Candidate Name: _____ Class _____ Index No. _____

FUHUA SECONDARY SCHOOL

Secondary Three Express

End of Year Examination 2016

3E

Fuhua Secondary Fuhua Secondary Fuhua Secondary

Section A: Multiple Choice Questions [30 marks]

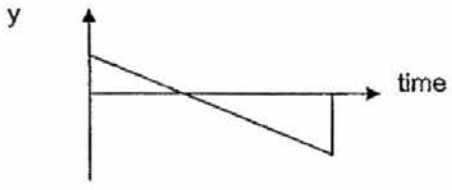
Answer **all** questions and shade your answers on the OMR sheet provided.

1 Which of the following sets consists of only vector?

(i) Gravitational field strength
(ii) Gravitational acceleration
(iii) Density
(iv) Temperature

A (i) and (ii) only
B (ii) and (iv) only
C (ii), (iii) and (iv) only
D (i), (ii) and (iv) only

2 A man on top of a building throws a ball vertically upwards. After the ball has reached its maximum height, it starts to fall to the ground floor of the building. The following graph describes the motion of the ball.



Which of the following correctly represents the y-axis of the graph?

A displacement
B speed
C velocity
D acceleration

3 Fig. 3.1 shows a velocity-time graph of an object in motion.

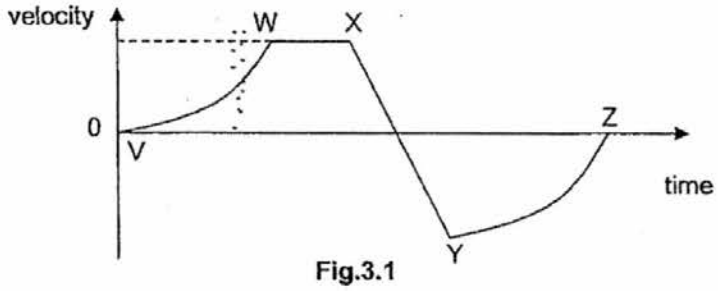


Fig.3.1

Which of the following statements are **not** correct?

(i) The direction the object is moving during XY is the same as during YZ.
(ii) The object is not moving during WX.
(iii) Both stages VW and YZ involve increasing rate of change of velocity.

A (i) and (ii) only
B (ii) and (iii) only
C (i) and (iii) only
D (i), (ii) and (iii)

Downloaded from SingaKids.com

4 Fig. 4.1 shows two cars P and Q started from the same point on a level road at different speeds.

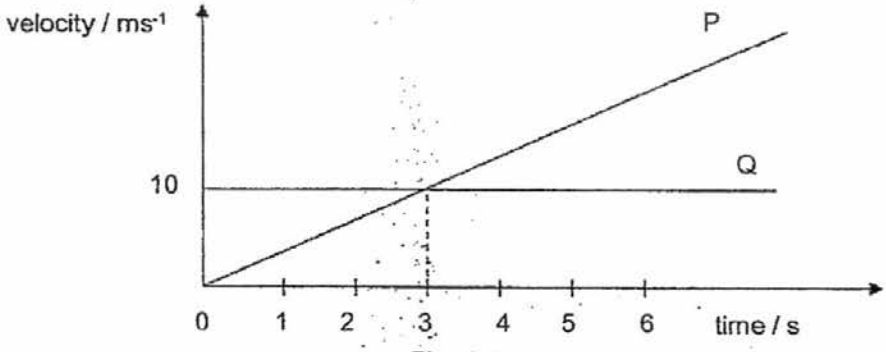


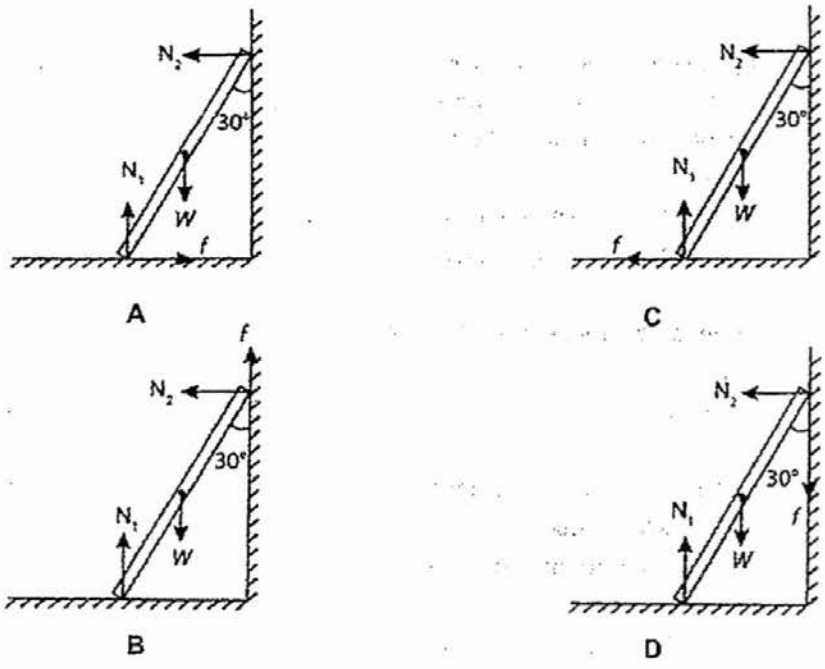
Fig. 4.1

Which of the following statements are correct?

(i) Both cars meet at 6.0 s.
(ii) Car Q is ahead of car P at 3.0 s.
(iii) Acceleration for car Q is zero while that for car P is 3.3 m/s².

A (i) and (ii) only
B (ii) and (iii) only
C (i) and (iii) only
D (i), (ii) and (iii)

5 A stationary uniform ladder of weight (W) is leaning against a smooth vertical wall on a rough ground. The ladder makes an angle of 30° with the vertical wall. Frictional force (f) and contact forces (N_1 and N_2) by the rough ground and the smooth wall acting on the ladder are given. Which diagram correctly shows the forces acting on the ladder?



Downloaded from SingaKids.com

6 Fig. 6.1 shows a car accelerating along a road. The wheel shown is connected to the engine. In which direction is the force of friction exerted by the road on the car tyre?

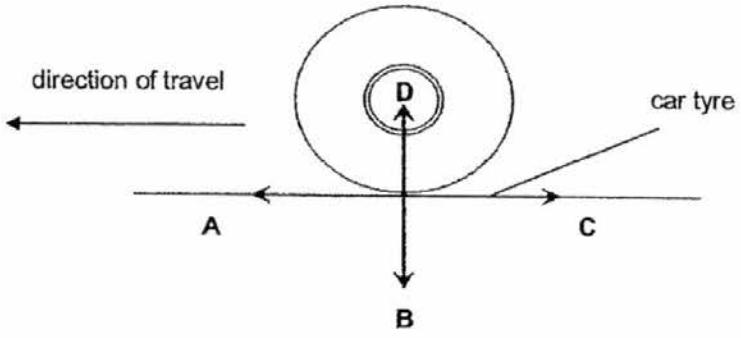


Fig. 6.1

7 A 20000 kg airplane travels at a constant speed of 175 ms^{-1}, at a constant height of 20 km above sea level. Its engines provide a constant forward pushing force of 500 kN.

Find the resultant force acting on the airplane.

A	539 kN	**C**	200 kN
B	500 kN	**D**	0 N

8 The table below shows the result of an experiment in which a piece of rubber with a density of 1.38 g/cm^3 is cut into half of its original size and is placed in four different liquids.

Liquid	Density of liquid / g cm^{-3}	Observation
Mercury	13.6	W
Water	1.00	X
Benzene	0.880	Y
Paraffin	0.700	Z

Which set shows how the small piece of rubber will behave in the different liquids?

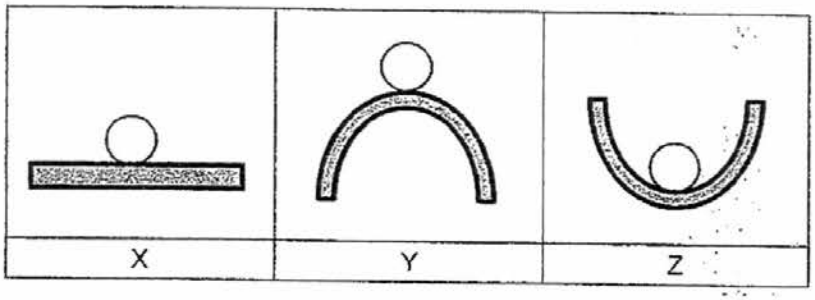
	W	X	Y	Z
A	floats	sinks	sinks	sinks
B	floats	floats	sinks	sinks
C	sinks	floats	floats	floats
D	sinks	sinks	floats	floats

9 Which of the following objects has the **least** inertia?

A A ball of mass 500 g travelling at 10.0 m/s
B A stationary trolley weighing 20 N.
C An athlete weighing 700 N running the 100 m race in 11 s
D A car of mass 800 kg moving at a constant speed of 80 km/h.

Downloaded from SingaKids.com

10 Which of the following sets shows the correct equilibrium position the sphere is in?



	X	Y	Z
A	stable	neutral	unstable
B	neutral	unstable	stable
C	stable	unstable	neutral
D	neutral	stable	unstable

11 A diver at position **P** has his centre of gravity (c.g.) as shown in Fig. 11.1. He raises his arms in position **Q** and bends his body in position **R** as shown.

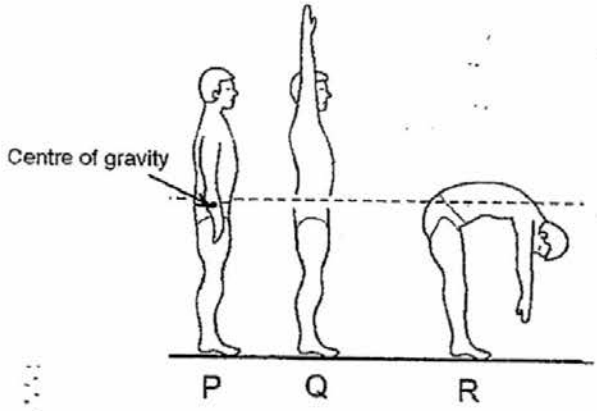


Fig. 11.1

Which of the statements are true?

(i) When he raises his arms at position Q, his c.g. is shifted upwards.
(ii) At position R, he becomes less stable.
(iii) The position of his c.g. remains unchanged throughout P, Q and R.

A (i) and (ii) only
B (ii) and (iii) only
C (i) and (iii) only
D (i), (ii) and (iii)

Downloaded from SingaKids.com

12 Fig. 12.1 shows a 5.0 kg cylindrical roller being pushed onto a step. Given that the radius of the roller is 5.0 cm and the step is 2.0 cm high, calculate the minimum force, **F**, needed to push the roller over the step. (g = 10 N/kg)

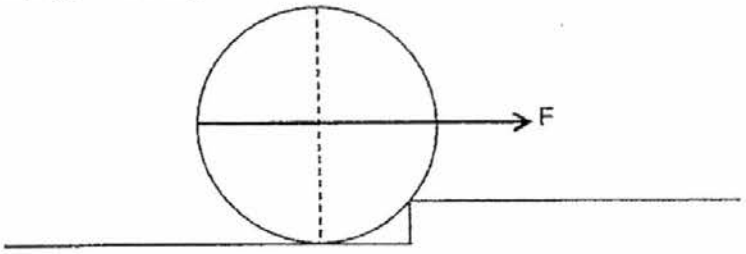
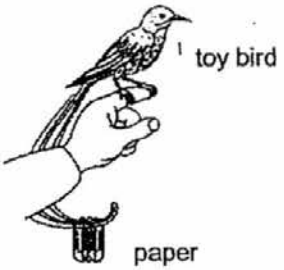


Fig. 12.1

A 62.5 N **B** 66.7 N **C** 75.0 N **D** 83.3 N

13 A toy bird balances on a finger as shown.



What is the purpose of the paper clips?

A Raise the centre of gravity of the toy for greater stability.
B Lower the centre of gravity of the toy for greater stability.
C Increase the mass of the toy for greater inertia.
D Raise the surface area of the toy for greater stability.

14 Fig. 14.1 shows a uniform cube of mass m on a rough surface.

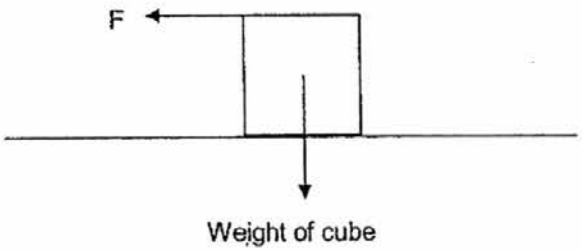


Fig. 14.1

If the minimum horizontal force F needed to just tilt the cube about its edge is 100 N, determine the mass m of the cube.

A 5.0 kg **B** 20 kg **C** 50 kg **D** 200 kg

Downloaded from SingaKids.com

15 Three forces of magnitude 10 N, 10 N and 20 N are applied on a wheel as shown in Fig. 15.1.

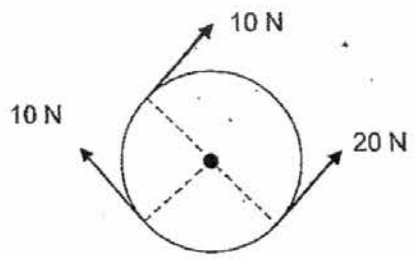


Fig. 15.1

Which of the statements regarding resultant force and resultant moment are correct?

	Net Force	Net Moment
A	Non-zero	Non-zero
B	Zero	Zero
C	Zero	Non-zero
D	Non-zero	Zero

16 The volume of a constant mass of gas in a cylinder is reduced at a constant temperature as shown in Fig. 16.1.

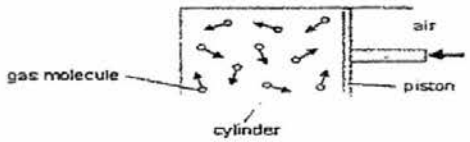


Fig. 16.1

Which of the statements are correct?

(i) The gas molecules will collide against the inner wall more frequently.
(ii) The average distance between the gas molecules will become shorter.
(iii) The gas molecules will move around more haphazardly at a higher average speed.

A (i) and (ii) only
B (ii) and (iii) only
C (i) and (iii) only
D (i), (ii) and (iii)

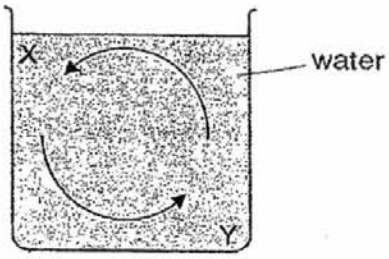
17 Brownian motion can be observed in illuminated smoke particles contained in a sealed transparent cell using a low power microscope.
Which of the following statements are **not** correct?

(i) The speed of the observed motion is unaffected by temperature.
(ii) The random motion of the smoke particles is due to their own collisions.
(iii) Air molecules are too tiny to be observed through the microscope.

A (i) and (ii) only
B (ii) and (iii) only
C (i) and (iii) only
D (i), (ii) and (iii)

Downloaded from SingaKids.com

18 A beaker contains water at room temperature.



How can the convection current be set up in the water as shown above?

A	Place an ice cube at X	C	Heat water at X with a heating coil
B	Put ice near Y outside beaker	D	Blow through a straw position at Y

19 In which of the following is an application of thermal conduction?

A	greenhouses	C	household hot water system
B	electric kettles	D	soldering iron rods

20 The whiteboard in a classroom normally feels cooler than the top of a table because the whiteboard is a better _____ than the top of the table.

A thermal conductor
B radiator of radiant heat
C reflector of radiant heat
D absorber of radiant heat

21 A resistance thermometer indicates 0.50 Ω at the ice point and 2.5 Ω at 650 °C.
What will be the resistance when the resistance thermometer is measuring the steam point?

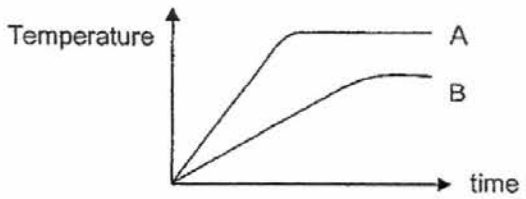
A	0.31 Ω	C	0.38 Ω
B	0.81 Ω	D	0.88 Ω

22 The energy required to change liquid water into water vapour at the same temperature is called the latent heat of vaporization. What does this energy do?

A It increases the average separation of the water molecules.
B It increases the average speed of the water molecules.
C It increases the temperature of the air near the water.
D It splits the water molecules into their separate atoms.

Downloaded from SingaKids.com

23 Two different liquids of equal masses are heated using the same heater. The graph shows how the temperature of each liquid changes with time.



Which of the following statements are true?

(i) Liquid A has a higher boiling point than liquid B.
(ii) Liquid B has a higher specific heat capacity than liquid A.
(iii) Liquid A boils earlier than liquid B.

A (i) and (ii) only
B (ii) and (iii) only
C (i) and (iii) only
D (i), (ii) and (iii)

24 A glass containing 50 g of water is left on a table in a room. After some time, only 10 g of the water remained.

Specific heat capacity of water = 4 200 J kg^{-1} $°C^{-1}$
Specific latent heat of vaporization = 2.3×10^6 J kg^{-1}

Determine the energy lost by the water in the glass due to evaporation.

A 92000 J **B** 23000 J **C** 16800 J **D** 42000 J

25 Fig. 25.1 shows the graph of a wave motion.

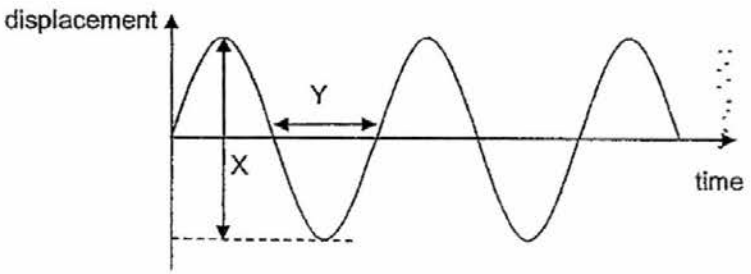


Fig. 25.1

Which of the following sets is correct?

	Amplitude	Frequency
A	X	Y
B	X	$(2Y)^{-1}$
C	X/2	Y
D	X/2	$(2Y)^{-1}$

Downloaded from SingaKids.com

26 Fig. 26.1 shows a thin converging lens is used to produce a focused image of a candle on a screen.

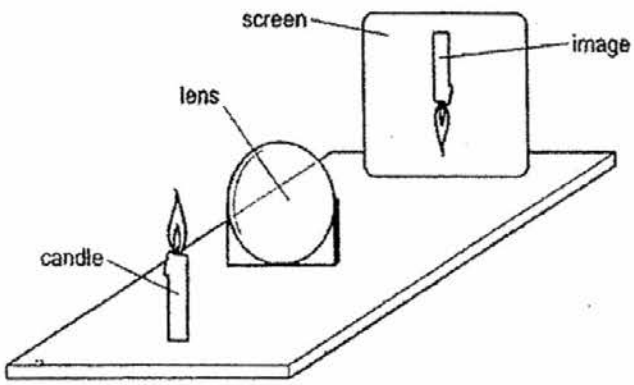


Fig. 26.1

If the lower half of the lens is covered with a piece of black tape, what will happen to the image?

A	It disappears.	**C**	It appears partially blocked.
B	It becomes dimmer.	**D**	It becomes vertically upright.

27 Fig. 27.1 shows the paths of two rays of light from an object. The object is 10 cm in front of a lens in the position shown.

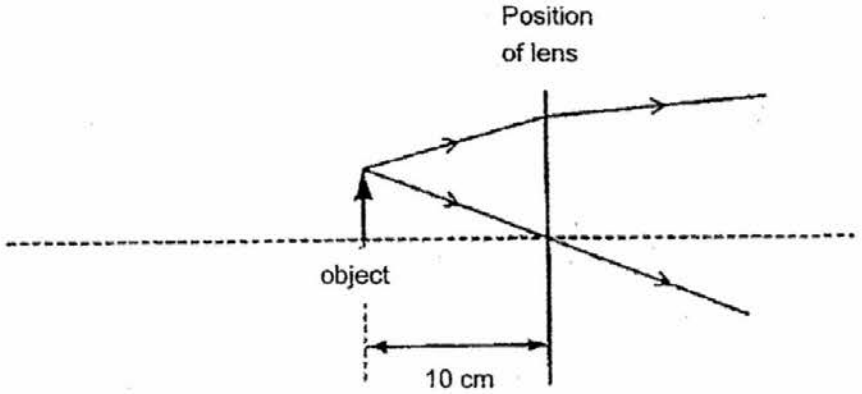


Fig. 27.1

Which of the following sets is correct?

	Type of lens	Focal length
A	Converging	less than 10 cm
B	Converging	more than 10 cm
C	Diverging	less than 10 cm
D	Diverging	more than 10 cm

Downloaded from SingaKids.com

28 A ray of light is incident upon a plane mirror at angle θ. The mirror is then rotated through 20 ° with the direction of the ray of light remains unchanged.

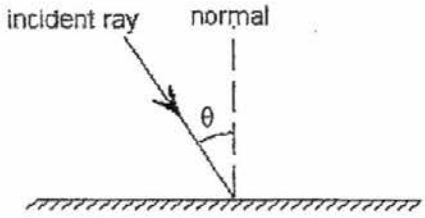


Fig. 28.1

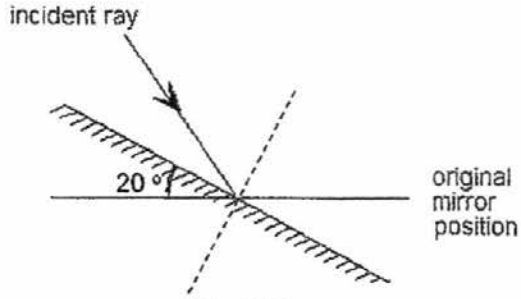


Fig. 28.2

If the angle of reflection in Fig. 28.2 is 30 °, determine the incident angle θ in Fig. 28.1.

A 10 ° **B** 20 ° **C** 30 ° **D** 45 °

29 Fig. 29.1 shows components in the electromagnetic spectrum.

P	X-rays	Q	visible light	infrared	*R*	radio waves

Fig. 29.1

	P	Q	R
A	ultraviolet	gamma rays	microwaves
B	ultraviolet	microwaves	gamma rays
C	microwaves	gamma rays	ultraviolet
D	gamma rays	ultraviolet	microwaves

30 A man standing at X sends out a loud sound from a transmitter. A sound sensor is placed at Y to collect the data of the sound received. When the sound wave travels from air to water, which of the following sets of data is correct?

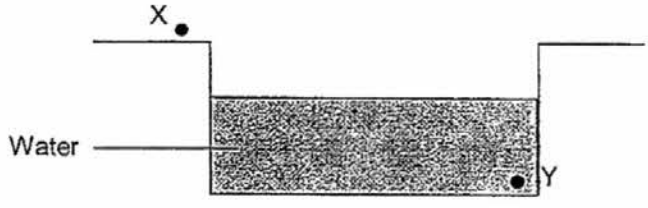


Fig. 30.1

	Pitch	Speed	Loudness
A	Higher	Unchanged	Softer
B	Lower	Unchanged	Louder
C	Unchanged	Faster	Softer
D	Unchanged	Slower	Louder

Downloaded from SingaKids.com

Section B: Structured Questions [40 marks]

Answer **all** the questions in this section.

31 A parachutist falls vertically after leaping off a plane. After falling for some time, he opens his parachute. Fig. 31.1 shows the velocity-time graph of the parachutist from the time he leapt off the plane to the time he landed safely on the ground.

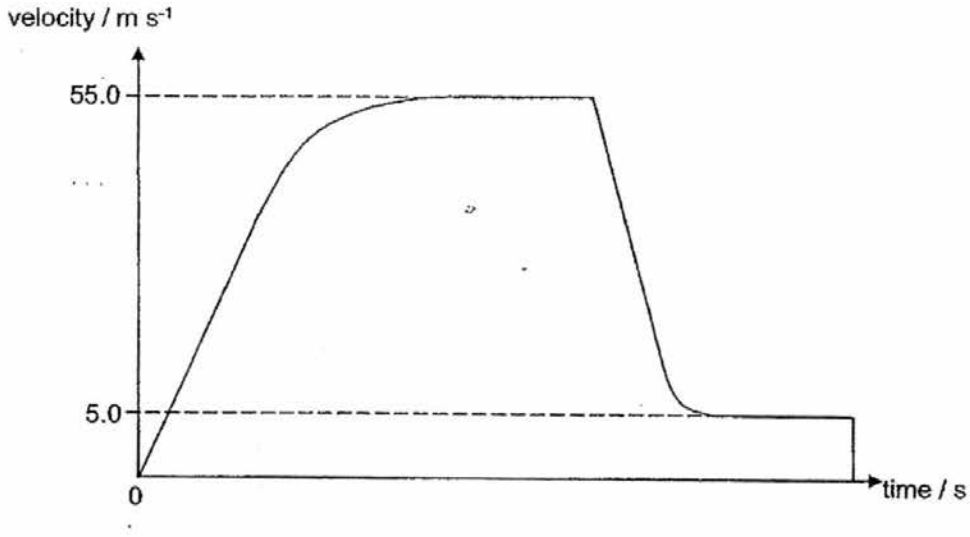


Fig. 31.1

(a) Identify the point at which the parachute is fully opened and that the parachutist starts to experience a net force of 0 N. Label this point as **P**. [1]

(b) Determine the duration from the time he reaches terminal velocity (with his parachute fully opened) to the time he lands on the ground if the distance covered during this period is 50 m.

duration = _____ [2]

(c) The same parachutist makes another jump. Suggest how he can achieve a bigger terminal velocity with his parachute open. Explain your answer.

_____

_____

_____

_____ [2]

Downloaded from SingaKids.com

32 Fig. 32.1 shows a 500 g clock hanging at the mid-point of a horizontal wire stretched between two nails. The magnitude of the force exerted by each nail on the wire is T.

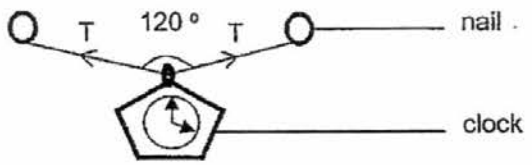


Fig. 32.1

(a) **"According to Newton's third law, the action-reaction pair for the weight of the clock is the resultant force of the tensions in the wire."**
Comment if the above statement is true. Explain your answer.

_____

_____

_____ [2]

(b) Calculate the force exerted by the weight of the clock on the wire.

weight W = _____ [1]

(c) By means of a scale diagram, determine the magnitude of the force T in the wire if the clock is at equilibrium and the angle made by the bent wire is 120 °. (Note that the diagram in Fig. 32.1 is not drawn to scale)

tension T = _____ [2]

Downloaded from SingaKids.com

33

(a) State what is meant by *inertia*.

_____

_____ [1]

(b) A hole is be drilled through a cube as shown in Fig. 33.1.

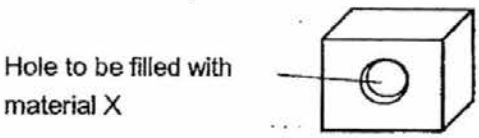


Fig. 33.1

Length of each side	5.0 cm
Radius of the hole	1.0 cm
Density of cube	8950 kg/m^3
Density of material X	7900 kg/m^3

Calculate the density of the composite cube. (Leave your answer in S.I. unit.)

density = _____ [4]

34 Fig. 34.1 shows a windsurfer in equilibrium with a wind force acting on the sail of his board. The weight of the windsurfer is 800 N.

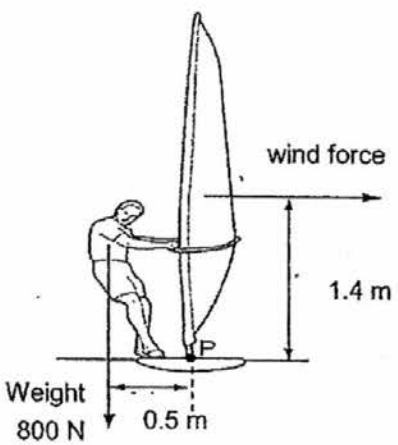


Fig. 34.1

Downloaded from SingaKids.com

(a) State the *principle of moments* that applies to a body in *equilibrium*.

_____

_____

_____ [1]

(b) Calculate the force of the wind acting on the sail.

force = _____ [2]

(c) If the force exerted by the wind on the sail is increased, suggest how the windsurfer is able to maintain his equilibrium. Explain your answer.

_____

_____

_____

_____ [2]

35 A partially inflated balloon is placed under a bell jar as shown in Fig. 35.1.

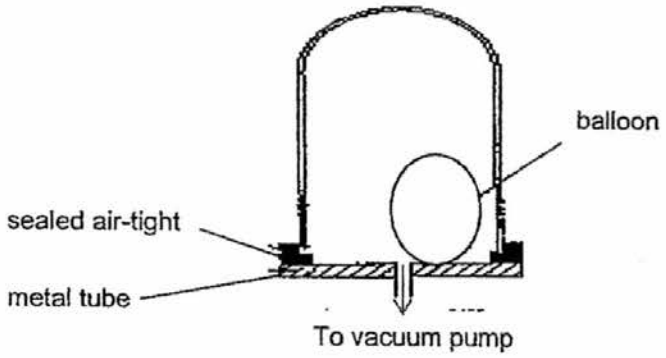


Fig. 35.1

(a) Explain in terms of molecular motion how the trapped air in the balloon creates a pressure on the balloon.

_____

_____

_____ [2]

Downloaded from SingaKids.com

(b) A vacuum pump is turned on (air is being taken out from the bell jar) for several minutes. Suggest and explain what will happen to the balloon.

[3]

36 A plastic cup of negligible mass contains 250 g of liquid at room temperature of 20 °C. An immersion heater is used to raise the temperature of the liquid by supplying 8.5 kJ of thermal energy.

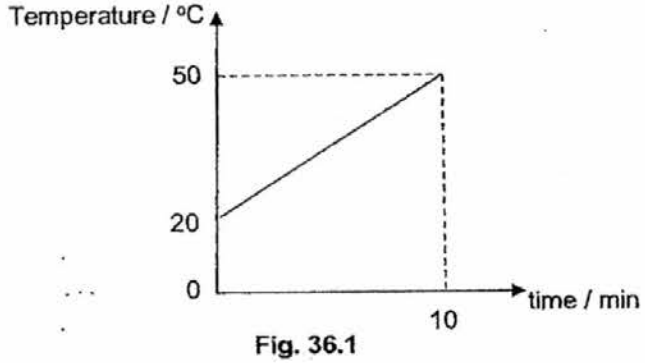


Fig. 36.1

The temperature of the liquid is found to rise in a linear fashion and reaches 50 °C in 10 minutes time as shown in Fig. 36.1. Assuming that there is no energy loss to the surrounding.

(a) Calculate the specific heat capacity of the liquid.

Specific heat capacity= _____ [2]

(b) In reality, there is energy loss to the surrounding. In Fig. 36.1, sketch how the temperature of the liquid will vary with time. [1]

(c) Suggest a way in which the energy from the heater may be wasted and explain how this factor would affect the measurement of the specific heat capacity of the liquid.

[3]

Downloaded from SingaKids.com

37 Fig. 37.1 shows an art piece displayed in a room.

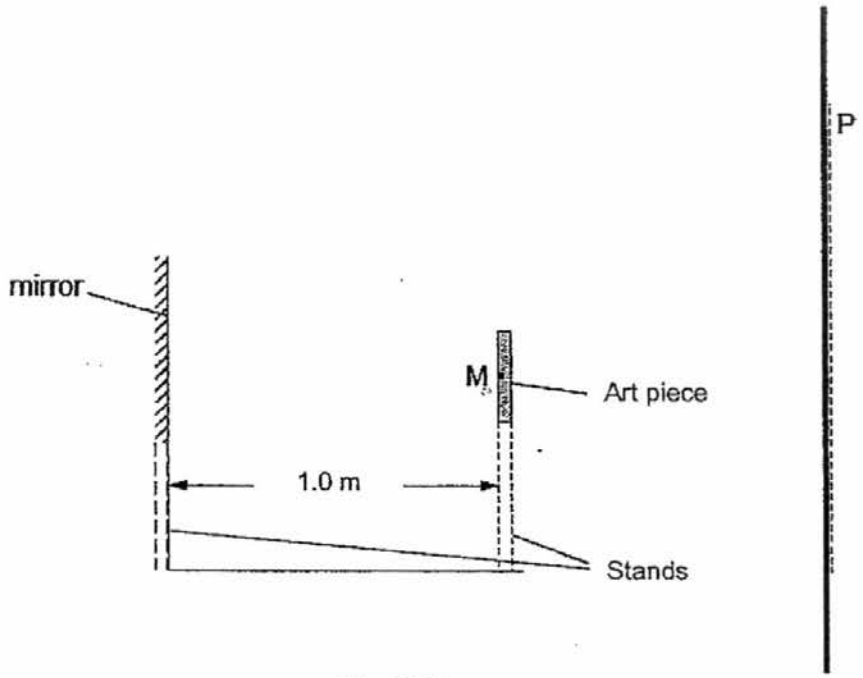


Fig. 37.1

(a) The art piece is supported by a transparent stand. A mirror is placed 1.0 m behind the art piece to ensure that the back of the art piece can be seen by anyone looking from the line P. M is a point on the back of the art piece.

(i) On Fig. 37.1, locate the image of point M behind the mirror and label it as X. [1]

(ii) Draw two rays of light from point M reflecting from the mirror to show the two furthest points at which the visitors at the line P can see the image. Indicate these two points with the letters A and B. [2]

(b) Fig. 37.2 shows two rays going into an air bubble in water. Complete the ray diagram if the refractive index is 1.33. Note that the figure below is drawn to scale. [2]

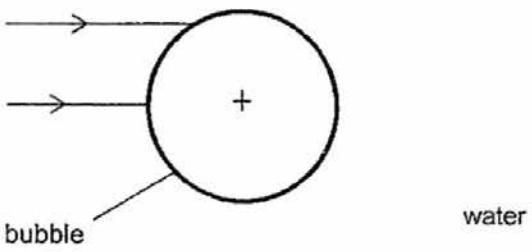


Fig. 37.2

17

42

Downloaded from SingaKids.com

38 An ultrasound device is placed near one wall and it emits an ultrasound wave that reflects back from the opposite wall. The time between sending out the ultrasound wave and receiving the reflection is 30 ms. The speed of ultrasound in air is 340 m/s.

(a) Calculate the distance between the device and the opposite wall.

Distance = _____ [2]

(b) Explain why ultrasound is used in pre-natal scanning instead of using X-rays.

_____

_____

_____

_____ [2]

Section C: Free Response Questions [30 marks]

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

Write your answers on the **writing paper** and **graph paper** provided.

39 A heat sink is a device used to remove thermal energy from a machine. Fig. 39.1 shows a heat sink with the computer chip placed under it. The heat sink and the computer chip are in contact with each other.

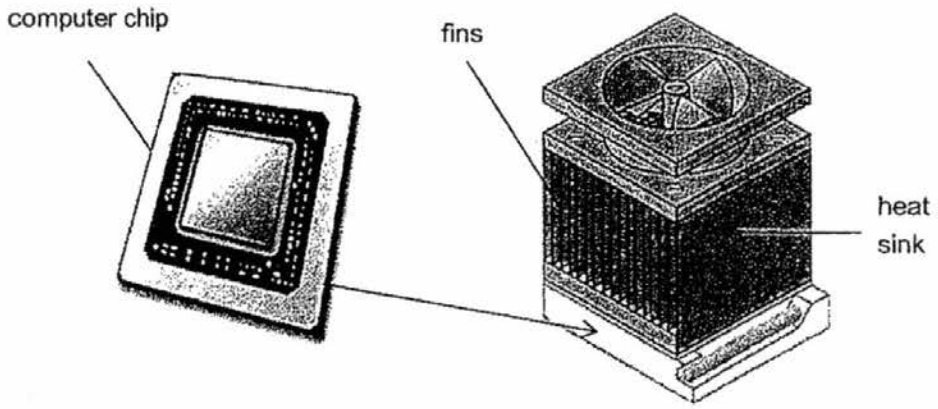


Fig. 39.1

The heat sink is made of aluminium and the top of the computer chip is made of plastic. Fig. 39.2 shows the heat sink designed with many fins and air spaces between the fins.

Downloaded from SingaKids.com

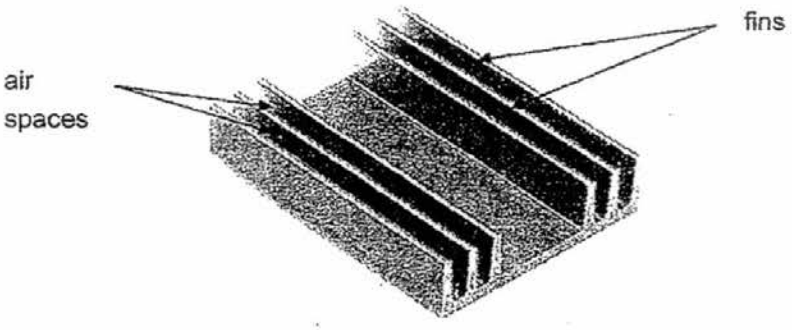


Fig. 39.2

Fig. 39.3 shows a graph that illustrates how the temperature difference between the heat sink and the surrounding air varies with the amount of heat energy released by the heat sink per second.

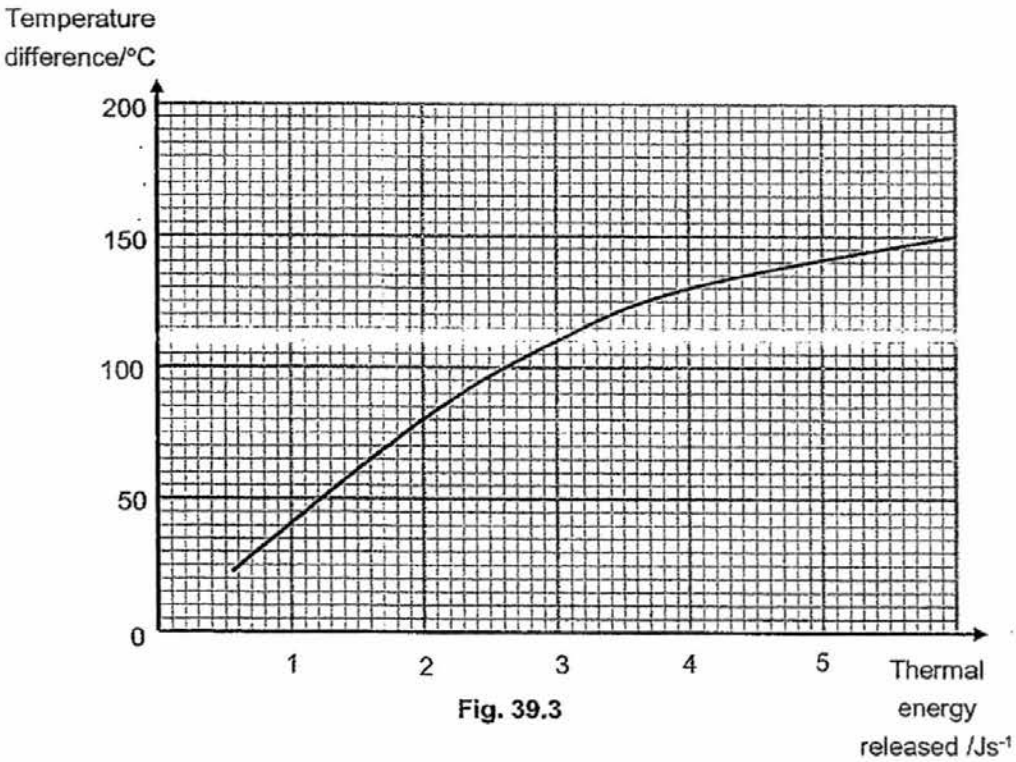


Fig. 39.3

(a) State the three processes involved in transferring thermal energy away from the chip. [3]

(b) Explain how each feature of the heat sink can help in promoting each process mentioned in **(a)**. [3]

(c) State the conclusion you can make from Fig. 39.3 and suggest a reason for this conclusion. [2]

(d) The room temperature is at 20 °C. If the heat sink is at 100 °C, determine the amount of thermal energy released in half an hour. [2]

Downloaded from SingaKids.com

40 Fig. 40.1 shows a side view of a water wave produced in a ripple tank. The wave generator moves up and down 10 times in 20 s. The horizontal distance between adjacent crests is 4.0 cm and the vertical distance between the crest and trough is 2.0 cm. Water waves are classified as transverse waves.

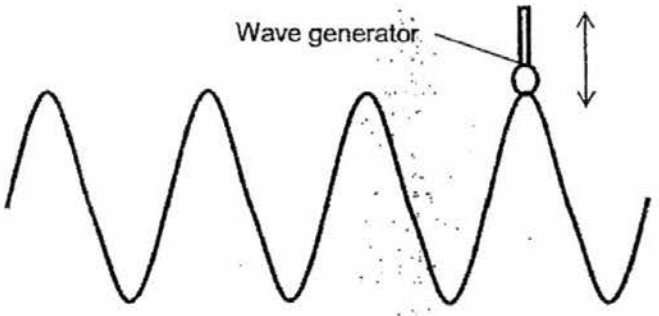


Fig. 40.1

(a) Define the term *transverse wave*. [1]

(b) Determine the frequency and period of the wave. [2]

(c) Hence, or otherwise, calculate the speed of the wave. [2]

(d) The depth of the water in the ripple tank is increased and the speed is doubled. Determine the new wavelength of the wave. [2]

(e) Assuming no energy lost, sketch a graph of displacement /cm against distance /cm for the new water wave on your graph paper with all values clearly labelled. [2]

(f) On the same graph, sketch a new wave to show how the wave will appear 0.50 s later. Label this graph as X. [1]

Downloaded from SingaKids.com

41 A converging lens is used to produce an image of an illuminated object on a screen. For each object position, the measurement of distance between the object and lens (object distance) and the measurement of distance between image and lens (image distance) were recorded. Fig.41.1 shows a graph of image distance against object distance.

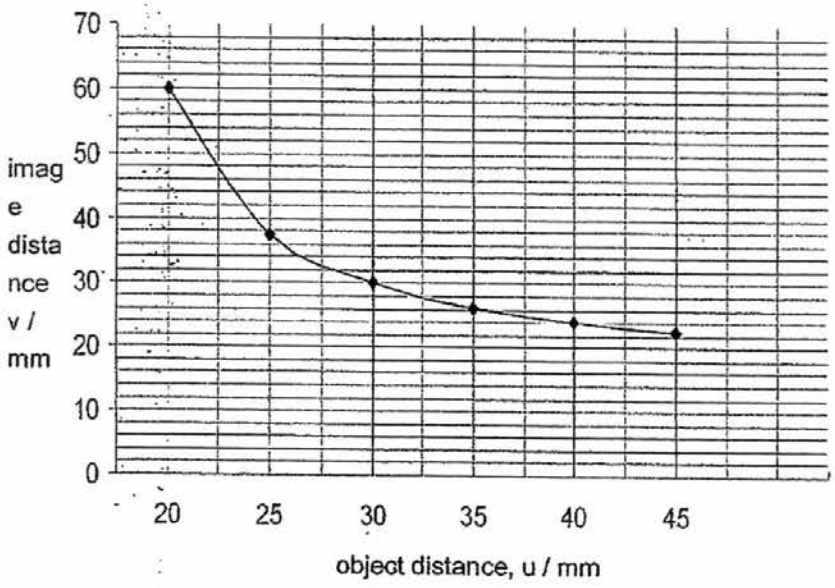


Fig. 41.1

(a) From the graph, determine the focal length of the lens. Explain how you obtained your answer. [2]

(b) Calculate the magnification m when the object distance is 40 mm. (Given: m = v/u) [2]

(c) Describe the nature of the image formed in **41(b)**. Hence, name the instrument that would produce this kind of image. [2]

(d) An object with a 4.0 cm height is now placed 1.0 cm in front of the same converging lens. Draw a scaled ray diagram on the graph paper provided and determine the height of the new image. Label your diagram clearly. [3]

(e) Describe, as accurately as possible, the nature of the new image formed. [1]

End of Paper

Downloaded from SingaKids.com

Downloaded from SingaKids.com

Candidate Name: _____ Class _____ Index No. _____

FUHUA SECONDARY SCHOOL

Secondary Three Express

End of Year Examination 2016

3E

Fuhua Secondary Fuhua Secondary Fuhua Secondary

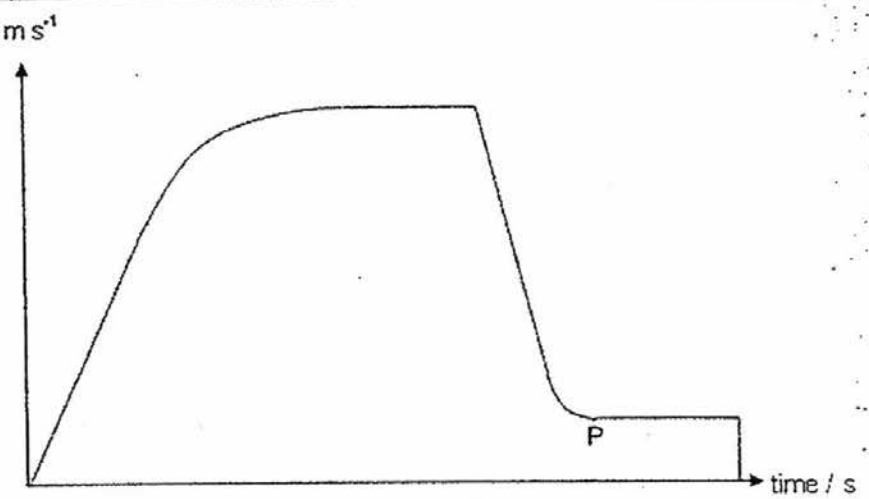
Marking Scheme

1	2	3	4	5	6	7	8	9	10
A	C	A	D	A	A	D	A	A	B

11	12	13	14	15	16	17	18	19	20
A	B	B	B	D	A	A	A	D	A

21	22	23	24	25	26	27	28	29	30
B	A	D	A	D	B	B	A	D	C

31a



[2]

[1]

b Duration = 50 / 5.0
= 10 s

c He can use a smaller surface parachute. With a smaller surface parachute, he will experience a smaller upward drag (air resistance). According to Newton's 2nd Law, he will experience a smaller net upward force compared to the first jump. As the upward drag balances with his weight, his deceleration decreases to zero at a bigger terminal velocity. (Alt Answer = Carry something heavy with him)

[1]

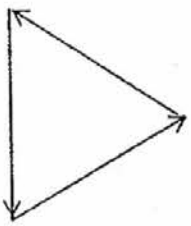
[1]

32a The statement is **false**. According to Newton's 3rd law, for action-reaction pair, the forces must be of the same nature and from different bodies. Since both the weight of the clock and the resultant force of the tensions are acting on the same body (clock) and they are different in nature, they cannot be action-reaction pair.

[1]

[1]

b W = mg
= 0.50 x 10
= 5.0 N



[1]

c T = 5.0 N

[1] diagram & appropriate scale

[1] T= 5.0 N

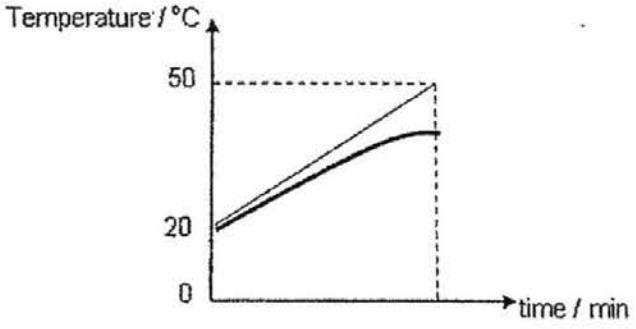
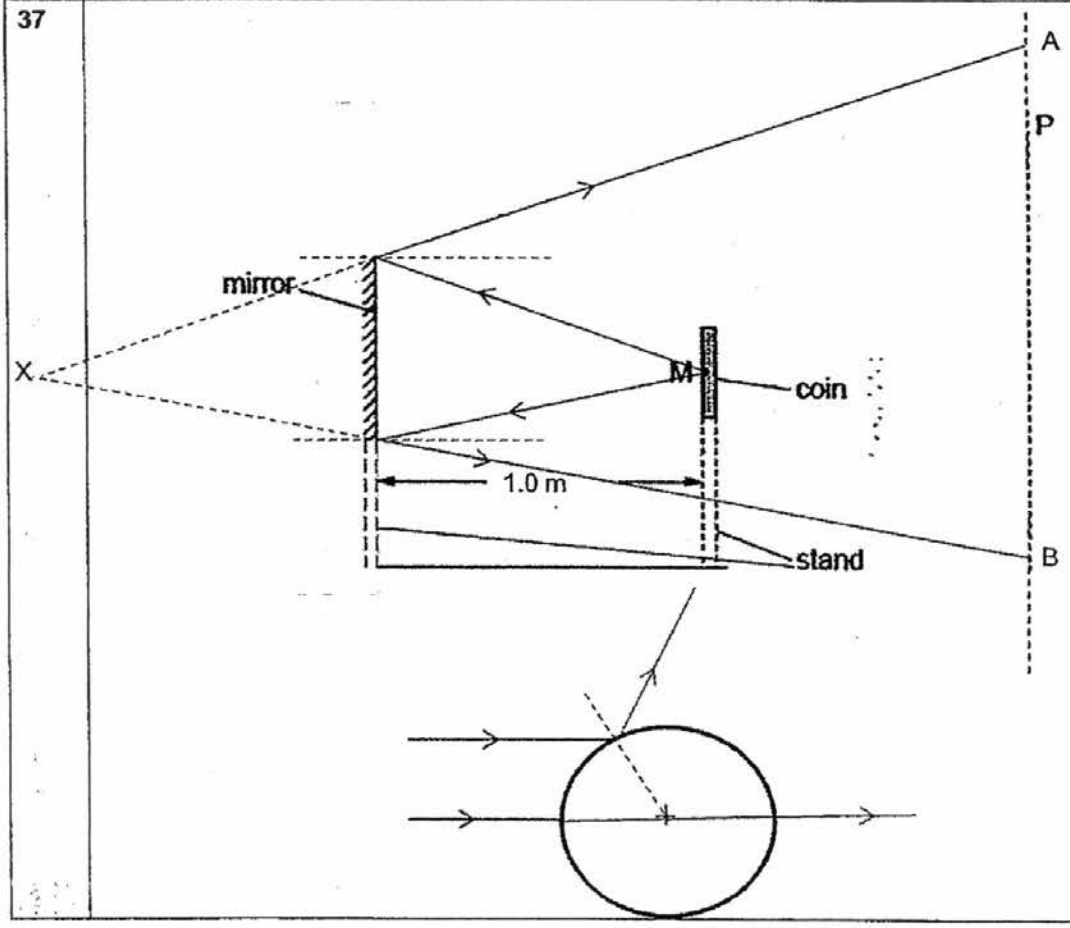
[1]

[1]

Downloaded from SingaKids.com

33a	The inertia of an object refers to the reluctance of the object to change its state of rest or motion, due to its mass.	[1]
b	Volume of cube = 5.0 x 5.0 x 5.0 = 125 cm^3 Volume of hole drilled = πr^2 x 5.0 = $\pi(1.0)^2$ x 5.0 = 15.7 cm^3	[1]
	Mass of cube after drilling = 8.950 x (125 – 15.7) = 978 g	
	Mass of X in hole = 7.9 x 15.7 = 124 g	[1]
	Density of composite = Total Mass / Total Volume = (978 + 124) / 125 = 8.82 g/cm^3 or 8.8 g/cm^3 = 8820 kg/m^3 or 8800 kg/m^3	[1] [1]
34a	Principle of moments states that when a body is in equilibrium, the sum of clockwise moments about the pivot is equal to the sum of anticlockwise moments about the same pivot.	[1]
b	By Principle of Moments, Taking moments about pivot P, Total ACW moments = Total CW moments (800 N)(0.5 m) = (F_{wind})(1.4 m) F_{wind} = 286 N	[1] [1]
c	The man can lean further away from the sail where the line of action of his weight is further away from pivot P. When he leans further away, he creates a larger anticlockwise moment to balance / counteract the bigger clockwise moment created by the wind.	[1] [1]
35a	Air molecules moving randomly collide with the inner wall of the balloon. This exerts a force which in turn creates a pressure within the balloon since pressure is defined as the ratio of force exerted to the area it is being exerted on.	[1] [1]
b	The balloon becomes bigger (or expands). When the air is removed from the jar by the vacuum pump, the pressure in the jar becomes smaller than the pressure in the balloon. This pressure difference will cause a net force to be exerted out from the balloon to cause its expansion until the pressure in the balloon becomes the same as the pressure in the jar.	[1] [1] [1]
36a	8 500 = 0.25 x c x (50-20) c = 1100 J kg^{-1} $°C^{-1}$ or 1130 J kg^{-1} $°C^{-1}$ or c = 1.1 J g^{-1} °C or 1.13 J g^{-1} $°C^{-1}$	[1] [1]

Downloaded from SingaKids.com

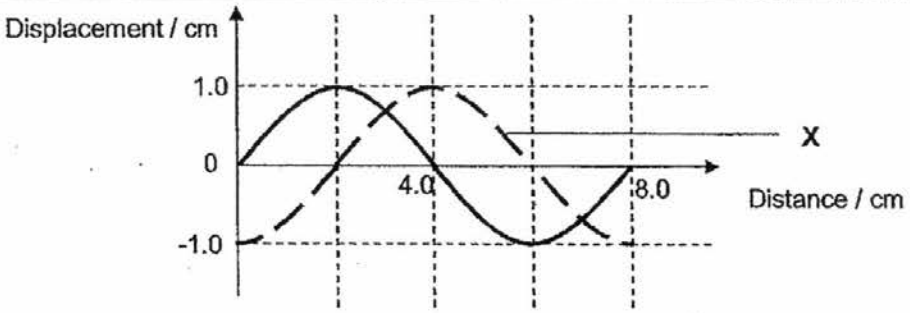
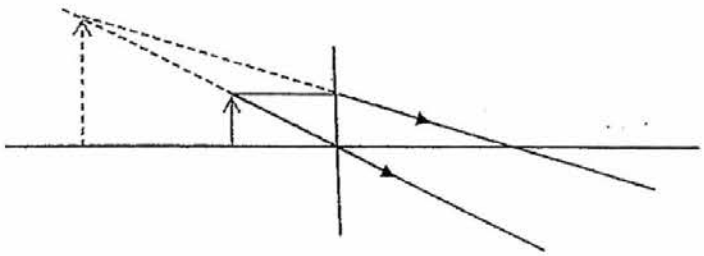
b		[1]
c	Thermal energy is lost to the surrounding. or Thermal energy is absorbed by the plastic cup. (Any other reasonable answers)	[1]
	The <u>specific heat capacity of the liquid will be larger</u> than expected.	[1]
	Specific heat capacity = Energy supplied / (mass x change in temperature). If same amount of energy is supplied by the heater and that energy is lost from the water to surrounding, the change in temperature of the water will be then be minimal for the same duration. This will result in a larger specific heat capacity obtained.	[1]
37		[1] [1] [1] [1] [1]

Downloaded from SingaKids.com

38a	Let distance between the device and the opposite wall be d. Speed of sound = Total distance / Total Time $340 = \frac{2d}{0.030}$ $2d = 10.2$ $d = 5.1$ m (2 s.f.)	[1] [1]
b	X-rays are ionizing and causes mutation of cells which will cause harm to the foetus. Hence, ultrasound is used instead of X-rays in the scanning of foetus.	[1] [1]

39a	Conduction, convection, radiation	[3]
b	Aluminium is a good thermal conductor. It helps in conducting thermal energy away quickly via both molecular vibration and free electron diffusion. The fins have big area exposed to the air. Hence, it helps in radiant heat emission at a higher rate. The air circulating near the fins gains thermal energy and convection occurs. The air expands and becomes less dense. The hot air rises while the denser cool air sinks to cool the fins further. (Accept: **Convection current** formed will help in cooling the fins)	[1] [1] [1]
c	The conclusion is that the higher the temperature difference between the heat sink and the surrounding air, the higher the rate of energy released. The higher the temperature difference between the heat sink and the surrounding air, the higher the rate of emission of radiant heat (infrared radiation).	[1] [1]
d	From graph, when temperature difference = 100 – 20 = 80 °C, P = 2.0 J/s E = Pt E = 2.0 x 30 x 60 E = 3600 J	[1] [1]
40a	**Transverse waves** are waves that travel **perpendicular** to the direction of the medium's particle vibration.	[1]
b	f = 10 / 20 = 0.50 Hz T = 20/10 = 2.0 s	[1] [1]
c	v = fλ = 0.50 x 4.0 (allow for e.c.f.) = 2.0 cm/s	[1] [1]
d	4.0 = 0.50 x λ (allow for e.c.f.) λ = 8.0 cm	[1] [1]

Downloaded from SingaKids.com

e		[1]
f		[1] [1]
41a	Focal length is 15 mm. At 2F, object distance of 30 mm is equal to the image distance of 30 mm. Hence focal length = 30/2 = 15 mm.	[1] [1]
b	When object distance is 40 mm, image distance is 24 mm as shown in the graph. Hence m = 24/40 = 0.60 (no unit and 2s.f.)	[1] [1]
c	Image formed is diminished, real and inverted. Camera	[1] [1]
d	 Two real rays from object Arrowheads Dotted lines and image (Height = 12.0 cm) The image is virtual, upright and magnified.	[1] [1] [1] [1]

Downloaded from SingaKids.com