BOON LAY SECONDARY SCHOOL

END-OF-YEAR EXAMINATION

2019

Name	( )
Class	

Subject	:	**SCIENCE (PHYSICS)**
Paper	:	**2**
Subject Code	:	**5076/02**
Level	:	**SECONDARY THREE EXPRESS**
Date/Day	:	**8 OCTOBER 2019 (TUESDAY)**
Time	:	**1045 – 1200**
Duration	:	**1 HOUR 15 MINUTES**

READ THESE INSTRUCTIONS FIRST

Before you start your exam, check that you have received the correct paper and the number of printed pages are correct.
Write your name and index number on all the work you hand in.
Do not use staples, paper clips, glue or correction fluid.

Section A [45 marks]
Answer **all** questions in the spaces provided.
In calculations, you should show all steps in your working, giving your answer at each stage.

Section B [20 marks]
Answer any two questions from this section.
Write your answers in the spaces provided on the question paper.

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

For Examiner's Use	
Section A	
Section B	
Total	

This question paper consists of 15 printed pages.

Section A [45 marks]
Answer **all** questions in the spaces provided.

1 A ball is given a push at a starting point. It is allowed to roll up a smooth slope and then roll down. Fig. 1.1 shows the motion of a ball.

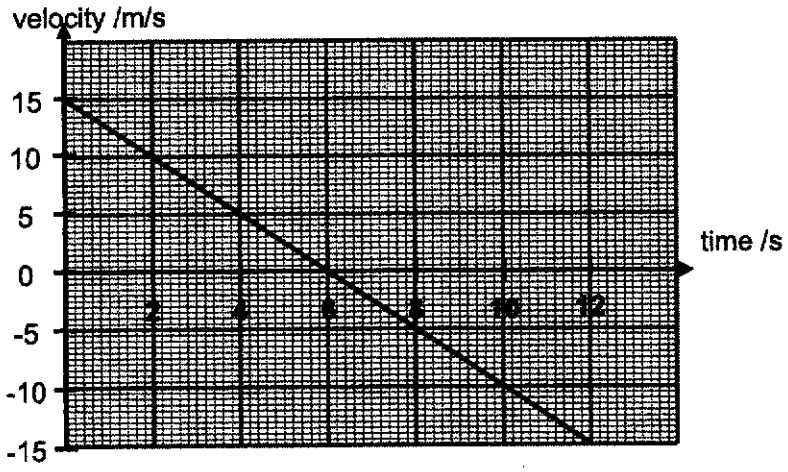


Fig. 1.1

(a) Find the acceleration of the ball.

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

(b) State the time when the ball reaches the highest point on the slope.

..... [1]

(c) Find the distance travelled by the ball when it reaches the highest point on the slope.

distance = ... m [2]

(d) Find the displacement of the ball at time t = 10 s.

displacement = ... m from the starting point [2]

2 Fig. 2.1 shows the top view of two tractors pulling a tree trunk and the force exerted by each tractor.

By means of a scaled diagram, determine

(a) the resultant force, and

(b) the angle between the resultant force and the 40 000 N force. [5]

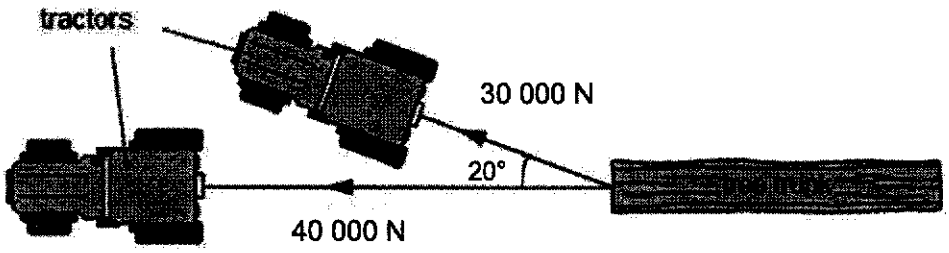


Fig. 2.1

scale = ...

magnitude of resultant force: ..... N

angle of resultant force from 40 000 N force: .....°

3 The stages in an experiment to determine the density of a solid are shown in Fig. 3.1.

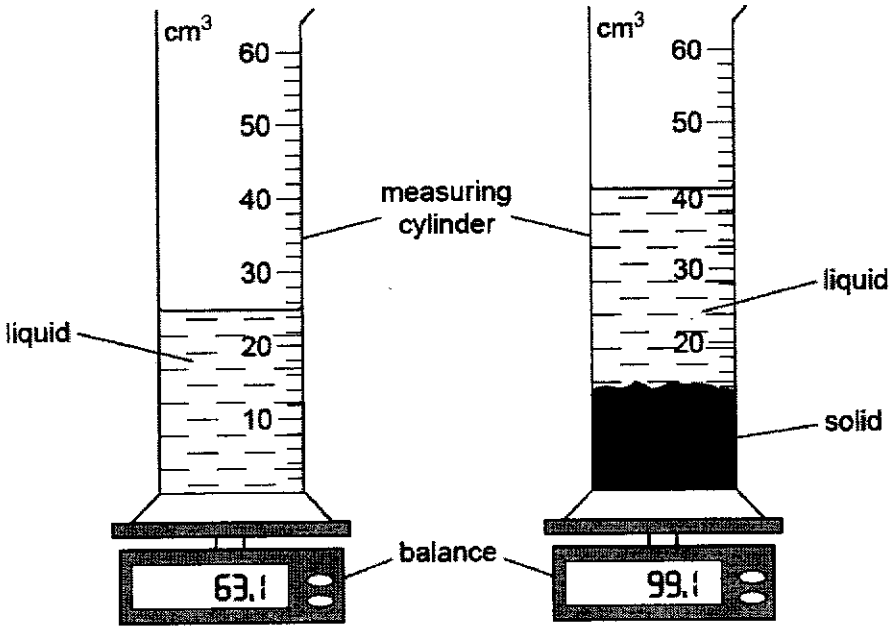


Fig. 3.1

Use data from Fig. 3.1 to complete the results of the experiment in the spaces below.

(a) **(i)** mass of solid = ... g [1]

(ii) volume of solid = ...cm^3 [1]

(b) Use your answers in **(a)** to calculate the density of the solid.

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

(c) The liquid used is **not** water. Suggest one possible reason why water may not be suitable.

.....

..... [1]

4 Snoopy and his brother Olaf are playing on a seesaw.
Snoopy weighs 120 N and Olaf weighs 200 N.

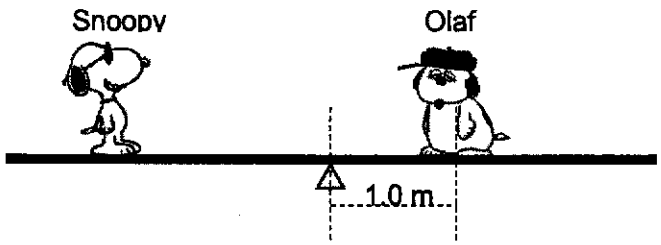


Fig. 4.1

(a) State the Principle of Moments.

.....

.....

..... [1]

(b) Using information given in Fig. 4.1, calculate how far from the pivot Snoopy needs to be to keep the seesaw in equilibrium.

distance = ... m [2]

5 Fig. 5.1 shows a roller coaster track with its height information. The combined mass of the car and the passengers is 450 kg and has a speed of 0 m/s at W.
Assume that there is zero air resistance and negligible frictional force between the roller coaster and the track.

Height above ground level

Point	metre
W	50
X	2
Y	40
Z	15

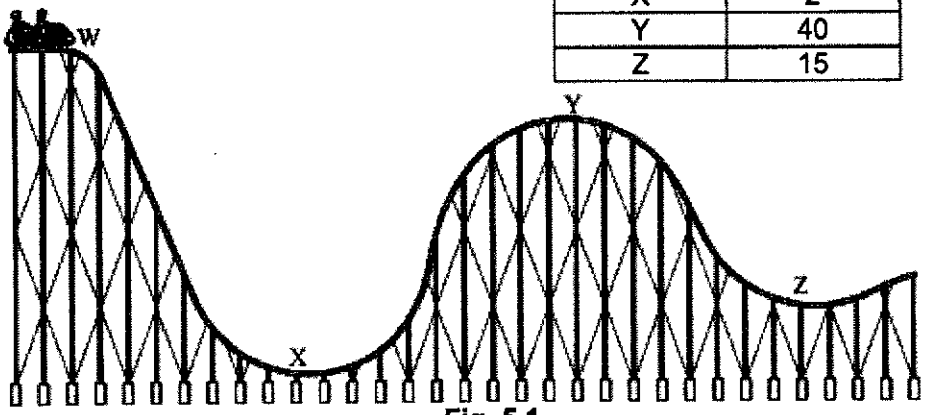


Fig. 5.1

(a) State the Principle of Conservation of Energy.

.....

..... [1]

(b) Calculate the total amount of energy possessed by the car and its passengers at point W.

total energy = ... J [2]

(c) State the energy possessed by the car and its passengers at point Y.

total energy = ... J [1]

(d) Calculate the speed of the car and its passengers at point Z.

speed = ... m/s [2]

6(a)(i) State the kinetic model of matter.

.....

..... [2]

(ii) Explain, using the kinetic model of matter, why liquid mercury has fixed volume but no fixed shape.

.....

.....

.....

..... [2]

(b) State how the following properties of the air in an enclosed room change after the electric heater is switched on. Complete Table 5.1 using the terms "increases', "decreases" or "unchanged" for each answer.

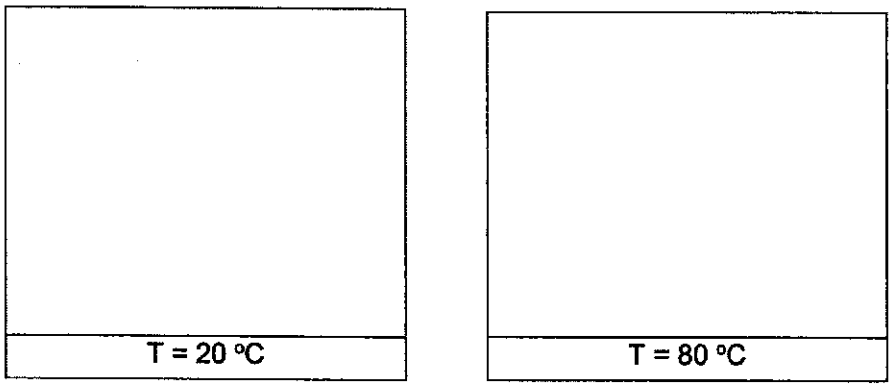
property	change
average intermolecular distance	
average size of the air molecules	
average kinetic energy of the air molecules	
rate of collisions between the air molecules	

[2]

Table 5.1

(c) Substance X has the following properties:
melting point : 30 °C
boiling point : 150 °C

Draw the molecular arrangement of the substance X at the two temperatures stated below.



[2]

7 A test tube containing solid cyclohexane is removed from a refrigerator and placed in a room. Fig. 7.1 shows how the temperature of the cyclohexane varies over time.

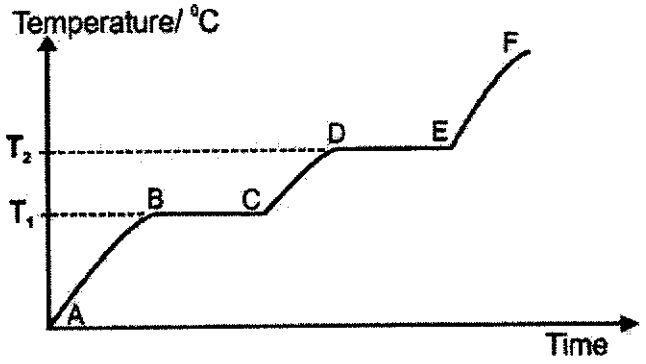


Fig. 6.1

(a) State the portion on the graph showing the state of cyclohexane as

(i) a solid;

..... [1]

(ii) a mixture of solid and liquid;

..... [1]

(iii) a liquid.

..... [1]

(b) Explain why the temperature remains constant during the interval between B and C.

.....

.....

..... [2]

(c) Name the temperatures T_1 and T_2.

T_1:.....

T_2:..... [2]

(d) Write down either "gain in internal potential energy" or "gain in internal kinetic energy" as the cause of the

(i) temperature increase in portion AB: ..... [1]

(ii) change in state in portion BC: ..... [1]

8 Write down one similarity and one difference between boiling and evaporation.

similarity:.....

.....

difference:.....

..... [2]

Section B [20 marks]

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

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

9(a)(i) Define moment of a force and state its SI unit.

.....

.....

..... [2]

(ii) Define stability of an object.

.....

.....

..... [1]

(iii) Define centre of gravity.

.....

..... [1]

(b) Fig 9.1 shows a roly poly toy with water trapped at the base. When the toy is pushed, it tends to go back to its original upright position.

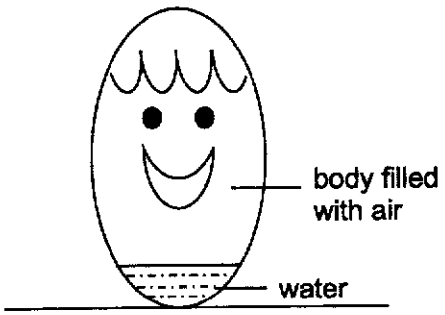


Fig 9.1 Upright

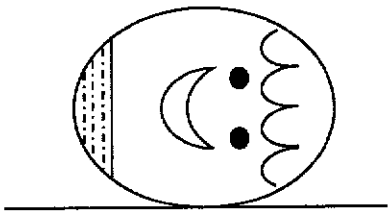


Fig 9.2 Push

(i) On Fig 9.1, indicate and label the approximate position of the centre of gravity of the toy with a **cross.** [1]

(ii) Explain, in terms of moments, why the toy always returns to its upright position.

.....

.....

..... [2]

(iii) Explain why an empty lorry is less likely to topple over than a fully-loaded lorry.

.....

..... [1]

(c) State the two ways to increase the stability of an object.

.....

..... [2]

10(a) Fig. 10.1 shows a hydraulic device that is used to compress paper in a waste disposal site. A force applied at piston A causes a pressure. The liquid transmits this pressure to piston B which then causes a force to be exerted on the paper.

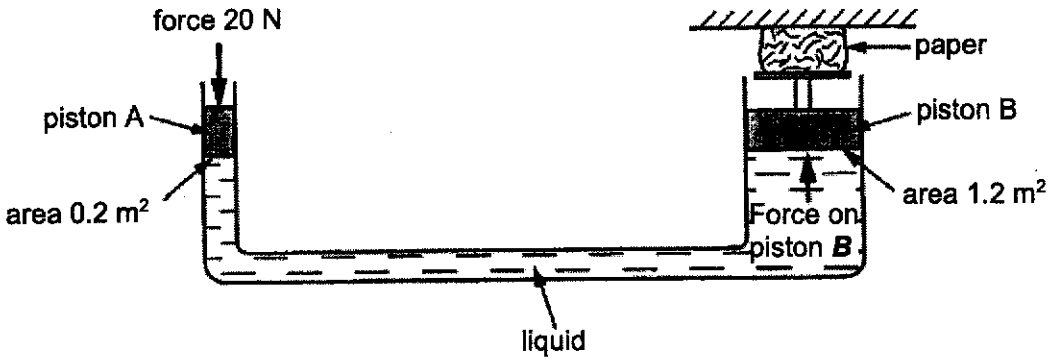


Fig. 10.1

A force of 20 N is exerted on piston A. The area of piston A is 0.2 m^2. The area of piston B is 1.2 m^2. Calculate,

(i) the pressure produced by piston A, stating clearly the formula that you use,

[2]

(ii) the force exerted on piston B.

[2]

10(b) Fig. 10.2 shows a 5 kg box being pushed by an external force *F* of 20 N along a rough tabletop. This causes the box to move at constant speed.

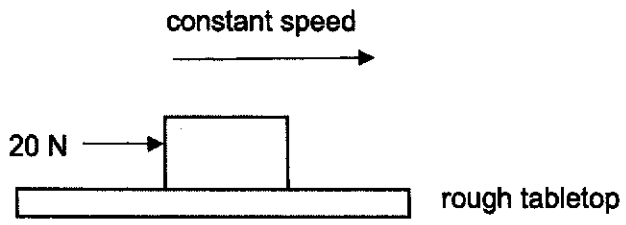


Fig. 10.2

(i) On Fig. 10.2, indicate another horizontal force, *f* acting on the box. Include its direction and magnitude. [2]

(ii) Explain how you obtained the magnitude of this horizontal force, f in **(i)**.

.....

..... [1]

(iii) If the extended force, *F* is increased to 30 N, calculate the acceleration produced.

[2]

10(c) State Newton's First Law of motion.

.....

.....

..... [1]

11 In an experiment, two kettles were used to boil equal volumes of water over a stove. One of the kettles used was shiny and smooth, and the other was dull black as shown in Fig. 11.1.

Shiny and smooth Dull black

Fig. 11.1

The result of the experiment with the dull black kettle is shown in Fig. 11.2.

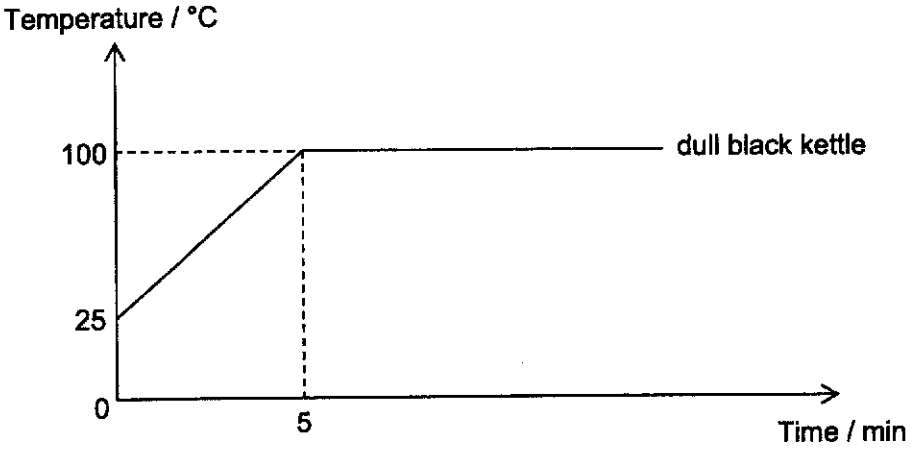


Fig. 11.2

(a) Describe in terms of thermal energy transfer at the molecular level, why a metal is a much better conductor of heat than wood.

.....

.....

.....

..... [3]

(b)(i) Sketch on Fig. 11.2, the temperature-time graph that you would expect for the shiny and smooth kettle. [2]

(b)(ii) Explain your answer to part **(b)(i)** using your understanding of the concepts of thermal energy transfer.

.....

..... [1]

(c) Fig. 11.3 shows a vacuum flask.

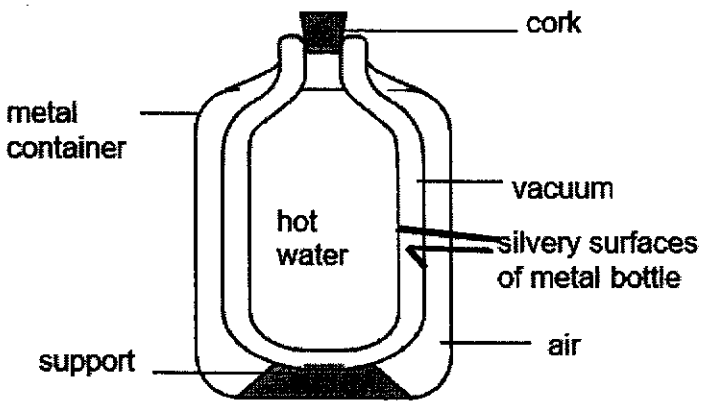


Fig. 11.3

(i) Explain how the vacuum reduce the amount of heat lost from the hot water.

.....

..... [1]

(ii) Explain how both silvered surfaces work together to reduce the amount of heat lost from the hot water.

.....

..... [2]

(iii) Explain how the cork helps to reduce the amount of heat lost from the hot water.

.....

..... [1]

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2019

Name	( )
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Subject	:	**SCIENCE (PHYSICS)**
Paper	:	**1**
Level	:	**SECONDARY THREE EXPRESS**
Date/Day	:	
Time	:	
Duration	:	**1 HOUR**

READ THESE INSTRUCTIONS FIRST

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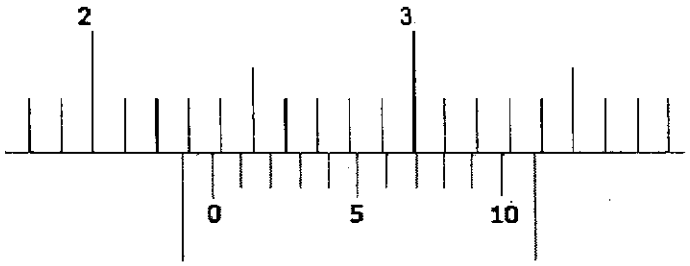
Write your name and index number on all the work you hand in.
Do not use staples, paper clips, glue or correction fluid.

There are 40 questions in this paper. Answer all questions.
For each question, there are 4 possible answers, **A**, **B**, **C** or **D**. Choose the correct answer and shade it using a 2B pencil in the OTAS provided.

This question paper consists of printed pages.

Paper 1 [40 marks]

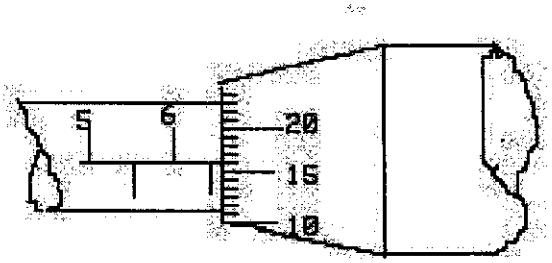
1 The diagram shows part of a vernier scale.



What is the correct reading?

A 2.27 cm
B 2.28 cm
C 2.37 cm
D 2.38 cm

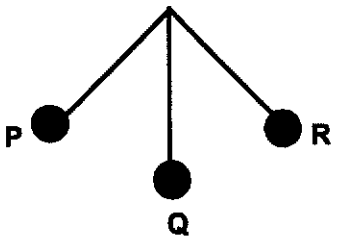
2 The diagram below shows the reading of the length of an object measured using a micrometer screw gauge.



What is the length of the object?

A 6.15 mm
B 6.16 mm
C 6.50 mm
D 6.66 mm

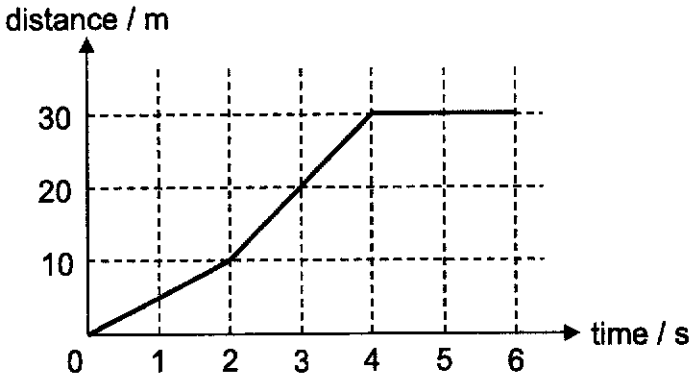
3 The diagram shows a simple pendulum. The bob of the pendulum is released at point P. The period of the oscillation is found to be 0.56 s.



What is the time taken for the pendulum bob to swing from R to P?

A 0.14 s
B 0.28 s
C 1.12 s
D 2.24 s

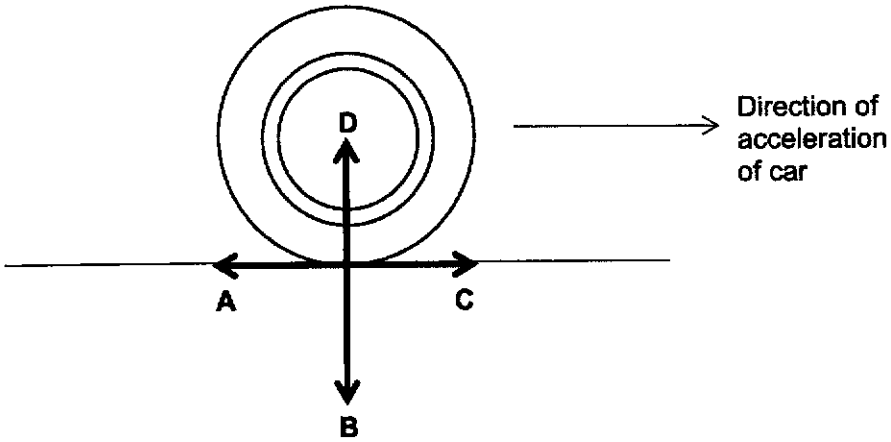
4 The distance-time graph of a toy car is shown below.



Which statement does **not** describe the graph?

A The speed of the toy car at 3 s is greater than its speed at 1 s.
B The speed of the toy car increases from 0 s to 2 s.
C The toy car did not move from 4 s to 6 s.
D The toy car moved 30 m in 6 s.

5 The wheel of a moving car is driven by the engine. The car is accelerating in the direction shown. In which direction does the frictional force between the wheel and the road surface act?

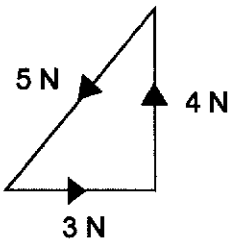


6 Which object exerts the greatest pressure on the ground?

	weight / N	area of contact with ground / m^2
A	60	2
B	240	4
C	770	5
D	1 200	8

7 Which diagram correctly shows the addition of 3 N and 4 N forces?

A



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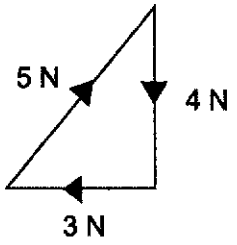
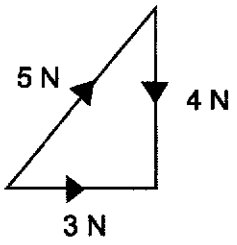


C



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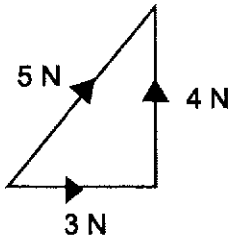
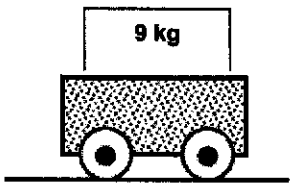
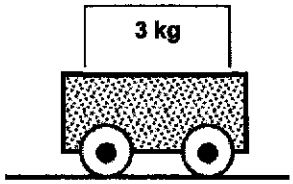


8 Which of the following has the highest inertia?

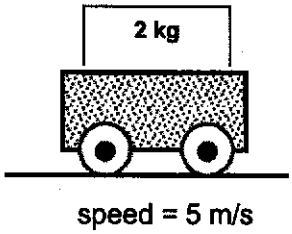
A



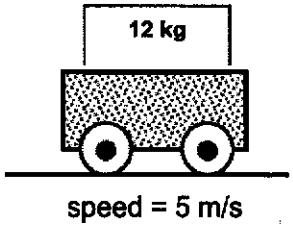
C



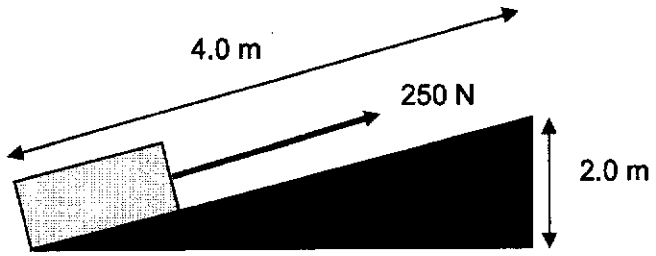
B



D



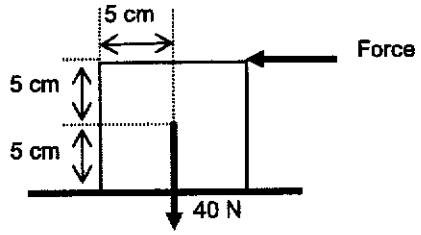
9 The diagram shows a box being pulled up a frictionless slope.



How much work is done by the 250 N force?

A 500 J
B 500 W
C 1000 J
D 1000 W

10 In the diagram below, the force needed to just tilt the cube, weight 40 N is



A 10 N
B 20 N
C 30 N
D 40 N

11 A girl of weight 440 N runs up a flight of stairs of height 5 m in 4 seconds. What is her power?

A 440 W
B 550 W
C 660 W
D 770 W

12 Which row compares the intermolecular forces between the molecules in ice, water and steam correctly?

	Weakest	⟶	Strongest
A	Ice	Steam	Water
B	Ice	Water	Steam
C	Steam	Water	Ice
D	Water	Steam	Ice

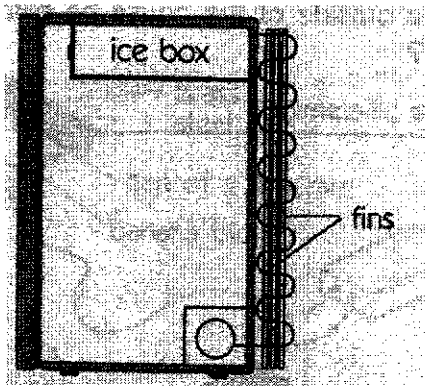
13 The size of an inflated balloon increases when it is left under the Sun. Why does this happen?

A The number of air molecules in the balloon increases.
B The air in the balloon expands as its molecules increase in size.
C The air molecules in the balloon gain kinetic energy causing them to move faster and further apart.
D The air molecules in the balloon gain potential energy causing them to move faster and further apart.

14 Which property **cannot** be explained by the Kinetic Model of Matter?

A Colour
B Volume
C Compressibility
D Density

15 The diagram below shows a section of a refrigerator.



The fins are painted black because

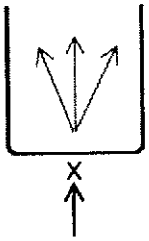
A black colour is more beautiful.
B a black surface can conduct heat well.
C a black surface is a good emitter of heat.
D they will not get dirty easily.

16 Cooling always accompanies evaporation because .....

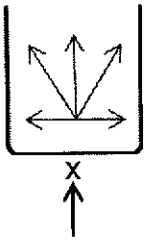
A the air molecules cool the liquid surface.
B the more energetic molecules leave the liquid.
C there are more liquid molecules left in the liquid.
D the escaped molecules return to the liquid.

17 Water in a beaker is heated at X. Which diagram best shows the convection currents?

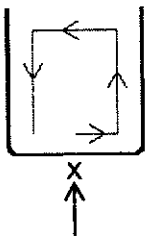
A



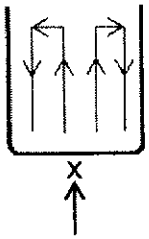
B



C



D



18 Certain physical characteristics of a polar bear help it to reduce heat loss in winter. Which of the following statements explain correctly how each characteristic reduces heat loss?

1 Its white coat reduces heat loss by radiation.
2 A layer of fat under its skin reduces heat loss by conduction.
3 The thick fur reduces heat loss by conduction.

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D All of the above

19 A jug of water is at room temperature. Several ice cubes at a temperature of 0 °C are dropped into it and they begin to melt. What happens to the temperature of the water and ice cubes immediately after the ice cubes are dropped?

	temperature of water	temperature of ice cubes
A	decreases	increases
B	decreases	stays constant
C	stays constant	increases
D	stays constant	stays constant

20 Four beakers containing the same amount of water at the same temperature are placed on hot metal plates. The plates are all of the same size, same temperature but are made from four different metals. The time taken to produce the stated temperature rise of the water is given below. Which metal is the poorest conductor?

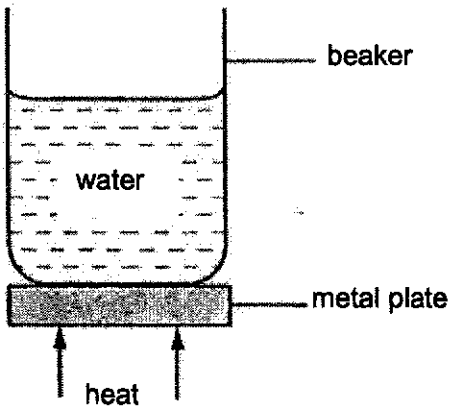


plate	temperature rise / °C	time / s
A	10	100
B	12	100
C	15	200
D	18	200

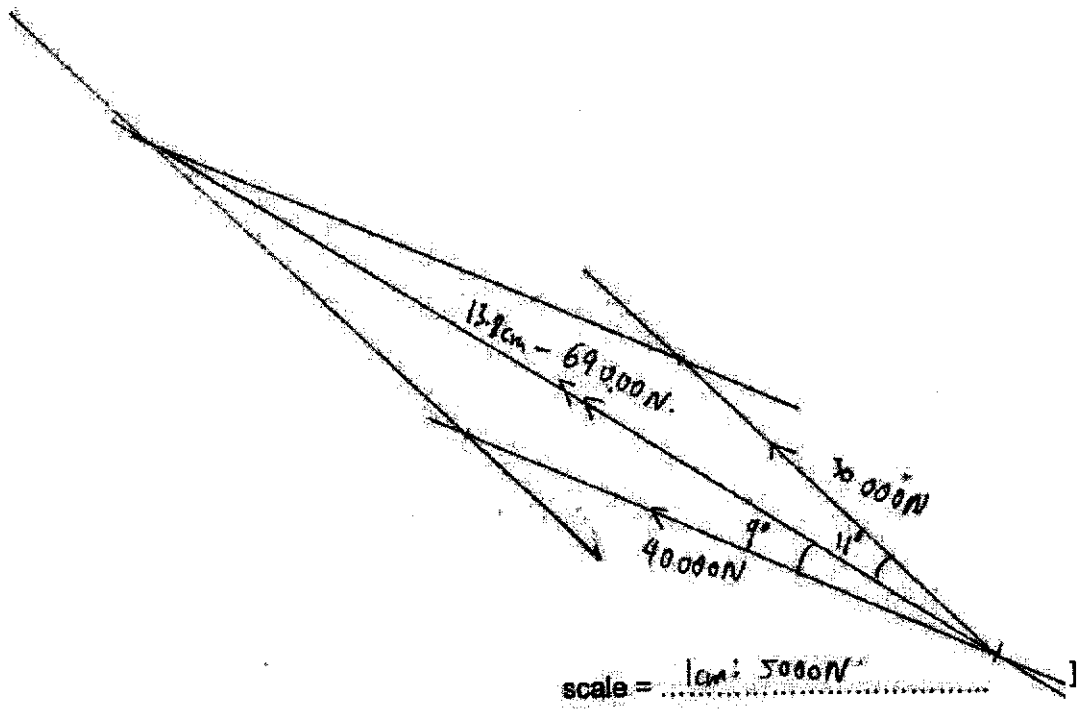
Boon Lay Secondary School
EOY 2019
Secondary 3 Express
Science Physics
Answer Key

P1

1	**D**	Main scale = 2.3 cm, Vernier scale = 0.08 cm, correct reading = 2.38 cm
2	**D**	Main scale = 6.5 mm, thimble scale = 0.16 mm, length of object = 6.66 mm
3	**B**	From R to P is half a period, 0.56 s / 2 = 0.28 s
4	**B**	From 0 to 2 s, the speed is constant.
5	**C**	The direction of the wheel is to the left, hence friction which opposes motion. Hence answer C.
6	**C**	Pressure = F / A A: 60 / 2 = 30 Pa B: 240 / 4 =60 Pa C: 770 / 5 = 154 Pa D: 1200 / 8 = 150 Pa
7	**D**	Tip-to-tail method.
8	**D**	Inertia is related to the mass. The bigger mass will have the highest inertia. Hence answer D
9	**C**	Work done = F x d = 250 N x 4 m = 1000 J
10	**B**	F x 10 = 40 x 5 F = 200 / 10 = 20 N
11	**B**	Power = WD / time = (440 x 5) / 4 = 550 W
12	**C**	Gas ———— Liquid ———— Solid Weakest ———————— Strongest (intermolecular force)
13	**C**	When the balloon is left under the sun, the air molecules gain kinetic energy, increase speed and move faster and further apart.
14	**A**	The colour of the object cannot be explained by Kinetic Model of Matter
15	**C**	Black is a good emitter of heat
16	**B**	Evaporation causes cooling as the most energetic molecules leave the surface, hence leaving behind the less energetic molecules, hence the temperature decreases.
17	**D**	Convection currents in a beaker.
18	**D**	White is a poor emitter of infrared radiation, thick fur traps air, air being poor conductor of heat will help to keep the polar bear warm. All of the above will help reduce heat loss.
19	**B**	During a change of state, the temperature of the ice remains constant. Ice at 0°C melts to form water at 0°C. Initially the temperature of water decreases from room temperature and will reach 0°C finally.

20	**C**	Poorest conductors mean that the metal will produce the lowest temperature change within the same period of time. **A**: 10 °C in 100 s **B**: 12 °C in 100 s **C**: 7.5 °C in 100 s **D**: 9 °C in 100 s

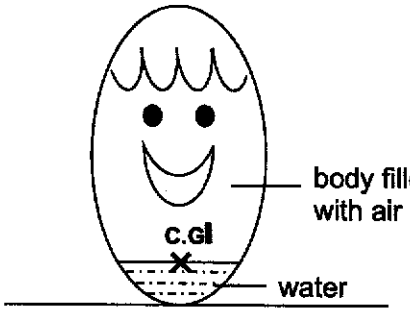
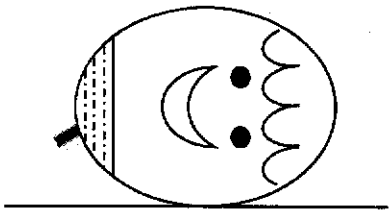
P2
Section A

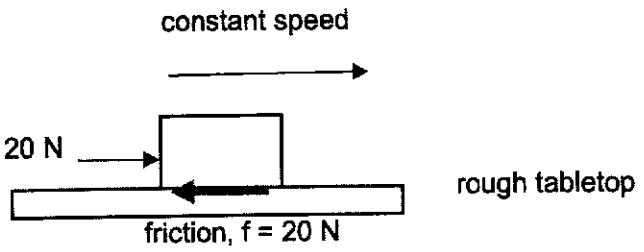
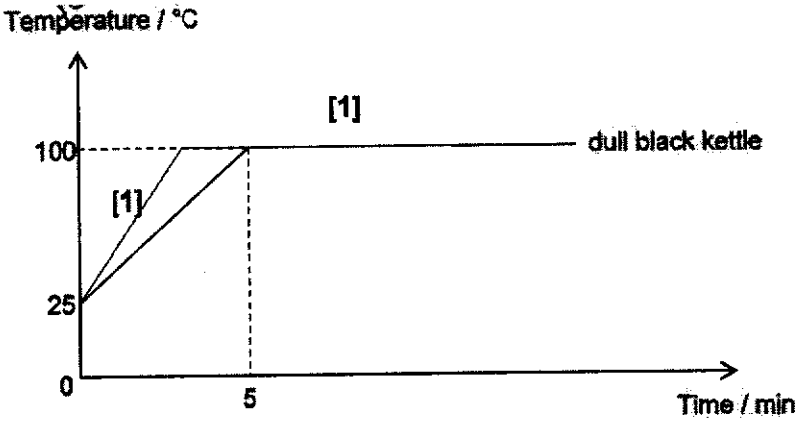
1a	The acceleration occurs from 6 to 12 s. Take the negative sign of velocity (vector quantity) as the opposite direction of the ball i.e. the ball is rolling back down. Therefore the negative sign can be left out in the calculation. a=(v-u)/t = 15-0/12-6 = 2.5 m/s^2	[1] [1]
b	6 s	[1]
c	distance = area under the graph (0 to 6 s) = 0.5 x 6 x 15 = 45 m	[1] [1]
d	distance travelled from 6 to 10s = 0.5 x 4 x 10 = 20 m displacement = 45 – 20 = 25 m from the starting point	[1] [1]
2	[1] – all lines and forces correctly indicated [1] – correctly labelled of resultant force  magnitude of resultant force = 69 000 N angle of resultant force from 40000 N force = 9°	] [1] [1]

3a(i) a(ii)	Mass of solid = 36 g Volume of solid = 41 – 25 = 16 cm^3	[1] [1]
b	d = m/V = 36/16 = 2.25 g/cm^3	[1]
c	The solid may be soluble in water and this causes a change in its mass.	[1]
4(a)	Principle of Moments states that for a body to be in equilibrium the sum of clockwise moments about a pivot is equal to the sum of anticlockwise moments about the same pivot.	[1]
(b)	Total clockwise moment (Olaf) = 200 N x 1.0 m = 200 Nm. By Principles of moments, T. CW Moments = T. CCW Moments 200 Nm = 120 N x d (200 Nm) / (120 N) = d d = 1.67 m [M1 for correctly determining CW moments by Olaf] [M1/A1 for correctly determining the distance by equating moments in both directions.]	
5(a)	The principle of conservation of energy states that energy can neither be created nor destroyed, it can only be converted from one form to another. The total energy in an enclosed system remain constant.	[1]
5(b)	Total Energy = GPE + KE GPE = (450 kg) x (10 N/kg) x (50 m) = 225000 J KE = ½ x 450 kg x 0^2 = 0 J Total Energy = 225000 J	
5(c)	Total Energy at W = Total Energy at Y = 225000 J	
5(d)	TE at Z = 225000 J KE at Z = TE at Z – GPE at Z KE at Z = 225000 – (450 kg)(10 N/kg)(15 m) ------- [M1] KE at Z = 157500 J ½ × m × v^2 = 157500 J v = 26.5 m/s (3s.f)	
6a(i)	All matter is made up of a large number of tiny particles in continuous and random motion.	[2]
6a(ii)	The particles in liquid mercury are closely packed and held by strong forces. Therefore, liquid mercury cannot be compressed and has fixed volume. However the forces are weaker in the liquid state than in the solid state, allowing the particles in the liquid state to slide over one another. Therefore, liquid mercury has no fixed shape.	[1] [1]
6b	unchanged, unchanged, increases, increases 4 correct – [2], 2,3-[1], 1 – [0]	[2]

6c	Molecular arrangement of <u>solid</u> - same sized molecules - closely packed - no spaces between molecules - regular pattern - no overlap [M1] T = 20 °C (solid) Molecular arrangement of <u>liquid</u> - same sized molecules - closely packed - little or no spaces between molecules - irregular pattern - no overlap [M1] T = 80 °C (liquid)	[2]
7(a)(i)	a solid – AB	[1]
(a)(ii)	a mixture of solid and liquid – BC	[1]
(a)(iii)	a liquid - CD	[1]
7(b)	Temperature is constant as the thermal <u>energy</u> supplied <u>is absorbed</u> by the cyclohexane to <u>break the regular arrangement</u> between the molecules. The molecules move further apart and the cyclohexane changes states from solid to liquid.	[2]
7(c)	T1: Melting point T2: Boiling point	[1] [1]
7(d)(i)	gain in internal kinetic energy	[1]
7(d)(ii)	gain in internal potential energy	[1]
8	Similarity : Both processes involve a change of state from liquid to gaseous state.	[1]
	Difference: Boiling takes place throughout the liquid, Evaporation takes place at the surface of the liquid.	[1]

Section B

9a(i)	The moment of a force is the product of the force *F* and the perpendicular distance *d* from the pivot to the line of action of the force. SI unit: newton metre (Nm)	[1] [1]
a(ii)	The stability of an object is a measure of its ability to return to its original position after it is slightly displaced.	[1]
a(iii)	The centre of gravity of any object is defined as the point through which its whole weight appears to act.	[1]
9(b)(i)	 **Fig 9.1** Upright  **Fig 9.2** Push	
9(b)(ii)	If the toy is pushed to one side, the weight of the toy which acts vertically through the position of c.g. will create turning effect about the pivot.[1] It will turn anti-clockwise and returns to its original position.[1]	[2]
9b(iii)	When the lorry is empty, the centre of gravity shifts downwards and the stability of the lorry increases. Hence, an empty lorry is less likely to topple over.	[1]
9c	The two ways are: (1) its centre of gravity should be kept as low as possible (2) its base area should be kept as wide as possible	[2]
10(a)(i)	Pressure = Force / Area = 20 N / 0.2 m^2 = 100 N/m^2 or Pa	[1] [1]
10(a)(ii)	Pressure at A = Pressure at B [Note: student must state this statement] Pressure = Force / Area 100 = Force / 1.2 Force = P x A = 100 x 1.2 = 120 N	[1] [1]

10(b) (i)	 [1] – direction [1] – magnitude	
10(b)(ii)	Since the box moved at constant speed, acceleration is zero, hence the resultant force = 0 N (F = m x a). Since resultant force = 0 N, the frictional force is equal to the pushing force of 20 N.	[1]
10(b)(iii)	By Newton's Second Law, resultant force = F – f = ma a = (F – f) / m = (30 – 20) / 5 = 2.0 m/s^2	[1] [1]
10(c)	Newton's first law of motion states that every object will continue in its state of rest or uniform motion in a straight line unless a resultant force acts on it.	[1]
11(a)	In both metal and wood, the molecules that are heated vibrate faster and at a greater amplitude. Thermal energy is transferred when they collide with less energetic neighbouring molecules making them vibrate more faster. This process of thermal energy transferred by molecular vibration is slow. [1] In metal, there are free electrons, [1] these free electrons gain kinetic energy when heated, the electrons move at great speeds towards the cooler regions. As the electrons move, they collide with the molecules in the cooler regions, making them vibrate even more vigorously. [1] Thus metal is a better conductor of heat than wood.	[3]
11(b)(i)	 Fig. 11.2	[2]

11(b)(ii)	**Dull black surface is a better radiator** than a shiny and smooth surface. So the **dull black kettle loses heat faster** than the shiny smooth kettle and hence takes a longer time to reach 100°C.	[1]
11(c)(i)	The vacuum between the walls of the flask reduces heat loss by conduction and convection as conduction and convection need a medium for the transfer of thermal energy .	[1]
	The silvered surfaces reduce heat loss by radiation. The **inner** silvered surface reflects the radiant heat back into the **hot** liquid. The **outer** silvered surfaces, being poor emitter of infrared radiation, will help to reduce the heat loss to the surrounding.	[2]
	The stopper made of cork is a poor conductor of heat. It reduces heat loss by conduction and evaporation.	[1]