Geylang Methodist School (Secondary)
End-Of-Year Examination 2016

PHYSICS **5059/01**

Paper 1 **Sec 3 Express**

Additional materials : OAS **45 minutes**

Setter : Mr Sng Peng Hock **12 Oct 2016**

READ THESE INSTRUCTIONS FIRST

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

Do not open this booklet until you are told to do so.

Answer all questions. Shade your answers on the OAS provided.

At the end of the examination, submit OAS and the question paper separately.

INFORMATION FOR CANDIDATES

Each correct answer will score one mark.

Any rough work should be done in this booklet.

Gravitational field strength is assumed to be 10 N/kg and acceleration due to gravity, *g*, is assumed to be 10 m/s^2, unless otherwise specified.

This document consists of **11** printed pages and **1** blank page.

[Turn over

68

Downloaded from SingaKids.com

1 What is the correct unit for the quantity shown?

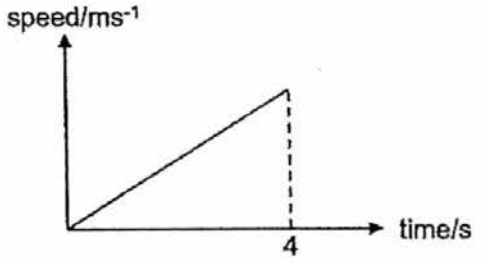
	quantity	unit
A	electromotive force (e.m.f.)	N
B	latent heat	J
C	pressure	kg/m^2
D	weight	kg

2 A simple pendulum takes 34.0 s to complete 20 oscillations.

What would be the period of the pendulum if the mass of the pendulum bob was doubled and the experiment repeated?

A 0.85 s B 1.7 s C 3.4 s D 6.8 s

3 The diagram below shows the speed time graph of a stone released from a certain height and hit the ground in 4 seconds.



At what height was the stone released? (Ignore air resistance)

A 20 m B 40 m C 80 m D 160 m

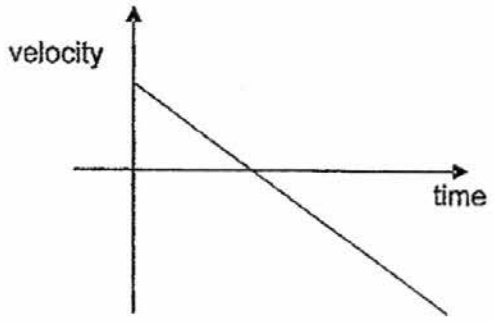
4 A box of mass 2 kg is pushed with a force of 10 N on a rough surface. It accelerates from rest to a speed to 10 m/s after 5 seconds.

What is the frictional force acting on the box?

A 0 N B 4 N C 6 N D 10 N

Downloaded from SingaKids.com

5 The graph shows how the velocity of a ball varies with time.



Which of the following situations is best illustrated by the graph?

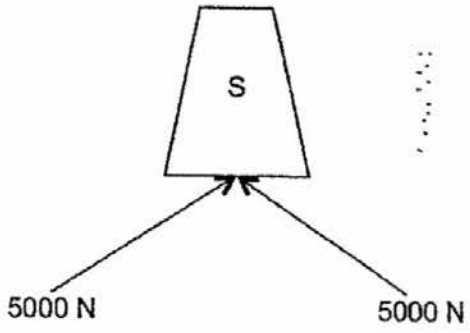
A The ball is released from a height.

B The ball is thrown upwards.

C The ball is thrown down from a height.

D The ball rolls down a slope.

6 Two tug boats were pushing a sand barge, S, with 5000 N forces each. The forces are acting at an angle of 120° from one another as shown below.



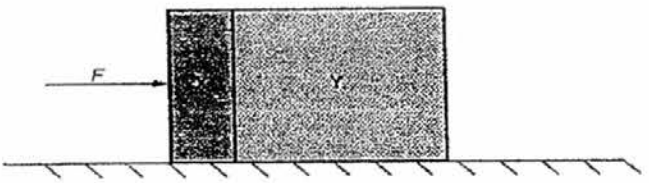
What is the value of the resultant force acting on the sand barge?

A 4000 N B 5000 N C 5500 N D 6000 N

69

Downloaded from SingaKids.com

7 Two blocks X and Y, of masses m and $4m$ respectively, are accelerated along a smooth horizontal surface by a force F applied to block X as shown.



What is the magnitude of the force exerted by block Y on block X during this acceleration?

A F/5 **B** 2F/5 **C** 3F/5 **D** 4F/5

8 When a solid X of mass 12 g is immersed in a displacement can filled with water, it displaces the same volume of water as a solid Y of mass 8 g.

What can be deduced about the densities of solids X and Y?

A Both X and Y have the same density

B The density of X is greater than Y by 4 g/cm^3.

C The density of X is one and half times the density of Y.

D The density of Y is one and half times the density of X.

9 An object weighs 16 N on the moon where the acceleration of free fall is 1.6 m/s^2.

How much will it weigh on Earth where the acceleration of free fall is 10 m/s^2?

A 16 N **B** 25.6 N **C** 100 N **D** 160 N

10 The position of the centre of gravity of an object _____

A always lies within the body object.

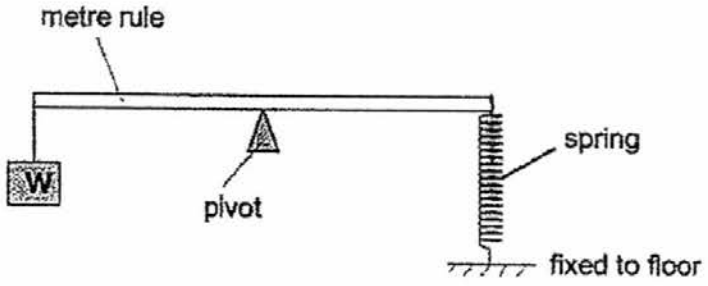
B depends on the weight of the object.

C depends on the distribution of mass.

D depends the gravitational field strength around the object.

Downloaded from SingaKids.com

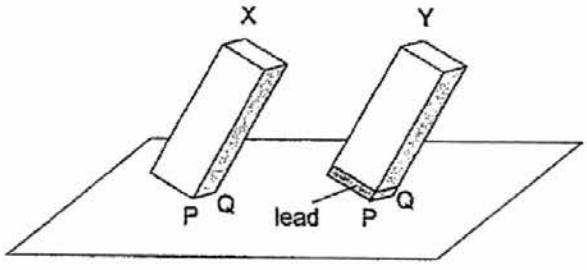
11 A **stretched** spring is attached to one end of a metre rule as shown. A weight W is hung at the other end. The metre rule is pivoted at the centre and remains horizontal.



The weight W is moved towards the pivot.
How does the force in the spring change?

	force in spring	direction of spring force acting on metre rule
A	increases	down
B	decreases	down
C	increases	up
D	decreases	up

12 The figure below shows two identical rectangular wooden blocks X and Y.
Block Y has a layer of lead attached to its base.
The blocks were tilted about edges PQ as shown in the figure.



Which of the following statements is true?

A X and Y will topple together at the same angle.

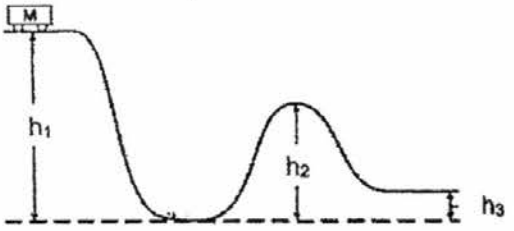
B X will topple over at a smaller angle of tilt compared to Y.

C Y will topple over at a smaller angle of tilt compared to X.

D Both will not topple over.

Downloaded from SingaKids.com

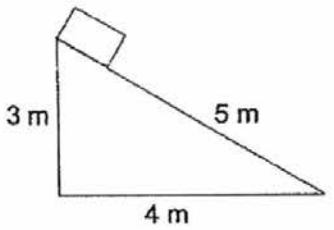
13 A cart of mass M on a frictionless track is at rest at the top of a hill of height h_1, as shown in the diagram. It starts moving down the first slope towards the second hill of height h_2.



What is the kinetic energy of the cart when it reaches the top of the next hill with a height of h_2?

A $Mg(h_2 - h_3)$ **B** Mgh_2 **C** $Mg(h_1 - h_2)$ **D** $Mg(h_1 - h_3)$

14 A box of mass 2 kg slides down a slope from rest as shown below.



Given that friction along the slope is 3.2 N, what is the speed of the box at the foot of the ramp?

A 6.63 m/s **B** 7.10 m/s **C** 7.75 m/s **D** 8.72 m/s

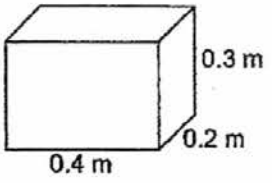
15 An electric motor lifts a load of 1000 N through a vertical height of 2.0 m in 10 s. The input power to the motor is 500 J/s.

What is the efficiency of the crane?

A 10 % **B** 40 % **C** 50 % **D** 60 %

Downloaded from SingaKids.com

16 A block of dimension 0.2 m by 0.3 m by 0.4 m rests on the floor as shown in the diagram below. The block has density of 6000 kg/m^3.



What is the pressure exerted by the block on the floor?

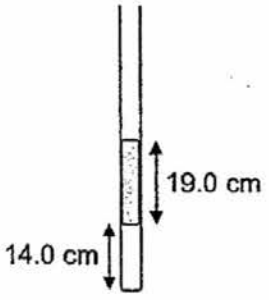
A 1800 Pa **B** 18000 Pa **C** 100000 Pa **D** 1000000 Pa

17 The RSS Archer submarine is cruising at a depth of 65 m. The density of seawater is 1020 kg/m^3 and atmospheric pressure is 1 x 10^5 Pa.

What is the pressure acting on the submarine at this depth?

A 66300 Pa **B** 166300 Pa **C** 663000 Pa **D** 763000 Pa

18 In the figure below, a column of air 14.0 cm long is trapped in a capillary tube by a thread of mercury 19.0 cm long. The atmospheric pressure is equivalent to 76.0 cm Hg.

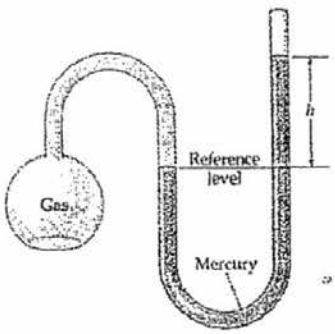


What is the pressure of the air in the tube?

A 14.0 cm Hg **B** 57.0 cm Hg **C** 62.0 cm Hg **D** 95.0 cm Hg

Downloaded from SingaKids.com

19 The diagram below shows a constant volume gas thermometer.



What is the thermometric property used in this thermometer?

A volume of gas

B volume of mercury

C height of mercury

D pressure of gas

20 A gas is heated in a rigid sealed vessel.

What happens to the internal energy and density of the gas?

	internal energy	density
A	remains constant	remains constant
B	remains constant	decreases
C	increases	remains constant
D	increases	increases

21 Air is enclosed in a cylinder and the piston is pushed down slowly at constant temperature until the volume is halved.

Which of the following is true?

A The average kinetic energy of the molecules is doubled.

B The average number of molecules per unit volume is halved.

C The number of collisions per unit area is doubled.

D The total force exerted by the molecules on the piston is unchanged.

Downloaded from SingaKids.com

22 Which statement describes the motion and the arrangement of the molecules in a solid?

A Molecules vibrate about fixed positions within an orderly arrangement.

B Molecules vibrate about fixed positions within a random arrangement.

C Molecules move randomly within an ordered arrangement.

D Molecules move randomly within a random arrangement.

23 A match would ignite if it was held 10 cm above a bunsen flame but would not ignite if held 10 cm to one side of the flame. This is because there is more heat energy transferred by _____.

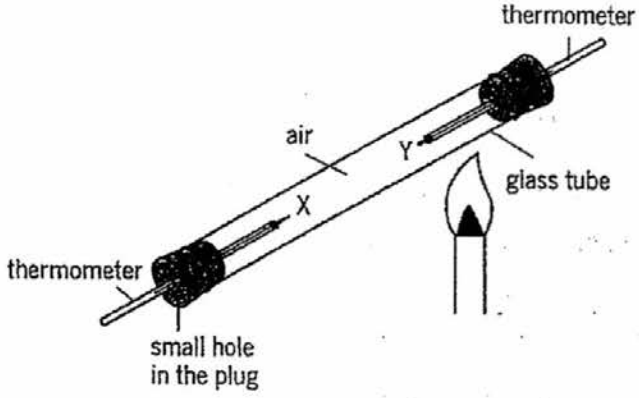
A conduction

B convection

C diffusion

D radiation

24 The diagram below shows a glass tube with two thermometers inserted at X and Y. The air in the glass tube has an initial temperature of 25 °C. The glass tube is then heated for one minute.



Which of the following shows the most likely temperatures recorded by thermometers X and Y?

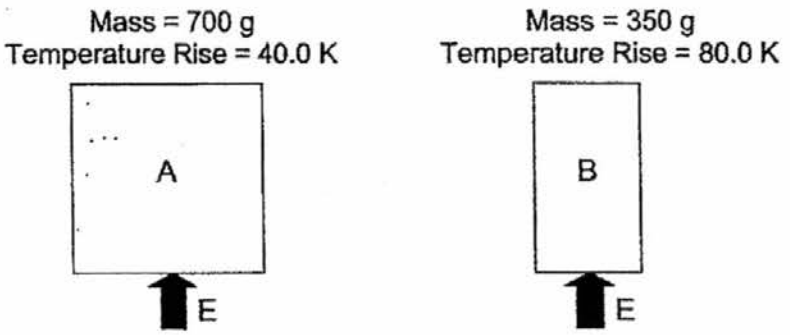
	temperature at X / °C	temperature at Y / °C
A	25	25
B	25	45
C	45	35
D	45	45

Downloaded from SingaKids.com

25 In which of the following is most of the heat transferred by conduction?

A keeping warm beside a fire place
B boiling of water in a kettle
C frying of an egg on a metal pan
D heating of food in a microwave oven

26 Two blocks of copper, A and B, each receives the same amount of energy E. The mass of A is twice the mass of B. The temperature rise of A is half the temperature rise of B.



Which statement about A and B is incorrect?

A The specific heat capacity of A is the same as the specific heat capacity of B.
B The heat capacity of A is the same as the heat capacity of B.
C Both A and B have the same specific latent heat of fusion.
D The heat capacity of A is twice the heat capacity of B.

27 An ice cube at a temperature of 0 °C is put into a drink at a temperature of 10 °C. After a short time during cooling, some of the ice has melted and the drink has cooled to a temperature 8 °C.

What is the temperature of the remaining ice?

A 0 °C B 2 °C C 4 °C D 8 °C

Downloaded from SingaKids.com

28 A small amount of alcohol and water are at the same temperature. Which of the following statement best explains why the alcohol feels cooler when placed on the hand as compared to water?

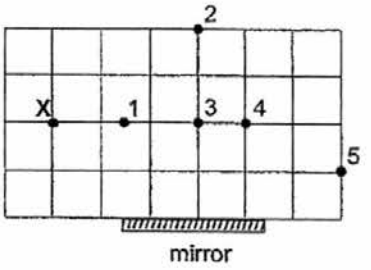
A Alcohol has a lower boiling point than water.

B Alcohol is a better conductor of heat compared to water.

C Alcohol has a higher specific latent heat of vaporisation than water.

D Alcohol evaporates more readily than water.

29 A student stands at point X as shown in the diagram below.



Which of the pins, 1, 2, 3, 4 or 5, will he be able to see in the mirror?

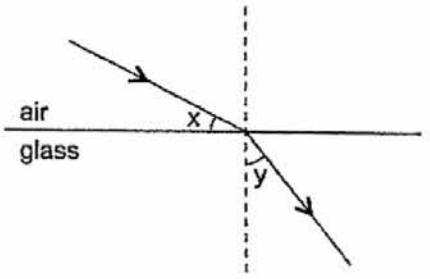
A pins 1, 2 and 3

B pins 2, 3 and 4

C pins 3, 4 and 5

D pins 2, 3, 4 and 5

30 A ray of light passes through from air to glass as shown in the following diagram below (which is not to scale).



Given that x = 20° and y = 40°, what is the refractive index of the glass?

A 0.53 B 1.46 C 1.53 D 1.87

End of paper

#3

Downloaded from SingaKids.com

Blank page

Downloaded from SingaKids.com

Geylang Methodist School (Secondary)
End-Of-Year Examination 2016

Candidate Name

Class

Index Number

PHYSICS

5059/02

Paper 2 Physics

Sec 3 Express

Additional materials : Nil

1 hour 30 minutes

Setter : Mr Sng Peng Hock

12 Oct 2016

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions. Write your answers in the spaces provided on the question paper.

Section B
Answer **all** questions. Write your answers on the writing papers provided.

At the end of the examination, fasten the writing papers securely with the question paper.

Candidates are reminded that all quantitative answers should include appropriate units. You are advised to show all your working in a clear, orderly manner.

Gravitational field strength is assumed to be 10 N/kg and acceleration due to gravity, *g*, is assumed to be 10 m/s^2, unless otherwise specified.

For Examiner's Use	
Section A	/ 40
Section B	/ 30
Total	/ 70

This document consists of **11** printed pages and **1** blank page.

[Turn over

74

Downloaded from SingaKids.com

SECTION A

Answer **ALL** questions in this section in the spaces provided.

1 A 5 kg parcel is dropped off vertically from a helicopter 600 m above the ground at time t = 0 s. After some time of falling through the air, its parachute is deployed by remote control. The speed-time graph for the first 25 seconds of its journey through the air is shown in Fig. 1.1 below.

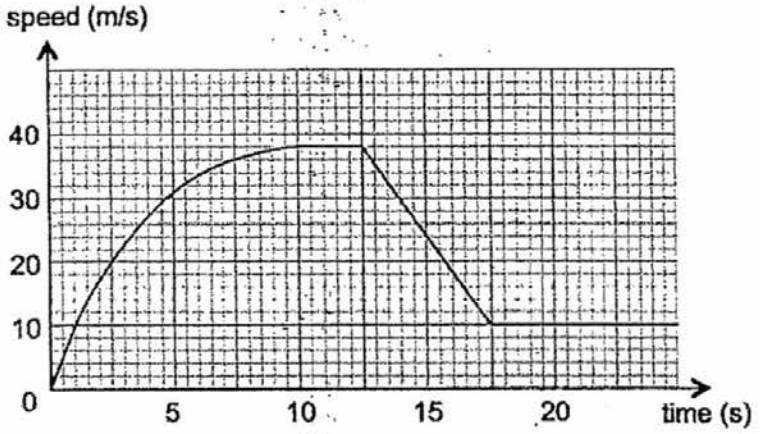


Fig. 1.1

(a) Is the object free-falling at any point during the first 25 seconds?

Explain your answer clearly with reference to Fig. 1.1 above.

_____

_____

_____

_____ [3]

(b) State the time at which the object first achieves terminal velocity.

_____ [1]

(c) Explain, in terms of forces, how the object achieves the first terminal velocity.

_____

_____

_____

_____ [3]

Downloaded from SingaKids.com

(d) Explain, in terms of forces, why the object experiences deceleration at time 12.5 s.

_____

_____

_____

_____ [3]

2 Fig. 2.1 shows a cube with sides 8 cm, made of substance X. Substance X has a density of 12.5 g/cm^3.

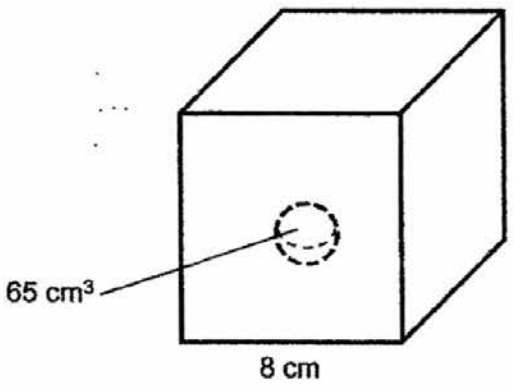


Fig. 2.1

The cube has a hollow spherical centre with a volume of 65 cm^3.

(a) Find the mass of the cube with the hollow spherical centre.

mass = _____ [2]

Downloaded from SingaKids.com

(b) The hollow spherical centre is then filled with substance Y, which has a density 5 g/cm^3.

Calculate the average density of the block with the substance Y filled in the centre.

density = _____ [3]

3 Fig. 3.1 shows a student, of weight *W* N, standing 0.30 m from end A of a uniform plank AB.

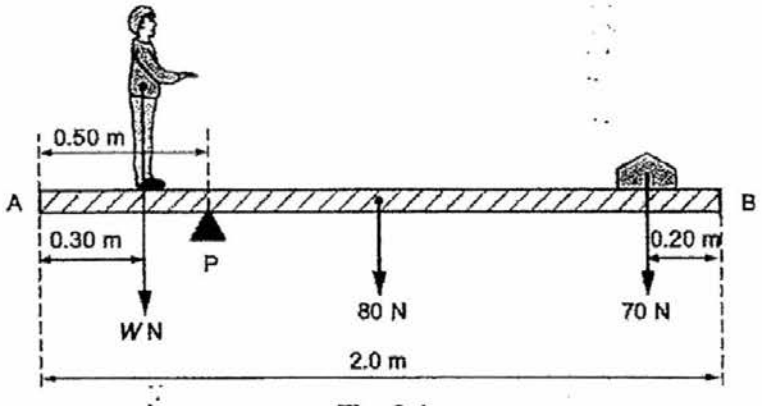


Fig. 3.1

The plank has a weight of 80 N and length 2.0 m. A pivot P supports the plank and is 0.50 m from end A. A weight of 70 N is moved to balance the weight of the student. The plank is in equilibrium when the 70 N weight is 0.20 m from end B.

Calculate the weight of the student.

weight = _____ [3]

Downloaded from SingaKids.com

4 Fig. 4.1 shows a conveyor belt moving boxes, each of weight 80 N. A motor is used to keep the conveyor belt moving continuously.

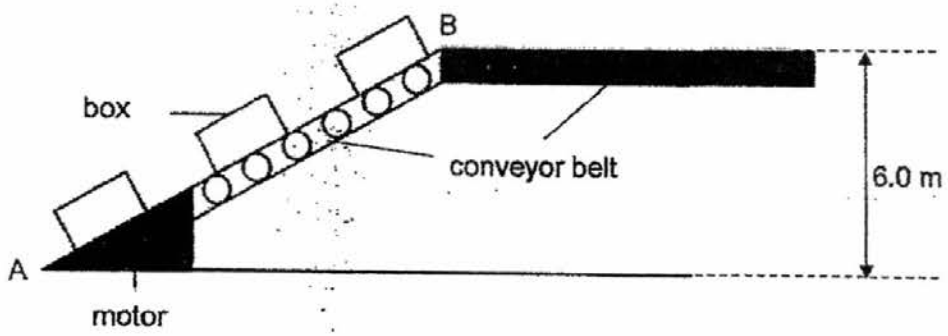


Fig. 4.1

(a) Calculate the increase in gravitational potential energy of a box when it moves from position A to position B.

gain in GPE = _____ [2]

(b) The conveyor belt is able to move 4 boxes from position A to B in 1.0 minute. Determine the power output of the motor.

power = _____ [2]

5 The stem of a thermometer is graduated in centimetres. It registers 1 cm when the bulb is -10 °C and 25 cm when the bulb is in steam at atmospheric pressure.

What is the temperature in °C when the thermometer registers 18 cm?

76 temperature = _____ [2]

Downloaded from SingaKids.com

6 Fig. 6.1 below shows the arrangement of particles of a particular substance as it is cooled.

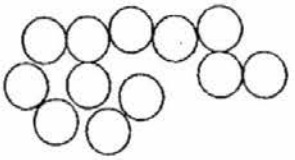
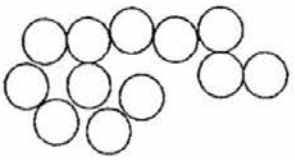
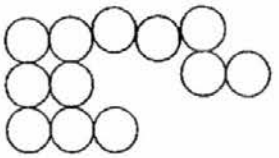
Time elapsed / min	Arrangement of particles	Temperature / °C	State(s) of substance
0		50	All liquid
5		10	
10		10	
15		10	All solid

Fig 6.1

(a) Complete the table. [3]

(b) Name the process which is occurring from t = 5 min to t = 15 min.

_____ [1]

(c) Explain how you arrived at your answer in part (b). Which component of internal energy has been changing?

_____

_____

_____ [2]

Downloaded from SingaKids.com

7 Fig. 7.1 shows a method of heating a room using solar energy instead of conventional sources of energy during cold weather in temperate countries. A brick wall with a blackened surface is placed behind a double-glazed window facing the Sun. During the day, the wall stores energy received from the Sun as thermal energy. At night, the heat from the blackened surface is transferred to the air next to it.

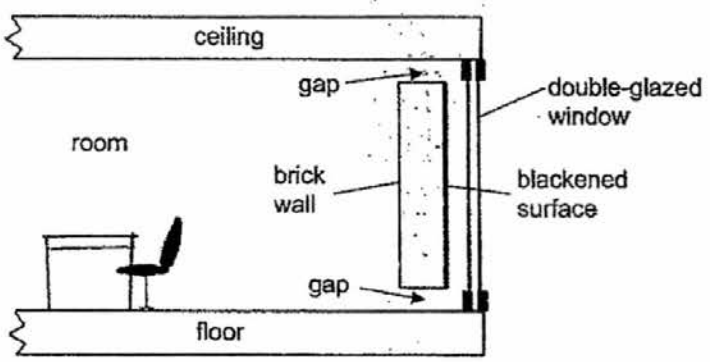


Fig 7.1

(a) Explain how the blackened surface helps to heat up the room during the night.

_____

_____

_____ [2]

(b) Describe how the heated air next to the wall is transferred throughout the room during the night.

_____

_____

_____ [2]

(c) The double-glazed window consists of two sheets of glass which traps a layer of air between them.

Explain how the double-glazed window helps to reduce heat loss in the room during the night.

_____

_____

_____ [2]

Downloaded from SingaKids.com

8 The diagram below shows a large rectangular tank containing a transparent liquid. A plane mirror is placed along the bottom of the tank. A ray of light is incident on the surface of the liquid at an angle of 35° as shown below.

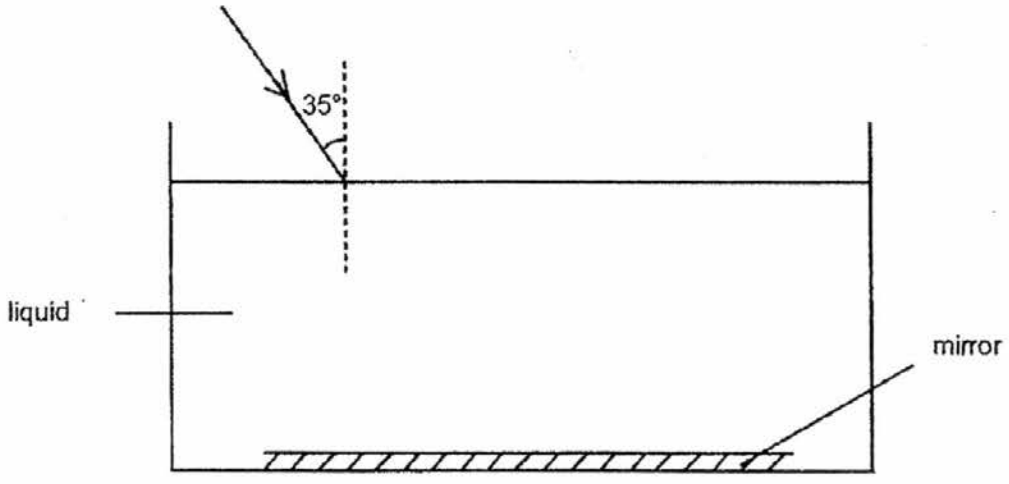


Fig 8.1

(a) If the refractive index of the liquid is 1.47, calculate the angle of refraction as the light ray enters the transparent liquid.

angle of reflection = _____ [2]

(b) Complete the diagram above to show the path of the ray of light until it emerges from the surface. Indicate all the angles with their respective normals. (You need not measure the angles to scale). [2]

End of Section A

Downloaded from SingaKids.com

SECTION B

Answer **all** the questions in this section
Write your answers on the writing papers provided.

9 Fig. 9.1 shows a helicopter with a mass of 1000 kg. The rotation of the blades can produce a maximum upward force of 18 kN.

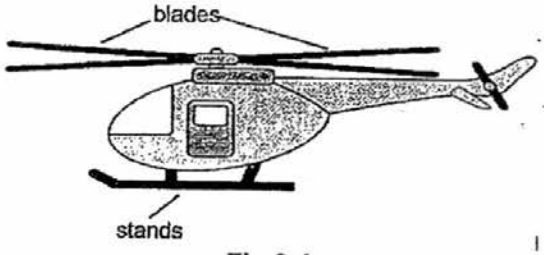


Fig 9.1

(a) The helicopter is stationary with its stands resting on the ground. The weight of the helicopter is one of the two forces that form an action-reaction pair of forces.

Describe the other force of this action-reaction pair. [2]

(b) Explain using Newton's third Law, how the helicopter produces an upward force. [2]

(c) The pilot flying the helicopter has a mass of 80 kg.

(i) What is the minimum upward force the helicopter must produce in order to lift off? [1]

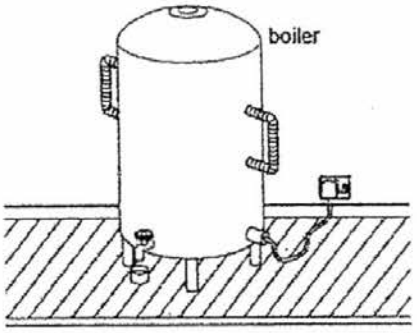
(ii) What is the highest possible upward acceleration using the maximum upward force? [2]

(d) After applying the maximum upward force for 10 s, the helicopter is in the air. The pilot then decides to hover the helicopter at a fixed height.

Using Newton's first Law, explain how this can be achieved. [3]

Downloaded from SingaKids.com

10 Fig.10.1 below shows an electric boiler in a kitchen.



The boiler contains 35 kg of water at 28 °C.
The specific heat capacity of water is 4200 J/(kg °C).
The specific latent heat of vaporization of water is 2.26 MJ/kg.

(a) Calculate the thermal energy needed to raise the temperature of the water from 28 °C to its boiling point. [2]

(b) The water in the boiler is heated by a 7200 W immersion heater.

Calculate the minimum time required for the heater to bring the water to its boiling point. [2]

(c) Suggest one reason why the actual time is greater than the minimum time calculated in **(b)**. [1]

(d) Due to a fault in the thermostat setting, the heater is not deactivated when the water reaches its boiling point and steam is produced.

Calculate the mass of the water left in the boiler 5 minutes after steam is first produced. [4]

(e) Suggest a mechanical safety feature that would prevent any danger created by the fault in **(d)**. [1]

Downloaded from SingaKids.com

11 A light ray is incident upon a triangular glass block with a speed of 3×10^8 m/s as shown in the Fig 11.1 below (not to scale). It was found that the speed of light in the glass block is two-third that of the speed of light in air.

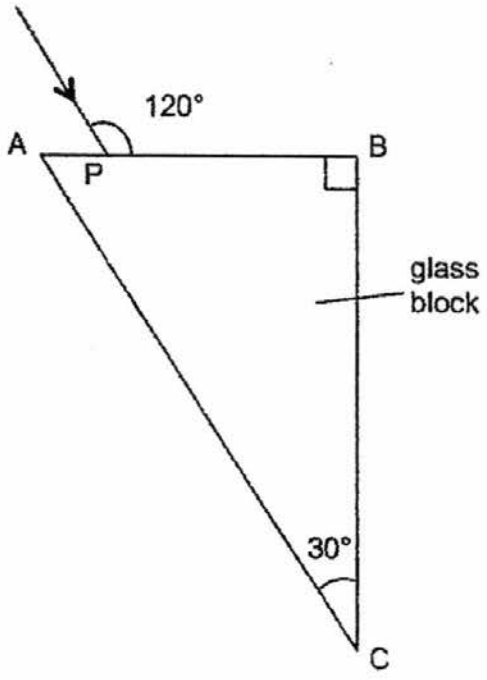


Fig 11.1

(a) Explain what will happen to the light ray as it enters the glass block. [2]

(b) Determine the refractive index, n, of the glass block. Hence, find the angle of refraction of the light ray after passing through point P. [4]

(c) Calculate the critical angle of the glass block. [1]

(d) Complete the path of the light ray from point P in Fig 11.1 and show what happens on the side AC. Indicate all angles and normal clearly. [3]

END OF PAPER

Downloaded from SingaKids.com

BLANK PAGE

Downloaded from SingaKids.com

Geylang Methodist School (Secondary)
End-Of-Year Examination 2016

PHYSICS **5059/01**

Paper 1 **Sec 3 Express**

Additional materials : OAS **45 minutes**

Setter : Mr Sng Peng Hock **12 Oct 2016**

READ THESE INSTRUCTIONS FIRST

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

Do not open this booklet until you are told to do so.

Answer **all** questions. Shade your answers on the OAS provided.

At the end of the examination, submit OAS and the question paper separately.

INFORMATION FOR CANDIDATES

Each correct answer will score one mark.

Any rough work should be done in this booklet.

Gravitational field strength is assumed to be 10 N/kg and acceleration due to gravity, *g*, is assumed to be 10 m/s^2, unless otherwise specified.

This document consists of **11** printed pages and **1** blank page.

[Turn over

80

Downloaded from SingaKids.com

1 What is the correct unit for the quantity shown?

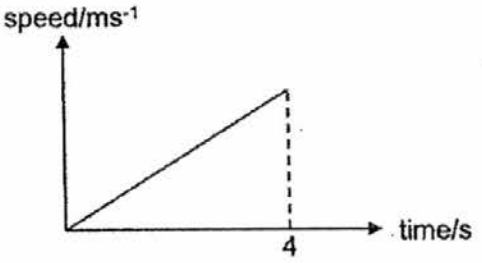
	quantity	unit
A	electromotive force (e.m.f.)	N
B	latent heat	J
C	pressure	kg/m^2
D	weight	kg

2 A simple pendulum takes 34.0 s to complete 20 oscillations.

What would be the period of the pendulum if the mass of the pendulum bob was doubled and the experiment repeated?

A 0.85 s **B 1.7 s** C 3.4 s D 6.8 s

3 The diagram below shows the speed time graph of a stone released from a certain height and hit the ground in 4 seconds.



At what height was the stone released? (Ignore air resistance)

A 20 m B 40 m **C 80 m** D 160 m

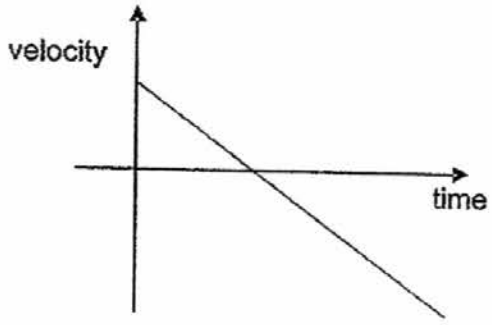
4 A box of mass 2 kg is pushed with a force of 10 N on a rough surface. It accelerates from rest to a speed to 10 m/s after 5 seconds.

What is the frictional force acting on the box?

A 0 N B 4 N **C 6 N** D 10 N

Downloaded from SingaKids.com

5 The graph shows how the velocity of a ball varies with time.



Which of the following situations is best illustrated by the graph?

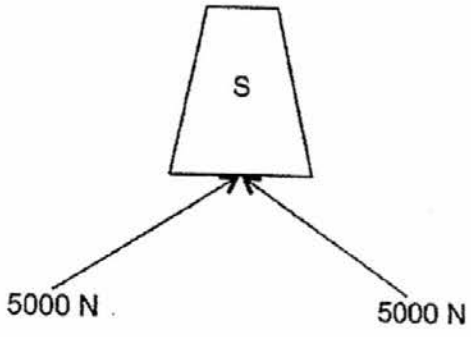
A The ball is released from a height.

B The ball is thrown upwards.

C The ball is thrown down from a height.

D The ball rolls down a slope.

6 Two tug boats were pushing a sand barge, S, with 5000 N forces each. The forces are acting at an angle of 120° from one another as shown below.



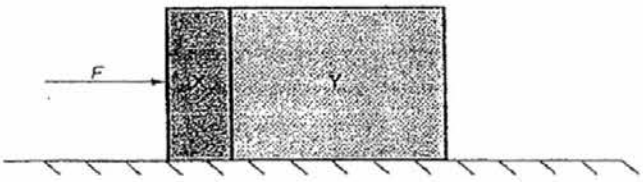
What is the value of the resultant force acting on the sand barge?

A 4000 N **B** 5000 N C 5500 N D 6000 N

81

Downloaded from SingaKids.com

7 Two blocks X and Y, of masses m and $4m$ respectively, are accelerated along a smooth horizontal surface by a force F applied to block X as shown.



What is the magnitude of the force exerted by block Y on block X during this acceleration?

A F/5 **B** 2F/5 **C** 3F/5 **D** 4F/5

8 When a solid X of mass 12 g is immersed in a displacement can filled with water, it displaces the same volume of water as a solid Y of mass 8 g.

What can be deduced about the densities of solids X and Y?

A Both X and Y have the same density

B The density of X is greater than Y by 4 g/cm^3.

C The density of X is one and half times the density of Y.

D The density of Y is one and half times the density of X.

9 An object weighs 16 N on the moon where the acceleration of free fall is 1.6 m/s^2.

How much will it weigh on Earth where the acceleration of free fall is 10 m/s^2?

A 16 N **B** 25.6 N **C** 100 N **D** 160 N

10 The position of the centre of gravity of an object _____

A always lies within the body object.

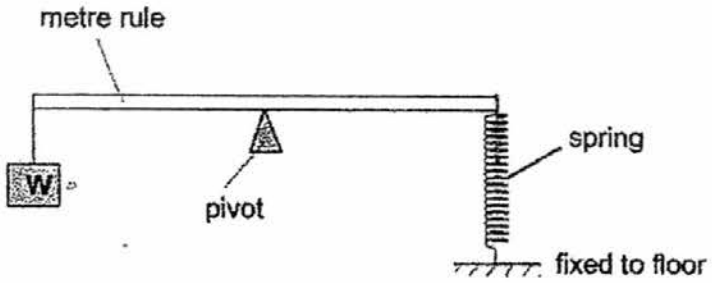
B depends on the weight of the object.

C depends on the distribution of mass.

D depends the gravitational field strength around the object.

Downloaded from SingaKids.com

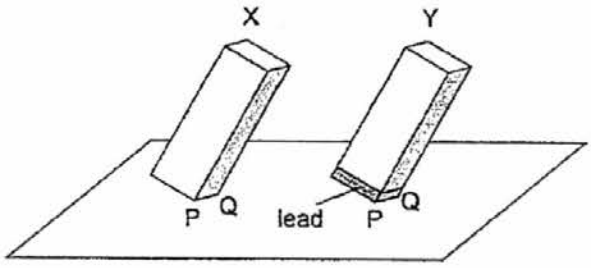
11 A **stretched** spring is attached to one end of a metre rule as shown. A weight W is hung at the other end. The metre rule is pivoted at the centre and remains horizontal.



The weight W is moved towards the pivot.
How does the force in the spring change?

	force in spring	direction of spring force acting on metre rule
A	increases	down
B	decreases	down
C	increases	up
D	decreases	up

12 The figure below shows two identical rectangular wooden blocks X and Y.
Block Y has a layer of lead attached to its base.
The blocks were tilted about edges PQ as shown in the figure.



Which of the following statements is true?

A X and Y will topple together at the same angle.

B X will topple over at a smaller angle of tilt compared to Y.

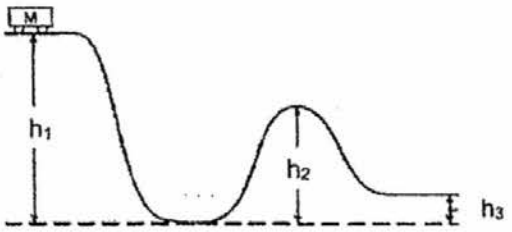
C Y will topple over at a smaller angle of tilt compared to X.

D Both will not topple over.

82

Downloaded from SingaKids.com

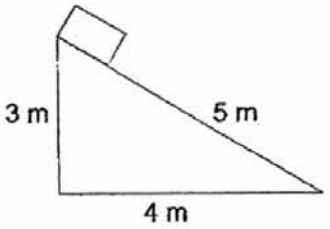
13 A cart of mass M on a frictionless track is at rest at the top of a hill of height h_1, as shown in the diagram. It starts moving down the first slope towards the second hill of height h_2.



What is the kinetic energy of the cart when it reaches the top of the next hill with a height of h_2?

A $Mg(h_2 - h_3)$ **B** Mgh_2 **C** $Mg(h_1 - h_2)$ **D** $Mg(h_1 - h_3)$

14 A box of mass 2 kg slides down a slope from rest as shown below.



Given that friction along the slope is 3.2 N, what is the speed of the box at the foot of the ramp?

A 6.63 m/s **B** 7.10 m/s **C** 7.75 m/s **D** 8.72 m/s

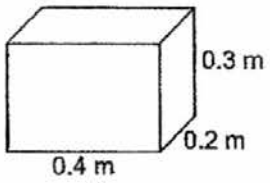
15 An electric motor lifts a load of 1000 N through a vertical height of 2.0 m in 10 s. The input power to the motor is 500 J/s.

What is the efficiency of the crane?

A 10 % **B** 40 % **C** 50 % **D** 60 %

Downloaded from SingaKids.com

16 A block of dimension 0.2 m by 0.3 m by 0.4 m rests on the floor as shown in the diagram below. The block has density of 6000 kg/m^3.



What is the pressure exerted by the block on the floor?

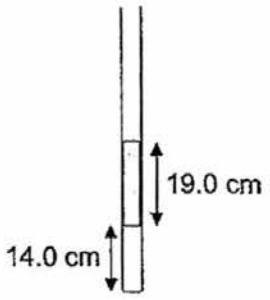
A 1800 Pa **B** 18000 Pa **C** 100000 Pa **D** 1000000 Pa

17 The RSS Archer submarine is cruising at a depth of 65 m. The density of seawater is 1020 kg/m^3 and atmospheric pressure is 1 x 10^5 Pa.

What is the pressure acting on the submarine at this depth?

A 66300 Pa **B** 166300 Pa **C** 663000 Pa **D** 763000 Pa

18 In the figure below, a column of air 14.0 cm long is trapped in a capillary tube by a thread of mercury 19.0 cm long. The atmospheric pressure is equivalent to 76.0 cm Hg.

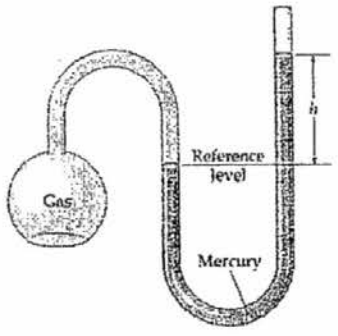


What is the pressure of the air in the tube?

A 14.0 cm Hg **B** 57.0 cm Hg **C** 62.0 cm Hg **D** 95.0 cm Hg

Downloaded from SingaKids.com

19 The diagram below shows a constant volume gas thermometer.



What is the thermometric property used in this thermometer?

A volume of gas

B volume of mercury

C height of mercury

D pressure of gas

20 A gas is heated in a rigid sealed vessel.

What happens to the internal energy and density of the gas?

	internal energy	density
A	remains constant	remains constant
B	remains constant	decreases
C	increases	remains constant
D	increases	increases

21 Air is enclosed in a cylinder and the piston is pushed down slowly at constant temperature until the volume is halved.

Which of the following is true?

A The average kinetic energy of the molecules is doubled.

B The average number of molecules per unit volume is halved.

C The number of collisions per unit area is doubled.

D The total force exerted by the molecules on the piston is unchanged.

Downloaded from SingaKids.com

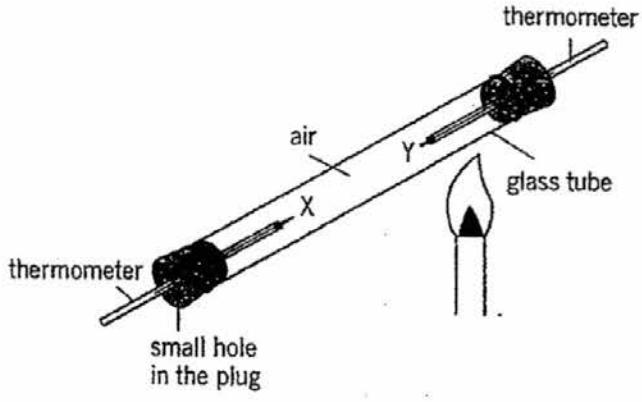
22 Which statement describes the motion and the arrangement of the molecules in a solid?

A Molecules vibrate about fixed positions within an orderly arrangement.
B Molecules vibrate about fixed positions within a random arrangement.
C Molecules move randomly within an ordered arrangement.
D Molecules move randomly within a random arrangement.

23 A match would ignite if it was held 10 cm above a bunsen flame but would not ignite if held 10 cm to one side of the flame. This is because there is more heat energy transferred by _____.

A conduction
B convection
C diffusion
D radiation

24 The diagram below shows a glass tube with two thermometers inserted at X and Y. The air in the glass tube has an initial temperature of 25 °C. The glass tube is then heated for one minute.



Which of the following shows the most likely temperatures recorded by thermometers X and Y?

	temperature at X / °C	temperature at Y / °C
A	25	25
B	25	45
C	45	35
D	45	45

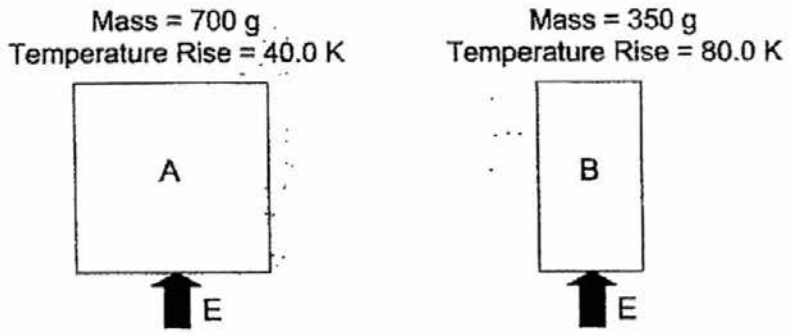
84

Downloaded from SingaKids.com

25 In which of the following is most of the heat transferred by conduction?

A keeping warm beside a fire place
B boiling of water in a kettle
C frying of an egg on a metal pan
D heating of food in a microwave oven

26 Two blocks of copper, A and B, each receives the same amount of energy E. The mass of A is twice the mass of B. The temperature rise of A is half the temperature rise of B.



Which statement about A and B is incorrect?

A The specific heat capacity of A is the same as the specific heat capacity of B.
B The heat capacity of A is the same as the heat capacity of B.
C Both A and B have the same specific latent heat of fusion.
D The heat capacity of A is twice the heat capacity of B.

27 An ice cube at a temperature of 0 °C is put into a drink at a temperature of 10 °C. After a short time during cooling, some of the ice has melted and the drink has cooled to a temperature 8 °C.

What is the temperature of the remaining ice?

A 0 °C B 2 °C C 4 °C D 8 °C

Downloaded from SingaKids.com

28 A small amount of alcohol and water are at the same temperature. Which of the following statement best explains why the alcohol feels cooler when placed on the hand as compared to water?

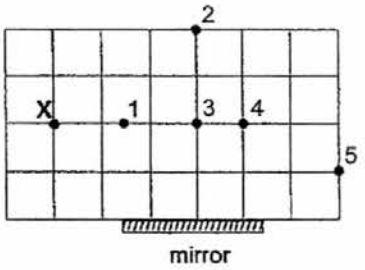
A Alcohol has a lower boiling point than water.

B Alcohol is a better conductor of heat compared to water.

C Alcohol has a higher specific latent heat of vaporisation than water.

D Alcohol evaporates more readily than water.

29 A student stands at point X as shown in the diagram below.



Which of the pins, 1, 2, 3, 4 or 5, will he be able to see in the mirror?

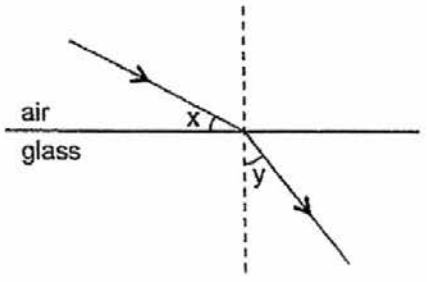
A pins 1, 2 and 3

B pins 2, 3 and 4

C pins 3, 4 and 5

D pins 2, 3, 4 and 5

30 A ray of light passes through from air to glass as shown in the following diagram below (which is not to scale).



Given that x = 20° and y = 40°, what is the refractive index of the glass?

A 0.53 **B** 1.46 **C** 1.53 **D** 1.87

End of paper

85

Downloaded from SingaKids.com

Blank page

Downloaded from SingaKids.com

Geylang Methodist School (Secondary)
End-Of-Year Examination 2016

Candidate Name: Solutions

Class: _____ Index Number: _____

PHYSICS **5059/02**

Paper 2 Physics **Sec 3 Express**

Additional materials : Nil **1 hour 30 minutes**

Setter : Mr Sng Peng Hock **12 Oct 2016**

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions. Write your answers in the spaces provided on the question paper.

Section B
Answer **all** questions. Write your answers on the writing papers provided.

At the end of the examination, fasten the writing papers securely with the question paper.

Candidates are reminded that all quantitative answers should include appropriate units. You are advised to show all your working in a clear, orderly manner.

Gravitational field strength is assumed to be 10 N/kg and acceleration due to gravity, *g*, is assumed to be 10 m/s^2, unless otherwise specified.

For Examiner's Use	
Section A	/ 40
Section B	/ 30
Total	/ 70

This document consists of **11** printed pages and **1** blank page.

[Turn over

86

Downloaded from SingaKids.com

SECTION A

Answer **ALL** questions in this section in the spaces provided.

1 A 5 kg parcel is dropped off vertically from a helicopter 600 m above the ground at time t = 0 s. After some time falling through the air, its parachute is deployed by remote control. The speed-time graph for the first 25 seconds of its journey through the air is shown in Fig. 1.1 below.

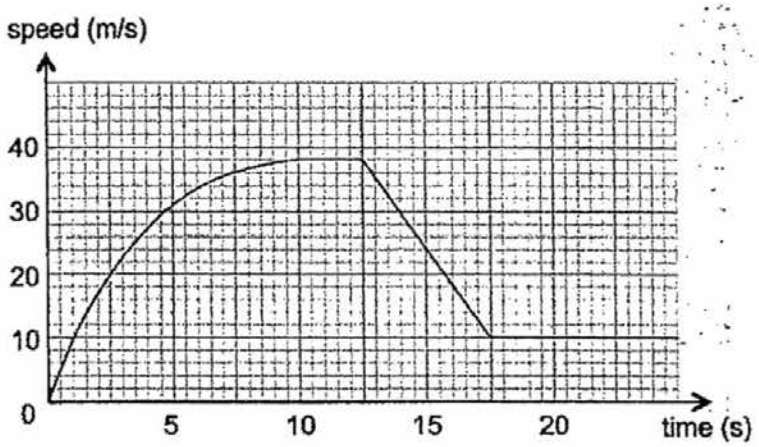


Fig. 1.1

(a) Is the object free-falling at any point during the first 25 seconds?

Explain your answer clearly with reference to Fig. 1.1 above.

No. Free falling means the only force acting on the object is its own weight. [1] The graph will show a positive constant acceleration. [1] The graph does not show any positive constant acceleration throughout the 25 s. [1]

(b) State the time at which the object first achieves terminal velocity.

At 10 s. [1]

(c) Explain, in terms of forces, how the object achieves the first terminal velocity.

As the object starts falling, it accelerates due to the gravitational force. [1] As its speed increases, air resistance acting on it in the opposite direction starts to increase. [1] When the air resistance equals the its weight in magnitude, there is zero resultant force and it falls with constant velocity. [1]

Downloaded from SingaKids.com

(d) Explain, in terms of forces, why the object experiences deceleration at time 12.5 s.

At 12.5 s, the parachute is deployed. [1] The increase in surface area causes the air resistance to increase and exceeds the object's weight. [1] This gives a resultant force in the upward direction, causing the object to decelerate. [1]

2 Fig. 2.1 shows a cube with sides 8 cm, made of substance X. Substance X has a density of 12.5 g/cm^3.

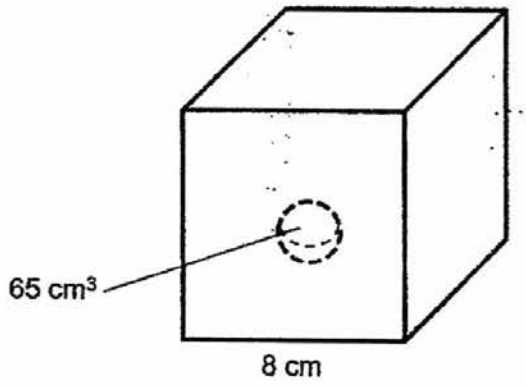


Fig. 2.1

The cube has a hollow spherical centre with a volume of 65 cm^3.

(a) Find the mass of the cube with the hollow spherical centre.

vol = 8 x 8 x 8 – 65 cm^3 = 447 cm^3 [1]

mass = 447 x 12.5 g = 5587.5 g [1]

mass = _____

Downloaded from SingaKids.com

(b) The hollow spherical centre is then filled with substance Y, which has a density 5 g/cm^3.

Calculate the average density of the block with the substance Y filled in the centre.

mass of substance Y = 65 x 5 g = 325 g [1]
total mass = 5587.5 + 325 g = 5912.5 g [1]
average density = 5912.5 / 512 g/cm^3 = 11.5 g/cm^3 [1]

density = _____

3 Fig. 3.1 shows a student, of weight *W* N, standing 0.30 m from end A of a uniform plank AB.

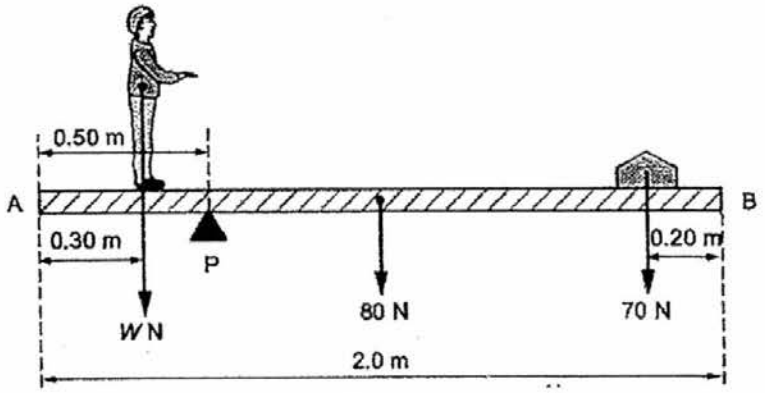


Fig. 3.1

The plank has a weight of 80 N and length 2.0 m. A pivot P supports the plank and is 0.50 m from end A. A weight of 70 N is moved to balance the weight of the student. The plank is in equilibrium when the 70 N weight is 0.20 m from end B.

Calculate the weight of the student.
Since the plank is in equilibrium, sum of clockwise moments is equal to sum of anti-clockwise moments about pivot P. [1]

80 x 0.5 + 70 x 1.3 = W x 0.2 [1]

W = 665 N [1]

weight = _____

Downloaded from SingaKids.com

4 Fig. 4.1 shows a conveyor belt moving boxes, each of weight 80 N. A motor is used to keep the conveyor belt moving continuously.

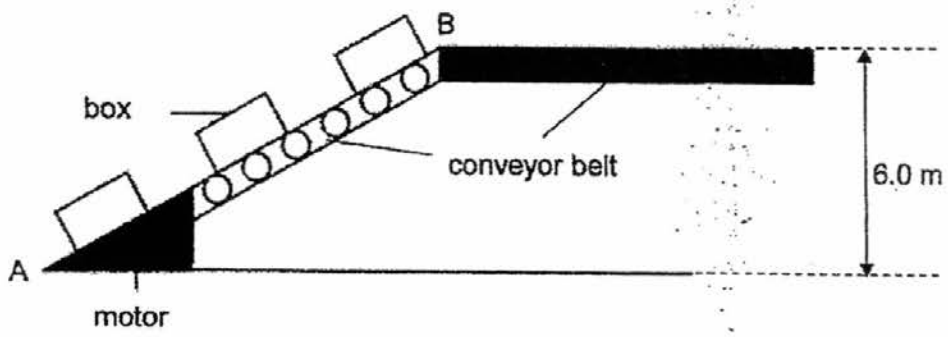


Fig. 4.1

(a) Calculate the increase in gravitational potential energy of a box when it moves from position A to position B.

gain in GPE = 80 x 6 J [1]
= 480 J [1]

gain in GPE = _____

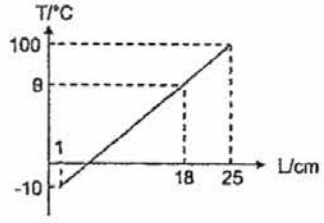
(b) The conveyor belt is able to move 4 boxes from position A to B in 1.0 minute. Determine the power output of the motor.

power = work done / time
= (480 x 4) / (1 x 60) W [1]
= 32 W [1]

power = _____

5 The stem of a thermometer is graduated in centimetres. It registers 1 cm when the bulb is -10 °C and 25 cm when the bulb is in steam at atmospheric pressure.

What is the temperature in °C when the thermometer registers 18 cm?



[100 – (-10)] / (25 – 1) = (100 - θ) / (25 – 18) [1]

θ = 67.9 °C [1]

temperature = _____

88

Downloaded from SingaKids.com

6 Fig. 6.1 below shows the arrangement of particles of a particular substance as it is cooled.

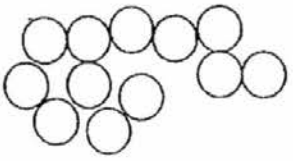
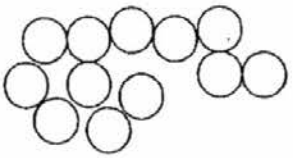
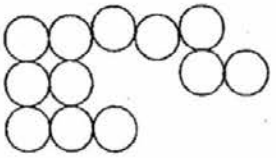
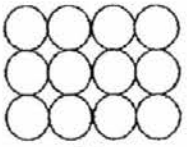
time elapsed / min	arrangement of particles	temperature / °C	state(s) of substance
0		50	All liquid
5		10	All Liquid [1]
10		10	Liquid & Solid [1]
15	 [1]	10	All solid

Fig 6.1

(a) Complete the table. [3]

(b) Name the process which is occurring from t = 5 min to t = 15 min.

Solidification [1]

(c) Explain how you arrived at your answer in part (b).

Which component of internal energy has been changing?

The arrangement of the particles is changing from random to orderly. [1]

Internal potential energy is decreasing. [1]

Downloaded from SingaKids.com

7 Fig. 7.1 shows a method of heating a room using solar energy instead of conventional sources of energy during cold weather in temperate countries. A brick wall with a blackened surface is placed behind a double-glazed window facing the Sun. During the day, the wall stores energy received from the Sun as thermal energy. At night, the heat from the blackened surface is transferred to the air next to it.

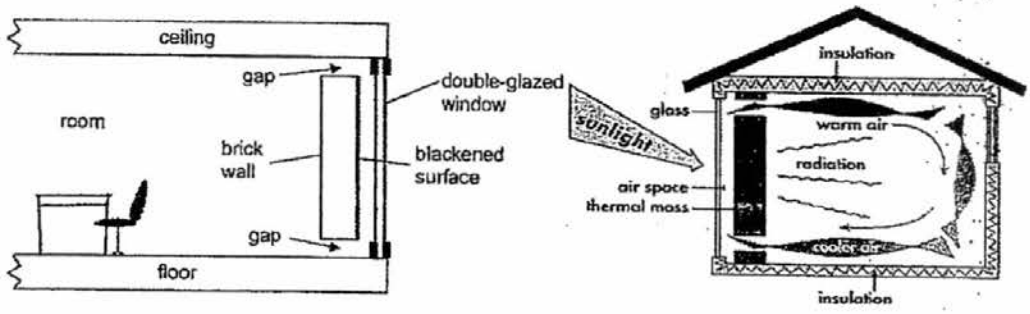


Fig 7.1

(a) Explain how the blackened surface helps to heat up the room during the night.

Black surfaces are good emitter of radiant heat. [1]

At night it will radiate heat to the room more efficiently. [1]

(b) Describe how the heated air next to the wall is transferred throughout the room during the night.

The heated air being less dense will rise and move through the top gap into the room. [1] Cooler air in the room being denser will sink and move through the bottom gap into area next to wall. [1] This sets up a convection current.

(c) The double-glazed window consists of two sheets of glass which traps a layer of air between them.

Explain how the double-glazed window helps to reduce heat loss in the room during the night.

Air between the two sheets of glass is a poor conductor of heat. [1]

This help to reduce heat loss from the room to surrounding by conduction. [1]

89

Downloaded from SingaKids.com

8 The diagram below shows a large rectangular tank containing a transparent liquid. A plane mirror is placed along the bottom of the tank. A ray of light is incident on the surface of the liquid at an angle of 35° as shown below.

[1] correct angles, [1] correct arrows

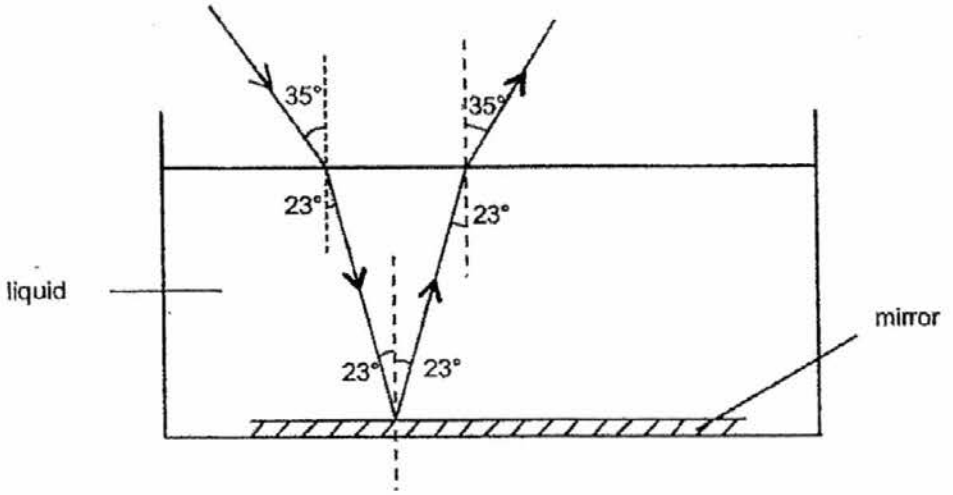


Fig 8.1

(a) If the refractive index of the liquid is 1.47, calculate the angle of refraction as the light ray enters the transparent liquid.

sini / sinr = 1.47 [1]

$r = \sin^{-1}(\sin i / 1.47) = 23.0°$ [1]

angle of reflection = _____

(b) Complete the diagram above to show the path of the ray of light until it emerges from the surface. Indicate all the angles with their respective normals. (You need not measure the angles to scale). [2]

End of Section A

Downloaded from SingaKids.com

SECTION B

Answer **all** the questions in this section
Write your answers on the writing papers provided.

9 Fig. 9.1 shows a helicopter with a mass of 1000 kg. The rotation of the blades can produce a maximum upward force of 18 kN.

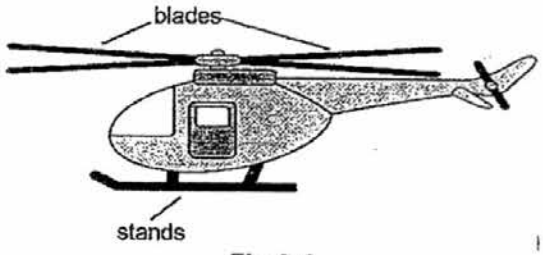


Fig 9.1

(a) The helicopter is stationary with its stands resting on the ground. The weight of the helicopter is one of the two forces that form an action-reaction pair of forces.
Describe the other force of this action-reaction pair.
The other force is the attractive force[1] the helicopter exerts on the Earth. [1]

(b) Explain using Newton's third Law, how the helicopter produces an upward force.
The blades pushes air down, and based on Newton's third Law, the air will exert an equal force on the blades upwards. [1] This force gives the helicopter an upward force since the blades are attached to the helicopter. [1]

(c) The pilot flying the helicopter has a mass of 80 kg.

(i) What is the minimum upward force the helicopter must produce in order to lift off?
force = 1080 X 10 = 10800 N [1]

(ii) What is the highest possible upward acceleration using the maximum upward force?
F_{net} = 18000 – 10800 = 7200 N [1]
a = 7200 / 1080 = 6.67 m/s^2 [1]

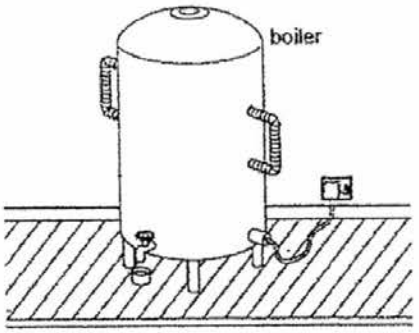
(d) After applying the maximum upward force for 10 s, the helicopter is in the air. The pilot then decides to hover the helicopter at a fixed height.

Using Newton's first Law, explain how this can be achieved.
Based on Newton's first Law, there should be no resultant vertical force acting on the helicopter in order for it to stay at a fixed height. [1] The pilot need to reduce the upward force [1] until the upward force balances the weight / is 10800N. [1]

90

Downloaded from SingaKids.com

10 Fig.10.1 below shows an electric boiler in a kitchen.



The boiler contains 35 kg of water at 28 °C.
The specific heat capacity of water is 4200 J/(kg °C).
The specific latent heat of vaporization of water is 2.26 MJ/kg.

(a) Calculate the thermal energy needed to raise the temperature of the water from 28 °C to its boiling point.

$Q = mc\Delta\theta = 35 \times 4200 \times (100 - 28)$ [1]
$= 10584000$ J [1]

(b) The water in the boiler is heated by a 7200 W immersion heater.

Calculate the minimum time required for the heater to bring the water to its boiling point.

time = 1058400 / 7200 [1]
= 1470 s = 24.5 min [1]

(c) Suggest one reason why the actual time is greater than the minimum time calculated in **(b)**.

Heat is lost to the surrounding. [1]

(d) Due to a fault in the thermostat setting, the heater is not deactivated when the water reaches its boiling point and steam is produced.
Calculate the mass of the water left in the boiler 5 minutes after steam is first produced.

$Q = 5 \times 60 \times 7200 = 2160000$ J [1]
$m = Q / l_v = 2160000 / 2.26 \times 10^6$ [1]
$= 0.956$ kg [1]
mass of water left = 35 – 0.956 = 34.0 kg (3sf) [1]

(e) Suggest a mechanical safety feature that would prevent any danger created by the fault in **(d)**.

A release valve is needed to prevent pressure build up in the boiler when steam is produced. [1]

Downloaded from SingaKids.com

11 A light ray is incident upon a triangular glass block with a speed of 3 x 10^8 m/s as shown in the Fig 11.1 below (not to scale). It was found that the speed of light in the glass block is two-third that of the speed of light in air.

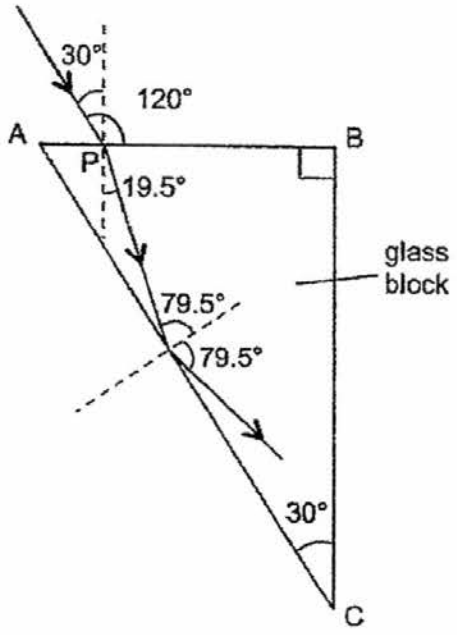


Fig 11.1

[1] each arrow [1] for correct angles

(a) Explain what will happen to the light ray as it enters the glass block.
Refraction will take place and the light ray will bend towards the normal. [1]
This happens because the speed of light in the glass block is lower than that in air. [1]

(b) Determine the refractive index, n, of the glass block. Hence, find the angle of refraction of the light ray after passing through point P.
speed of light in the glass block is 2/3 of c,
using n = c / v [1]
n = 1.5 [1]
n = sini / sinr
1.5 = sin30 / sinr [1]
r = $\sin^{-1}$ (sin30 / 1.5) = 19.5° [1]

(c) Calculate the critical angle of the glass block.
n = 1 / (sinc)
c = $\sin^{-1}$ (1/1.5) = 41.8° [1]

(d) Complete the path of the light ray from point P in Fig 11.1 and show what happens on the side AC. Indicate all angles and normal clearly. [3]

END OF PAPER

9

Downloaded from SingaKids.com

BLANK PAGE

Downloaded from SingaKids.com