KUO CHUAN PRESBYTERIAN SECONDARY SCHOOL

2016 END OF YEAR EXAMINATION

Secondary 3 Express

NAME

CLASS **REG. NO**

Physics (SPA)

10 October 2016

2 Hours

Additional Materials: Multiple Choice Answer Sheet

Setter: Mr Yap Shinn

READ THESE INSTRUCTIONS FIRST

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

Section A
Answer all questions.
Write in soft pencil.
Do not use staples, paper clips, highlighters and glue or correction fluid.
Write your class, name and index number on the Multiple Choice Answer Sheet in the spaces provided.

There are **thirty** questions in Section **A**. For each question, there are four possible answers, **A**, **B**, **C** and **D**. Choose the one you consider correct and record your choice in **soft** pencil on the separate Multiple Choice Answer Sheet.

Section B
Answer all questions.
Write your class, name and index number on the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagram, graphs or rough working.
Write your answers in the spaces provided in the Question Paper.

Section C
Answer all questions. Question **10** has a choice of parts to answer.
Write your answers in the spaces provided in the Question Paper.

For sections **A**, **B** and **C**, please assume acceleration of free fall as 10 ms^{-2}

The number of marks is given in brackets [ ] at the end of each question or part question.
Candidates are reminded that all quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner.
You are allowed to use calculators.

....
Parent's signature/ Date

FOR EXAMINER"S USE	
Section **A**	/ 30
Section **B**	/ 40
Section **C**	/ 30
Total	

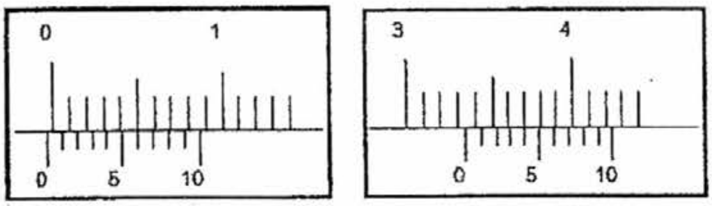
This document consists of **31** printed pages including the cover page.

109

[Turn over

Section A (30 marks)

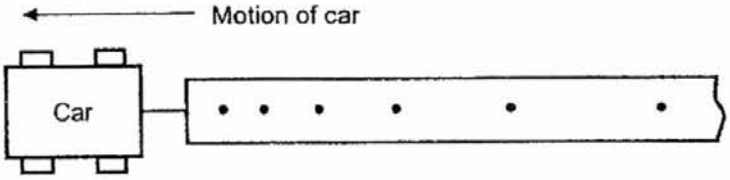
1 The diagram on the left shows the reading on the vernier caliper when the jaws are closed. The diagram on the right shows the reading on the vernier caliper when a piece of nail was placed between the jaws.



What is the length of the nail?

A 3.28 cm
B 3.30 cm
C 3.38 cm
D 3.40 cm

2 A ticker tape timer is used to investigate the speed of a toy car. The ticker tape obtained is shown below.



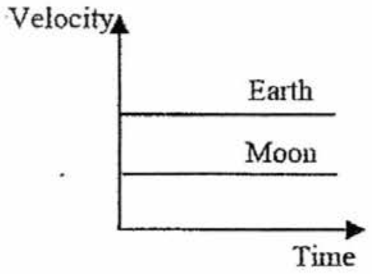
The speed of the remote control car is __________.

A increasing with increasing acceleration
B increasing with decreasing acceleration
C decreasing with increasing deceleration
D decreasing with decreasing deceleration

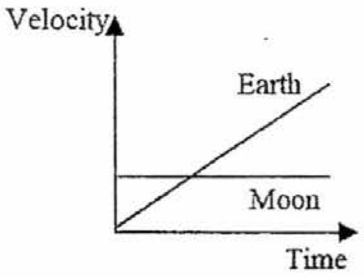
3 When a rock is dropped on Earth, it accelerates at about 10 ms^{-2}. However, when a rock is dropped on the moon, it only accelerates at 1/6 of the acceleration on Earth.

Which diagram shows the velocity-time graph when rocks of the same mass are dropped on Earth and on the moon?

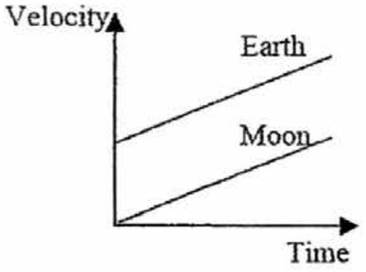
A



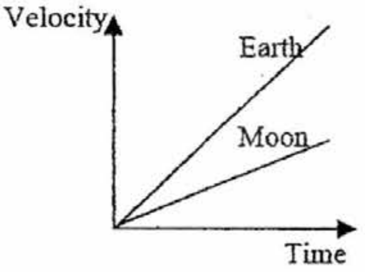
B



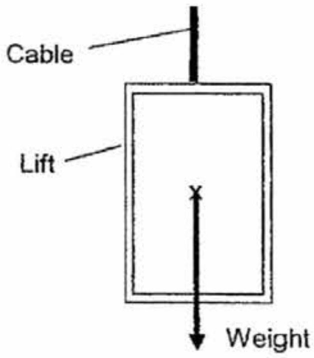
C



D



4 The diagram shows an empty lift with mass 400 kg being pulled up by a cable. It is travelling upwards with constant speed.



What is the resultant force acting on the lift?

A 0 N

B 400 N

C 4000 N

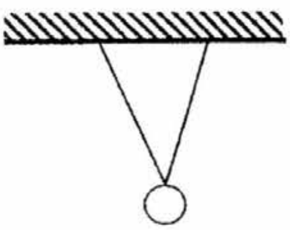
D 8000 N

5 Which of the following statements **does not** illustrate the effect of inertia?

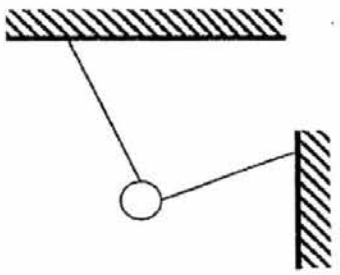
A When a bus accelerates suddenly from rest, a person sitting in the bus tends to jerk backwards.
B If a pile of coins is placed on a table, the bottom one can be flicked away without disturbing the others.
C It is easier to slide a heavy box up an incline to a certain height than to lift it vertically to the same height.
D It is difficult to stop a shopping trolley full of things when it is moving.

6 A small ball is suspended by two strings. Which of the following arrangements is **impossible?**

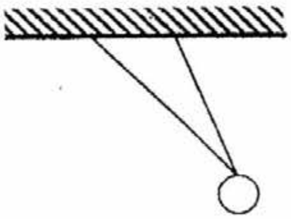
A



B



C



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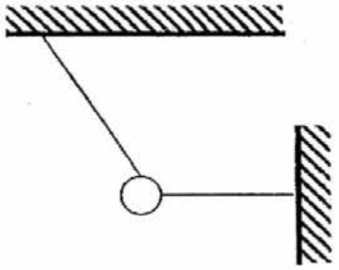


7 Which of the following statements about weight and mass is correct?

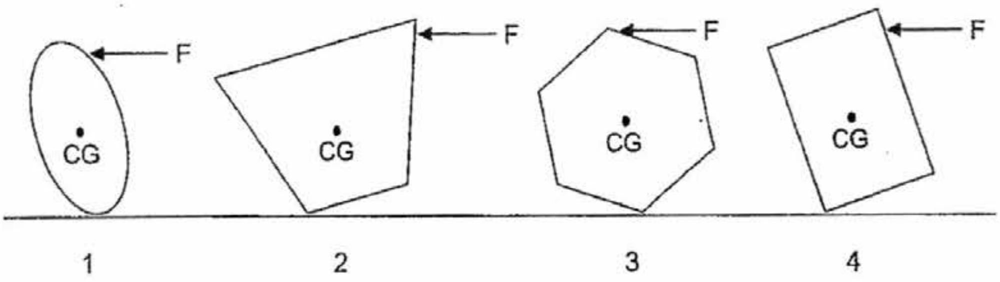
1 In a gravitational field, the weight on object is directly proportional to its mass.
2 Mass is measured in kilograms and weight in newtons.
3 Both mass and weight do not change with location.

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

8 When object A of mass 5 g is immersed in a measuring cylinder filled with water, it displaces half the volume of water as object B of 10 g. What can be deduced about the densities of A and B?

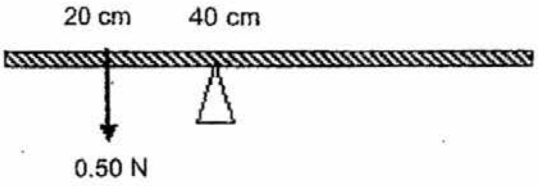
A A and B have the same density.
B Density of A is ¼ times the density of B.
C Density of A is ½ times the density of B.
D Density of A is 2 times the density of B.

9 The objects are displaced slightly to the left with a force F as shown below. Which of the following object(s) display(s) stable equilibrium when F is removed?



A 1 and 2 **B** 3 and 4
C 1 and 3 **D** 2 and 4

10 The diagram shows a uniform metre rule supported at the 40 cm mark. When a downward force of 0.50 N is applied at the 20 cm mark, the metre rule is balanced.



Determine the weight of the metre rule.

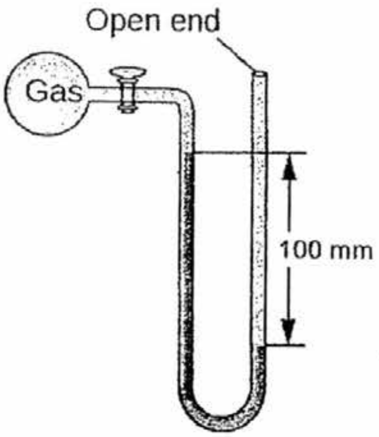
A 0.20 N **B** 0.25 N
C 0.50 N **D** 1.0 N

11 Which of the following would affect the pressure acting on a submerged submarine?

1 The depth at which the submarine is
2 The density of the seawater
3 The surface area of the submarine
4 The weight of the submarine

A 1 and 2 **B** 3 and 4
C 1, 2 and 3 **D** All of the above

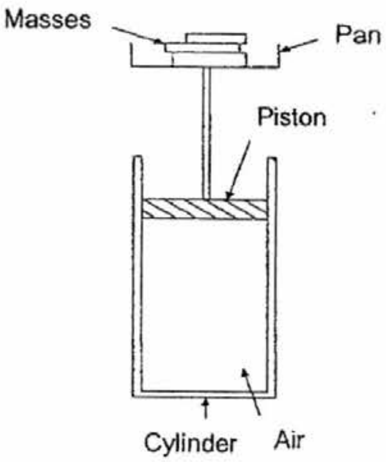
12 The diagram below shows a simple manometer that is filled with mercury.



Which of the following statements is correct?

A The pressure of the gas cylinder is 100 mmHg higher than atmospheric pressure.
B The 100 mm difference in the mercury height between the right and left arm does not change when a manometer with bigger diameter is used.
C When the mercury is replaced with a liquid with lower density, the 100 mm difference in the mercury height between the right and left arm decreases.
D When the pressure of the gas cylinder decreases, the 100 mm difference in the mercury height between the right and left arm increases.

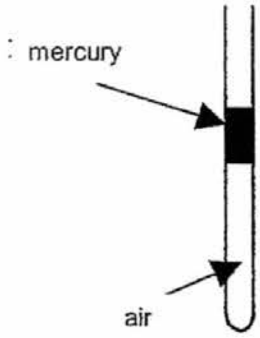
13 A cylinder with a close-fitting piston contains air at 50°C. The piston supports a small pan containing some masses.



What happens when the temperature of the air in the piston is heated to 60°C?

A The piston moves downwards as the air pressure in the cylinder decreases.
B The piston does not move as the air pressure in the cylinder remains the same.
C Masses has to be added into the small pan to keep the air pressure in the cylinder constant.
D Masses has to be added into the small pan to keep the volume of the air in the cylinder constant.

14 A small amount of mercury traps some air in a long glass tube which is sealed at one end.



When the tube is rotated slowly to a horizontal position,

A the air column increases in length because its pressure decreases.
B the air column decreases in length because its pressure increases.
C the length of the air column does not change because its pressure remains the same.
D the mercury flows out of the tube when the tube is in the horizontal position.

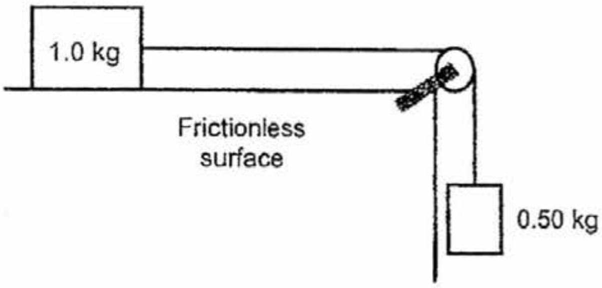
15 Which of the following is equivalent to the unit of power?

A J s **B** N m
C kg m^2 s^{-2} **D** kg m^2 s^{-3}

16 A ball being thrown vertically upwards reaches a height of 2.0 m. How high will the same ball reach if it is thrown with twice the initial velocity?

A 1.0 m **B** 2.0 m
C 4.0 m **D** 8.0 m

17 The diagram shows a trolley being pulled from rest along a frictionless horizontal table by a falling mass. The trolley's mass is 1.0 kg and the falling mass is 0.50 kg.



What is the maximum amount of kinetic energy of the trolley after the falling mass falls through a height of 0.5 m?

A 1.7 J **B** 2.5 J
C 5.0 J **D** 7.5 J

18 In the Brownian motion experiment, which statement best states what happens when the smoke specimen is being heated?

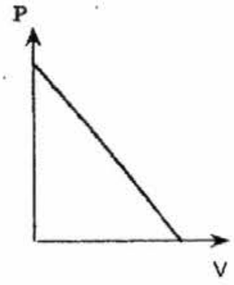
- **A** The smoke particles expand in size.
- **B** The smoke particles move more vigorously because the air particles bombard the smoke particles more rapidly.
- **C** The smoke particles move more vigorously because the smoke particles gain kinetic energy with the increase in temperature.
- **D** No observable difference in the motion of the smoke particles.

19 A gas is heated in sealed container. Which of the following does not increase?

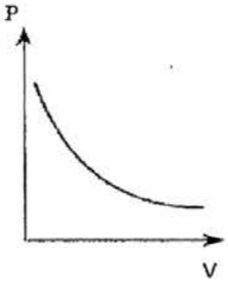
- **A** Frequency of collisions
- **B** Intermolecular distance between the particles
- **C** Average force of collisions between particles and walls of container
- **D** Average kinetic energy of particles

20 In an experiment to investigate the relationship between the volume V of a fixed mass of gas and the pressure P, a graph of P against V is plotted.

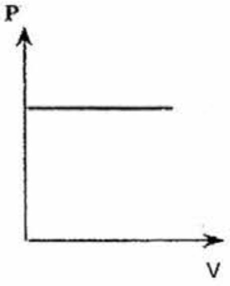
Which of the following graphs shows the correct relationship at constant temperature?



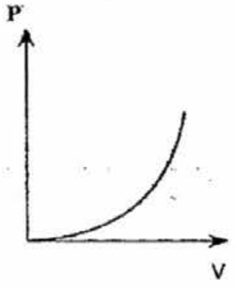
A



B

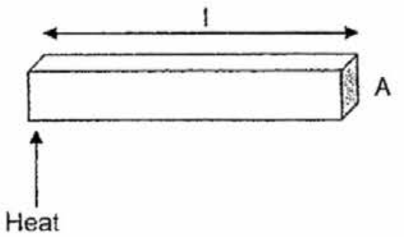


C



D

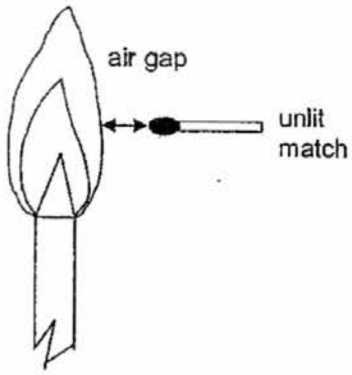
21 A metal bar with the following dimensions is heated.



Which of the following quantities does not change?

- **A** Internal energy
- **B** Heat capacity
- **C** Length, l
- **D** Cross sectional area, A

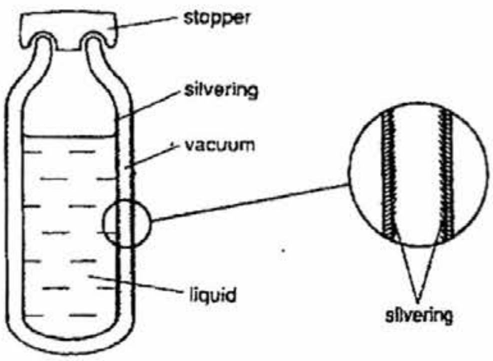
22 The diagram below shows an unlit match held near to a steady Bunsen flame.



The match does not light up because

A the flame is not hot enough.
B the match head is a poor absorber of radiation.
C the flame does not radiate thermal energy sideways.
D air is a poor conductor of thermal energy.

23 The diagram shows the features of a vacuum flask that can help to keep the liquid inside hot for a longer period of time.



Which of the above feature(s) is/are able to prevent heat loss by conduction and convection?

A Silvering
B Vacuum
C Stopper
D All of the above

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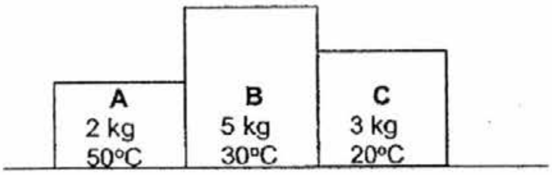
24 An uncalibrated thermometer placed alongside a ruler has the ice and steam points at the 6 mm and 206 mm marks respectively. When the mercury level in the thermometer reaches the 100 mm mark on the scale, the temperature is

A 40°C **B** 47°C
C 50°C **D** 100°C

25 Three objects, A, B and C, with different masses and temperatures are placed beside each other as shown.



A There is no net flow of thermal energy.
B There is a net flow of thermal energy from A to B to C.
C There is a net flow of thermal energy from B to A and C.
D There is a net flow of thermal energy from C to B to A.

26 Heat capacity and specific heat capacity have different definitions. Which statement best describes the difference?

A Heat capacity depends on mass but not specific heat capacity.
B Heat capacity depends on the change in temperature but not specific heat capacity.
C Specific heat capacity depends on mass but not heat capacity.
D Specific heat capacity depends on the change in temperature but not heat capacity.

27 Water is used in a heat exchanger to cool the nuclear reactor in a nuclear power station. It enters the heat exchanger at 4 °C and leaves at 15 °C. Given that the specific heat capacity of water is 4200 J/(kg°C) and the rate at which thermal energy is removed is 1.2×10^8 J per second, find the rate of water flow in the heat exchanger.

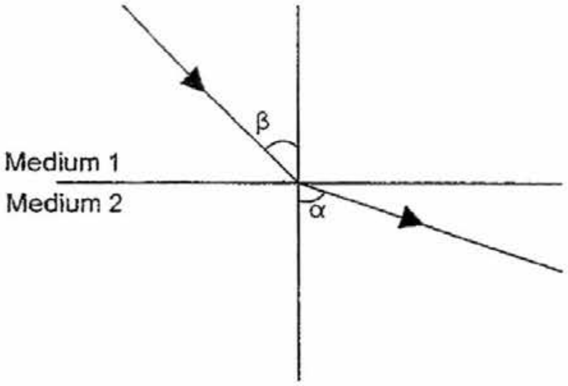
A $\frac{1.2\times10^8}{4200\times11}$ kg/s

B $\frac{1.2\times10^8\times11}{4200}$ kg/s

C $\frac{4200\times11}{1.2\times10^8}$ kg/s

D $\frac{4200}{1.2\times10^8\times11}$ kg/s

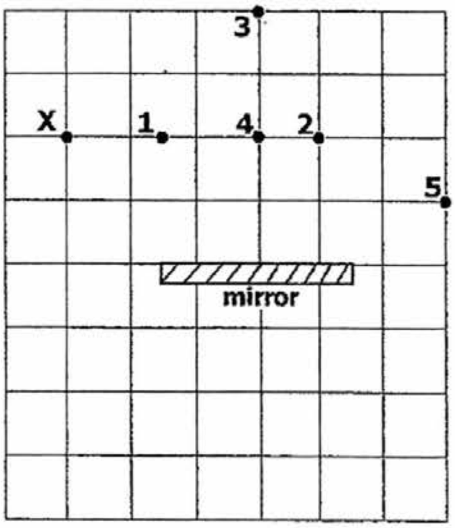
28 The diagram shows a ray of light moving from medium 1 to medium 2.



If the two media are glass and air, which of the following is correct?

	Medium 1	**Medium 2**	**Refractive Index of Glass**
A	Air	Glass	$\frac{\sin\alpha}{\sin\beta}$
B	Glass	Air	$\frac{\sin\alpha}{\sin\beta}$
C	Air	Glass	$\frac{\sin\beta}{\sin\alpha}$
D	Glass	Air	$\frac{\sin\beta}{\sin\alpha}$

29 A person stands at point X as shown in the diagram. There are 5 objects placed at various positions.



Which objects will the person be able to see in the mirror from point X?

A 1 and 4
B 2, 3 and 4
C 2, 4 and 5
D 1, 2 and 4

14

30 When an object is placed at O, an image is formed at I. Where should the object be placed such that the image is formed at P?

Section B (40 marks)

1 In Euro Cup 2016, Cristiano Ronaldo of Portugal tries to score a goal while the defender from the other team tries to stop him from scoring. The defender kicks the ball with a force of 100 N due south west at the same time as Ronaldo kicks the ball with a force of 160 N due North as shown in Fig. 1.1

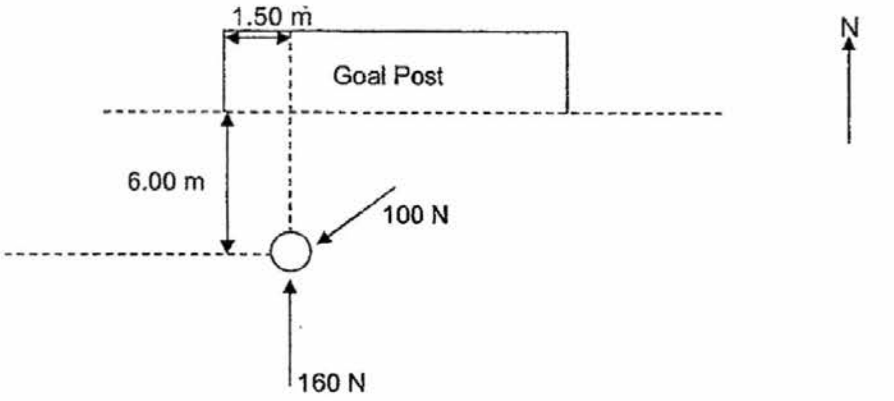


Fig. 1.1

(a) By means of a scaled diagram, find the resultant force on the ball.

Resultant Force = ... [3]

115

(b) Hence, determine if the ball is able to enter the goal post.

[2]

2 A skateboarder is travelling along a level road. It then moves up and down a hill. The v-t graph of the skateboarder is shown in Fig. 2.1

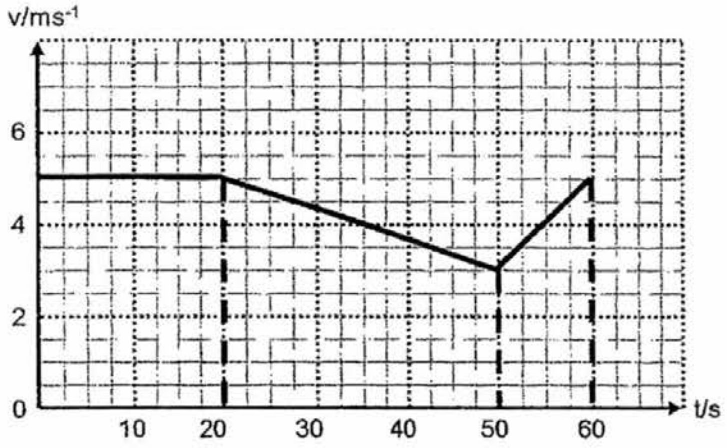


Fig. 2.1

(a) Find the deceleration of the skateboarder as he moves up the hill.

Deceleration = ... [2]

(b) Describe the motion of the skateboarder during the whole journey.

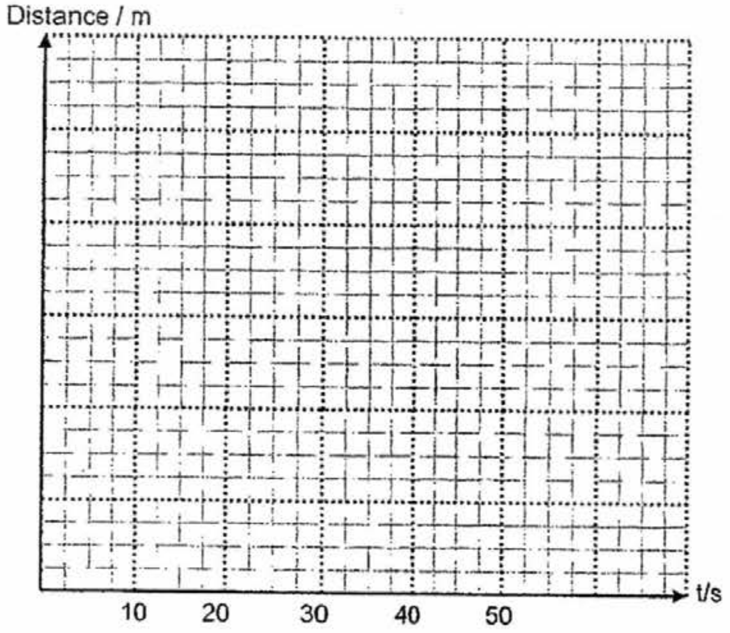
....

....

....

.... [3]

(c) In Fig. 2.2, sketch the distance – time graph of the skateboarder from t = 0 s to 50 s.



[2]

Fig. 2.2

3 An astronaut wants to determine the density of a piece of rock he has found on the moon. This piece of rock has an irregular shape.

(a) He uses a beam balance on the moon to measure the mass of the rock. The mass of the rock is 440 g. Explain whether the measurement of mass will be different if he uses the beam balance on Earth.

....

....

....

....

[2]

(b) He then uses the water displacement method to measure the volume of the rock as shown in Fig. 3.1

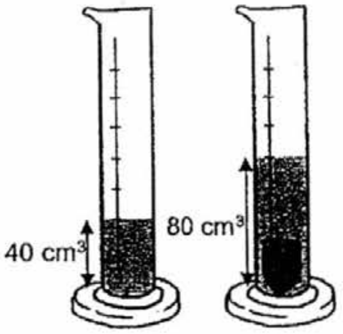


Fig. 3.1

Determine the density of the rock in SI units.

Density = ... [2]

(c) When the rock is brought to the laboratory, the density determined is lower than what is calculated in (b). Suggest a reason why is this so.

....

....

.... [1]

4 A uniform rule of length 1.0 m and mass 0.080 kg hangs freely from a pivot at one end. It is pulled aside by a horizontal force **F** so that the centre of the ruler is at a horizontal distance of 0.40 m and a vertical distance of 0.30 m from the pivot. The ruler is at equilibrium as shown in Fig. 4.1.

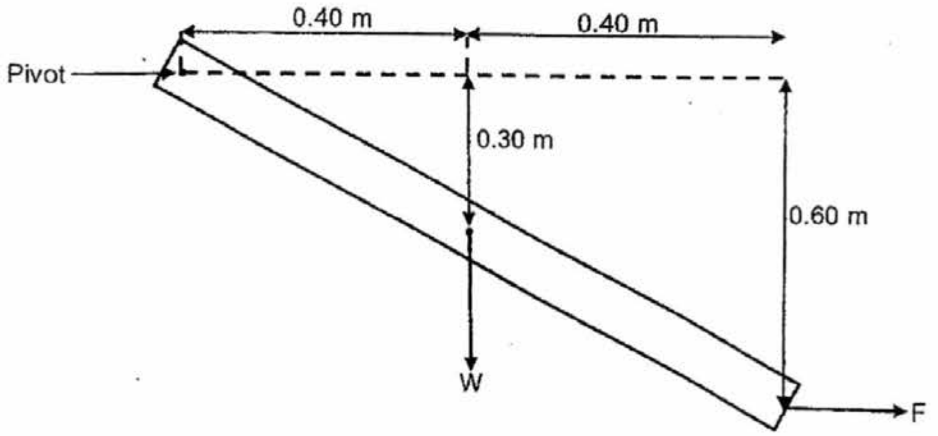


Fig. 4.1

(a) Calculate the moment due the weight about the pivot.

Moment = ... [1]

(b) Hence, calculate the force, F.

Force = ... [2]

(c) Why is the reaction force at the pivot not considered in the calculation in (b).

....

....

.... [2]

5 Fig. 5.1 below shows a double walled coffee cup.

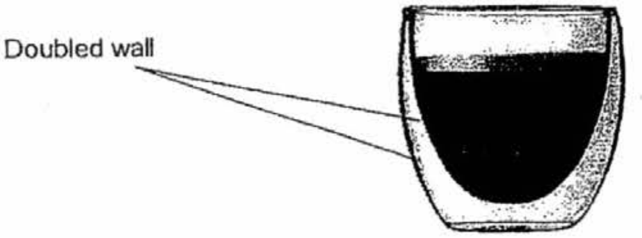


Fig. 5.1

The cup features two walls of glass with air in between.

(a) Explain how the double wall reduces the formation of condensation on the sides of the cup when it is used to contain cold drinks.

....

....

....

.... [2]

(b) **(i)** Peter uses this cup daily for his coffee. He observes that the top of the coffee becomes cold quickly while the bottom is still hot. Explain his observation.

....

....

....

.... [2]

(ii) Suggest and explain what Peter can do to keep the top of his coffee hot for a longer period of time.

....

....

....

....

.... [2]

[Turn over

6 Helium is used to inflate birthday balloons as shown in Fig. 6.1.

Fig. 6.1

(a) Using Kinetic Theory of Matter, explain how the helium exerts a pressure on the walls of the balloon.

....

....

....

....

.... [3]

(b) One of the balloons is placed inside a bell jar. The air inside the bell jar is slowly removed through a vacuum pump.

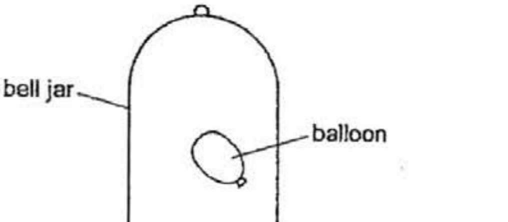


Fig. 6.2

Describe and explain what happens to the balloon as air is removed from the bell jar.

....

....

....

....

.... [3]

11 8

7 The refractive indices of three transparent materials are shown in the Fig. 7.1.

Medium	**Refractive index, n**
Material 1	1.70
Material 2	1.50
Material 3	1.30

Table. 7.1

(a) State and explain which material will light travel the fastest in?

....

....

.... [2]

(b) Blocks made of the three materials are stacked on top on another and a ray of light is shone through them. Sketch the path of light in Fig. 7.2 until it emerges into air again.

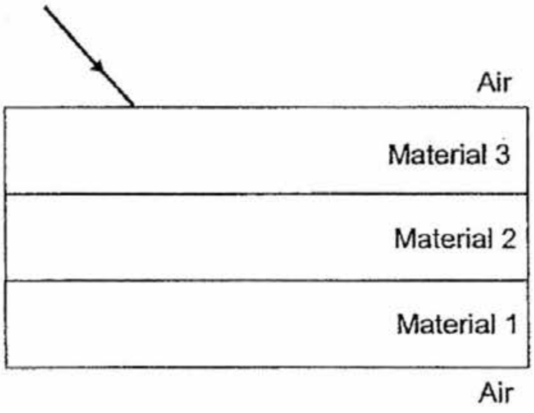


Fig. 7.2 [2]

(c) Other than refraction, another phenomenon may occur at the boundary between Material 1 and air as the ray of light emerges from the block.

Name this phenomenon and calculate the minimum angle of incidence at the boundary between Material 1 and air for this to occur.

Name of phenomenon: ....

Angle of incidence = ... [2]

Section C (30 marks)

Answer **all** questions. Question **10** has a choice of parts to answer.

8 A toy car with a rocket engine moves along a horizontal track as shown in Fig. 8.1.

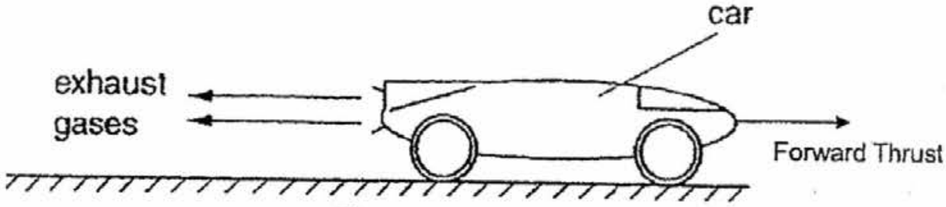


Fig. 8.1

The rocket engine produces a constant forward thrust of 4.6 N. The car loses mass continuously as exhaust gases are produced by the rocket.

The velocity – time graph of the toy car is as shown in Fig. 8.2.

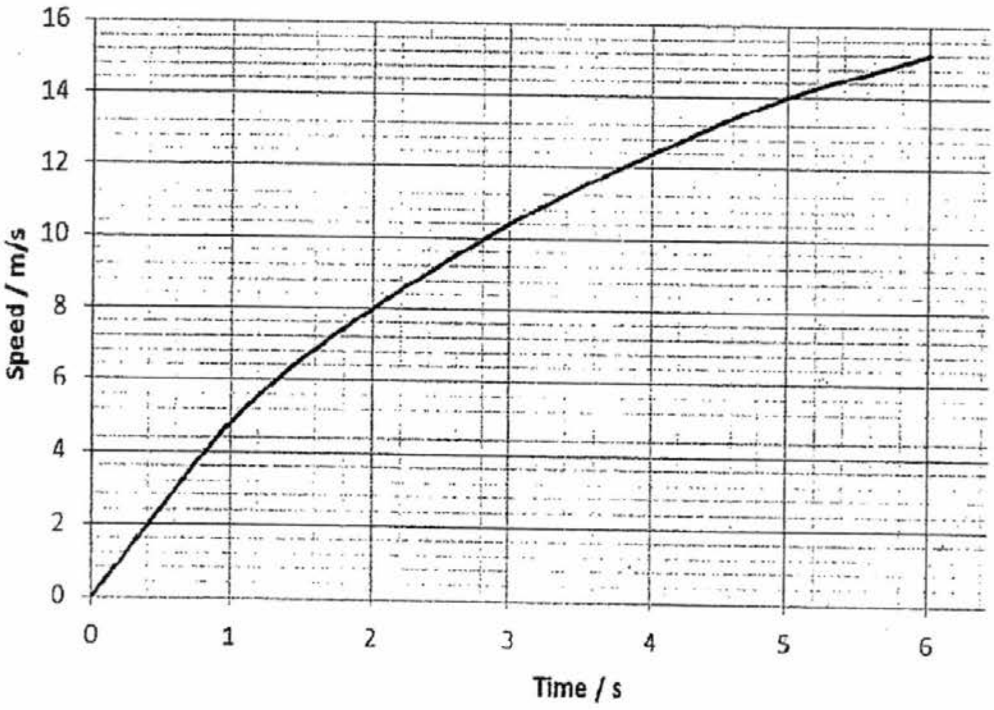


Fig. 8.2

(a) As the fuel in the rocket burns, the car pushes the exhaust gases backwards and the toy car moves forward. Identify the action and reaction pair that pushes the toy car forward.

....

.... [1]

(b) The mass of the car is 450 g.

(i) Using Fig 8.2, determine the acceleration of the car at t = 2.0 s.

Acceleration = ... [2]

(ii) Hence, determine the magnitude of the resistive force acting on the toy car.

Resistive force = ... [2]

(c) Using Fig 8.2, explain the changes to the resistive force acting on the toy car.

....

....

....

....

....

.... [3]

(d) The toy car is re-fuelled and placed on the ground such that it is pointing upwards.

(i) By considering the initial acceleration of the toy car at t = 0 s to be 8.0 m/s^2, calculate the mass of the toy car.

Mass = ... [1]

(ii) Hence, explain if the force produced by the rocket engine of 4.6 N is sufficient to lift the toy car off the ground vertically.

....

....

.... [1]

[2]

9 Fig. 9.1 shows two setups are used to determine the specific latent heat of fusion of ice as shown in Fig. 9.1.

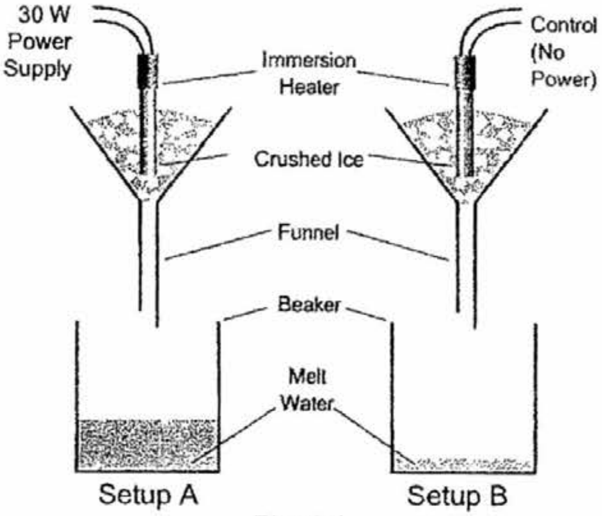


Fig. 9.1

The power supply to Setup A is turned on. After melting occurs at a constant rate for **both setups**, the melted water is collected in the beakers for a period of 10.0 mins. It is said that the ice in Setup A is melted by the heater and the surroundings.

The data shown in Fig. 9.2 are obtained.

	Mass of water / g
Setup A	64.7
Setup B	16.6

Table. 9.2

(a) What is meant by the "specific latent heat of fusion of ice"?

....

....

.... [1]

(b) What is the purpose of measuring the mass of melted water in Setup B?

....

....

.... [1]

(c) **(i)** Calculate the amount of energy supplied by the heater to Setup A.

Energy = ... [1]

(ii) Hence by considering the amount of water that is melted by **the heater only**, calculate the specific latent heat of fusion for ice.

Specific latent heat of fusion = ... [3]

(iii) Suggest and explain how your answer in c(ii) will change if a large block of ice is used instead of crushed ice.

....

....

....

.... [2]

(d) When the temperature of the melting ice in the funnel is monitored, it is observed that the temperature remains at 0°C. Explain why the temperature of the melting ice does not increase even when thermal energy is supplied.

....

....

....

.... [2]

10 either

The figure below provides information about three telescopes used to examine different sources of radiation from space.

Location	Objective Lens Diameter (D)	Source of radiation	Wavelength detected (λ)
Mauna Kea Observatories (Hawaii)	10.0 m	Sirius	500 nm
Mount Graham (Arizona)	8.4 m	Polaris	600 nm
McDonald Observatory (Texas)	9.5 m	Inter-stellar hydrogen	0.21 m

Table. 10.1

(a) In a telescope, there are 2 lenses (objective and eyepiece) as shown in Fig. 10.2.

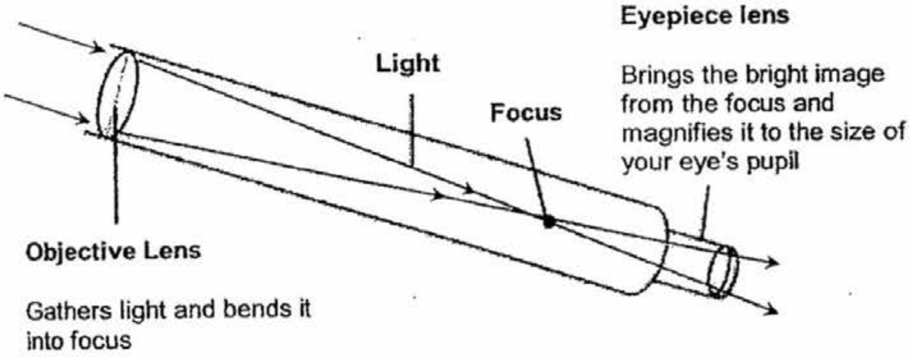
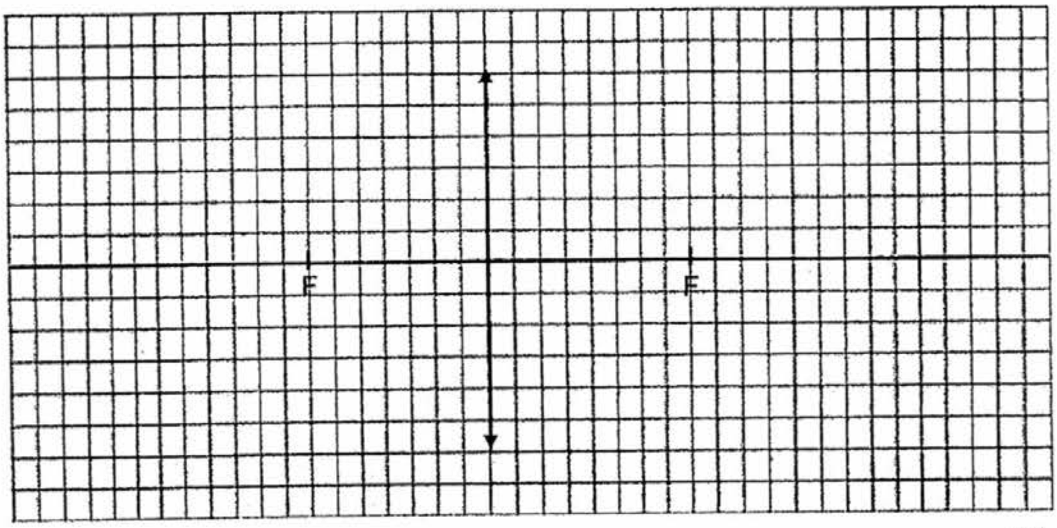


Fig. 10.2

(a) (i) In the space below, complete the ray diagram to show how the objective lens gathers light from the distant object to form an image.



[2]

(ii) How does the ray diagram show that the object is far from the objective lens?

....

.... [1]

(iii) The image formed is said to be **REAL**. Explain what is meant by a real image.

....

.... [1]

(iv) State two other characteristics of the image formed by the objective lens.

....

.... [1]

(b) **(i)** The **smaller** the ratio of the wavelength to the objective lens diameter, the more effective is the telescope in clearly separating the images of distant sources. This ratio is called the resolving power of the telescope.

$$\text{Resolving power} = \frac{\lambda}{D}$$

Using the data from Table. 10.1, show by calculation which telescope has the best resolving power.

Telescope with best resolving power: .... [4]

(ii) A large objective diameter improves the resolving power. By studying the features of the telescope in Fig. 10.2, suggest another reason why telescope should have a large objective diameter.

....

.... [1]

10 or

Fig. 10.3 shows the setup of a reverse bungee jump. A capsule is connected by two identical elastic cords each attached to a tower 30.0 m tall. The mass of the capsule when fully loaded with three passengers has a total mass of about 300 kg. When released, the capsule will shoot up at high speed. As the capsule shoots up, the cords are stretched and unstretched depending on the position of the capsule.

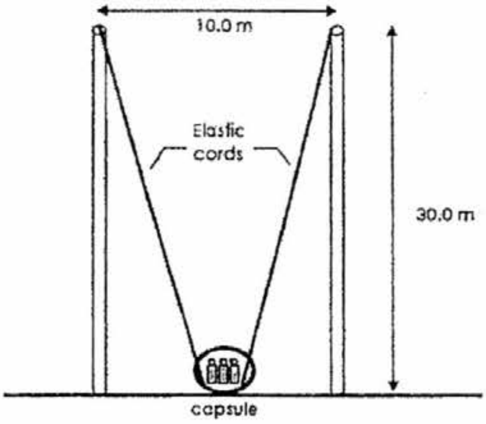


Fig. 10.3

(a) State the principle of conservation of energy.

....

....

....

.... [2]

(b) Describe the energy changes as the capsule moves

(i) from the starting position to the point the cords become unstretched.

....

....

.... [1]

(ii) from the point the cords become unstretched to the highest point of the capsule.

....

....

.... [1]

(c) The elastic potential energy in the elastic cord is 510 kJ when the capsule is on the ground.

(i) When the capsule reaches the highest height, the elastic potential energy in the cords is said to be also at 510 kJ. Comment on the validity of this statement.

....

....

....

.... [2]

(ii) Calculate the gravitational potential energy of the capsule when it is 30 m above the ground.

Gravitational potential energy = ... [1]

(iii) Hence, calculate the speed of the capsule 30 m above the ground.

Speed = ... [3]

~ End of Paper ~

KUO CHUAN PRESBYTERIAN SECONDARY SCHOOL

2016 END OF YEAR EXAMINATION

Secondary Express

NAME Marking Scheme

CLASS

REG. NO

Physics

Oct 2016

2 Hours

Additional Materials: Multiple Choice Answer Sheet.

Mr Yap Shinn

READ THESE INSTRUCTIONS FIRST

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

Section A
Answer all questions.
Write in soft pencil.
Do not use staples, paper clips, highlighters and glue or correction fluid.
Write your class, name and index number on the OMR Sheet in the spaces provided.

There are **thirty** questions in Section **A**. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**. choose the one you consider correct and record your choice in **soft** pencil on the separate answer sheet.

Section B
Answer **all** questions.
Write your class, name and index number on the work you hand in.
Write in dark blue pen.
You may use a soft pencil for any diagram, graphs or rough working.
Write your answers in the spaces provided in the Question Paper.

Section C
Answer **all** questions. Question **10** has a choice of parts to answer.
Write your answers in the spaces provided in the Question Paper.

For sections **A**, **B** and **C**, please assume acceleration of free fall as 10 ms^{-2}

The number of marks is given in brackets [ ] at the end of each question or part question.
Candidates are reminded that all quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner.
You are allowed to use calculators.

……………………………
Parent's signature/ Date

FOR EXAMINER"S USE	
Section **A**	
Section **B**	
Section **C**	
Total	

This document consists of 7 printed pages

[Turn over

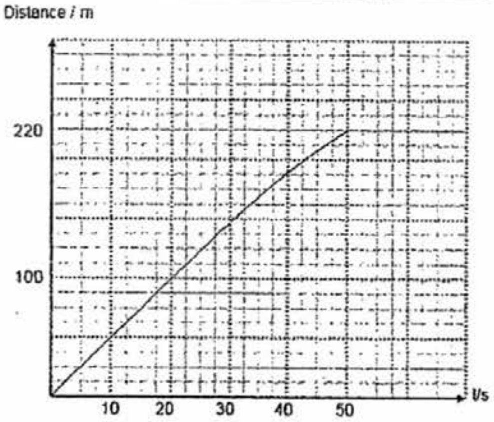
Section A (30 marks)

1	C	2	A	3	D	4	A	5	C
6	C	7	C	8	A	9	D	10	D
11	C	12	B	13	D	14	A	15	D
16	D	17	A	18	B	19	B	20	B
21	B	22	D	23	B	24	B	25	B
26	A	27	A	28	B	29	C	30	D

Section B

1	(a)		 Scale used : 1 cm to 20 N Correct triangle with correct arrow heads directions Resultant Force = 5.7 cm x 20 N = 114 N ± 10%	1 1 1
	(b)		From vector diagram, angle of travel for ball = **39° from vertical** Angle of left corner of goal post from postion of ball = tan $^{-1}$(1.5/6.0) = **14°** Ball will not enter goal post.	1 1
				5

2	(a)		a = (v-u)/t = (3.0 – 5.0)/30 = - 0.067 m/s^2 Deceleration = 0.067 m/s^2	1 1
	(b)		From 0 s to 20 s, speed is constant. From 20 s to 50 s, speed is decreasing at an uniform rate. From 50 s to 60 s, speed is increasing at an uniform rate.	1 1 1

	(c)		 Correct shape – Straight line 0s to 20s; Curve 20s to 50s Values on vertical axis	1 1
				7

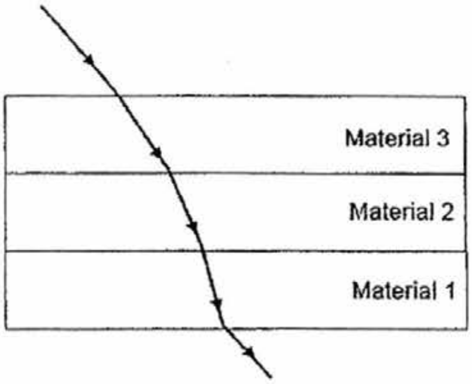
3	(a)		The measurement will be the same. Mass is independent on location. Hence, the measurement of mass will be the same.	1 1
	(b)		Volume = 80 – 40 cm^3 = 40 cm^3 = 40 x 10^{-6} m^3 Density = mass/volume = 0.44 / (40 x 10^{-6}) = 11 000 kg/m^3	1 1
	(c)		When the rock is lowered into the measuring cylinder, some of the water may have splashed on the sides of the measuring cylinder. Hence, the measured volume is lower than actual.	1
				5

4	(a)		Moment = 0.80 x 0.40 = 0.32 Nm	1
	(b)		Taking moments about pivot, ACW = CW F (0.60) = 0.32 F = 0.53 N	1 1
	(c)		The perpendicular distance between line of action of reaction force and pivot is zero. Hence, moments due to reaction force is zero.	1 1
				5

5	(a)		Thermal energy needs to be conducted away from air surrounding cup to cause condensation. Air between walls is a poor conductor of heat. Thermal energy cannot be conducted quickly enough away from air surrounding sides of cup.	1 1
	(b)	(i)	Thermal energy still can be lost quickly from the top of the coffee via radiation and convection	1

			Heat loss via sides of cup is very slow.	1
		(ii)	Cover the top with a cap. This prevents the set up of convection currents so heat loss by convection can be reduced.	1 1
				6

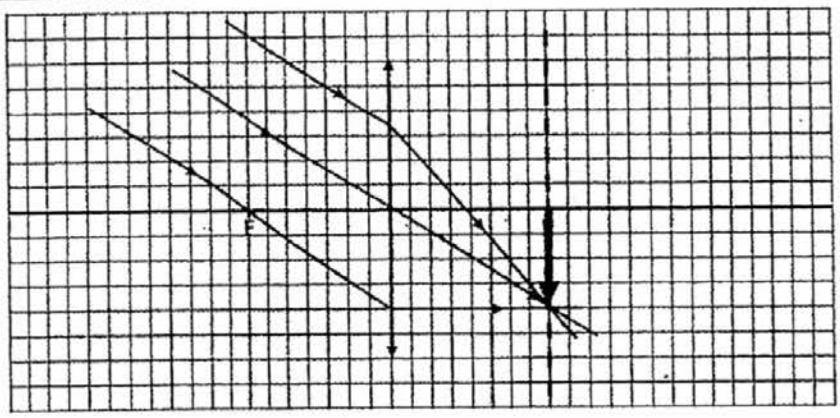
6	(a)		Helium particles are moving randomly and continuously. They collide with the walls of balloon, exerting a force. Average forcer per unit area gives rise to pressure,	1 1 1
	(b)		Pressure of bell jar decreases as air is removed. Since pressure in balloon is higher, volume of balloon increases. Pressure in balloon decreases. As the pressure of bell jar decreases, volume of balloon increases and will burst eventually.	1 1 1
				6

7	(a)		Material 3. It has the lowest optical density as Material 3 has the lowest refractive index so **light will slow down the least when it travels into material 3.** Alternative answer: Since $v = c/n$ and the speed of light in vacuum is constant at 3.0×10^8 m/s, light will travel the fastest in the material with the lowest n.	1 1
	(b)		 Bend towards normal at each boundary Emergent ray parallel to incident ray.	1 1
	(c)	(i)	Total internal reflection $n = 1 / \sin c$ $1.70 = 1 / \sin c$ $c = 36.1°$	1 1
				6

<u>Section C (30 marks)</u>

8	(a)		Force on exhaust gas by car Force on car by exhaust gas	1
	(b)	(i)	Tangent drawn correctly at 2.0 s a = gradient of tangent = 2.68 m/s^2	1 1
		(ii)	Resultant force = 0.450(2.68) = 1.206 N Resultant force = Forward thrust – resistive force 1.206 = 4.6 – Resistive force Resistive force = 3.40 N	1 1
	(c)		Fig 9.2 shows the gradient of graph decreasing. The acceleration of toy car decreases. Resultant force decreases. Resistive force increases since forward thrust is constant.	1 1 1
	(d)	(i)	At t = 0s, 4.6 N = m(8.0) m = 0.575 kg	1
		(ii)	Since the initial weight of the toy car is greater than 4.6 N, the toy car cannot be lifted off.	1
				10

9	(a)		It is the amount of thermal energy needed to change 1 kg of **ice** from solid to liquid state or vice versa without a change in temperature.	1
	(b)		To determine the amount of water melted by the surroundings / without the use of heater.	1
	(c)	(i)	Q = Pt = 30(10 x 60) = 18000 J	1
		(ii)	Mass of water melted by heater alone = 64.7 – 16.6 = 48.1 g L_f = (mass of water melted by heater alone)(l_f) 18000 = (48.1)(l_f) L_f = 374 J/g	1 1 1
		(iii)	The value will increase. Less mass of water is collected in the beaker if the same amount of energy is used. / More energy is needed to melt the same amount of ice.	1 1
	(d)		The thermal energy absorbed by ice is used to overcome the forces of attraction between the particles so that the ice change its state into water. Average kinetic energy does not increase so temperature does not increase.	1 1
				10

<table>
<tr><td>10
either</td><td>(a)</td><td>(i)</td><td>
Image formed on focal plane
Correct refracted rays</td><td>1
1</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>The incident rays are parallel to each other.</td><td>1</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>The image can be captured on a screen.</td><td>1</td></tr>
<tr><td></td><td></td><td>(iv)</td><td>Inverted, diminished</td><td>1</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>
<table>
<tr><th>Location</th><th>Objective Lens Diameter (D)</th><th>Wavelength detected (λ)</th><th>Resolving power</th></tr>
<tr><td>Mauna Kea Observatories (Hawaii)</td><td>10.0 m</td><td>500 nm = 500×10^{-9}m</td><td>5.0×10^{-8}</td></tr>
<tr><td>Mount Graham (Arizona)</td><td>8.4 m</td><td>600 nm = 600×10^{-9} m</td><td>7.1×10^{-8}</td></tr>
<tr><td>McDonald Observatory (Texas)</td><td>9.5 m</td><td>0.21 m</td><td>0.022</td></tr>
</table>

Mauna Kea</td><td>1
1
1
1</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>The image will be brighter as more light rays will pass through the lens.</td><td>1</td></tr>
<tr><td></td><td></td><td></td><td></td><td>10</td></tr>
</table>

10 or	(a)		Energy cannot be created or destroyed but must be converted from one form to another. The total energy of the system remains constant.	1 1
	(b)	(i)	Elastic potential energy in the elastic cords is converted to gravitational potential energy and kinetic energy of the capsule.	1
		(ii)	Kinetic energy of the capsule is converted to gravitational potential energy and elastic potential energy.	1
	(c)	(i)	The elastic potential energy should be lower than 510 KJ. When the capsule is at the highest height, it would have gained GPE. Some of the initial elastic PE would have been converted to GPE	1

				1
		(ii)	Gain in GPE = mgh = 300(10)(30) = 90000 J	1
		(iii)	Elastic potential energy at the start = GPE + KE at 30 m	1
			510000 = 90000 + KE	
			KE = 420000 J	1
			KE = 1/2 m v^2	
			420000 = ½ (300) v^2	
			v = 52.9 m/s	1
				10