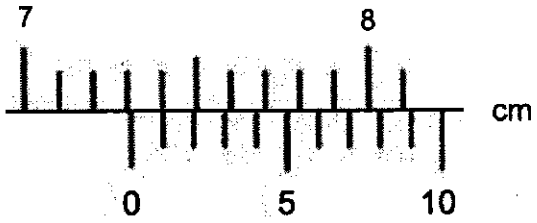
1 Which of the following is a base quantity?

A density
B force
C inertia
D length

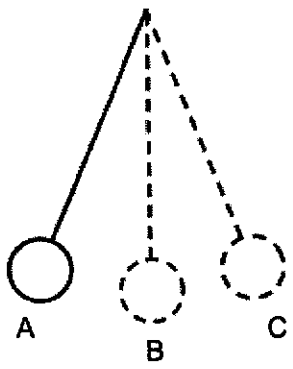
2 A vernier caliper is used to measure the internal diameter of a tube. Given the thickness of the tube is 0.05 cm. The vernier caliper has a zero error of -0.01 cm.



What is the external diameter of the tube?

A 7.27 cm **B** 7.31 cm **C** 7.32 cm **D** 7.42 cm

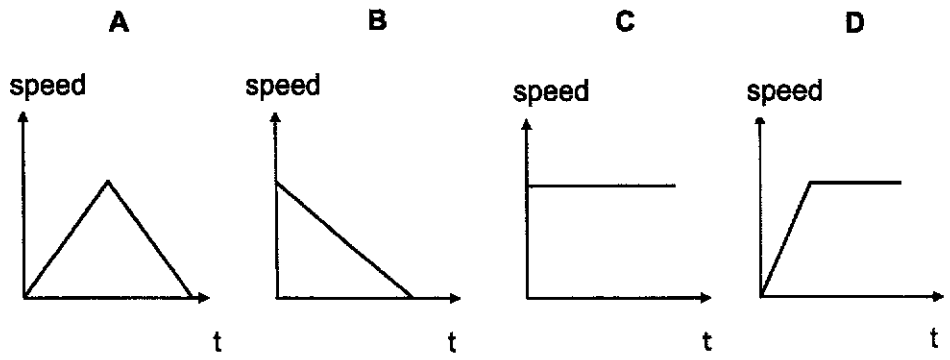
3 The time taken for the bob to move from A to B took 0.23 s.



The period of the pendulum can be increased by increasing the

A colour intensity of the bob.
B density of the bob.
C length of the pendulum.
D mass of the bob.

4 Which of the following speed-time graphs correctly represents an object being thrown upward?



5 An object accelerates uniformly from rest to 30 m/s in 10 s.
What is the distance covered in 10 s?

A 3 m **B** 75 m **C** 150 m **D** 300 m

6 In Fig. A, an object accelerates under the influence of a force F_1 on a frictionless surface. A while later, in Fig. B, an opposing force F_2 of the same magnitude acts on it. What will happen to the object?

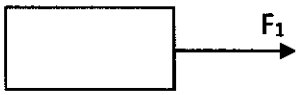


Fig. A

Fig. B

A The object will slow down.
B The object will move at a constant velocity.
C The object will move in the opposite direction.
D The object will come to rest immediately after the opposing force acts on it.

7 A car is moving from rest with a forward force of 1000 N.
The car has a mass of 500 kg. Ignore all frictional forces.
What is the acceleration of the car after 2 s?

A 0.5 m/s^2 **B** 2.0 m/s^2 **C** 4.0 m/s^2 **D** 8.0 m/s^2

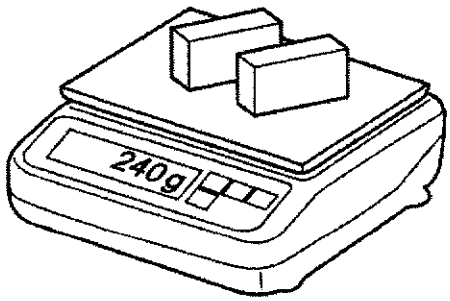
8 A person wants to find out which of the three crowns P, Q and R was pure gold, pure silver or a mixture of gold and silver. The table below shows the information of each crown.

	crown P	crown Q	crown R
mass / g	5252	9665	5952
volume / cm^3	500	500	500

Given that gold is denser than silver, which of the following correctly matches each crown with its material?

	crown P	crown Q	crown R
A	gold	silver	mixture
B	gold	mixture	silver
C	silver	gold	mixture
D	mixture	gold	silver

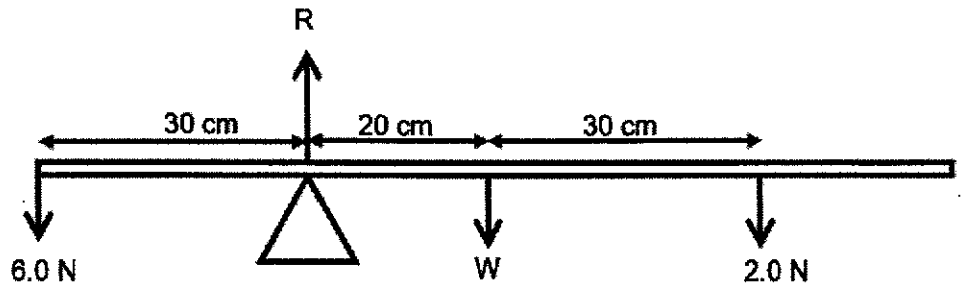
9 Two identical blocks are placed on a balance.
Each block measures 2.0 cm × 5.0 cm × 10.0 cm.



What is the density of the block?

A 0.42 g/cm^3 **B** 0.83 g/cm^3 **C** 1.2 g/cm^3 **D** 2.4 g/cm^3

10 A uniform metre rule is pivoted at the 30.0 cm mark. A 6.0 N load and a 2.0 N load are hung on the metre rule as shown. R is the reaction force at the pivot and W is the weight of the metre rule.



Calculate the values of R and W.

	R /N	W /N
A	12.0	4.0
B	10.0	4.0
C	12.0	6.0
D	10.0	6.0

11 A boy of mass 70 kg and a man of greater mass both run up a flight of steps of height 10 m in the same time of 5 s. Which of the following options is correct?

	power generated by boy / W	power generated by man
A	140	less than boy
B	140	more than boy
C	1400	less than boy
D	1400	more than boy

12 Approximately 80% of the power consumed by a light bulb is emitted as heat, rather than as visible light. Calculate the amount of useful energy (i.e. as visible light) if an 80 W light bulb is switched on for 30 s.

A 32 J

B 480 J

C 1920 J

D 2400 J

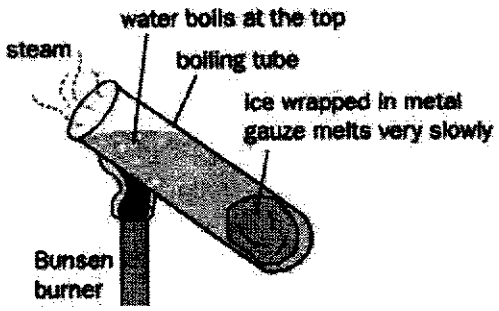
13 Which sequence correctly describes the density of a substance in increasing order?

A gas to liquid to solid
B gas to solid to liquid
C solid to gas to liquid
D solid to liquid to gas

14 What is meant by the melting point of a solid?

A the place in a solid where both solid and liquid exist together
B the place in a solid where it starts to melt
C the temperature at which it begins to evaporate
D the temperature at which it can exist as both solid and liquid

15 An ice cube is wrapped in metal gauze sinks at the bottom of the test tube and the heat from a Bunsen burner causes the water to boil at the top.

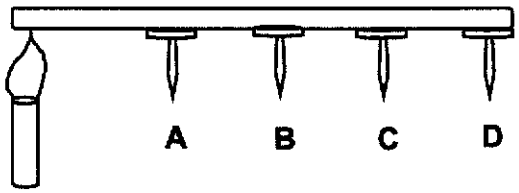


Which statement(s) explain(s) why the ice does **not** melt?

I Heat does not reach the ice via convection.
II The test tube is a bad conductor of heat.
III Water is a bad conductor of heat.

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

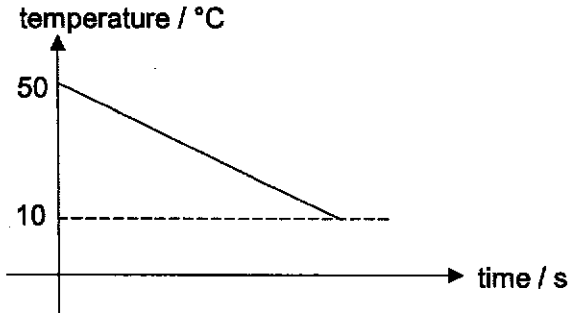
16 Four nails are stuck to a metal rod using wax.
When one end of the rod is being heated up, which nail will most likely drop first?



17 When a piece of silver is heated, the silver atoms

A diffuse from one region to another.
B escape from the metal surface.
C move about with greater speed.
D vibrate faster.

18 The temperature-time graph below shows a substance cooling down, what happened to the internal energy of the substance?

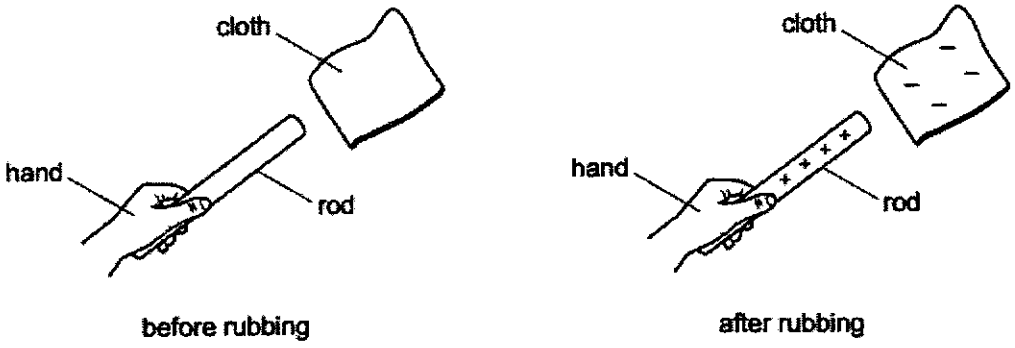


A internal kinetic energy decreases
B internal kinetic energy increases
C internal potential energy decreases
D internal potential energy increases

19 Which substance will be repelled from a negatively charged object?

A electron
B neutral sphere
C positively charged rod
D proton

20 A student holds a rod in her hand. She rubs the rod with a cloth. The rod becomes positively charged and the cloth becomes negatively charged.



before rubbing

after rubbing

Which statement explains why the rod becomes positively charged?

A The negative charges from the cloth are transferred to the rod.

B The negative charges from the rod are transferred to the cloth.

C The positive charges from the cloth are transferred to the rod.

D The positive charges from the rod are transferred to the cloth.

Name : _____

Class	Index Number

ESTD 1906

OUTRAM SECONDARY SCHOOL END-OF-YEAR EXAMINATION 2019

Subject	:	**SCIENCE (PHYSICS)**
Paper No.	:	**5076/02**
Level (Stream)	:	**Secondary 3 Express**
Date	:	**10 October 2019**
Duration	:	**1 hour 15 minutes**
Marks	:	**65**

Additional Material: Nil

INSTRUCTIONS TO CANDIDATES

Write your class, index number and name on all the work you hand in.
You may use an HB 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 brackets [ ] at the end of each question or part question.

This question paper consists of 17 printed pages, including this cover page.

Setter: Ms Wong Hui Yi

Section A (45 marks)

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

1 A block is pulled at a steady speed through a surface by two horizontal cables as shown in Fig. 1.1 (not drawn to scale) in top view. Draw a vector diagram to determine the magnitude of the resultant force exerted on the block by the cables.

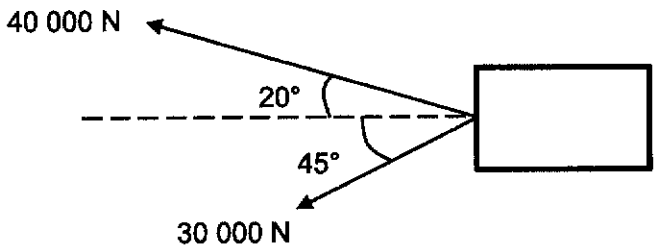


Fig. 1.1

scale: 1 cm represents _____ [1]

magnitude = _____ [1]

direction = _____ [1]

2 Fig. 2.1 shows a Roly-poly toy that will **not** topple over.

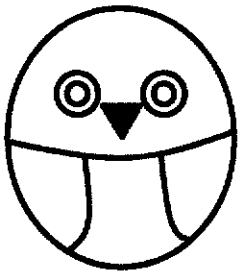


Fig. 2.1

(a) **(i)** Mark with an X on the diagram above, a possible position of the centre of gravity of the toy. [1]

(ii) Explain why the toy does **not** topple over no matter how it was being pushed.

_____

_____

_____ [2]

3 After exercise, perspiration takes place and this brings about cooling effect which helps to remove excess heat built up in the body.

(a) Using the ideas of kinetic theory, explain why water evaporates at any temperature, but the rate of evaporation increases as the temperature rises.

_____

_____

_____ [2]

(b) State **two** difference between evaporation and boiling.

_____

_____

_____ [2]

4 Thunderclouds contain charges. Water drops are carried up by air currents and become charged. Fig. 4 shows a negatively charged cloud and a positively charged water drop.

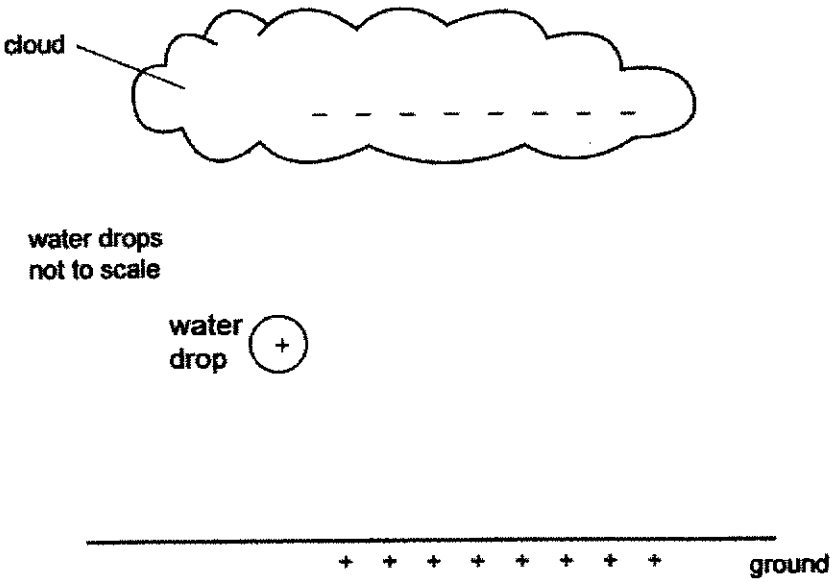
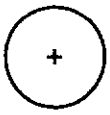


Fig. 4

(a) Draw the electric field lines for the positively charged water drop. [2]



(b) Describe and explain the movement of the water drop as it passes under the thundercloud. (assuming the mass is negligible)

_____

_____

_____ [2]

5 Two test-tubes A and B are filled with equal masses of same liquid at a temperature of 80 °C, as shown in Fig. 5.1.

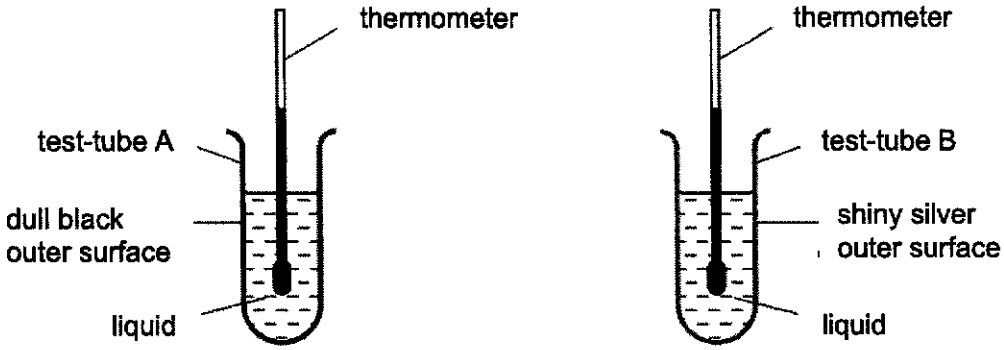


Fig. 5.1

Test-tube A has a dull black outer surface and test-tube B has a shiny silver outer surface.

Both test-tubes are placed on a bench and the temperature of the substance in each test-tube is measured every minute. The variation with time of the temperature of the substance in test-tube B is shown in Fig. 5.2.

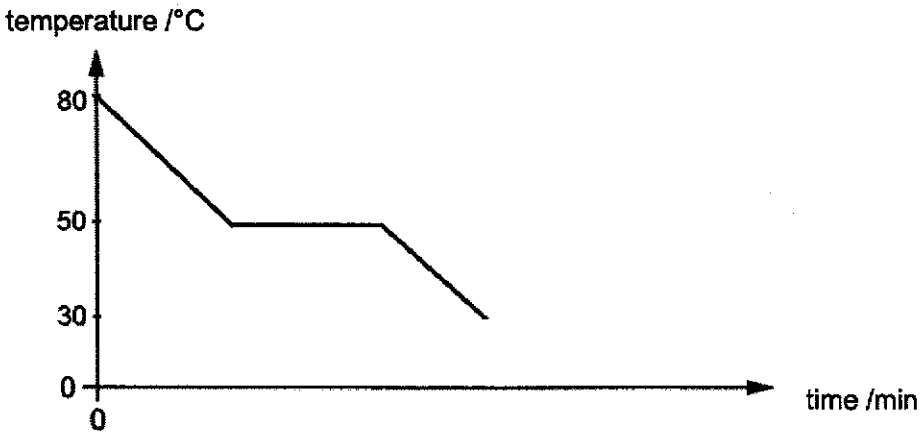


Fig. 5.2

(a) Describe how thermal energy is transferred from the liquid to the surroundings.

_____

_____

_____ [2]

(b) Suggest if test tube A will lose heat faster than test tube B. Explain your answer.

_____

_____

_____ [2]

(c) **(i)** Label the respective states of matter on Fig. 5.2 from 30 °C to 80 °C [2]

(ii) Explain why there is **no** change in temperature at 50 °C.

_____

_____

_____ [2]

6 A steel ball of mass 270 g falls from a platform on a tower to the ground below. The ball falls from rest through a vertical distance of 192 m. Assume air resistance is negligible. Take g = 10 N/kg.

(a) **(i)** Calculate the gravitational potential energy of the ball just before it is released.

gravitational potential energy = _____ J [2]

(ii) Hence or otherwise, calculate the speed of the ball just before it hits the ground.

speed = _____ m/s [2]

(iii) State and explain what happens to the speed in (ii) if a heavier ball is used.

_____

_____

_____ [2]

7 Fig.7.1 shows a metal rod with a strip of metal foil attached to it. The rod and strip have no charge. The metal rod and metal foil contain electrons that can move easily through metals.

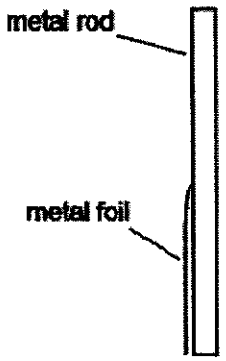


Fig. 7.1

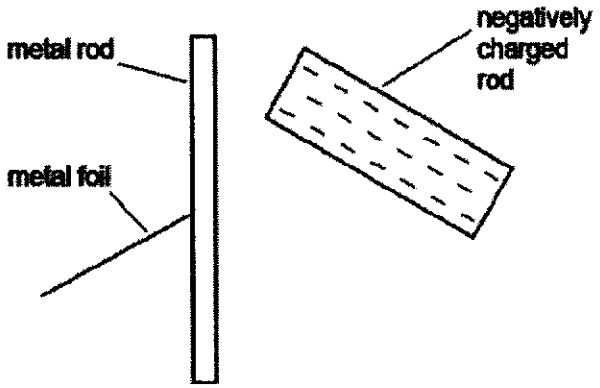


Fig. 7.2

A negatively charged rod is brought towards the top of the metal rod. The foil moves away from the metal rod as shown in Fig. 7.2.

(a) Explain why the foil moves as shown in Fig. 7.2.

_____

_____

_____ [2]

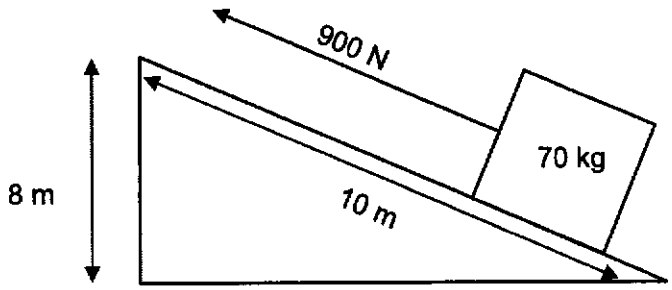
(b) Describe the arrangement and motion of the solid particles in the metal rod.

_____

_____

_____ [2]

8 A 900 N force is applied on the 70 kg box to pull the box up the ramp.



Calculate

(a) the useful work done applied (i.e. gravitational potential energy gained),

useful work done = _____ J [2]

(b) the total work done,

total work done = _____ J [2]

(c) the work done against friction,

work done against friction = _____ J [1]

(d) the frictional force on the slope.

frictional force = _____ N [2]

9 Fig. 9 shows a set-up of a beaker of water being heated up.

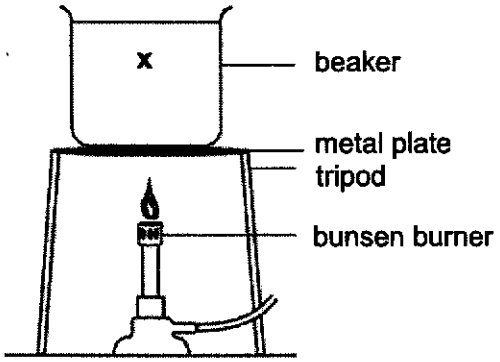


Fig. 9

(a) State the main process of heat transfer between the metal plate and beaker.

_____ [1]

(b) State and describe the main heat transfer process in heating up the region of water marked with **x** in Fig. 9.

_____

_____

_____

_____

_____ [2]

(c) Suggest how you would modify the beaker as shown in Fig. 9 to

reduce heat loss to the surrounding.

_____

_____

_____ [1]

(d) After some time, the water in the beaker gets heated up and becomes water vapour.

Describe the change in arrangement and motion of the particles.

_____

_____

_____

_____

_____ [2]

Section B (20 marks)

Answer **any TWO** questions in this section in the spaces provided.

10 **(a)** A bullet train carriage has a mass of 4.50×10^5 kg and a normal operating speed of 90 m/s. It could be braked by a constant force of 2.80×10^5 N. The distance between station PQR and station XYZ is 120 km.
If the train start to deceleration to rest from normal operating speed, calculate

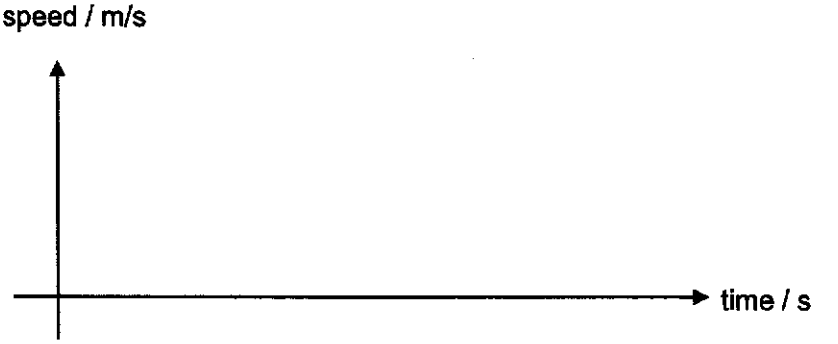
(i) its deceleration,

deceleration = _____ m/s^2 [2]

(ii) the minimum distance required to start applying brake before station XYZ.

minimum distance = _____ m [2]

(iii) Sketch a speed-time graph of the journey when the train starts to apply brake and stops at station XYZ.



[2]

(b) Aeroplanes fly at high altitudes where the temperature of the surroundings can easily reach below 0 °C. Ice forms on the surface of the aeroplane and eventually it will fall off and strike the ground. The mass of a falling block of ice is 1.5 kg. (gravitational field strength = 10 N/kg)

Fig. 10 shows the speed-time graph for the block of ice as it falls to the ground.

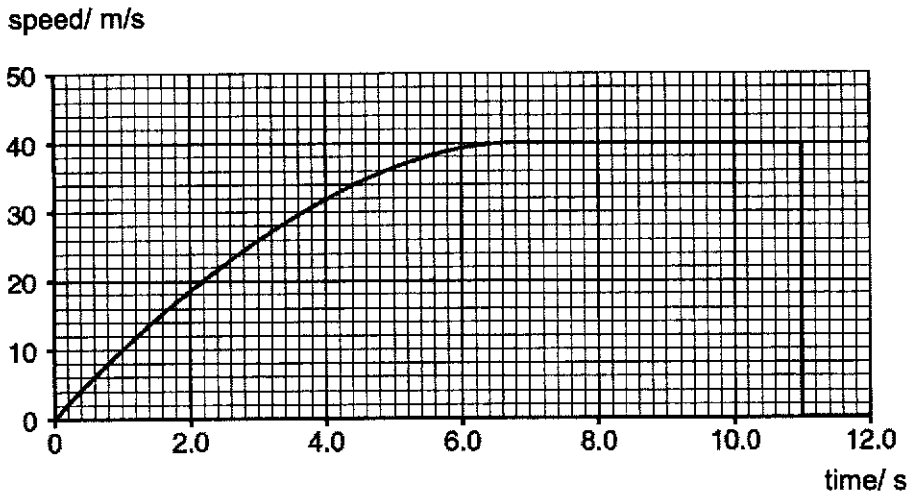


Fig. 10

(i) State and explain how the weight of the block of ice relates to the air resistance when it is falling at constant speed.

_____

_____

_____ [2]

(ii) Using information from Fig. 10, calculate the maximum kinetic energy of the block of ice when it is falling.

maximum kinetic energy = _____ J [2]

11 A U-shaped tube with a cross-sectional area of 2.50×10^{-4} m^2, contains some water of density 1000 kg/m^3. Oil which does **not** mix with water is then poured into the right-hand side of the tube.

Fig. 11 shows the levels of the water and the oil when equilibrium is reached.

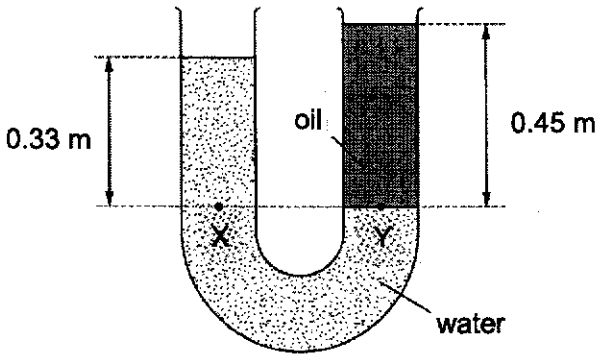


Fig. 11 (not to scale)

Point Y is at the junction between oil and water. Point X is at the same horizontal level in water. The surface of oil is 0.45 m above point Y. The surface of water is 0.33 m above point X. Take g = 10 N/kg.

(a) Calculate the mass of water above point X.

mass = _____ kg [2]

(b) The pressure due to the water above point X is 6600 Pa. The pressure due to the oil at point Y is the same as the pressure at point X. Calculate the density of the oil.

density = _____ kg/m^3 [3]

(c) Explain why the pressure at point Y is higher when the oil is replaced with a denser liquid of the same height.

_____

_____

_____ [2]

(d) A student measures the thickness of the U-shaped tube using a micrometre screw gauge. The student checks for zero error and finds that it has a zero error of +0.02 mm. The observed reading is as shown in Fig. 11.2.

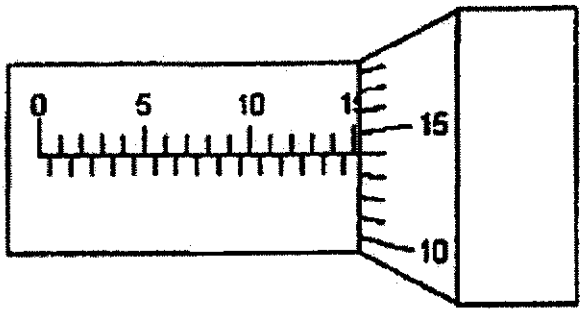


Fig. 11.2

(i) State another precaution when using this instrument.

_____

_____ [1]

(ii) Calculate the corrected reading of the thickness of the tube.

corrected reading = _____ mm [2]

12 **(a)** Fig. 12.1 below shows a simplified hydraulic braking system.

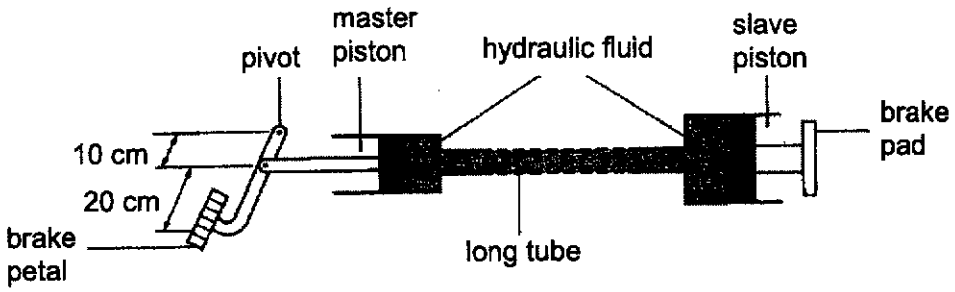


Fig. 12.1

(i) Define pressure.

_____ [1]

(ii) If the area of contact between the master piston and the hydraulic fluid is 1.5 cm^2, what is the pressure along the fluid when a force of 1800 N is exerted by the master piston?

pressure = _____ Pa [2]

(iii) Why is liquid used as the hydraulic fluid instead of gas?

_____

_____ [1]

(b) Fig. 12.2 shows an enlarged diagram of the hydraulic braking system.

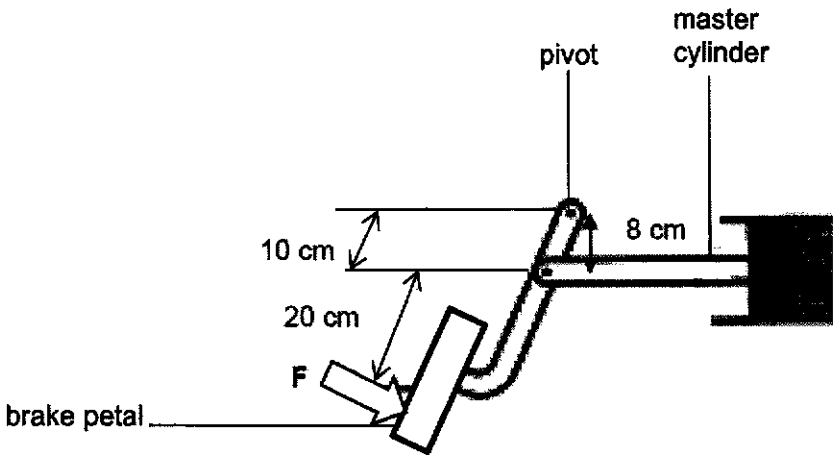


Fig. 12.2

(i) State *principle of moment.*

_____

_____ [2]

(ii) Given that the amount of force acting on master cylinder is 375 N. Calculate the force acting on the brake pedal, F.

force F = _____ N [2]

(iii) State two possible changes to be made to Fig. 12.2 such that the force applied on the master cylinder can be increased without changing the magnitude of force F.

_____

_____ [2]

- End of Paper 2 –

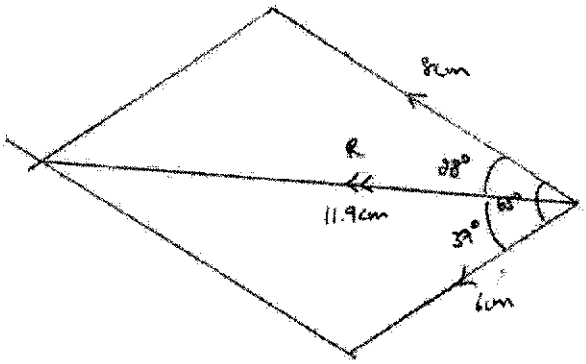
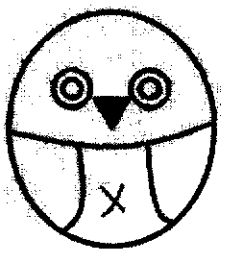
3E EOY 2019

Answer Key

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

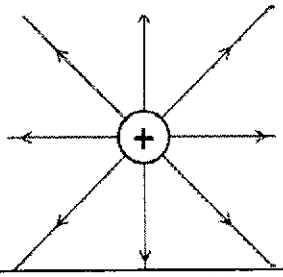
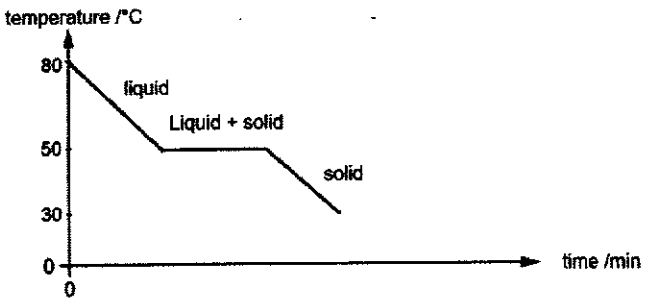
A: 5, B:5, C: 5, D: 5

Section A

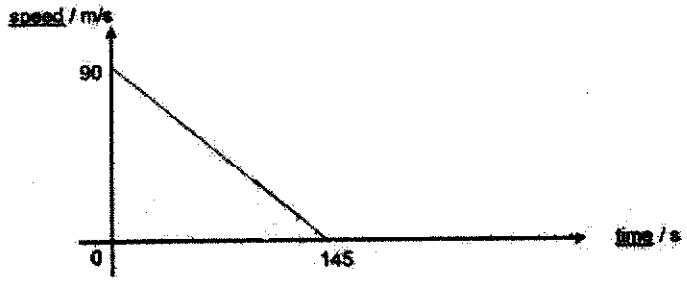
No.	Answer	Marks
1	Scale: 1 cm : 5000 N Magnitude= 59500 N (56525N to 62475 N) Direction = 28 ° from 40 000 N or 37 ° from 30 000 N  	[3] Deduct [1] if without arrows and label
2	(a)(i)  	[1] Lower than centre
	(a)(ii) The **centre of gravity is very low** [1]thus no matter how hard it was being pushed, the **moment caused by the weight** [1]will enable the toy to **return to upright position**.	[2]
3	(a) Molecules near the liquid surface may escape from the liquid by **absorbing heat energy from the surroundings at any temperature.** If the surrounding temperature is increased, **more liquid molecules gain more heat energy** to be able to escape from the liquid.	[1] [1]

	(b) [2] Any 2	

Evaporation	Boiling
Occurs at <u>any</u> temperature	Occurs at <u>fixed</u> temperature
It is a relatively <u>slow</u> process	It is a relatively <u>quick</u> process
Takes place only at the <u>surface</u> of the liquid	Takes place <u>throughout</u> the liquid
<u>No</u> bubbles are formed in the liquid	Bubbles are <u>formed</u> in the liquid
Temperature usually <u>decreases</u> during evaporation	Temperature remains <u>constant</u> during boiling
Thermal energy is supplied by the <u>surroundings</u>	Thermal energy is supplied by an <u>energy source</u>

4	(a) 	[1]: correct direction [1]: no overlap of lines
	(b) The water drop will <u>move upwards</u> [1] as it is <u>attracted to the negatively-charged cloud since unlike charges attract</u> [½] and <u>repelled by the positively charge ground since like charges repel.</u> [½]	[2]
5	(a) Thermal energy is through - heat from liquid is conducted to test-tube and then to the surrounding air [½] - hot air escaping to surroundings via convection [½] test-tube radiates heat to surroundings [1]	[2]
	(b)<u>Yes.</u>[1] Since test tube A has a <u>dull and black surface</u> which makes it a <u>better emitter of radiation</u>[1] than test tube B which has a silver shiny surface.	[2]
	 (c)(i)	[½] each for liquid and solid [1]: liquid + solid
	(c)(ii) During <u>freezing</u>, [½] thermal energy is <u>lost to form the forces of attraction between the particles</u> [½]. Thus, internal kinetic	[2]

	energy remains unchanged [½] while internal potential energy decreases. [½]	
6	(a)(i) GPE = mgh = (270/1000) x 10 x 192 = 518.4 = 518 J	[1]: working [1]: final answer
	(a)(ii) KE gained = GPE lost ½ mv^2 = 518.4 J ½ (270/1000) v^2 = 518.4 v^2 = 3840 v = 61.97 = 62.0 m/s	[1]: working [1]: final answer Allow ECF
	(a)(iii) Speed remains unchanged [1]. Since KE gained = GPE lost, ½ mv^2 = mgh v^2 = 2gh v = $\sqrt{2gh}$ [1] Hence, the speed is independent of the mass of the object.	[2]
7	(a) As negatively charged rod is brought towards the top of the metal rod, the electrons from the top of the metal rod will be repelled downwards into the metal foil and rod. [1] Both the metal foil and rod would be negatively charged. [1] and as like charges repel thus the metal foil moves away from the rod.	[2]
	(b) Solid particles in metal rod vibrate about fixed position [1]and closely pack and arranged in regular pattern. [1]	[2]
8	(a) useful work done = mgh = 70 x 10 x 8 = 5600 J	[1]: working [1]: final answer
	(b) total work done = F x s = 900 N x 10 m = 9000 J	[1]: working [1]: final answer
	(c) work done against friction = total WD – useful WD = 9000 J – 5600 J = 3400 J	[1]: final answer Allow ECF
	(d) WD against friction = Friction x s 3400 J = Friction x 10 m Friction = 3400 / 10 = 340 N	[1]: working [1]: final answer Allow ECF
9	(a) conduction	[1]
	(b) Convection. When the water near the bottom of the beaker get heated up,[½] they will expand, become less dense and rise up. [½]The water at region (x) being colder [½]will be denser and sink. [½]This set up a convection current in the beaker.	[2]
	(c) Cover the beaker with a lid/ wrap a layer of Styrofoam around the beaker/ paint the colour of the beaker white.	[1]

	(d) arrangement: from closely packed to far apart [1] Motion : from slide over one another to move freely in all direction.[1]	[2]
10	(a)(i) F = ma -2.80×10^5 N = 4.50×10^5 kg x a a = -0.622 m/s^2 deceleration = - acceleration = 0.622 m/s^2	[1]: working [1]: final answer
	(a)(ii) $a = \frac{v-u}{t}$ $-0.622 \text{ m/s}^2 = \frac{0-90}{t}$ t = 144.6 s distance required = area –under the graph = ½ x 144.6 x 90 = 6508.9 m = 6510 m	[1]: working [1]: final answer Allow ECF
	(a)(iii)  	[1]: shape of graph [1]: label Allow ECF
	(b)(i) The weight is equal to the magnitude of air resistance [1] and acting in opposite direction. When the ice is falling at constant speed, the acceleration is zero and hence the net force/resultant force acting on the ice is zero [1], therefore W = air R	[2]
	(b)(ii) max KE; max speed Max speed = 40 m/s Max KE = ½ mv^2 = ½ x 1.5 kg x (40 m/s)^2 = 1200 J	[1]: working [1]: final answer
11	(a) volume of water above point X = 0.33 m x 2.50×10^{-4} m^2 = 8.25×10^{-5} m^3 Mass of water = density of water x volume of water = 1000 kg/m^3 x 8.25×10^{-5} = 0.0825 kg	[1]: working [1]: final answer
	(b) Pressure = F/A 6600 Pa = F/2.50×10^{-4} m^2	[3]

	F = 6600 Pa x 2.50 x 10^{-4} m^2 F= 1.65 N [1] F = Weight of oil = mass of oil x g 1.65 N = mass of oil x 10 Mass of oil = 0.165 kg [1] Density of oil = mass of oil / volume of oil = 0.165 kg/ (0.45m x 2.50 x 10^{-4} m^2) = 1466.7 kg/m^3 = 1470 kg/m^3 [1]	
	(c) The force or weight acting on Y will be larger [1] and since the cross-sectional area is the same and pressure = F/A [1], thus pressure at Y will be higher .	[2]
	(d)(i) Turn the spindle by the ratchet until a clicking sound is heard.	[1]
	(d)(ii) observed reading = 15.14 mm [1] Corrected reading = 15.14 – (+0.02) = 15.12 mm [1]	
12	(a)(i) Pressure is force per unit area.	[1]
	(a)(ii) Area = 1.5 cm^2 = 1.5 x $(10^{-2})^2$ = 1.5 x 10^{-4} m^2 [1] Pressure = 1800 N/ 1.5 x 10^{-4} m^2 = 12000000 Pa [1]	[2]
	(a)(iii) Liquid is incompressible.	[1]
	(b)(i) When a body is in equilibrium [1], the sum of clockwise moments about a pivot is equal to the sum of anti-clockwise moments about the same pivot.[1]	[2]
	(b)(ii) Sum of clockwise moment = sum of anti-clockwise moment 375 N x 8 cm = F x 30 cm [1] F = 100 N [1]	[2]
	(b)(iii) Increase the perpendicular distance between the brake pedal and the pivot. decrease the perpendicular distance between the master cylinder and the pivot.	[2]