and F_G respectively.

Which one of the following correctly compares the forces of attraction between particles in solids, liquids and gases, from the strongest to the weakest?

A $F_S > F_L > F_G$ **B** $F_S > F_G > F_L$
C $F_G > F_L > F_S$ **D** $F_G > F_S > F_L$

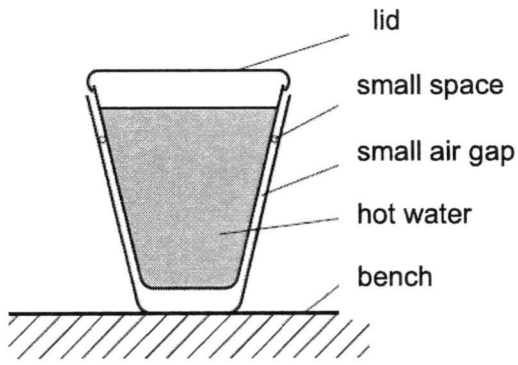
15 A solid substance is placed in a boiling tube and heated steadily. The temperature-time graph of the substance is shown in the diagram.



At which portions is the substance absorbing heat that result in a change of state?

A **PQ** and **QR** **B** **PQ** and **RS**
C **QR** and **ST** **D** **RS** and **ST**

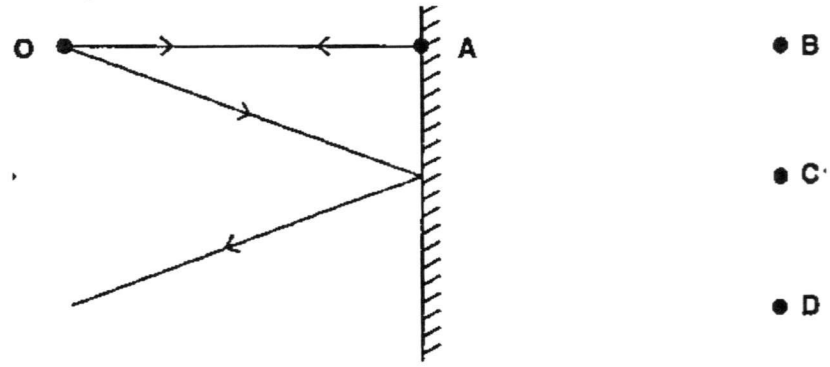
16 Two plastic cups are placed one inside the other. Hot water is poured into the inner cup and a lid is put on top as shown in the diagram.



Which one of the following statements is correct?

A No heat passes through the sides of either cup.
B The lid is used to reduce heat loss by convection.
C Heat loss by radiation is prevented by the small air gap.
D The bench is heated by convection from the bottom of the outer cup.

17 The diagram shows rays of light from an object **O** being reflected from a plane mirror. At which position will the image be formed?

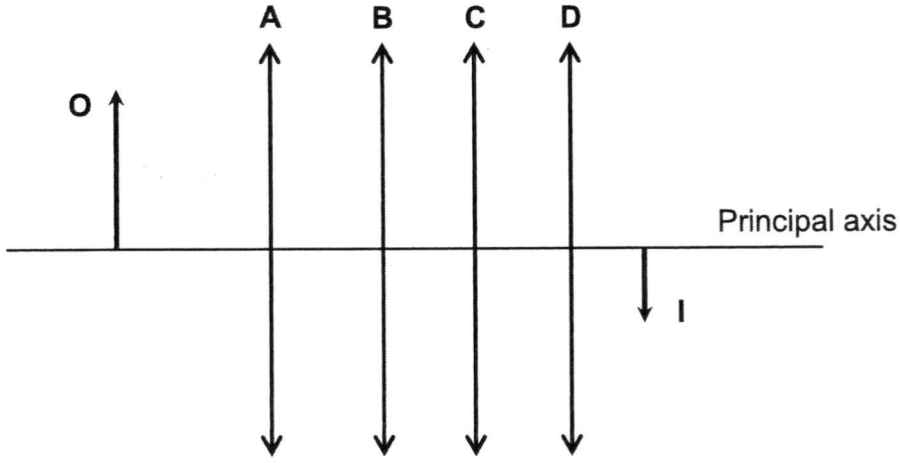


18 Which is/are the condition(s) needed for total internal reflection to take place?

I The angle of incidence is 0°.
II The angle of incidence must be greater than the critical angle.
III Light ray travels from an optically denser medium to an optically less dense medium.

A **II** only
B **I** and **III** only
C **II** and **III** only
D **I**, **II** and **III**

19 An object **O** and its image **I** are shown in the diagram which is drawn to scale. At which position, **A**, **B**, **C** or **D**, is the converging lens placed?



20 A photocopying machine uses a converging lens with focal length 6 cm. How far is the document from the lens when the machine is used to photocopy an exact size of the document?

A 3 cm
B 6 cm
C 9 cm
D 12 cm

SECTION B : [40 marks]

Answer **ALL** *questions in this section. Show your working and write your answers in the space provided.*

1 Complete the following:

(a) 75 W = ... kW ..... **[1]**

(b) 1 nm = ... mm ..... **[1]**

2 A measuring cylinder contains 25 cm^3 of water. When a stone of weight 0.97 N is dropped into the water, it sinks to the bottom and the water level rises to the 65 cm^3 mark.

(a) Calculate the mass of the stone, given that g = 10 N/kg.

mass = ... kg ..... **[2]**

(b) Calculate the density of the stone, giving your answer in g/cm^3.

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

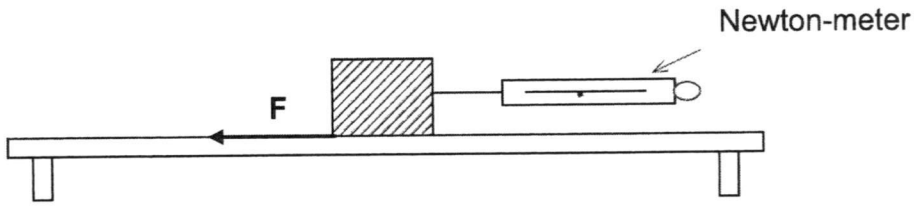
(c) Explain why the above method is not suitable to determine the density of any object that has a value lower than that of the density of water.

.....

.....

..... **[2]**

3 The diagram shows a wooden block being pulled along at constant speed.



The frictional force **F** opposing the motion is shown by the arrow. The reading on the Newton-meter is 6.5 N.

(a) What is the magnitude of the frictional force **F**? Explain your answer.

.....

.....

..... **[2]**

(b) The wooden block continues to be pulled along on the table top but with a greater force. The reading on the Newton-meter is 7.0 N.

Assuming frictional force stays constant and the mass of the block is 0.4 kg,

(i) calculate the resultant force experienced by the block and

resultant force = ... N **[1]**

(ii) hence calculate the acceleration of the block.

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

4 A 0.35 kg electric toy car consumes 20 J of energy in 10 s.

(a) Calculate the power of the electric toy car.

power = ... W **[2]**

(b) During the 10 s, the toy car accelerates from 3 m/s to 7 m/s on a level road. Calculate the gain in its kinetic energy.

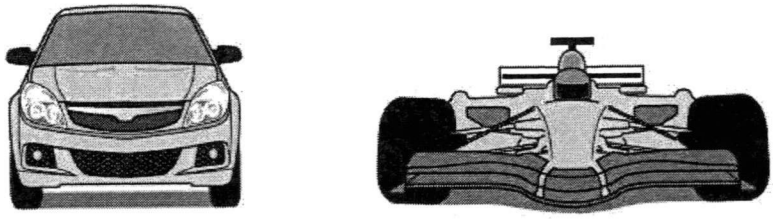
gain in kinetic energy = ... J **[3]**

(c) Explain why the energy consumed by the car is different from the gain of kinetic energy found in **(b)**.

.....

..... **[1]**

5 The diagram shows the front views of two cars, drawn according to the same scale.



family car racing car

Fig. 5.1

(a) Predict if the family car exerts *less*, *same* or *more* pressure on the ground than the racing car. Explain your answer.

.....

.....

..... **[2]**

(b) The weight of the family car and its contents is 9000 N. Each of its four tyres has an area of 0.012 m^2 in contact with the ground. Calculate the pressure exerted by the car on the ground in kPa. State clearly the formula you used.

pressure = ... kPa **[3]**

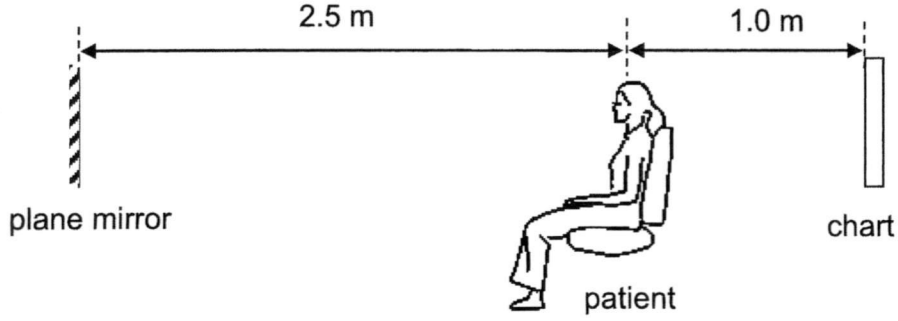
(c) Suggest which car has a greater stability and state two reasons to support your answer.

.....

.....

..... **[3]**

6 The diagram shows a plane mirror and an eye chart in a room where a patient has her eyes tested.



(a) Determine the distance between the patient and the image of the chart.

.....

[1]

(b) The distance between the plane mirror and the chart is fixed. By shifting the patient chair forward or backward, calculate the maximum distance between the image of the chart and the patient.

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

(c) It is known that the image of the chart formed in the mirror is a virtual image. Explain what is meant by a ***virtual image***.

.....

.....

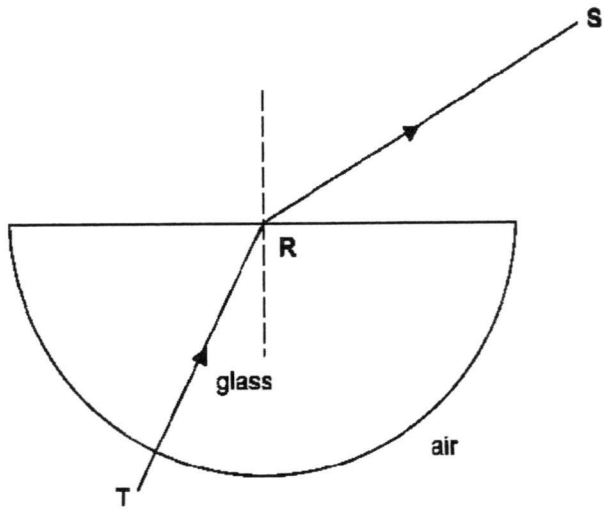
[1]

(d) State **one other** characteristic of the image formed by a plane mirror.

.....

[1]

7 In the diagram, a ray of light **TRS** is shown entering, passing through and leaving a semi-circular glass block which has a refractive index of 1.48.



(a) When the light exits the glass block, it bends away from the normal. Explain why.

.....

..... **[1]**

(b) Given that the speed of light in air is 3×10^8 m/s, calculate the speed of light in the glass.

speed = ... m/s **[2]**

(c) Define ***critical angle***.

.....

..... **[1]**

(d) Calculate the critical angle of the glass.

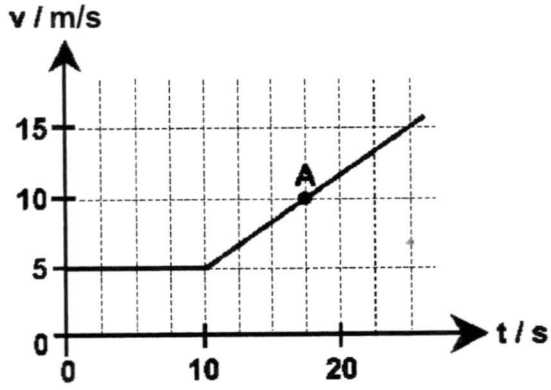
critical angle = ... ° **[2]**

(e) Draw in the diagram, the path of another light ray entering the glass block such that the angle of incidence at **R** in the glass block is equal to the critical angle and the subsequent path until it leaves the glass block. **[1]**

SECTION C : [20 marks]

Each question is worth **10 marks**. *Answer any* **TWO FULL** *questions in this section. Show your working and write your answers in the space provided.*

8 The diagram shows a graph which represents the motion of a toy train along a particular section of its track.



(a) What is the instantaneous speed of the train at **A**?

..... **[1]**

(b) Find the acceleration of the train at **A**.

[2]

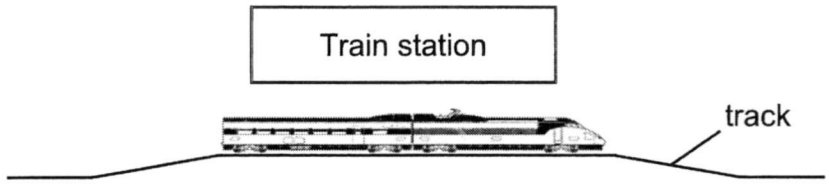
(c) Find the distance travelled by the train in the first 25 s.

[2]

(d) Find the average speed of the train along the track in the first 25 s.

[2]

(e) In reality, it is an advantage for the portion of the track at train stations to be raised higher than the other parts of the track as shown in the diagram.



Explain, in terms of changes in kinetic energy and gravitational potential energy, why this is so for any train approaching the station as well as leaving the station.

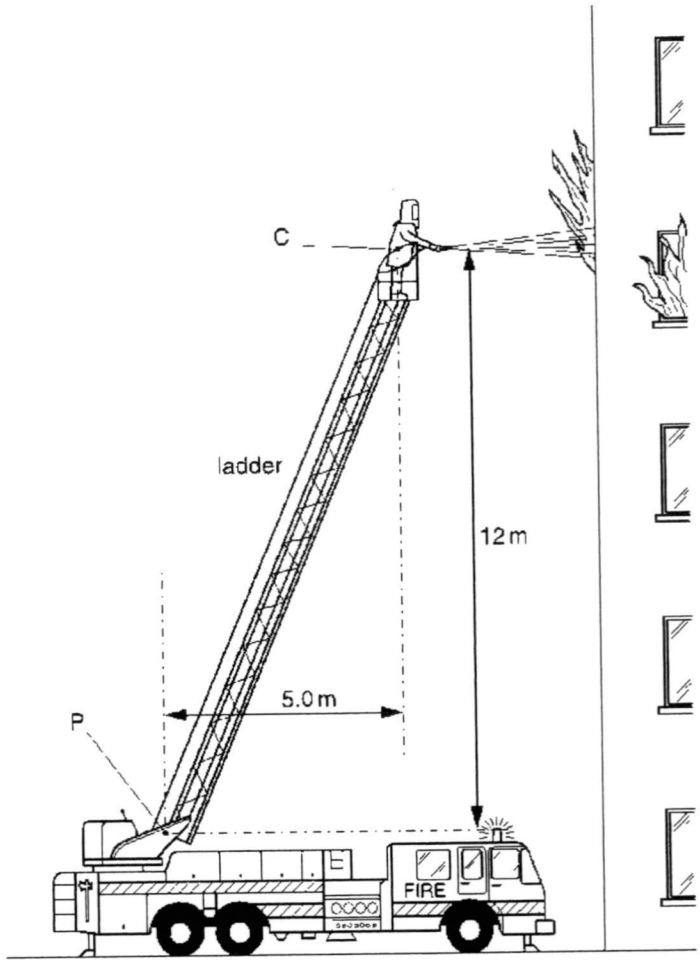
.....

.....

.....

..... **[3]**

9 **(a)** The diagram shows a fire fighter of total mass 84 kg in equilibrium at the top of a ladder that is pivoted at point **P**.



The ladder leans towards a burning building at an angle such that the centre of gravity **C** of the fire fighter is 12 m above and 5.0 m to the right of **P**. The fire fighter holds a hose that directs a high-speed jet of water horizontally into a burning building.

(i) What does it mean by the phrase '***in equilibrium***'?

.....

..... **[1]**

(ii) Calculate the weight of the fire fighter.

[1]

(iii) Calculate the moment **M** of the fire fighter's weight about **P.**

[2]

(iv) The jet of water causes a horizontal force **R** on the fire fighter that acts towards the left, through **C**. This opposes the turning effect of his weight. Calculate the size of **R** that, on its own, ensures that **M** is exactly cancelled.

[2]

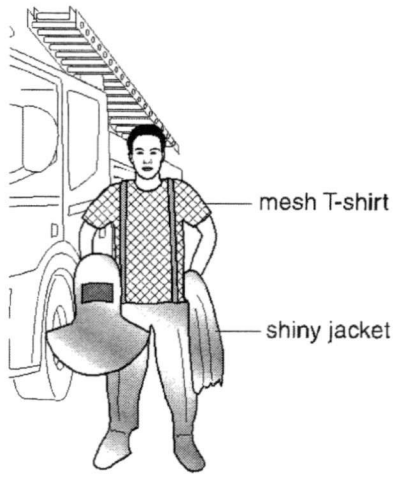
(v) Suggest a third force that has a turning effect about P on the ladder.

.....

[1]

(b) The diagram shows a fire fighter.

The jacket of his protection suit has a shiny outer surface. Underneath it he wears a loosely-woven mesh T-shirt (string vest).



(i) Explain how wearing the shiny jacket helps the fire fighter when he is close to a source of intense heat.

.....

.....

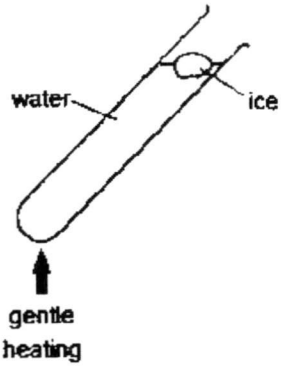
[2]

(ii) Suggest a suitable colour for his protection suit.

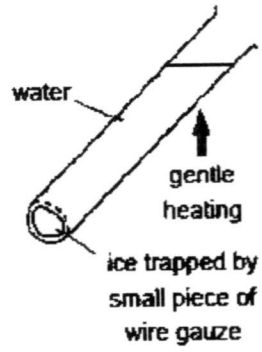
.....

[1]

10 **(a)** The diagram shows two experiments to investigate energy transfer in water.



Experiment 1
Cold water is gently heated at the bottom. The ice at the top melts before the water boils.



Experiment 2
Cold water is gently heated at the top. The ice trapped at the bottom remains solid, even when the water at the top begins to boil.

(i) Name the process by which thermal energy travels through the glass.

.....

[1]

(ii) **(A)** Name the main process in **Experiment 1** that transfers thermal energy from the water at the bottom to the ice at the top.

.....

[1]

(B) Describe how the process in **(A)** occurs.

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[2]

(iii) Suggest two reasons why the ice in **Experiment 2** does not melt, even when the water at the top begins to boil.

1. .....

.....

2. .....

..... [2]

(b) (i) State **two** similarities between evaporation and boiling.

1. .....

.....

2. .....

..... [2]

(ii) A nurse places a damp cloth on the forehead of a sick patient. As water evaporates, the patient's forehead is cooled. Explain in terms of the water molecules, how the cooling is produced.

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..... [2]

END OF PAPER

ST. PATRICK'S SCHOOL
END-OF-YEAR EXAMINATIONS 2017

SUBJECT : SCIENCE PHYSICS 5076 DATE : 6 OCT 2017

LEVEL : SECONDARY 3 EXPRESS DURATION : 1 H 30 MIN

ANSWER SCHEME

Section A [20 marks]

1	2	3	4	5	6	7	8	9	10
B	**C**	**D**	**A**	**B**	**D**	**A**	**A**	**B**	**A**

11	12	13	14	15	16	17	18	19	20
B	**C**	**C**	**A**	**C**	**B**	**B**	**C**	**C**	**D**

Section B [40 marks]

QN	Suggested Answers	Sub Ttl	Ttl
1a	75 kW = 0.075 kW	**1**	**2**
1b	1 nm = 0.000001 mm	**1**	

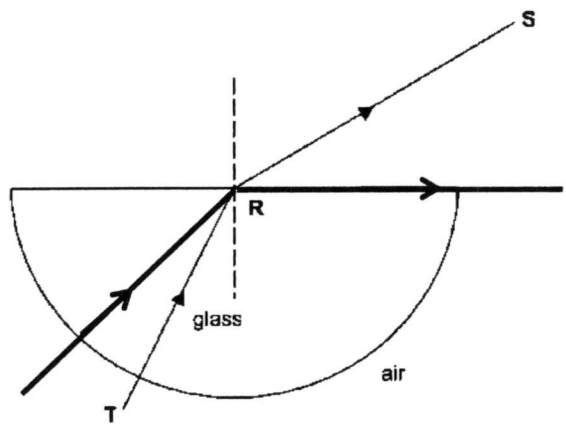
QN	Suggested Answers	Sub Ttl	Ttl
2a	W = mg 0.97 = m × 10 [1] m = 0.097 kg (to 3sf). [1]	**2**	**7**
2b	Mass of stone = 0.097 kg = 97 g [1] Volume of stone = 65 − 25 = 40 cm^3 [1] Density of the stone = 97 / 40 = 2.425 = 2.43 g/cm^3 (to 3sf) [1]	**3**	
2c	Any object of density lower than that of water will float on water. [1] This does not allow the full volume of the object to be displaced and measured. [1]	**2**	

QN	Suggested Answers	Sub Ttl	Ttl
3a	Frictional force F = 6.5 N [1] As the object is moving with a constant speed, the resultant force is zero [1]. The frictional force F is equal to the pulling force.	**2**	**5**
3bi	Resultant force = 7.0 – 6.5 = 0.5 N [1]	**1**	
3bii	a = F_R / m = 0.5 / 0.4 [1] = 1.25 m/s^2 [1]	**2**	

QN	Suggested Answers	Sub Ttl	Ttl
4a	P = E/t = 20 / 10 [1] = 2.00 W [1] Note: Answer to 2 or 3 sf.	**2**	**6**
4b	Gain in KE = ½ × 0.35 × 7^2 – ½ × 0.35 × 3^2 [1, 1] = 8.575 – 1.575 = 7.00 J [1] Note: Answer to 2 or 3 sf	**3**	
4c	The gain in KE is less than the energy consumed as the additional energy is required to overcome frictional forces [1].	**1**	

QN	Suggested Answers	Sub Ttl	Ttl
5a	The family car exerts more pressure [1] on the ground than the racing car. The contact area of the tyres of the family car with the ground is smaller than that of the racing car. [1]	2	**8**
5b	P = F/A = 9000 / (0.012 × 4) [1, 1] = 187500 Pa = 188 kPa (to 3 sf) [1]	3	
	The racing car has greater stability [1]. It has a lower centre of gravity [1] and a larger base area [1].	**3**	

QN	Suggested Answers	Sub Ttl	Ttl
6a	3.5 + 2.5 = 6.0 m [1]	**1**	**5**
6b	Maximum distance = 3.5 × 2 [1] = 7.0 m [1]	**2**	
6c	Virtual image cannot be captured on a screen. [1]	**1**	
6d	Upright/Same size/Laterally inverted [1]	**1**	

QN	Suggested Answers	Sub Ttl	Ttl
7a	It is because light travels slower in the glass block than in air. [1]	**1**	**7**
7b	$\eta = c / v$ $1.48 = 3.0 \times 10^8 / v$ [1] $v = 2.03 \times 10^8$ m/s [1] Answer to 3 sf.	2	
7c	Critical angle is the angle of incidence in the optically denser medium such that the angle of refraction in the optically less dense medium is 90°. [1]	1	
7d	$c = \sin^{-1} (1/\eta)$ $= \sin^{-1} (1/1.48)$ [1] $= 42.5°$ [1]	**2**	
7e		**1**	

Section C [20 marks]

QN	Suggested Answers	Sub Ttl	Ttl
8a	10 m/s [1]	**1**	**10**
8b	a = (v – u) / t = (15 – 5) / 15 [1] = 10 / 15 = 0.667 m/s^2 [1]	2	
8c	Distance travelled = Area under v-t graph = 10 × 5 + ½ × (5 + 15) × 15 [1] = 50 + 150 = 200 m [1]	2	
8d	Average speed = Total distance travelled / Total time taken = 200 / 25 [1] = 8.0 m/s [1]	**2**	
8e	When the train approaches the platform, it should slow down [½]. With the platform raised, kinetic energy is converted to gravitational potential energy [1] causing the train to lose kinetic energy and thus slows down faster. When the train leaves the platform, it should pick up speed [½]. With the train travelling down the platform, gravitational potential energy is converted to kinetic energy [1] causing the train to gain kinetic energy and thus moving off faster.	**3**	

QN	Suggested Answers	Sub Ttl	Ttl
9ai	When an object is in equilibrium, • the total clockwise moments about any point is equal to the total anti-clockwise moments about the same point. • resultant force is equal to 0 N. As long as the student states either one of the above points.	**1**	**10**
9aii	W = mg = 84 × 10 = 840 N [1]	1	
9aiii	Moment **M** = 840 x 5.0 [1] = 4200 Nm [1]	**2**	
9aiv	R × 12 = 4200 [1] R = 4200 / 12 = 350 N [1]	**2**	
9av	The weight of the ladder [1]	**1**	
9bi	The shiny surface helps to keep the fire fighter keep cool [1] as shiny surface is a good reflector/poor absorber [1] of radiant heat and minimizes the heat absorbed from the heat source.	**2**	
9bii	Sliver/white [1]	**1**	

QN	Suggested Answers	Sub Ttl	Ttl
10ai	Conduction [1]	**1**	**10**
10aiiA	Convection [1]	**1**	
10aiiB	The heated water at the bottom expands, becomes less dense [1] than the surrounding water and thus rises to the top to heat up the ice. [1]	**2**	
10aiii	1. The heated water at the top does not sink and can't be transferred by convection to the bottom. [1] 2. The heat is transferred to the bottom by conduction which is slow in water. [1]	**2**	
10bi	Both processes require heat energy. [1] Both processes involve the change of state from liquid state to gaseous state. [1]	**2**	
10bii	The water molecules gain heat energy [1] from the patient causing the water to evaporate. This removal of the heat energy from the patient causing his temperature to drop thus cooling is produced. [1]	**2**	