

Name :	Register	
	Class	Number

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Dunearn Secondary School
End of Year Examination 2017
Science (Physics) 5076
Sec 3 Express

11th October 2017 (Wednesday)

0800 – 0930 h

1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, class and register number in the spaces at the top of this page.

Section A

Answer **ALL** questions. Each question has 4 possible answers, A, B, C and D. Choose the one you consider correct and record your answer in soft pencil on the separate answer sheet provided.

Section B

Answer **ALL** questions. Write your answers in the spaces provided on the question paper.

Section C

Answer any **TWO** questions. Write your answers in the spaces provided on the question paper.

Candidates are reminded that **all** quantitative answers should include appropriate units. Candidates are advised to show all their workings in a clear and orderly manner.

Section A	Section B						Sub-total for Section B	/ 35
/ 20	1	2	3	4	5	6	Sub-total for Section C	/ 20
	Section C							
	7	8	9				Overall marks	/ 75

Setter: Mr Ow Gan Pin

Parent's / Guardian's Signature:

Section A: Multiple Choice Questions (20 marks)

Answer all questions.

Select the most appropriate answer and shade it on the OTAS provided.

- 1 Fig. A shows the reading on a pair of vernier calipers when the jaws are closed. Fig. B shows the reading on the same vernier calipers after a steel rod has been placed between the jaws.

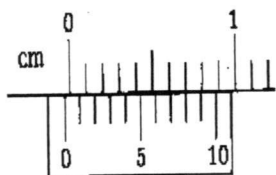


Fig. A

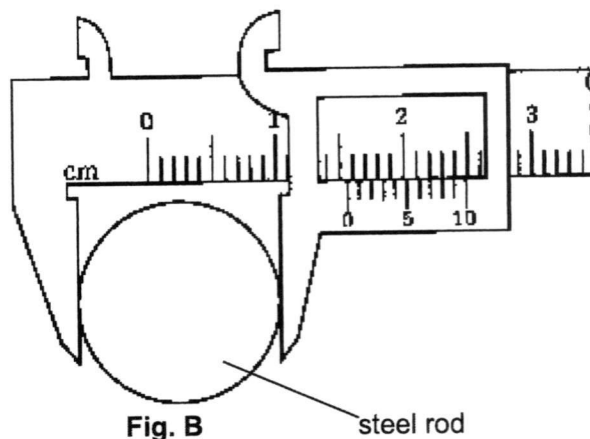


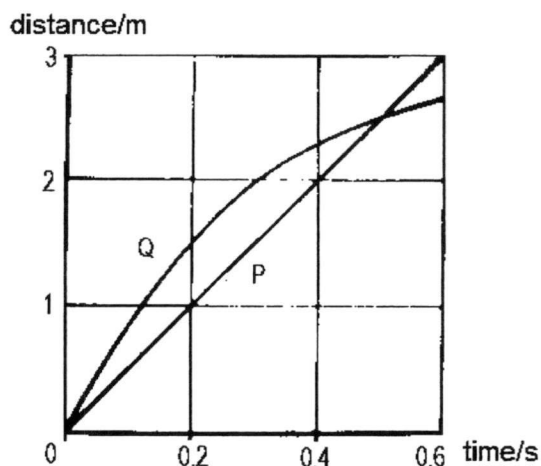
Fig. B

steel rod

What is the corrected reading for the diameter of the steel rod?

- A 1.50 cm
 B 1.58 cm
 C 1.60 cm
 D 1.66 cm
- 2 What is the order of magnitude of the diameter of planet Earth?
- A 1×10^{-7} m
 B 1×10^5 m
 C 1×10^7 m
 D 1×10^{10} m
- 3 What is meant by velocity?
- A rate of change of displacement
 B rate of change of distance
 C rate of change of mass
 D rate of change of time
- 4 Ahmad takes 20 min to walk from his house to a coffee shop that is 1.2 km away. He stays at the coffee shop for 15 min. He then walks back home in 12 min. What is his average speed for the whole journey?
- A 0.851 m/s
 B 1.25 m/s
 C 1.33 m/s
 D 51.1 m/s

- 5 The distance-time graphs of two cars **P** and **Q** are shown in the diagram below.

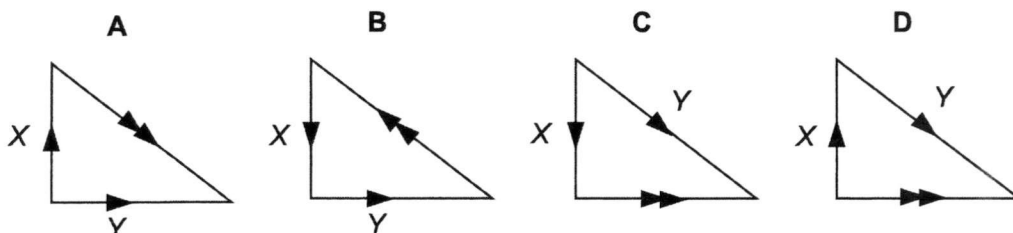


Which of the following statements is true?

- A Both **P** and **Q** are moving at an increasing speed.
 - B **P** is moving at a constant speed while **Q** is moving at a decreasing speed.
 - C **Q** is always moving faster than **P**.
 - D **Q** travels a greater distance than **P**.
- 6 Which of the following shows the correct examples of scalar and vector quantities?

	scalar quantity	vector quantity
A	density	time
B	displacement	mass
C	energy	acceleration
D	force	moment

- 7 Which diagram below correctly shows the addition of two forces, **X** and **Y**?



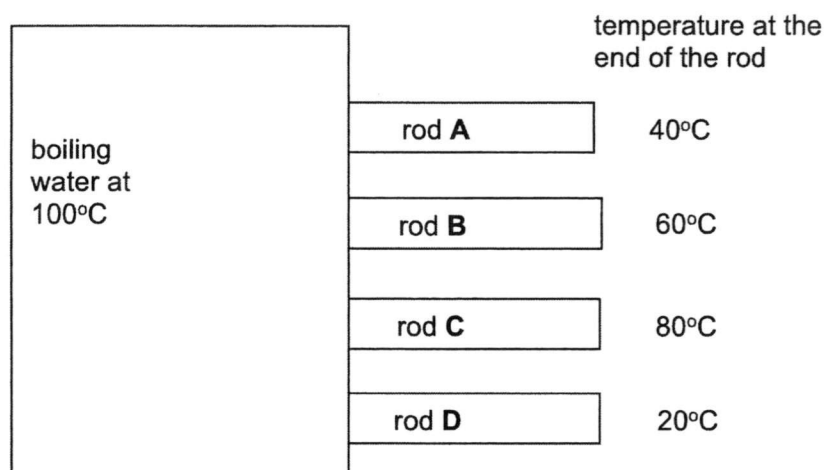
- 8 Which of the following depends only on the amount of matter in a body?

- A density
- B mass
- C volume
- D weight

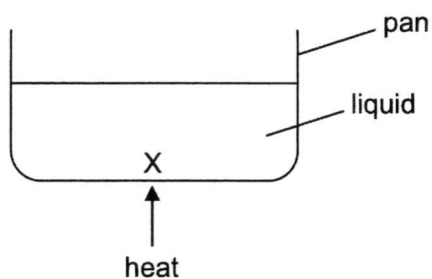
- 9 What is a gravitational field?
- A A region in which a mass experiences a force due to gravitational attraction.
 - B A region in which a mass experiences a force due to magnetic attraction.
 - C A region in which an object gains gravitational potential energy.
 - D A region in which an object gains speed towards the centre of the Earth.
- 10 Natasha's mother wants to put out some wet clothes to dry outside the window. She hangs the clothes on a long pole. How should Natasha advise her mother for maximum safety considerations?
- A Hang the wet clothes as far as possible to the window ledge so as to produce a larger moment.
 - B Hang the wet clothes as far as possible to the window ledge so as to produce a smaller moment.
 - C Hang the wet clothes as near as possible from the window ledge so as to produce a larger moment.
 - D Hang the wet clothes as near as possible from the window ledge so as to produce a smaller moment.
- 11 The principle of the conservation of energy states that
- A energy can be created or destroyed depending on how it is being converted from one form to another.
 - B energy cannot be created but can be destroyed after converting from one form to another.
 - C energy cannot be created or destroyed, but can be converted from one form to another.
 - D energy must be conserved by limiting the amount being converted from one form to another.
- 12 Which of the following is a property of a solid?
- A It has a fixed volume.
 - B It has low density.
 - C It is highly compressible.
 - D It takes any shape of a container.
- 13 Particles in a gas
- A are free to move slowly in circles.
 - B move about randomly at very high speeds.
 - C spin and roll along fixed axes.
 - D vibrate about fixed positions.

- 14 The diagram shows four rods each of different materials. One end of each rod is in contact with boiling water and the other end reaches the steady temperature shown.

Which rod is the **best** conductor of heat?



- 15 Some liquid in a pan is heated.



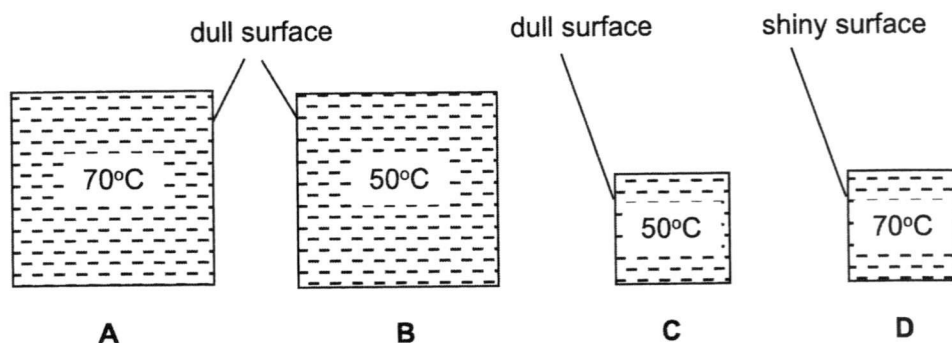
What happens to the mass, volume and density of the liquid in region X?

	mass	volume	density
A	decreases	stays the same	increases
B	increases	decreases	stays the same
C	stays the same	decreases	increases
D	stays the same	increases	decreases

- 16 The diagram below shows 4 different containers **A**, **B** and **C** and **D**. All containers are covered with a lid.

Containers **A** and **B** are of the same size; containers **C** and **D** are of the same size.
 Containers **C** and **D** are smaller than containers **A** and **B**.
 Containers **A**, **B** and **C** have dull surfaces; container **D** has a shiny surface.
 Containers **A** and **D** are filled with liquid at a temperature of 70°C ; containers **B** and **C** are filled with the same liquid but at a temperature of 50°C .

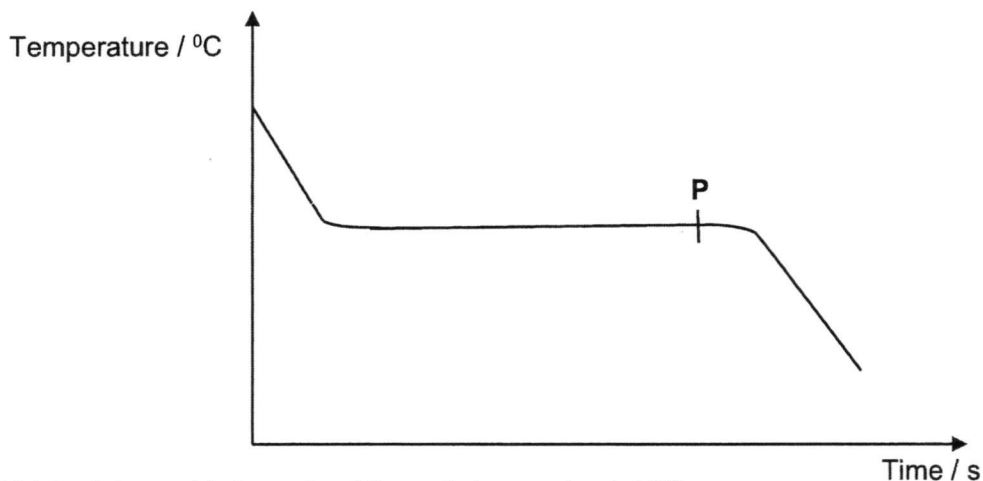
Which container radiates heat at the **highest** rate?



- 17 Which of the following statements about internal energy is correct?

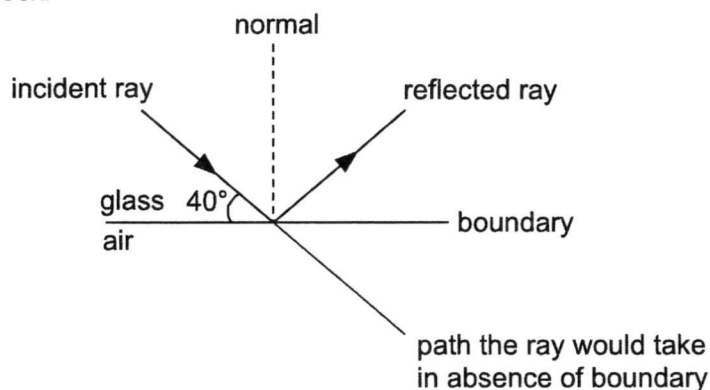
- A** When there is a drop in temperature of the substance, there must be an increase in the internal energy of a substance.
- B** When there is a rise in temperature of the substance, there must be an increase in the internal energy of a substance.
- C** When there is an increase in the internal energy of a substance, there must be a drop in temperature of the substance.
- D** When there is an increase in the internal energy of a substance, there must be a rise in temperature of the substance.

- 18 The diagram below shows the cooling curve of a substance in its gaseous state initially.



Which statement is true about the substance at point P?

- A Most of the substance will be in liquid state.
 - B The substance is expanding.
 - C The substance is undergoing solidification.
 - D Thermal energy is absorbed by the substance.
- 19 When a liquid evaporates, some molecules escape into the surrounding.
Which of the molecules escape?
- A The molecules at the surface with less energy than others
 - B The molecules at the surface with more energy than others
 - C The molecules throughout the liquid with less energy than others
 - D The molecules throughout the liquid with more energy than others
- 20 A ray of light travelling in a glass block will change direction when it reaches the edge of the block.



What is the angle of reflection of the light ray?

- A 40°
- B 50°
- C 80°
- D 130°

Section B: Structured Questions (35 marks)
Answer all the questions in the spaces provided.

- 1 (a) Complete the table by filling in the physical quantity measured by each instrument and the symbol for its SI unit.

instrument	quantity measured	symbol for SI unit
beam balance		
measuring tape		

[2]

- (b) Fig. 1.1 shows the side view of a set-up of a simple pendulum to investigate the relationship between the length of the pendulum and its period.

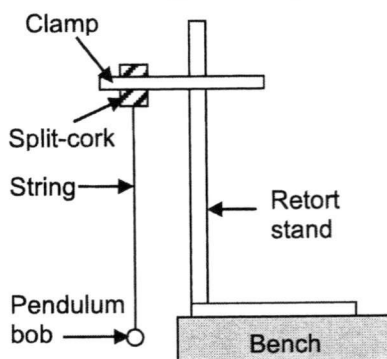


Fig. 1.1

- (i) During a particular experiment, the length of the pendulum is set at 0.400 m. A student then measures the time taken, t , for 20 oscillations. She obtains three sets of data: $t_1 = 29.92$ s, $t_2 = 25.14$ s and $t_3 = 25.46$ s. Calculate the period, T , of the pendulum based on her measured data.

period = _____ s [3]

- (ii) Comment on the accuracy of her measured data by comparing the value of period T in **b(i)** with the theoretical value of period T which can be calculated by the following formula:

$$T = 2\pi \sqrt{\frac{l}{g}}$$

where l = length of the pendulum

$$g = 10 \text{ m/s}^2$$

$$\pi = 3.14$$

[2]

- 2 Fig. 2.1 shows the speed-time graph of the motion of a truck. The truck is moving in a straight line on a level road.

speed / ms^{-1}

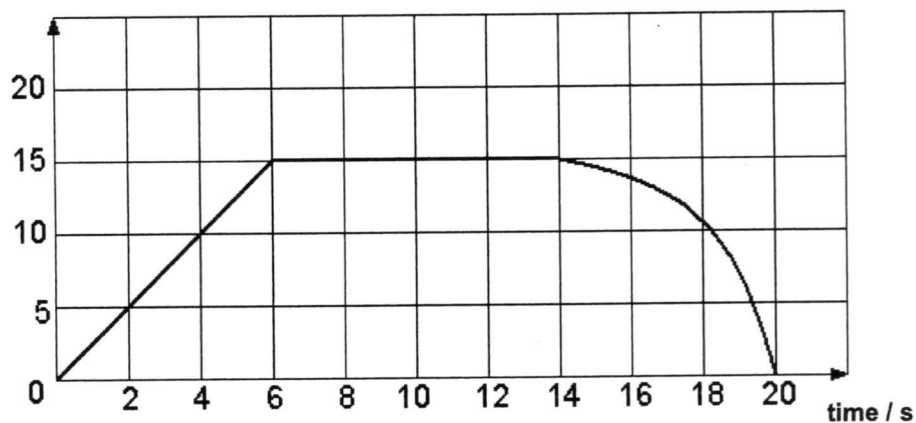


Fig. 2.1

- (a) Define acceleration.

_____ [1]

- (b) Calculate the acceleration of the truck from 0 s to 6.0 s.

acceleration = _____ m/s^2 [2]

- (c) Calculate the distance travelled by the truck in the first 14.0 s.

distance = _____ m [2]

- (d) Describe the motion of the truck from 14.0 s to 20.0 s.

_____ [1]

- 3 (a) Define pressure.

[1]

- (b) A hydraulic press is used to lift a car as shown in Fig. 3.1. A force of 1000 N is exerted on piston A with an area of 0.50 m^2 . Piston B has an area of 6.0 m^2 .

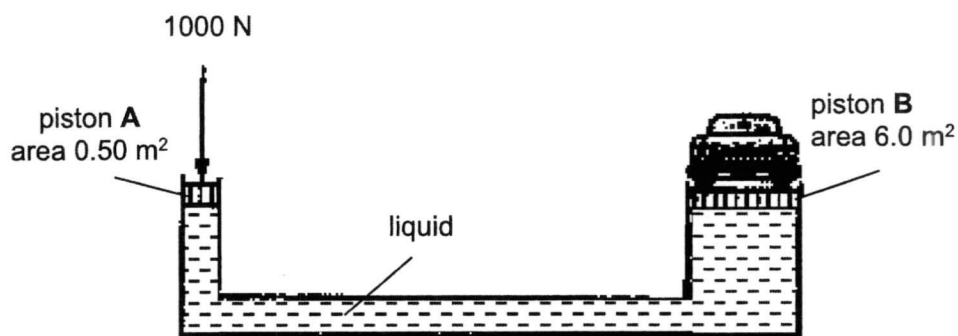


Fig. 3.1

Calculate

- (i) the pressure exerted by piston A,

pressure = _____ Pa [2]

- (ii) the weight of the car.

weight = _____ N [1]

- 4 Fig. 4.1 shows a hovercraft with a weight of 15000 N. It is hovering at a constant distance above the ground. Assume $g = 10 \text{ m/s}^2$.

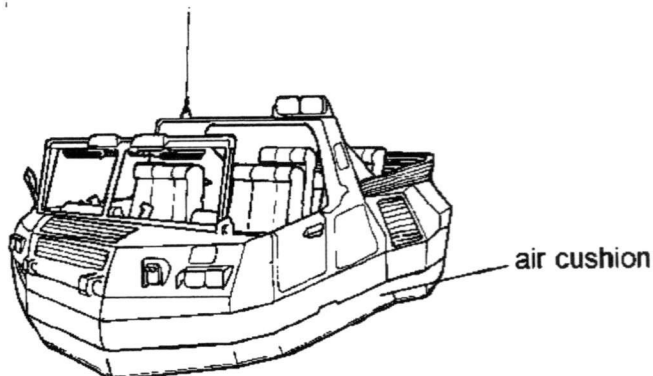


Fig. 4.1

- (a) State and explain the value of the upward force exerted by the air cushion.

[2]

- (b) Calculate the mass of the hovercraft.

mass = _____ kg [1]

- (c) The hovercraft accelerates horizontally at 2.0 m/s^2 . Calculate the resultant force acting on the hovercraft horizontally.

resultant force = _____ N [2]

- (d) Calculate the horizontal force exerted by the driving propeller on the hovercraft if the opposing force is 1200 N.

force = _____ N [1]

- (e) Name the force that opposes the motion of the hovercraft.

[1]

- 5 (a) There are three vehicles on a road – a double-decker bus, a motorcycle and a car. Which vehicle is **most** likely to have the **greatest** inertia? Provide a reason for your answer.

[2]

- (b) 20 g of water and 15 g of substance **X** are mixed together in a beaker. The average density of the mixture is 1.4 g/cm^3 .

- (i) Calculate the volume of the mixture.

volume of mixture = _____ cm^3 [2]

- (ii) Given that the density of water is 1.0 g/cm^3 , calculate the volume of water.

volume of water = _____ cm^3 [1]

- (iii) Hence, calculate the volume of substance **X**.

volume of substance **X** = _____ cm^3 [1]

- 6 Fig. 6.1 shows an old coin displayed in a museum.

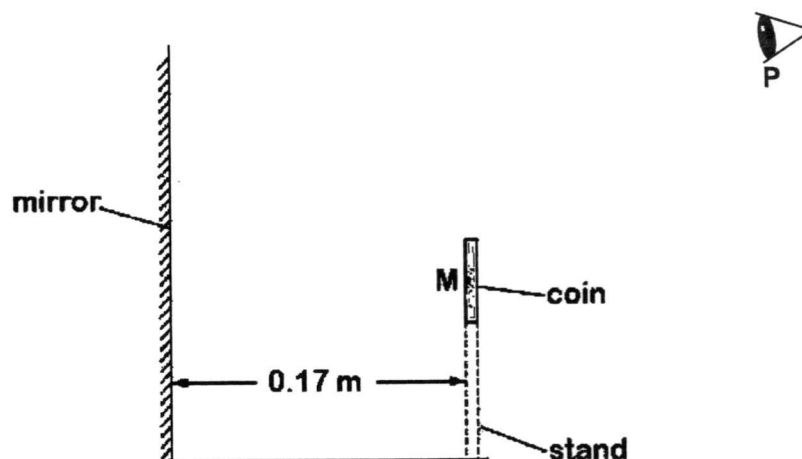


Fig. 6.1

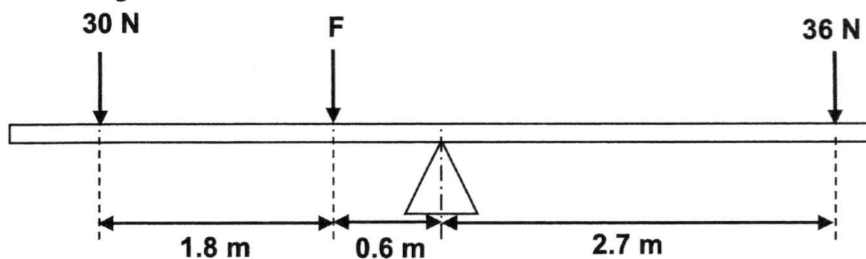
The coin is vertical and is supported by a transparent stand. A vertical mirror is placed 0.17 m behind the coin. **M** is a point on the back of the coin that a visitor **P** sees.

- (a) On Fig. 6.1, construct a ray diagram to show how the visitor **P** can see the image of the point **M** on the coin in the mirror. Label the image **I**. [3]
- (b) State two characteristics of an image formed in a plane mirror.

[2]

Section C: Free Response Questions (20 marks)**Answer any two questions from this section in the spaces provided.**

- 7 (a) A pivoted uniform bar is in equilibrium under the action of the forces as shown in Fig. 7.1 below.

**Fig. 7.1**

- (i) Calculate the moment of the 36 N force about the pivot, and state the direction of the moment.

moment = _____ Nm [1]

direction of moment = _____ [1]

- (ii) Calculate the value of the force, F .

F = _____ N [2]

- (iii) A force of 50 N is next exerted downwards on the pivot. How will this affect the value of F as calculated in a(ii)? Provide a reason for your answer.

[2]

- (b) Fig. 7.2 below shows one end of a uniform block of wood resting on a table.

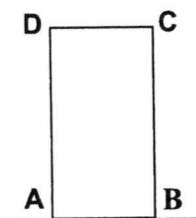


Fig. 7.2

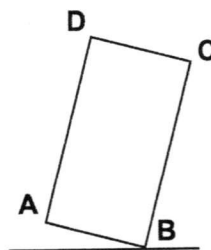


Fig. 7.3

The block is then slightly displaced to the position shown in Fig. 7.3.

- (i) On Fig. 7.3, locate and label the centre of gravity of the block as **CG**. Draw and label the line of action of the weight, **W**. [2]
- (ii) Explain what would happen to the block after it is slightly displaced to the position as shown in Fig. 7.3.

[2]

- 8 Fig. 8.1 shows a smooth slide at a water theme park. A child of mass 40 kg climbs up the stairs from point **A** to point **B**. She then slides down from point **B**, the top of the smooth curve slide. Beyond point **C**, the track is horizontal and the child decelerates as she passes through a track of water, coming to rest at point **D**. Assume that the gravitational field strength = 10 N/kg.

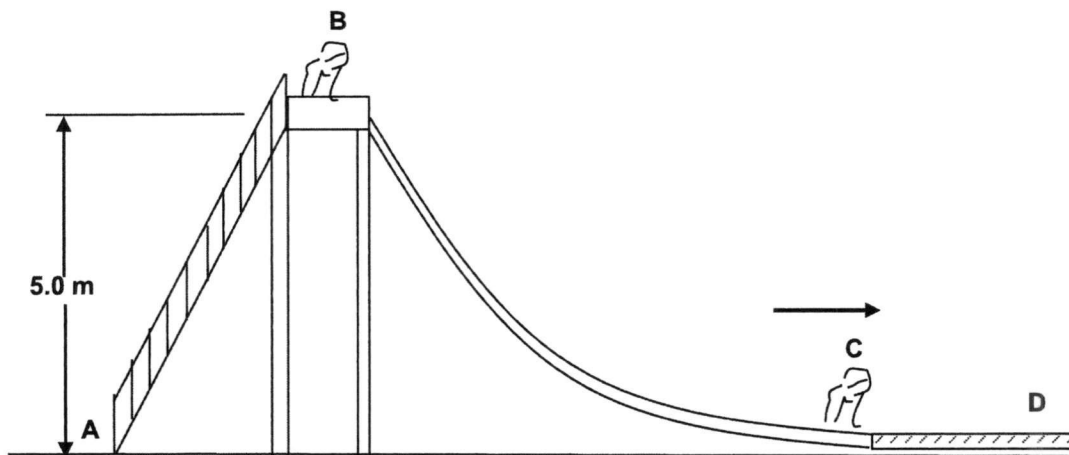


Fig. 8.1

- (a) Describe the main energy conversions that take place as the child moves from point **A** to point **B**, and from point **B** to point **C**.

Point **A** to point **B**: _____

Point **B** to point **C**: _____

_____ [2]

- (b) The rate of energy conversion increases as the girl slides down from point **B** to point **C**. Explain clearly why this is so.

_____ [2]

- (c) Calculate the speed of the child as she reaches point **C**.

speed = _____ m/s [2]

- (d) If the retarding force exerted by the water on the child is 300 N, how far along the horizontal track does the child slide before coming to rest at point D? Show your working clearly.

distance = _____ m [2]

- (e) State and explain how your answers to (c) and (d) would be different if the slide was **not** smooth.

 [2]

- 9 (a) Fig. 9.1 shows the apparatus used when some students investigated what happens to a solid, substance **R**, as it is heated. The solid is contained in a metal can. It is heated by an immersion heater.

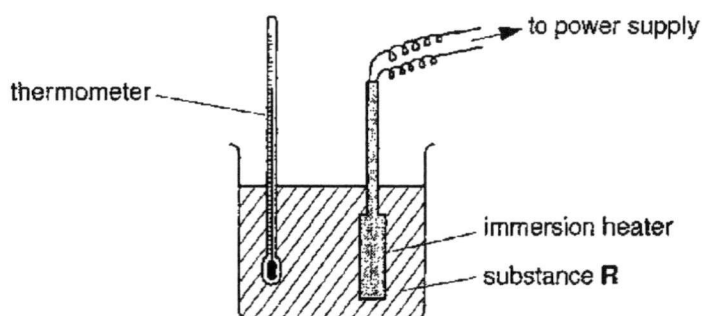


Fig. 9.1

The students measured the temperature of substance **R** at regular time intervals. Fig. 9.2 shows the graph that they plotted from their results.

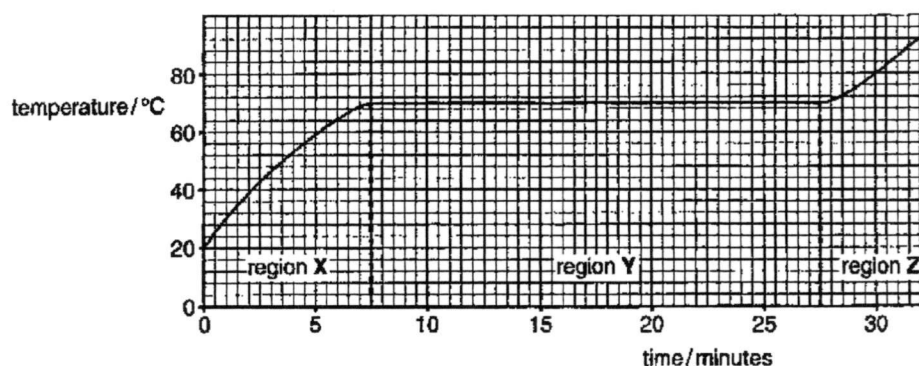


Fig. 9.2

- (i) State the melting point of substance **R**.

melting point = _____ °C [1]

- (ii) Name the state(s) of the substance in region **Y**.

_____ [1]

- (iii) The immersion heater has a power of 50 W. Use this information and Fig. 9.2 to calculate the output energy of the heater in region **Y**.

output energy = _____ J [2]

- (iv) Describe how the speed of the molecules and the intermolecular distance of substance **R** change in region **Z**.

[2]

- (b) Fig 9.3 shows a section of the solar heating system which helps to provide hot water for a house.

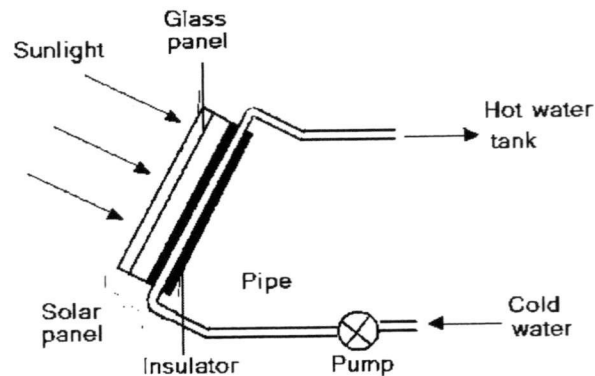


Fig. 9.3

It consists of a solar panel placed outside on a roof. Heat from the sun warms the water in the pipes and the water pipes are connected to a hot water tank inside the house. Inside this tank, heat is transferred from the water in the pipe to water in the tank and the cooler water is circulated back to the solar panel.

Besides the glass panel, identify two other features from Fig. 9.3 and explain how these features increase the efficiency in providing hot water for the house.

[4]

End of Paper

**Dunearn Secondary School
Secondary 3E Science (Physics)
End of Year Examination 2017
Marking Scheme**

Marking Order

Markers	11 Oct (Wed)	13 Oct (Fri)
Ow Gan Pin Section A (20 marks) + Section B Q1, Q2, Q4 and Q5 (26 marks)	3SP (16) & 3EM (21)	3TP (23)
Lee Yi Qiao Section B Q3 and Q6 (9 marks) + Section C (20 marks)	3TP (23)	3SP (16) & 3EM (21)

Each marker will be responsible for summing up the marks for each question and record on the cover page. In addition, if there is any cases of absence of units or wrong significant figures for the final answers, indicate -1 (units) or -1 (s.f.) on the cover page at the respective question(s).

Teacher teaching the class will calculate the total and deduct 1 m overall for wrong unit/s.f..

Section A (20 marks)


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

Section B (35 marks)

Qn	Solution	Mark									
1a	<table border="1"> <thead> <tr> <th>instrument</th><th>quantity measured</th><th>symbol for SI unit</th></tr> </thead> <tbody> <tr> <td>beam balance</td><td>Mass</td><td>kg</td></tr> <tr> <td>measuring tape</td><td>Length (accept: distance)</td><td>m</td></tr> </tbody> </table> <p>Give 1m for 2 to 3 correct answers; 2m for all 4 correct answers.</p>	instrument	quantity measured	symbol for SI unit	beam balance	Mass	kg	measuring tape	Length (accept: distance)	m	2
instrument	quantity measured	symbol for SI unit									
beam balance	Mass	kg									
measuring tape	Length (accept: distance)	m									
1bi	$\text{Average time for 20 oscillations} = \frac{29.92 + 25.14 + 25.46}{3}$ $= 26.84 \text{ s}$ $\text{Period, } T = \frac{26.84}{20}$ $= \underline{1.34} \text{ s} \quad (\text{do not accept } 1.3 \text{ s or } 1.342 \text{ s})$	1 1 1									

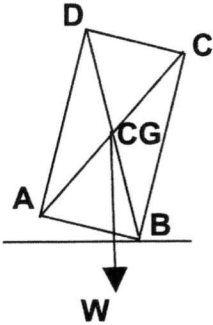
1bii	$T = 2\pi \sqrt{\frac{l}{g}} = 2(3.14) \sqrt{\frac{0.400}{10}} = 1.26 \text{ s (3 s.f.)}$ <p>(do not accept 1.3 s or 1.256 s; -1m once for wrong d.p./s.f. in bi and bii; 0m if no working)</p> <p>Comparing 1.26 s and 1.34 s, the percentage difference =</p> $\frac{1.26 - 1.34}{1.26} \times 100\% = -6.35\%$ <p>which is $> \pm 5\%$.</p> <p>Hence, her measured data was not accurate / t_1 was inaccurate / only t_2 and t_3</p>	1
	<p>Marker's comments:</p> <p>a) Generally ok. Some students wrote 'weight' instead of 'mass', 'g' instead of 'kg', and 'cm' instead of 'm'.</p> <p>bi and bii) Many students did not round off correctly to 1.34 s and/or 1.26 s. A number of students gave ambiguous or incomplete explanations e.g., it is not accurate, data is slightly off etc. Several students did not show working.</p>	1
		Total : 7
2a	Acceleration is the rate of change in velocity / change in velocity per unit time	1
2b	$a = \frac{v - u}{t}$ $\Rightarrow a = \frac{15 - 0}{6.0 - 0} \quad \left(\text{or } \frac{15}{6.0}\right)$ $= 2.5 \text{ m/s}^2$ <p>(accept gradient method from graph)</p>	1 1
2c	<p>Distance = area under graph for 0 s to 14.0 s</p> $= \frac{1}{2} (6.0)(15) + (14.0 - 6.0)(15) \quad \text{or} \quad \frac{1}{2} (8.0 + 14.0)(15)$ $= 45 + 120 \quad = 2 (330)$ $= 165 \text{ m} \quad = 165 \text{ m}$	1 1
2d	<p>The truck is moving with an increasing deceleration.</p> <p>Or the truck is decelerating at an increasing rate.</p> <p>(do not accept: decelerating at an increasing speed)</p>	1
	<p>Marker's comments:</p> <p>a) A number of students wrote 'speed' instead of 'velocity', or did not manage to define acceleration correctly e.g., acceleration is the increase in speed</p> <p>b) Several students used the gradient method to calculate acceleration. The formula for acceleration should preferably be used.</p> <p>c) Generally ok.</p> <p>d) A number of students gave incomplete answers e.g., the truck decelerates / slows down</p>	
		Total : 6
3a	<p>Force acting per unit area</p> <p>(do not accept: formula, or force over area)</p>	1
3bi	$P = \frac{F}{A} = \frac{1000 \text{ N}}{0.50 \text{ m}^2}$	1

	= 2000 Pa	1
3bii	Pressure at piston A is equal to the pressure at piston B . $\frac{W}{6.0} = 2000$ Hence $\Rightarrow W = \underline{12000}$ N (allow e.c.f.)	1
	Marker's comments: 3(a) missed out per unit area x per metre square area x per unit square of an area x over unit area x per square metre x amount of force acting on the surface/ area 3(c) Minority cant relate the transmission of pressure through liquid	
		Total : 4
4a	The upward force exerted is 15000 N . As the hovercraft is maintaining a constant height from the ground, it means that the resultant force in the vertical direction is zero . Hence, the weight is equal to the upward force.	1 1
4b	$W = mg \Rightarrow m = \frac{W}{g} = \frac{15000}{10}$ $= \underline{1500} \text{ kg}$ (accept: no working but answer is correct)	1
4c	$F_R = ma = (1500)(2.0) \text{ (allow e.c.f.)}$ $= \underline{3000} \text{ N}$	1 1
	$F = 3000 = \text{horizontal force} - 1200$ $\Rightarrow \text{horizontal force} = 3000 + 1200 \text{ (must show working)}$ $= \underline{4200} \text{ N (allow e.c.f.)}$	1
4e	Air resistance (accept: friction)	1
	Marker's comments: a) Many students did not state the value of the upward force at all, and/or gave incomplete or wrong explanations e.g., upward force is equal to the weight b) Generally ok. c) Some students did not know or apply $F=ma$. d) Many students wrote '3000 - 1200' instead of '3000 + 1200'. e) Generally ok.	
		Total : 7
5a	The double-decker bus most likely has the greatest inertia. This is because it has the greatest mass.	1 1
5bi	Average density = $\frac{\text{Total mass}}{\text{Total volume}}$ $\Rightarrow \text{Total volume} = \frac{\text{Total mass}}{\text{Average density}} = \frac{20 + 15}{1.4}$ $= \underline{25} \text{ cm}^3$	1 1

5bii	$\rho = \frac{m}{V} \Rightarrow \rho = \frac{20}{1} = \underline{20} \text{ cm}^3$ (accept no working but answer is correct)	1
5biii	Volume = $25 - 20 = \underline{5} \text{ cm}^3$ (allow e.c.f.) (accept no working but answer is correct)	1
	Marker's comments: a) Many students gave incomplete, ambiguous or wrong answers e.g., larger the mass, greater the inertia, bus is very heavy, bus has the largest weight etc. bi) Generally ok. However, students to take note that the concept is on Average Density, and not Density. bii) Generally ok. Some students used wrong method '20 x 1.0' and hence were not awarded mark. biii) Generally ok.	
Total : 6		
6a	 1m – 2 light rays with arrows that travel from M , reflected at mirror and travel towards P (to check: angle of incidence = angle of reflection) 1m – virtual rays (dotted lines) extended behind the mirror to intercept at image location 1m – object distance = image distance, and labelling of image I . (-1m overall if no arrow or wrong dotted/continuous lines drawn)	1,1,1
6b	Any <u>two</u> of the following: <ul style="list-style-type: none"> • Virtual • Upright • Same size as the object (do not accept: same size) • Laterally inverted • Distance (of image) from the mirror is equal to the distance of the object from the mirror OR image distance is equal to object distance OR image is as far behind the mirror as the object is in front (do not accept "same distance") 	1,1
	Marker's comments: 6(a) not reading question clearly. Many drew rays from whole coins many missed label image I 6(b) x laterally opposite	
Total : 5		

Section C (20 marks)

Answer any two questions.

Qn	Solution	Mark
7ai	moment = $36 \times 2.7 = \underline{97.2}$ Nm direction of moment = clockwise	1 1
7aai	Using Principle of Moments, for rotational equilibrium, Total anti-clockwise moment = Total clockwise moment $\Rightarrow 30 \times (1.8 + 0.6) + F \times 0.6 = 97.2$ (allow e.c.f.) $\Rightarrow 72 + 0.6 F = 97.2$ $\Rightarrow F = \underline{42}$ N (allow e.c.f.)	1 1
7aiii	<u>No</u> , the value of F will not be affected, as there is <u>no moment</u> of the 50 N force about the pivot. This is because the <u>perpendicular distance from the line of action of the force to the pivot is zero</u> .	1 1
7bi	 <p>1m – CG at geometrical centre 1m – line of action of weight, W must pass through CG</p>	1,1
7bii	The block will return to its original position . (do not accept: it will not topple) This is because the line of action of its weight lies inside its base area resulting in an anti-clockwise moment about the pivot .	1 1
	Marker's comments: 7ai) some wrote downwards moments 7aii) Many candidates used the wrong distance to multiply 30 N. 7aiii) Many didnt mention about no moments due to no perpendicular distance between force and pivot. 7bii) x same position as Fig. 7.2 Many cant write line of action of its weight lies inside the base, resulting in anticlockwise moment about pivot	
		Total : 10
8a	Point A to point B: chemical potential energy \rightarrow kinetic energy + gravitational potential energy (Accept: chemical PE \rightarrow KE + GPE, or chemical PE \rightarrow GPE) (Do not accept: chemical PE \rightarrow KE, or KE \rightarrow GPE) Point B to point C: gravitational potential energy \rightarrow kinetic energy (Accept: GPE \rightarrow KE) (Do not need to penalize student if student indicates that some energy is lost as	1 1

	heat or sound during energy conversion.)	
8b	The girl's speed increases as the girl slides down because of acceleration due to gravity / acceleration of free fall. (Give 1m overall if student writes the girl accelerates due to gravity without mentioning the increase in speed)	1 1
8c	Loss in GPE = Gain in KE $\therefore mgh = \frac{1}{2} mv^2$ $\Rightarrow 40(10)(5.0) = \frac{1}{2} (40)v^2$ $\Rightarrow v = \sqrt{100}$ $= \underline{10} \text{ m/s}$	1 1
8d	Work done to stop the girl at D = KE of girl at C $\Rightarrow \text{Retarding force} \times \text{distance moved along track} = \frac{1}{2} mv^2$ $\Rightarrow 300 \times d = \frac{1}{2} (40)(10)^2 \quad (\text{allow e.c.f.})$ $\Rightarrow d = \underline{6.67} \text{ m (to 3 s.f.) or } 6.7 \text{ m (to 2 s.f.)} \quad (\text{allow e.c.f.})$	1
	Speed would be slower and distance moved would be shorter. This is because some of the GPE is converted to heat / is used to overcome friction. (Accept: some energy is lost as heat)	1 1
	Marker's comments: badly done 8a) missed out chemical potential energy 8b) 8c) 8d) badly done 8e) mentioned that answers will be different only. x energy converted into friction force	
		Total : 10
9ai	70 °C	1
9aii	Solid and liquid states	1
9aiii	From the graph, the time taken for region Y = 27.5 – 7.5 = 20.0 minutes $P = \frac{E}{t}$ Using " $\frac{E}{t}$ " $\Rightarrow E = P \times t$ $= 50 \text{ W} \times 20.0 \text{ minutes}$ $= 50 \text{ W} \times (20.0 \times 60) \text{ seconds}$ $= \underline{60000} \text{ J}$ (Give 1m overall if student writes "50 × 20 minutes = 1000 J")	1 1
9aiv	The speed of the molecules increases as temperature is directly proportional to the average kinetic energy of the molecules.	1

	The intermolecular distance increases slightly too as the liquid expands slightly upon heating.	1
9b	<u>Feature #1</u> The insulator at the back of the solar panel / around the pipes. It minimizes heat loss by conduction from the hot water pipes to the surroundings. <u>Feature #2</u> Cold water flows in from bottom while hot water flows out from top. The position of the hot and cold water utilizes the convection current of water, such that hot water will rise and cold water will sink. Accept: The insulator or pipes are painted black . This is because a black surface is a better absorber of infrared radiation / increase heat gain by radiation (do not accept: better absorber of heat, or better emitter)	1 1 1 1
	Marker's comments:	
		Total : 10