NORTH VISTA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2019

40

NAME: _____( ) **CLASS:** _____

SUBJECT: PHYSICS **DATE: 18 SEP 2019**

LEVEL / STREAM: SECONDARY 4 EXPRESS **TIME: 1 HR**

CODE : 6091/1

INSTRUCTIONS TO CANDIDATES

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

There are **forty** questions on this paper. 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.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

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1 What is the correct order of magnitude for the diameter of Earth and diameter of a strand of human hair?

	diameter of Earth	diameter of human hair
A	10Gm	0.1mm
B	10Gm	0.1nm
C	10Mm	0.1mm
D	10Mm	0.1nm

2 Which is **not** a unit of a base quantity?

A ampere
B Kelvin
C kilogram
D Pascal

3 A vernier calipers is used to measure the diameter of a glass ball.

With the jaws closed and no glass ball, the vernier calipers reading is shown in Fig. 2.1.

With the jaws closed around the glass ball, the vernier calipers reading is shown in Fig. 2.2.

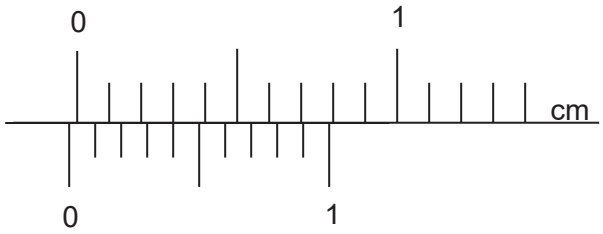


Fig. 2.1

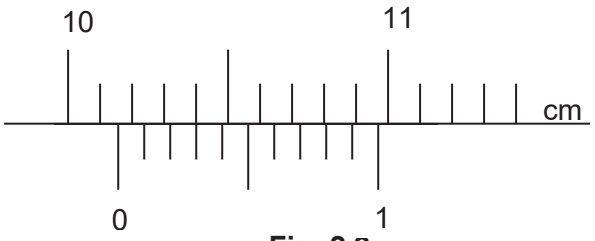
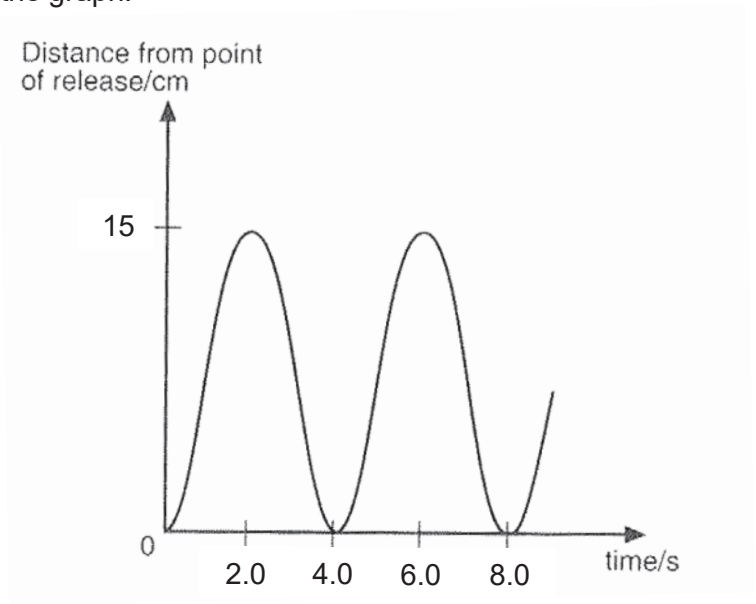


Fig. 2.2

What is the diameter of the glass ball?

A 10.07cm **B** 10.17cm **C** 10.19cm **D** 11.36cm

4 The bob of a simple pendulum is pulled to one side and released. The motion during its swing is shown on the graph.



What is the period of the pendulum?

A 2.0s **B** 4.0s **C** 6.0s **D** 8.0s

5 A ball is falling at terminal velocity.

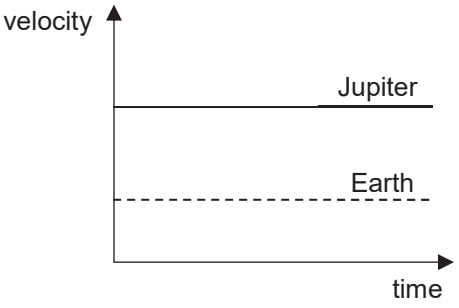
Which row best describes the acceleration of the ball and the velocity of the ball?

	acceleration of ball	velocity of ball
A	downwards	constant
B	downwards	zero
C	zero	constant
D	zero	zero

6 A rock was dropped on Earth and it accelerates at about $10 m/s^2$. When the rock is dropped on Jupiter, it accelerates at about $24.5 m/s^2$.

Which graphs are the corresponding graphs of velocity against time for the rock?

A



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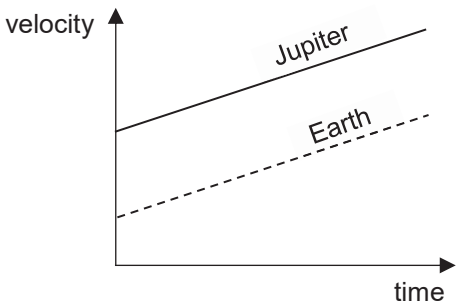
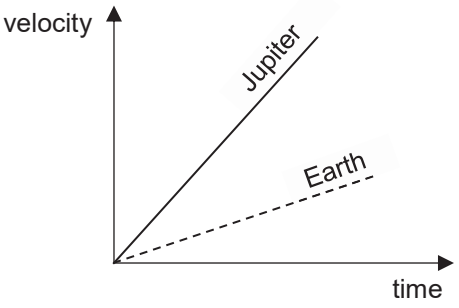
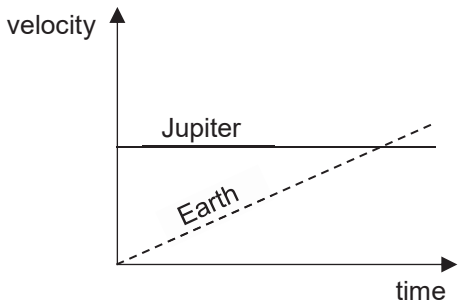


C



D



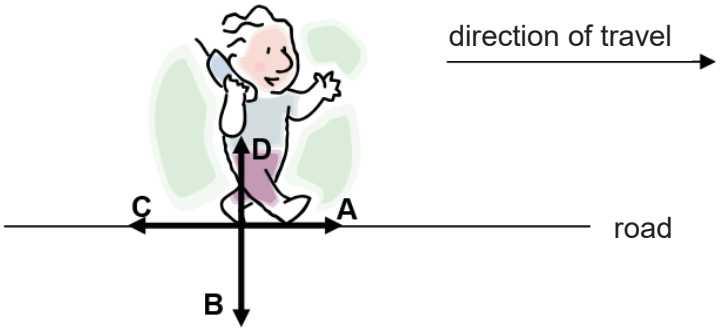
7 A ball is released from the bottom of a pond. After a short time, it rises at a constant speed.

Which statement best describes the resultant force then acting on the ball?

A Upwards and equal to the ball's weight
B Upwards and greater than the ball's weight
C Upwards and less than the ball's weight
D Zero

8 The diagram below shows a man walking along a road in the direction shown.

In which direction is the force of friction exerted by the road on the foot of the man?



9 What **must** change when a body is accelerating?

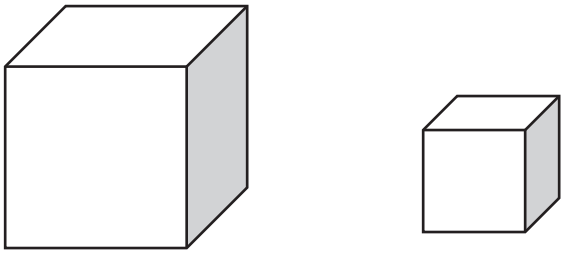
A the mass of the body
B the resultant force of the body
C the speed of the body
D the velocity of the body

10 The diagram shows a container filled with a liquid. There is a bubble in the liquid. The container is moved forward with a constant velocity as shown.

What will be the motion of the air bubble if the container suddenly decelerates?

A Air bubble will move in the backward direction.
B Air bubble will move in the forward direction.
C Air bubble will remain at the original position.
D Motion of air bubble cannot be determined as the total mass of the liquid is unknown.

11 Two cubes X and Y are made of iron.



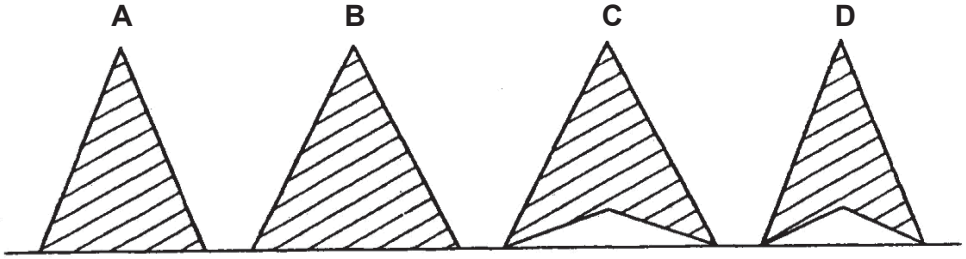
Cube X has sides that are twice as long as cube Y.

Which statement is correct?

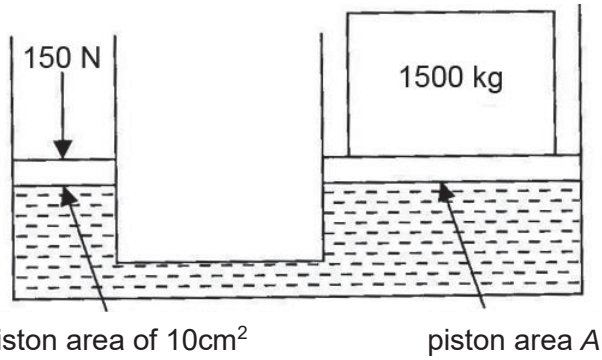
A The density of cube X is eight times that of cube Y.
B The density of cube X is four times that of cube Y.
C The density of cube X is two times that of cube Y.
D The density of cube X is equal to that of cube Y.

12 The diagrams show the cross-section of four solid objects.

Which object is the least stable?



13 The diagram shows a hydraulic press being balanced by a 150N force and a 1500kg mass.

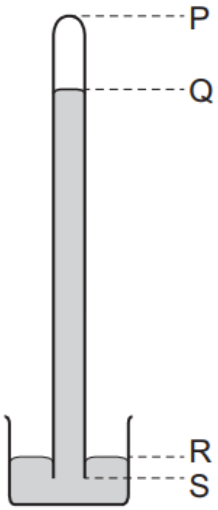


The area of the smaller piston is $10cm^2$ and the area of the larger piston is A.

What is the value of A?

A $1.0cm^2$ **B** $10cm^2$ **C** $100cm^2$ **D** $1000cm^2$

14 A long tube, full of mercury, is inverted in a small dish of mercury.



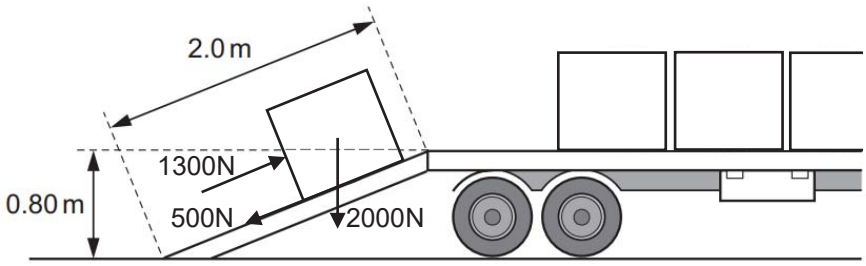
The mercury level in the tube falls, leaving a vacuum at the top.

When the atmospheric pressure decreases, which length increases?

A QR **B** PQ **C** PR **D** PS

15 A workman exerts a force of 1300N to move a box of weight 2000N up a plank and onto a lorry. The plank is 2.0m long and the back of the lorry is 0.80m above the horizontal surface of the road.

The box also experiences a friction force of 500N.



What is the useful work done on the box?

A 1600J **B** 2600J **C** 3000J **D** 4000J

16 A rocket of total mass *M* is travelling at a speed *v*. The engine of the rocket is fired and fuel is used up. The mass of the rocket decreases to ½*M* and its speed increases to 2*v*.

What happens to the kinetic energy of the rocket?

A It doubles.
B It halves.
C It increases by a factor of 4.
D It remains the same.

17 Smoke particles are introduced into a glass container.

When they are viewed under a microscope, the smoke particles are seen to be moving in a continuous and random motion.

Which row explains the motion of the smoke particles?

A collisions by air particles
B collisions with other smoke particles
C collisions against the walls of the glass container by the smoke particles
D motion due to high internal kinetic energy of the smoke particles

18 Hot water rises and cold water sinks due to changes in density.

Which statement explains the change in density?

A The water particles contract when heated.
B The water particles expand when heated.
C The water particles move further apart from each other when heated.
D The water particles have a smaller mass when heated.

19 The pressure of a gas in a container is the same at all points in the container.

Which statement explains this?

A The gas particles have the same size.
B The gas particles make the same number of collisions with the internal walls of the container per unit time.
C The gas particles move at the same speed.
D The gas particles are all moving in a continuous and random motion.

20 Oxygen can be supplied to a fish tank by bubbling air into the water.

What row describes the changes in the pressure and volume of the air bubbles when they rise to the surface of the water?

	volume	pressure
A	increases	increases
B	increases	decreases
C	decreases	increases
D	decreases	decreases

21 A pot is used to boil water.

How is thermal energy transferred from the base of a pot to the water?

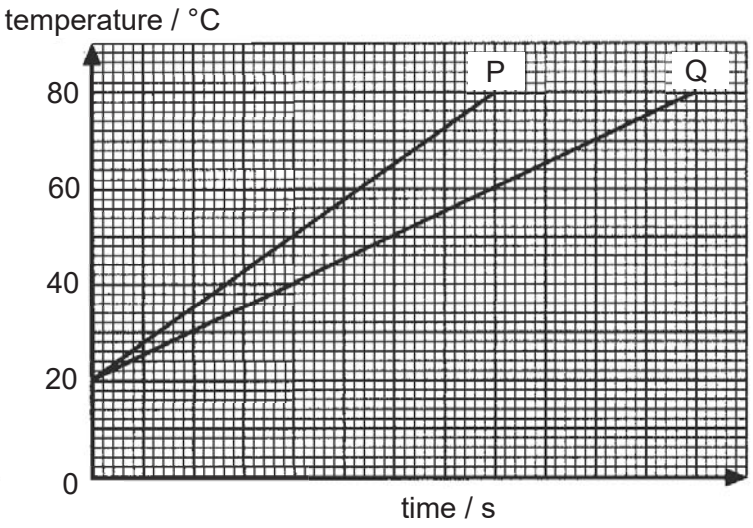
A by conduction only
B by convection only
C by conduction and convection only
D by convection and radiation only

22 A piece of wire has a resistance of 0.50Ω in melting ice and 2.50Ω in steam above boiling water.

What is the resistance of the wire at 40°C assuming that the resistance changes uniformly with temperature?

A 0.40Ω **B** 0.80Ω **C** 1.30Ω **D** 1.50Ω

23 Two well-insulated copper blocks P and Q are heated at the same power. The diagram shows the variation of temperature with time of the two blocks.



What is the ratio of the specific heat capacity of P to Q?

A 0.67 **B** 1.00 **C** 1.33 **D** 1.50

24 An ice pack is used to cool 0.20kg of water from 25°C to 0°C. The specific heat capacity of water is 4.20kJ/kg°C and the specific latent heat of fusion of ice is 334kJ/kg.

How much energy is removed from the water?

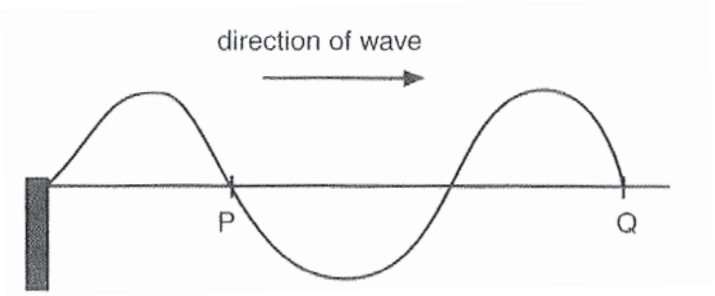
A 21kJ **B** 66.8kJ **C** 87.8kJ **D** 1670J

25 Water waves are travelling from deep region to shallow region.

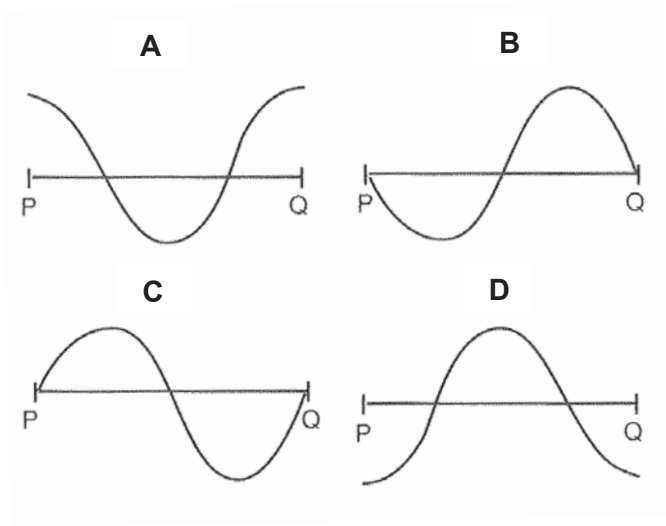
Which statement is true?

A The frequency in shallow region is lower.
B The speed of the waves in both regions is the same.
C The speed of the waves in shallow region is higher.
D The wavelength in shallow region is shorter.

26 A vibrator generates a travelling wave on a string. The diagram shows the shape of the string at a certain instant.



Which diagram shows the shape of the string between P and Q after half a period?

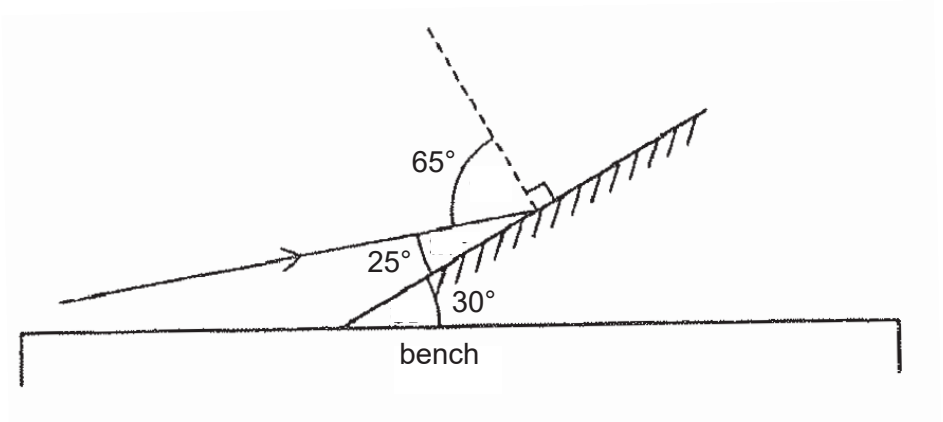


27 A ray of light passes from glass to air. In glass, the speed of light is 1.8×10^8m/s.

What is the critical angle for light passing from glass to air?

A 18.0° **B** 30.0° **C** 36.9° **D** 41.8°

28 The diagram shows a single ray of light being directed at a plane mirror.



What is the angle of reflection?

A 25° **B** 30° **C** 55° **D** 65°

29 An object is placed in front of a converging lens. The lens forms a magnified image of the object on a screen.

Which statement is correct?

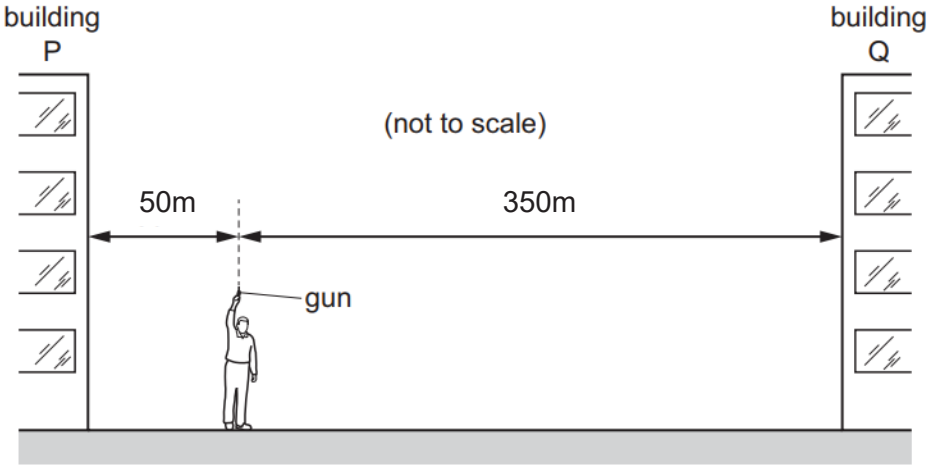
A The distance between the object and the lens is greater than the focal length.
B The image formed is a virtual image.
C The lens is acting as a magnifying glass.
D The image is upright.

30 Which statement about speed of sound is correct?

A Sound travels fastest in a vacuum.
B Sound travels fastest in gases.
C Sound travels fastest in liquids.
D Sound travels fastest in solids.

31 A man stands between two tall buildings, P and Q. The diagram is not drawn to scale.

The man is 50 m from P and 350 m from Q.



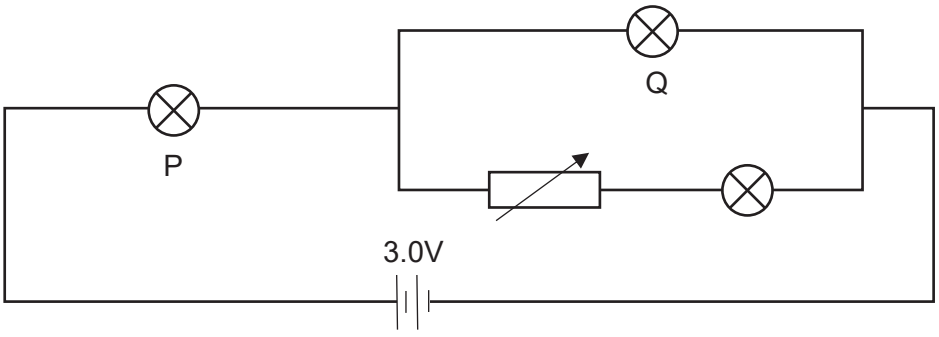
He fires a gun and the first two echoes he hears are 2.0 second apart.

What is the speed of sound calculated from this observation?

A 150m/s **B** 200m/s **C** 300m/s **D** 400m/s

Please refer to the diagram below for question 32 and 33.

The diagram shows a simple circuit consisting of three identical bulbs and a variable resistor. The e.m.f. of the battery is 3.0V.



32 When the variable resistor is adjusted to 0Ω, the current through the battery is 0.50A.

What is the resistance of each bulb?

A 2.0Ω **B** 4.0Ω **C** 6.0Ω **D** 18.0Ω

33 The resistance of the variable resistor is increased.

What happens to the brightness of bulb P and Q?

	bulb P	bulb Q
A	decrease	decrease
B	decrease	increase
C	increase	remains the same
D	remains the same	increase

Please refer to the following information for question 34 and 35.

A lighting system consists of 10 bulbs operating at their normal brightness. 5 bulbs are rated 230V 100W and the remaining 5 bulbs are rated 230V 120W.

34 What is the suitable fuse rating for the lighting system?

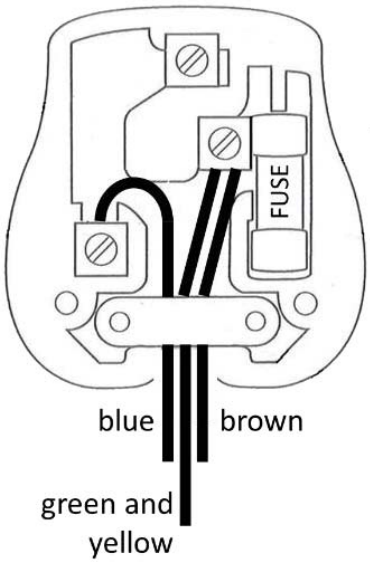
A 1A **B** 3A **C** 5A **D** 10A

35 The lighting system is switched on continuously for 1 week.

What is the total cost of using the lighting system if one unit of electrical energy cost $0.22?

A $1.69 **B** $5.81 **C** $8.13 **D** $40.66

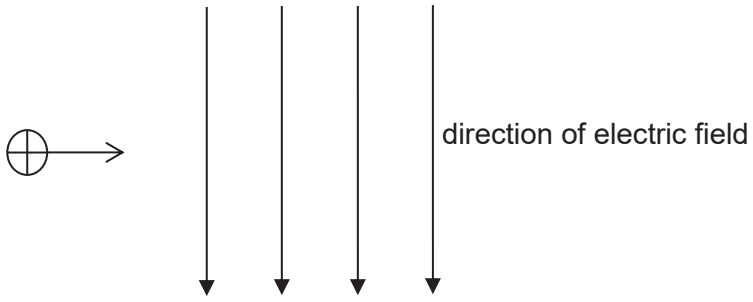
36 The diagram shows a plug that is wired wrongly. The appliance has an external metal casing.



What will happen when the plug is used?

A The appliance will not work because there is a short circuit and causes the fuse to melt.
B The appliance will not work because the external metal casing is at high voltage and causes the fuse to melt.
C The appliance will continue to work without any danger to users.
D The appliance will continue to work but the external metal casing is at high voltage.

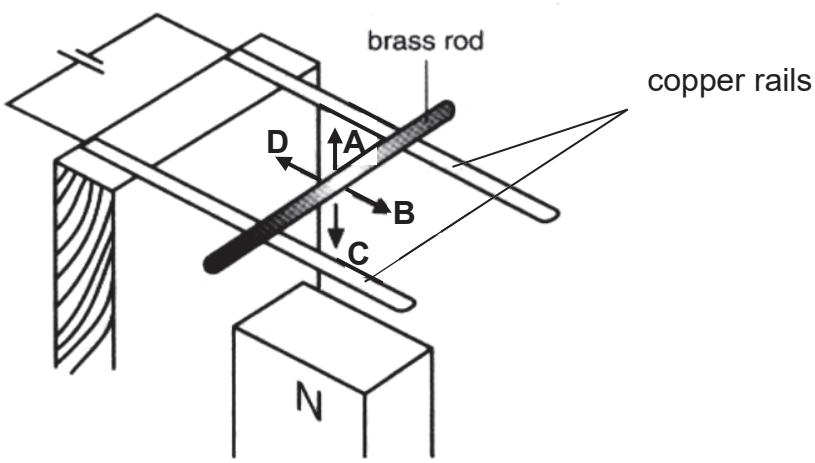
37 The diagram below shows a positive charge travelling towards an electric field.



What is the direction the positive charge will move when it first enters the electric field?

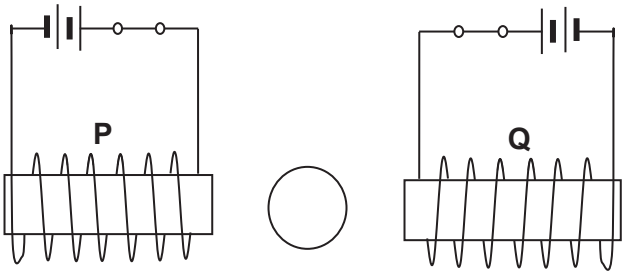
A into the paper
B out of the paper
C upwards
D downwards

38 The diagram shows a brass rod supported on two copper rails that are connected to a battery. The north pole of a magnet is placed beneath the rails.



What is the direction of the induced force acting on the brass rod?

39 The diagram shows a compass placed between two solenoids.



The e.m.f. of the battery connected to solenoid P is larger than that of the battery connected to solenoid Q.

Which is the correct direction of the compass needle.

A → **B** ← **C** ↗ **D** ↖

40 The primary coil of an ideal transformer has 200 turns and is connected to a 20V alternating voltage supply. The secondary coil has 3200 turns and is connected to a 120Ω resistor.

Which row gives the correct secondary voltage and primary current?

	secondary voltage / V	primary current / A
A	16	0.11
B	16	0.13
C	320	2.67
D	320	42.7

End of Paper

NORTH VISTA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2019

80

NAME: _____( ) **CLASS:** _____

SUBJECT: PHYSICS **DATE: 4 SEP 2019**

LEVEL / STREAM: SECONDARY 4 EXPRESS **TIME: 1 HR 45 MIN**

CODE : 6091/2

INSTRUCTIONS TO CANDIDATES

Write your full name, index number and class on all the work you hand in.
Write your answers in dark blue or black pen.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that all qualitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Section A

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

1 Fig. 1.1 shows a block of wood moving at a constant speed down a slope.

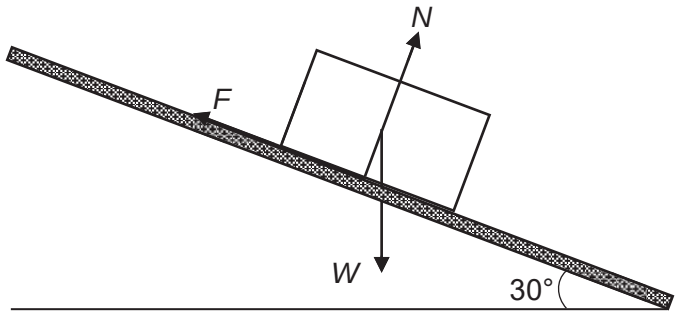


Fig. 1.1

The forces acting on the block are the weight *W* of the block, the normal reaction force *N* exerted by the slope and the friction *F* between the block and the slope.

F is 10.0N and *N* is 17.4N.

(a) In the space below, draw a labelled diagram to show the resultant of *F* and *N*.

Determine the size of the resultant force and the direction between the resultant force and the horizontal ground.

resultant force = ……

direction = ……..… [3]

(b) State the weight of the block of wood.

weight = ……..… [1]

(c) The resultant force in **(a)** and *W* are not a Newton's Third Law action-reaction pair.

Describe the other force that is part of the action-reaction pair with *W* and state which body it acts on.

……..

……..

……..…….. [2]

2 Fig. 2.1 shows a student standing with his right foot and right shoulder touching a wall.

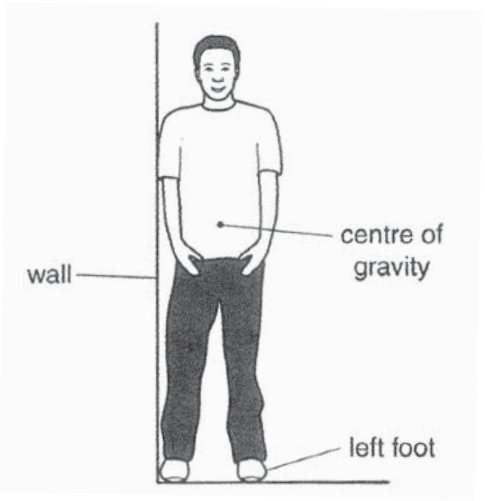


Fig. 2.1

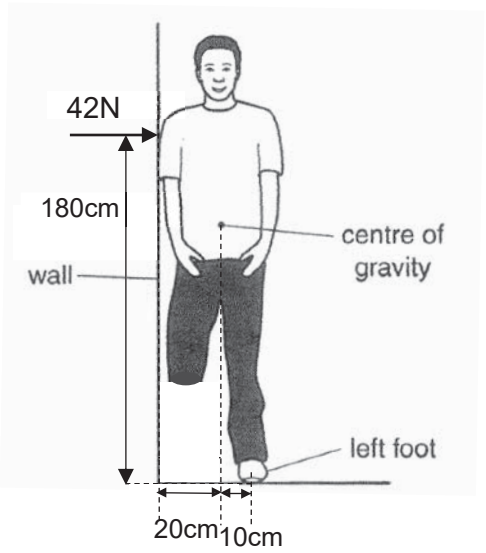


Fig. 2.2

(a) The centre of gravity of the student is shown in Fig. 2.1.

State what is meant by *centre of gravity*.

……..…….…….. [1]

(b) The student bends his right knee and raises his right foot off the ground.

Fig. 2.2 shows a 42N force exerted by the wall on his right shoulder to keep him balanced. His left foot acts as the pivot.

By taking moments, determine the weight of the student.

weight = ……..… [2]

(c) The student now raises his left foot off the ground instead of his right foot.

Using ideas about stability, state and explain what will happen to him.

……..

……..

……..

……..…….. [3]

3 Fig. 3.1 shows a small crack appearing in a vase of water and a stream of water is pushed out through the crack. The water hits the table where a puddle of water starts to form.

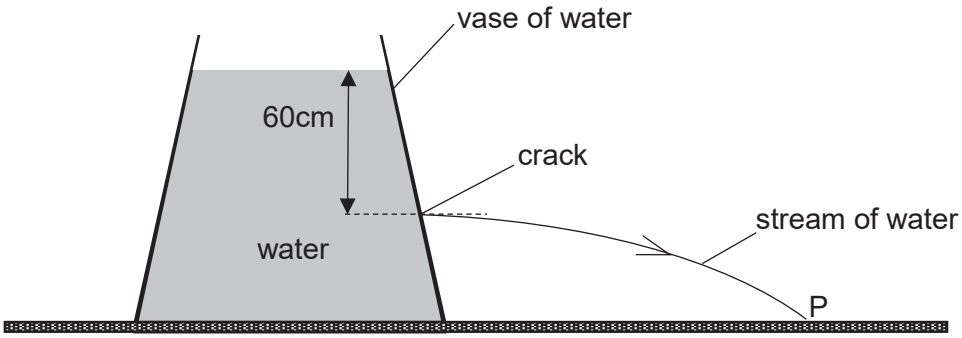


Fig. 3.1

The gravitational field strength *g* is equal to 10N/kg.

(a) The density of water is 1050kg/m^3 and the crack is 60cm below the surface of the water.

(i) Calculate the pressure due to the water at the level of the crack.

pressure = ……..… [2]

(ii) Explain why the atmospheric pressure does not affect the rate at which the water is pushed out through the crack.

……..…….. [1]

(b) As time passes, the point where the water hits the table moves away from P and towards the vase.

Explain why this happens.

……..

……..

……..…….. [2]

4 Fig. 4.1 shows a syringe that has a sealed end. Air is trapped in the syringe and the piston is free to move up and down. The piston has negligible weight.

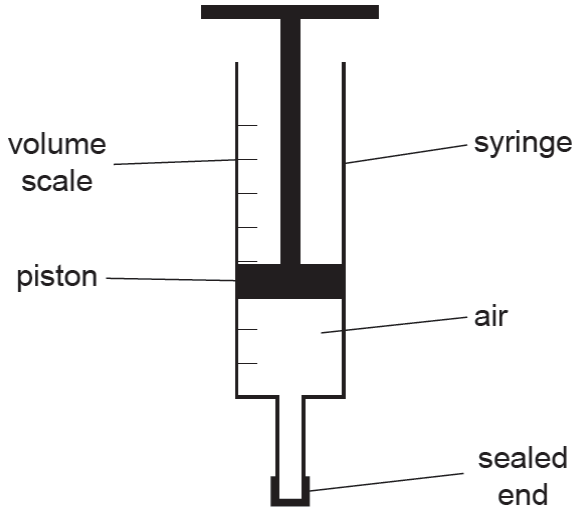


Fig. 4.1

Using the movement of particles,

(a) explain how the trapped air exerts pressure in the syringe;

……

……

……

…… [2]

(b) explain why the piston moves down when the temperature of the trapped air decreases.

……

……

……

…… [2]

5 Fig. 5.1 shows a ray of light incident at mid-point O of the plane surface AB of a semi-circular diamond block. The angle of incidence at O is 60°

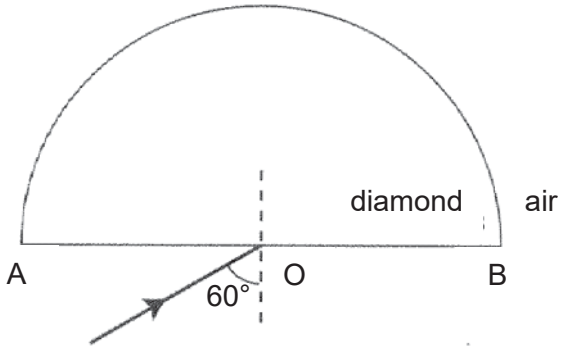


Fig. 5.1

The refractive index of diamond is 2.4.

(a) **(i)** State what is meant by *refractive index of 2.4*.

……..……..

……..……..…….. [1]

(ii) Calculate the angle of refraction of this ray at O.

angle of refraction = ……..…. [2]

(b) Draw the path of this ray from O on Fig. 5.1 and continue its path until it has emerged into the air. [2]

(c) Calculate the critical angle for the diamond-air boundary.

critical angle = ……..…. [1]

(d) The semi-circular diamond block can be used to demonstrate total internal reflection at surface AB.

Describe how this can be done.

……..……..

……..……..

……..……..…….. [2]

6 Fig. 6.1 shows a positively charged metal sphere, P hanging from a string. It is placed near an uncharged metal sphere, Q, supported on an insulating stand. P is attracted to Q but both spheres are not in contact.

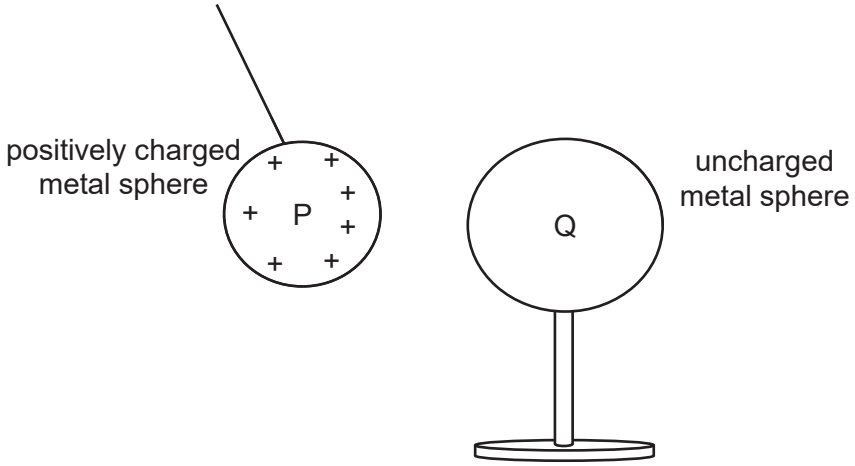


Fig. 6.1

(a) Define the term *direction of electric field*.

……...

…….. [1]

(b) On Fig. 6.1, draw the charge distribution in sphere Q and the electric field pattern in the space between the two spheres. [2]

(c) Explain why sphere P is less positively charged on the left side.

……...

…… [1]

(d) Sphere Q is moved towards the left until it makes contact with sphere P.

Describe and explain what happens to sphere P.

……...

……...

…… [2]

(e) When sphere P is earthed, 20C of charges flow to the sphere in 25s.

Calculate the current flowing in the earth wire.

current = …… [2]

7 Fig. 7.1 shows a magnet attached to a paper cone and placed near a coil of wire that is connected to a d.c. source. The magnet can **vibrate horizontally** about its rest position.

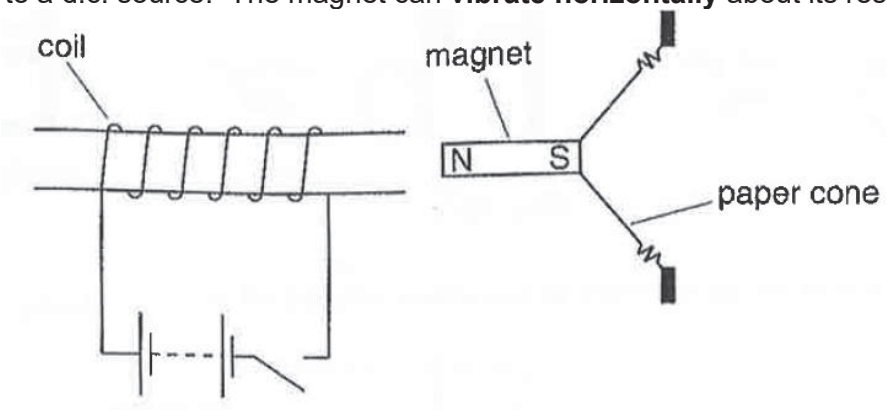


Fig. 7.1

(a) When the switch is closed, the magnet would move momentarily before it comes to a stop.

When the switch is opened, the magnet would move back to its original position.

State the direction the magnet would move when the switched is closed.

……..… [1]

(b) When the battery is replaced by an a.c. source, the alternating current in the coil will cause the magnet and the paper cone to vibrate continuously. Sound will be heard if the frequency of the vibration is within the audible frequency.

(i) State the range of audible frequency of a normal healthy human.

…….. [1]

(ii) Explain how sound is produced by the cone and transmitted to the surrounding.

……

……

……

……

…….. [3]

(iii) The magnet is now replaced by a soft iron bar.

State and explain whether the alternating current in the coil will cause the soft iron bar and the paper cone to vibrate continuously.

……

……

…….. [2]

8 Fig. 8.1 shows a torch that does not use batteries.

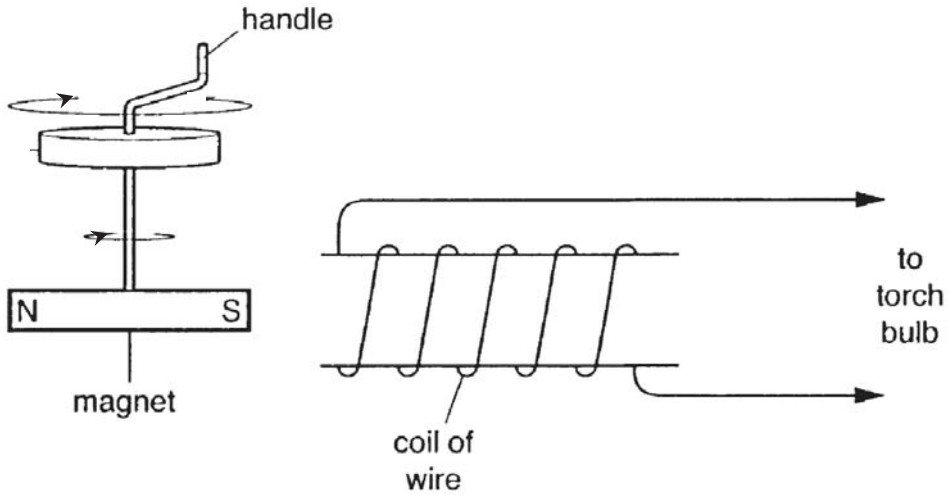


Fig. 8.1

To use the torch, the handle is turned to rotate a magnet near a coil of wire. This will illuminate the torch bulb.

(a) Explain why the torch bulb is illuminated when the magnet rotates.

……

……

……

…… [2]

(b) Describe the changes in light emitted, if any, by the torch bulb when the rate of rotation of the magnet is decreased slowly.

……

……

…… [2]

(c) When the handle is turned, a force is induced that acts against the rotation of the magnet.

Explain why there is an induced force and how it acts against the rotation of the magnet.

……

……

……

……

…… [2]

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Please Turn To Page 12 for Section B

Section B

Answer **all** the questions in the spaces provided.
Answer only one of the two alternative questions in **Question 11.**

9 Fig. 9.1 shows a circuit consisting of a thermistor and a 2.00kΩ fixed resistor connected in series to an a.c. source with a peak voltage of 230V. A cathode ray oscilloscope (c.r.o.) is connected in parallel to the fixed resistor. The circuit can be used to measure the room temperature by studying the display on the c.r.o.

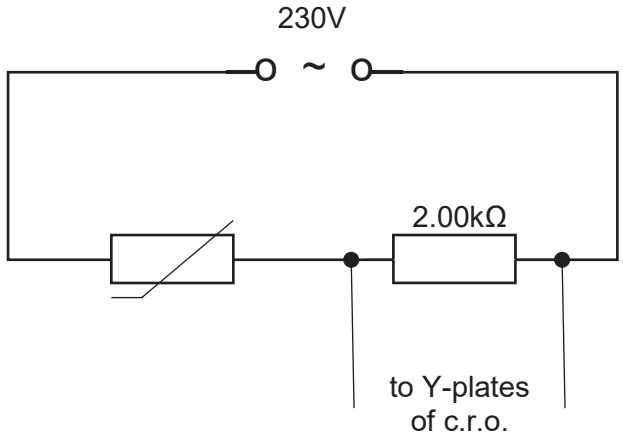


Fig. 9.1

Fig. 9.2 shows the resistance of the thermistor and peak voltage output to the c.r.o. at different temperature. The peak voltage of the a.c. source and the resistance of the fixed resistor remain constant.

temperature of thermistor / °C	resistance of thermistor / kΩ	resistance of fixed resistor / kΩ	peak voltage of a.c. source / V	peak voltage output to c.r.o / V
5.0	2.60	2.00	230	100
10.0	1.75	2.00	230	123
15.0	1.25	2.00	230	
20.0	1.10	2.00	230	148
25.0	1.00	2.00	230	153

Fig. 9.2

(a) The resistance of the thermistor is dependant of its temperature.

(i) Define the term *resistance*.

……..……..

……..……. [1]

(ii) Describe how the resistance of the thermistor changes with increasing temperature.

……..……..

……..……. [1]

(iii) Using Fig. 9.2, state and explain one limitation of the above circuit in measuring room temperature.

……..…….

…… [1]

(b) Calculate the peak voltage output to c.r.o when the temperature of the thermistor is 15.0°C.

peak voltage output = ... [2]

(c) Fig. 9.3 shows the display on the c.r.o. at 5°C. The time base setting is 5.0ms/div.

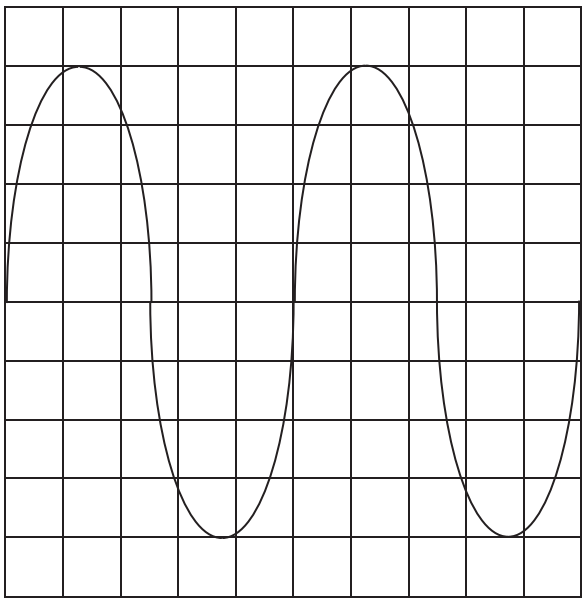


Fig. 9.3

(i) Calculate the Y-gain setting of the c.r.o.

Y-gain setting = ... [1]

(ii) Calculate the period of the a.c. source.

period = ... [1]

(iii) Describe the changes to the display, if any, on the c.r.o. if both the time base setting and the Y-gain setting are doubled.

.....

..... [2]

(d) The circuit in Fig. 9.1 is modified by replacing the fixed resistor with the thermistor. The new circuit is shown in Fig. 9.4

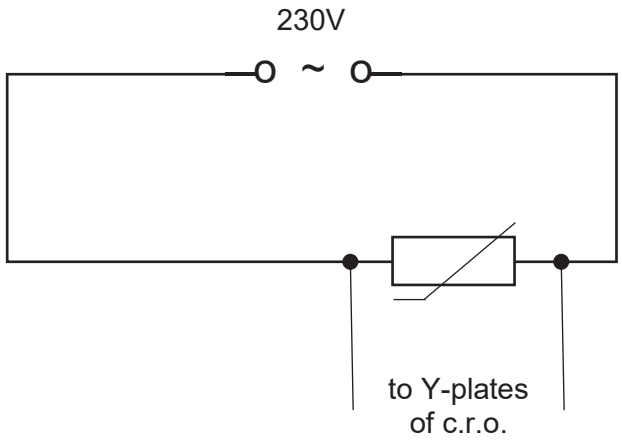


Fig. 9.4

State and explain if the modified circuit in Fig. 9.4 can be used to measure room temperature.

……..

……..

……. [1]

10 A student uses a long rope to demonstrate a transverse wave. A ribbon is tied at a point P on the rope.

Fig. 10.1 (full scale)

The student's hand moves up and down 10 times every 4.0 seconds. Fig. 10.1 shows, to full scale, a side-ways view of the rope at one instant.

(a) Determine the

(i) amplitude of the wave,

amplitude = ... [1]

(ii) wavelength of the wave

wavelength = ... [1]

(iii) Calculate the speed of the wave. State clearly the equation used.

speed = ... [2]

(b) On Fig. 10.1, mark a point on the rope that has the same vertical speed as point P, but which moves in the opposite direction to P. Label this point Q. [1]

(c) Using the same rope, the student produces a wave of longer wavelength than that shown in Fig. 10.1.

State how the student does this.

.....

..... [1]

(d) Electromagnetic waves are also transverse waves.

(i) State one property of electromagnetic waves that differentiate them from all other waves.

……..……. [1]

(ii) X-rays are part of the electromagnetic waves.

Hospital uses them to discover whether the bones are broken. However, X-rays can cause ionisation of living cells and tissue.

Explain what is meant by *ionisation* and describe the effects on living cells and tissue.

……..……..

……..……..

……..……..

……..……. [2]

(iii) Fig. 10.2 shows the relationship between the energy of electromagnetic waves and the wavelength of the waves.

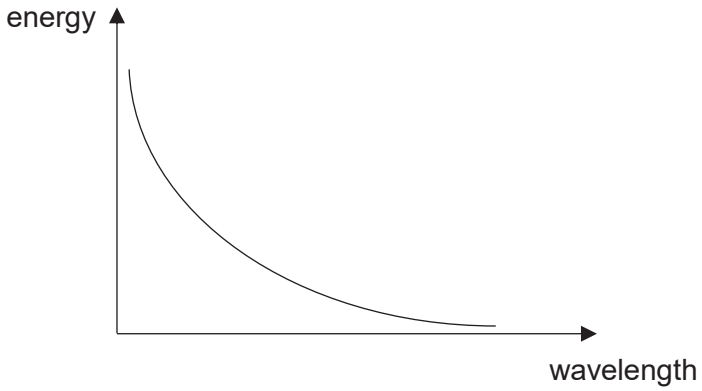


Fig. 10.2

State the component of the electromagnetic waves with the lowest energy.

……..……. [1]

11 EITHER

Fig. 11.1 shows a pot of water placed above a flame.

Fig. 11.1

(a) State the thermometer you would use to measure the temperature of the flame.

…….. [1]

(b) The pot, with the lid, is made of metal and has a shiny smooth external surface.

Explain how the above features of the pot minimises the time to boil the water

……...

……...

……...

……. [3]

(c) On Fig. 11.2, sketch the temperature-time graph of the water when its temperature is increased from room temperature to boiling point. [1]

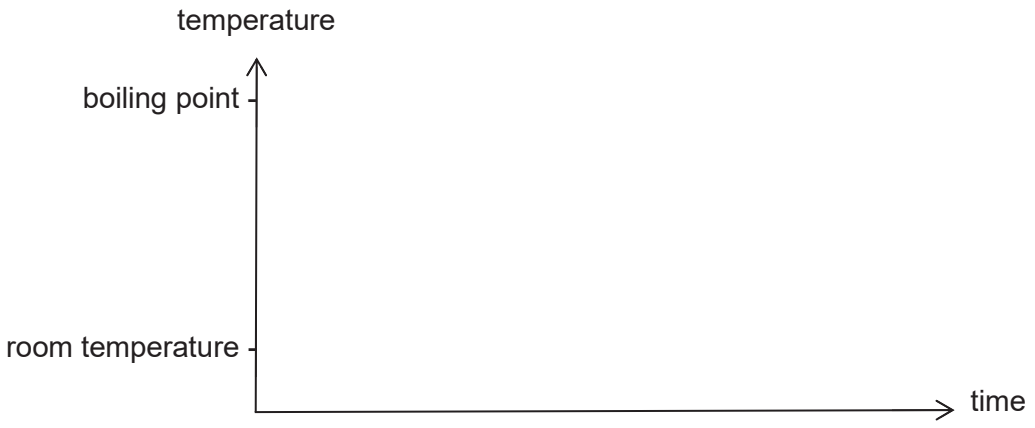


Fig. 11.2

(d) Noodles are placed in water at boiling point. In order to cook the noodles in a shorter time, the size of the fire is increased.

Explain why the above suggestion **does not** shorten the cooking time of the noodles.

……...

……... [1]

(e) The specific latent heat of vaporisation of water is 2200kJ/kg.

(i) State what is meant by the above statement.

……..

……..….. [1]

(ii) Using common apparatus found in school laboratory and the value of the specific latent heat vaporisation of water, describe a method to determine the approximate value of the rate of thermal energy supplied by the fire. State clearly how the result is obtained.

……

……

……

……

……

……

……

……...

……. [3]

OR

A children's ride consists of a steel cable that runs between two posts of different heights, as shown in Fig. 11.3.

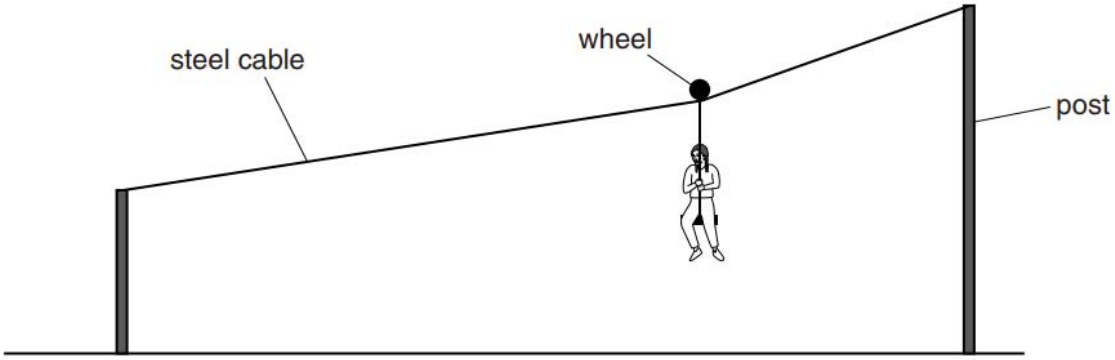


Fig. 11.3

A child starts and finishes the ride at rest. His horizontal motion can be taken as

- an initial decreasing acceleration for 5.0s, followed by
- a constant velocity of 1.6m/s for a further 3.0s and
- a final uniform deceleration that lasts for 1.0s.

(a) On Fig. 11.4, draw a velocity-time graph of the horizontal motion.

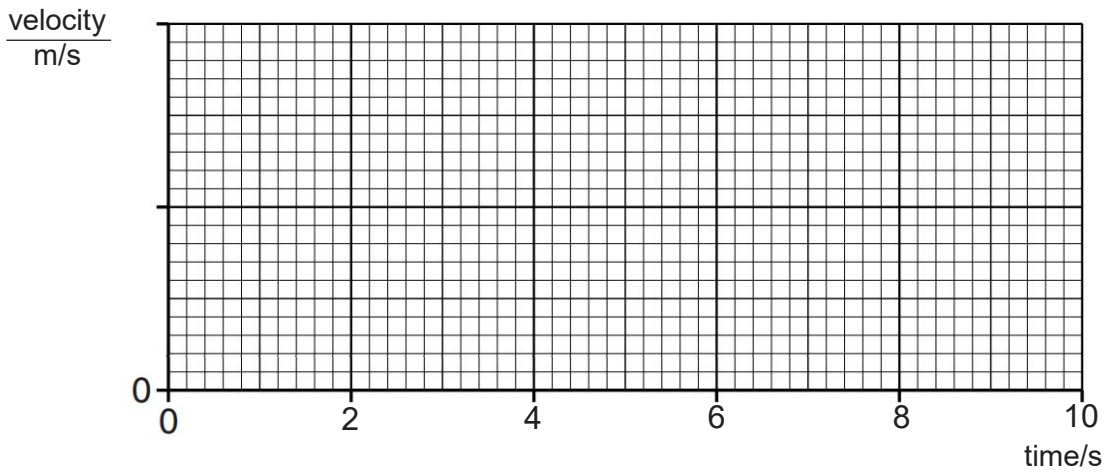


Fig. 11.4 [2]

(b) State how displacement is found from a velocity-time graph.

……

…… [1]

(c) **(i)** The child has a mass of 25kg and falls through a height of 2.0m during the ride.

The gravitational field strength *g* is 10N/kg.

Calculate the decrease in gravitational potential energy of the child.

decrease in potential energy = …….. [2]

(ii) Suggest why the loss in gravitational potential energy and the increase in kinetic energy are different and explain how the law of conservation of energy applies in this case.

……

……

……[2]

(d) A group of students make measurements to show that the child's velocity is constant during the middle section of the ride.

Suggest what measurements are made and how they show that the velocity is constant.

……

……

……

……

……

…….. [3]

END OF PAPER

Answer to P1

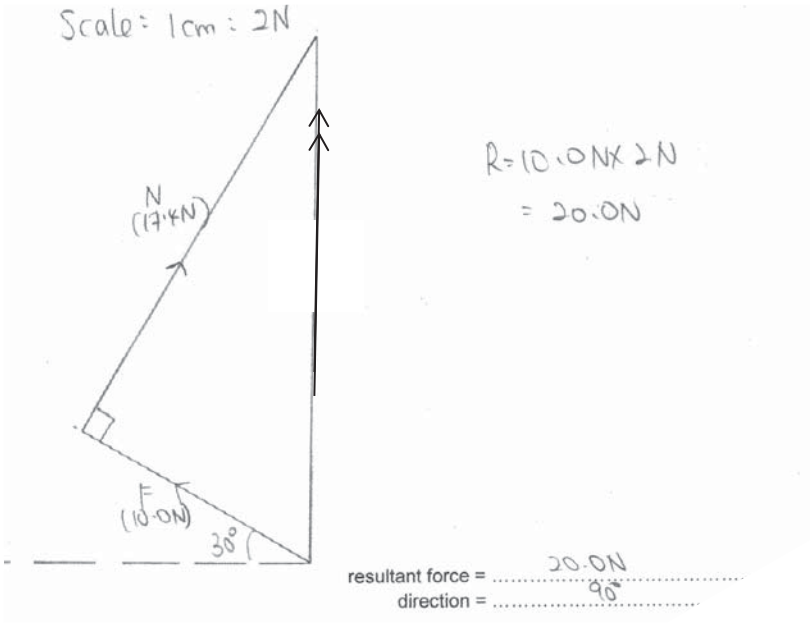
1	**C**	Refer to textbook page 6 and7.
2	**D**	Pascal is unit for Pressure
3	**C**	Diameter = measurement – zero error = 10.13 – (-0.06) = 10.19cm
4	**B**	Period is the time taken for one complete oscillation *(A to B and back to A again)*
5	**C**	Terminal velocity only happens when all forces are balanced (net force is zero), hence zero acceleration and constant velocity.
6	**C**	Higher acceleration means higher gradient (steeper vel-time graph).
7	**D**	Constant speed = zero acceleration = zero resultant force
8	**A**	Friction opposes the relative motion between 2 bodies in contact. The foot is pushing backward in order for the man to move forward. Hence friction pushes the foot forward (opposite direction)
9	**D**	Things to note: Acceleration is the rate of change of velocity. Change in velocity can be either direction or numerical value (speed). When there is an acceleration, a resultant force must be present. (not change in resultant force).
10	**A**	When the container decelerates, the water has bigger mass, bigger inertia as compare with the bubble of air. Hence the water will continue forward and pushes the air bubble backward.
11	**D**	Both cubes are made of the same material.
12	**D**	Least stability = highest C.G (top heavier) and smallest base area.
13	**D**	$P_1 = P_2$ 150/10 = (1500 x 10)/A A= 1000cm^2
14	**B**	When atmospheric pressure drops, mercury column QR decreases, PQ increases. R rises as more mercury flows out of mercury column, hence PR decreases. Height PS is fixed.
15	**A**	Useful work done = gain in mgh = 2000 x0.8 Or useful work done = resultant force x distance in direction of force = (1300-500)(2.0)
16	**A**	$E_k = ½ Mv^2$ New $E_k = ½ (M/2)(2v)^2 = 2 (½Mv^2) = 2E_k$
17	**A**	collisions by air particles Key word is "by" as air particles are moving in continuous and random motion at high speed
18	**C**	The water particles move further apart from each other when heated. This will increase the volume of water and decrease the density. **B** is wrong because particles do not expand when heated.
19	**D**	The gas particles are all moving in a continuous and random motion. The probability of the particles hitting at any point in the container with the same average speed (and force) is the same. **B** and **C** are wrong unless the options contain the word in bold: "**average** number of collisions with the internal walls of the container per unit time" and "move at the same **average** speed".

20	**B**	increases	decreases	
21	**A**	by conduction only C is wrong because the question did not ask for thermal energy transferred within the liquid.		
22	**C**	1.30Ω 40°C = [R - 0.50Ω]/[2.50Ω - 0.50Ω] × 100°C R = 1.30Ω		
23	**B**	1.00 Specific heat capacity is the same for objects from the same material		
24	**A**	21kJ energy removed = 0.20kg × 25°C × 4.20kJ/kg°C = 21kJ		
25	**D**	Speed of water waves decreases in shallow water as wavelength decreases. Frequency is constant.		
26	**C**	Shift the wave to the right by half a waveform		
27	**C**	n = c/v = $3.0x10^8$/ $1.8x10^8$ = 1.67 c= $\sin^{-1}$ (1/1.667) = 36.9°		
28	**D**	Angle of reflection is the same as angle of incidence, i.e. the angle between Normal and incident ray.		
29	**A**	Key words from question “Magnified image …. on a screen” [Real, magnified image] Case 4 from table 12.5 in textbook pg 242 where object is placed between f and 2f.		
30	**D**	Sound need medium to travel and is fastest in solid where particles are very closely packed.		
31	**C**	t diff = [2 x distance from Q to man/ speed] - [2 x distance from P to man/ speed] 2.0 = [2x350 - 2x50] / speed Speed = 300m/s		
32	**B**	4.0Ω 1.5R = 3.0V / 0.50A = 6.0Ω R = 4.0Ω		
33	**B**	Decrease because p.d. across P decreases	Increase because p.d. across Q increase	
34	**C**	5A current = 1100W / 230V = 4.78A		
35	**D**	$40.66 cost = (1.10kW × 7 × 24hrs) × $0.22 = $40.66		
36	**D**	The appliance will continue to work but the external metal casing is at high voltage. Both live and earth wire are at high voltage but are not connected to each other. The fuse is in the live wire. The fuse and the live wire are not connected to the earth wire unless the live wire touches the metal casing. So fuse will not melt because current is flowing through the appliance as normal.		
37	**D**	downwards Positive charge at the top and negative charge at the bottom. This does not require Fleming’s Left hand Rule because the field is not a magnetic field.		
38	**B** Using Fleming’s Left hand Rule b			

39	**B**	← Direction of the magnetic field of the two coils is the same. Using Right Hand Grip, the magnetic field is towards the left.		
40	**D**	320V secondary voltage = [3200 / 200] × 20V = 320V	42.7A power input = power input = $(320V)^2$ / 120Ω = 853.3W primary current = 853.3W / 20V = 42.7A	

Solutions for Section A

1 **(a)**



(b) 20.0N (downward)
Allow ecf from (a)

(c) Force by the block of wood on Earth.
Acting in opposite direction (or upwards) and equal in magnitude as W

2 **(a)** Centre of gravity is a point through which the whole weight seems to act.

(b) Taking moments about the left foot,
ACW = CW
W × 10 = 42 × 180
W = 756N

(c) The student will be unstable, causing him to topple/ lose his balance.
The line of action of weight falls outside the base (right foot),
resulting in a clockwise moment about his right foot.

3 **(a)** **(i)** P = hρg
= (60/100) (1050)(10)
= 6300Pa

(ii) Atmospheric pressure acts at both sides of the crack, i.e. at internal side and the external of the crack.
Accept there is atmospheric pressure at the top of liquid as well outside the crack.

(b) The height of water above the crack decreases.
Since P = hρg, the pressure due to the liquid at the crack decreases.

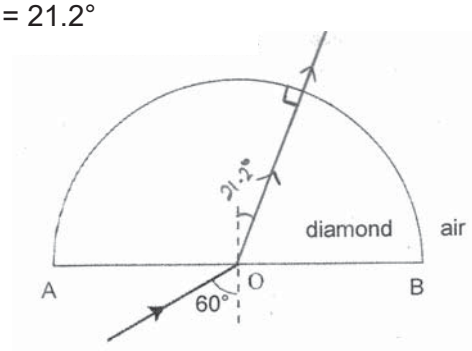
4 **(a)** **(i)** Air particles are travelling at high speed in a continuous and random motion. They collide with the internal walls of the syringe. The average force exerted per unit area is the air pressure.

(ii) KE (and speed) of the air particles decreases. They collide less frequently and with smaller force with the internal wall.
Pressure of trapped air is lower than atmospheric pressure and a resultant force acts downwards on the piston.

5 **(a)** **(i)** The speed of light in vacuum is 2.4 times faster than the speed of light in diamond.

(ii) 2.4 = sin 60/sin r
r = 21.2°

(b)

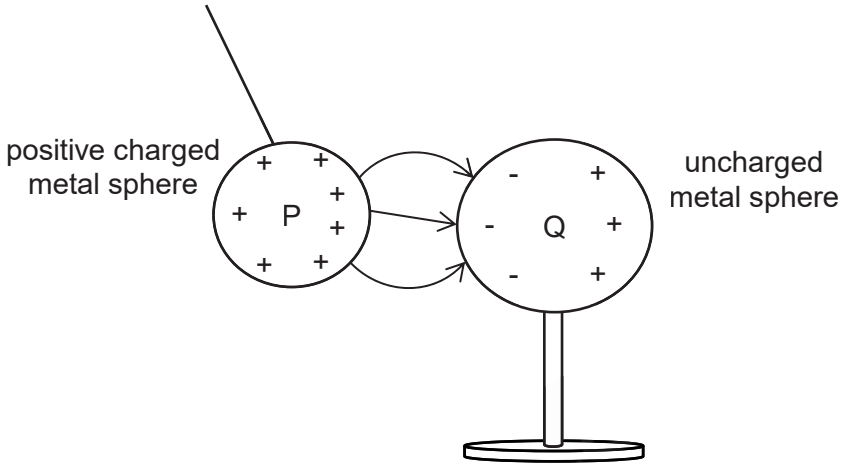


(c) $c = \sin^{-1}(1/n)$
$= \sin^{-1}(1/2.4)$
$= 24.6°$

(d) Ensure the ray of light is incident at the curved surface so that light can enter the diamond block and travel from diamond (more optically denser) towards the boundary with air (optically less dense).

Make sure the angle of incidence in diamond more than critical angle of 24.6°.

6



(a) The direction of the electric force acting on a small positive charge.

(b) See above.
Correct charge distribution
Correct field lines

(c) The induced negative charge on the left side of Q repel the electrons in P to the left side.

(d) The electrons in Q will be attracted by the positive charged P. They will move into P until both spheres are equally positive charged.
P swings away from Q because like charges repel.

(e) current = Q / t
= 20C / 25s [1] = 0.80A

7 **(a)** It will move to the left.

(b) **(i)** 20Hz to 20kHz.

(ii) The cone vibrates and collide with the neighbouring air particles to vibrate. This disturbance (or vibration) is passed on to other air particles.
The vibration of the particles is parallel to the propagation of the sound.
The sound is transmitted in a series of compressions and rarefactions.

(iii) The soft iron bar will always be attracted to the coil regardless of the direction of the magnetic field of the current.
The soft iron bar will not vibrate (and no sound is produced).

8 **(a)** There is a change in the magnetic field lines linkage with the coil.
This induces an emf and thus a current in the coil.

(b) Light is less bright and blink less often (or frequency of blinking decreases or light is emitted a shorter time).

(c) The interaction of the magnetic field of the induced current and the magnet will induce the force (or the induced current in the coil will set up a magnetic field that will exert a force on the magnet).
The direction of the induced force will oppose rotation of the magnet in accordance to Lenz's Law (a like pole will be induced when the magnet is moving towards the coil and an unlike pole will be induced when the magnet is moving away from it).

Solutions for Section B

9 **(a)** **(i)** The ratio of the p.d. across it to the current flowing through it.

(ii) Resistance decreases at a decreasing rate.

(iii) It cannot measure high temperature because the decrease in resistance is insignificant.

(b) peak voltage output = [2.00kΩ / (2.00 + 1.25)kΩ] × 230V
= 142V

(c) **(i)** Y-gain setting = 100V / 4div = 25V/div

(ii) period = 5.0ms/div × 5div = 25.0ms

(iii) time base setting: twice the no. of waveforms or 4 waves are seen
Accept: halved the period/number of divisions needed per waves
Y-gain setting: amplitude is halved or amplitude is 2 div

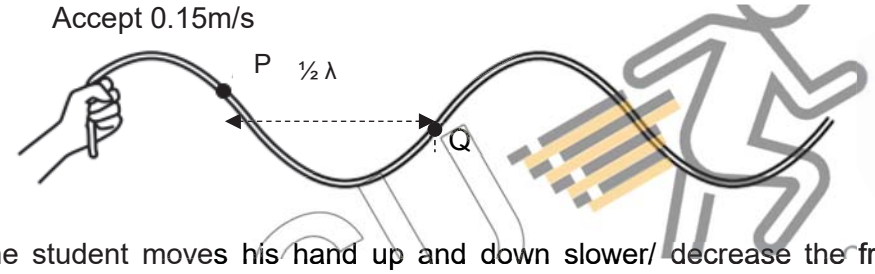
(d) No. The output voltage to c.r.o. is the same as the e.m.f. regardless of the resistance of thermistor.

10 **(a)** **(i)** amplitude = height from crest to tough / 2 = 2.0cm /2 = 1.0cm
Accept 0.9 to 1.1 cm

(ii) wavelength = distance between crest to crest = 6.0cm
Accept 5.8 to 6.2 cm

(iii) v = f λ
= (10/4) (6.0)
= 15 cm/s
Accept 0.15m/s

(b)



(c) The student moves his hand up and down slower/ decrease the frequency/ lower speed/ less times per second

(d) **(i)** *Accept one:*
Can travel in vacuum or
travel at 3.0×10^8 m/s in vacuum.

(ii) Ionisation is the removal of electrons from atoms/molecules to form ions.
Causes damage to living cells and abnormal cell divisions, e.g. cancer, deformed foetus.

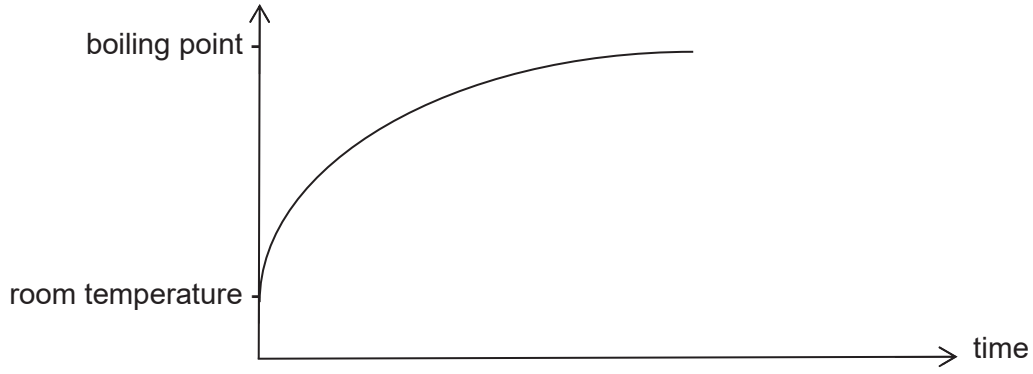
(iii) Radiowave

11 **(a)** Thermocouple or data logger with temperature sensor.

E

(b) Metal (is a good conductor of heat and) transfers thermal energy from the fire to the water quickly.
Shiny and smooth surface is a bad emitter of thermal energy.
Thermal energy is emitted to the surrounding at a slow rate.

(c)



(d) The bigger fire does not increase the temperature of the boiling water. Noodles is still cooked at the same temperature.

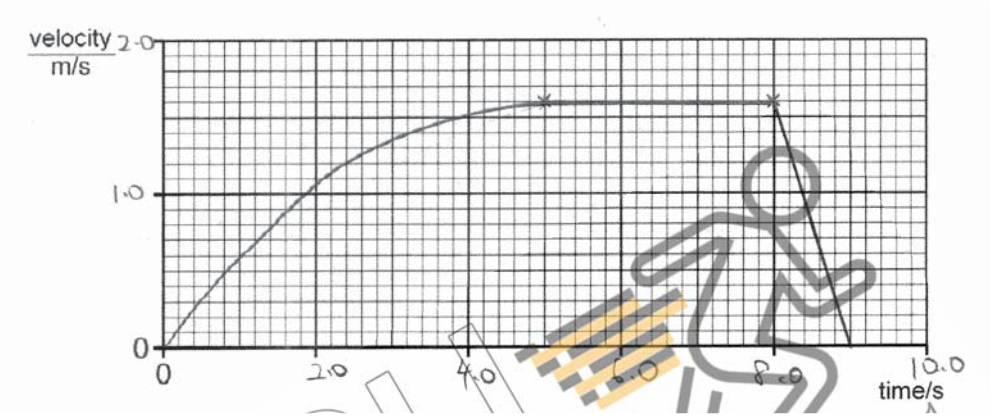
(e) **(i)** 2200kJ of thermal energy is needed to vaporise 1kg of water at boiling point.

(ii) When water is boiling, use a cold flat surface or the lid of the pot to condense the steam.
The mass of steam, m, condensed is measured using a weighing machine.
The time, t, take to condense the steam is measured using a stop watch.

Approx. rate of thermal energy supplied = m × 2200kJ/kg / t

Also accept measuring the different in mass of the pot and boiling water using weighing machine after a specific time.

11 O **(a)**



(b) Area under velocity-time graph

(c) **(i)** Decrease in GPE = mgh
= (25) (10) (2.0)
= 500J

(ii) Work done against the friction present between the moving parts in the ride/ work done against air resistance/ converted to thermal and sound energy
Energy cannot be created or destroyed but converted from one form to another and total energy is the same, i.e. the difference in loss of GPE and gain in KE is the amount of thermal and sound energy or work done against friction/air resistance.

(d) Measurement of least two distances/displacement and corresponding times mentioned.
Description of how the actual measurement is made
- make marking on the ground every second and measure the distances/displacements
- note video position every second and use a scale to find the distance/displacement
- make mark on ground every metre and measure the time as the girl passes

Description of how constant speed/velocity using measurement is proven
- Same distance/displacement travelled between each position for the same time interval
- Same time internal for same distance/displacement
- Constant gradient for distance-time graph/ displacement-time graph plotted.