F3 TOPICAL REVISION

PHYSICS

A SERIES OF TOPICAL QUESTIONS IN FORM 3 PHYSICS

FOR MARKING SCHEMES CALL/WHATSAPP 0705525657

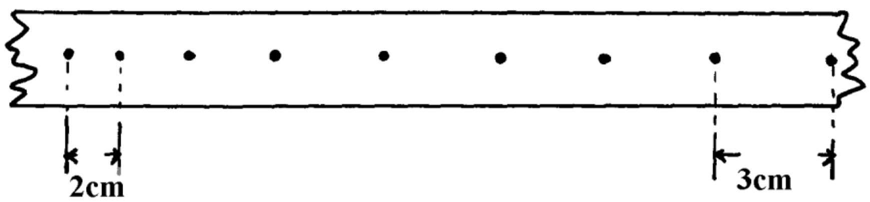
MR ISABOKE 0705525657

LINEAR MOTION

1. a) Distinguish between the terms '**uniform velocity'** and '**uniform acceleration**'

b) The figure below shows a section of a ticker tape. The dots were made at a frequency of 50 Hz.

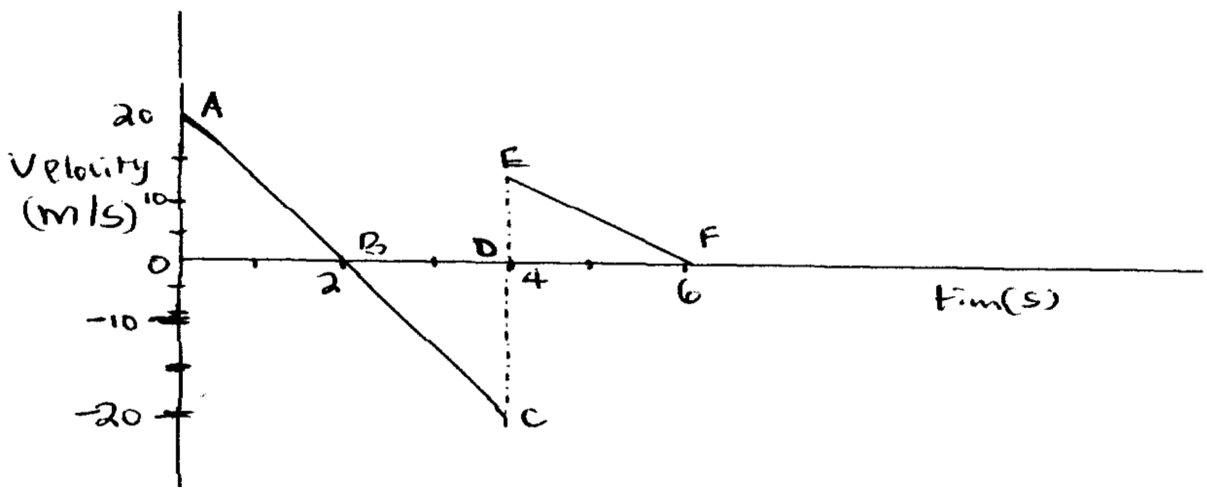
Determine the acceleration of the trolley pulling the tape



c) The graph below shows a part of the motion of a basket ball which is projected vertically

upwards from the ground and is allowed to bounce on the ground

E 20 A
10
B D
Velocity (m/s) 6
2 4 Time (s)
-20 -10 0



F

C

i) Explain the motion of the ball relating it to its different positions along the following

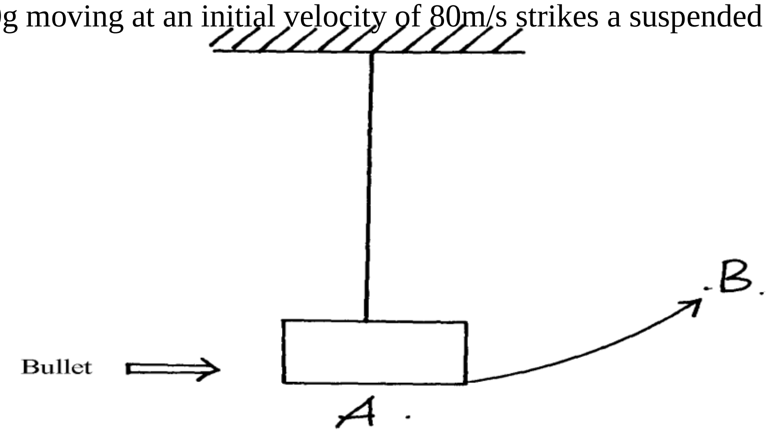
I.AB II.BC III.CE

ii) From the graph calculate the acceleration due to gravity

c) State Newton's second law of motion

2. One end of a metal rod is heated in a flame. After some time the other end becomes hot. Explain this observation

3. A bullet of mass 150g moving at an initial velocity of 80m/s strikes a suspended block of mass 2.5kg



3. (a)The block swings from point **A** to **B**. Determine the vertical displacement between **A** and **B**

. (b) What observations are you likely to observe on the block after collision

4. The diagram below shows a velocity – time graph of a certain motion.

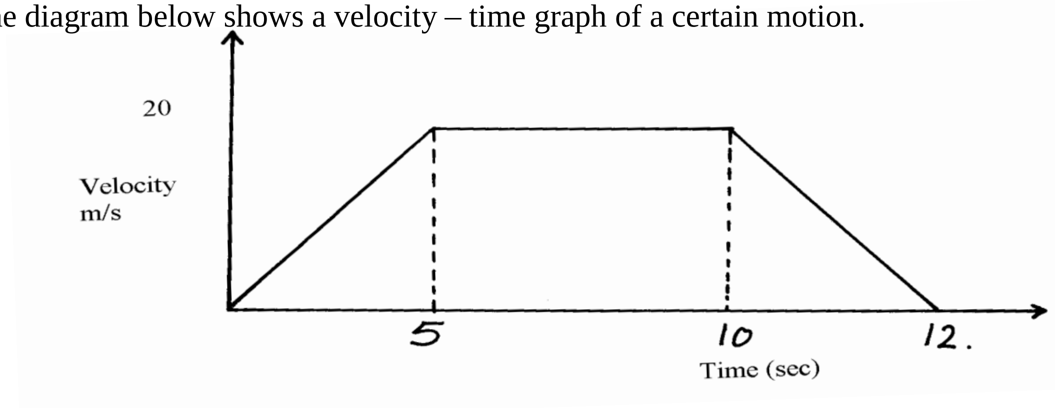


Figure 2

From the graph, determine the average speed of the body.

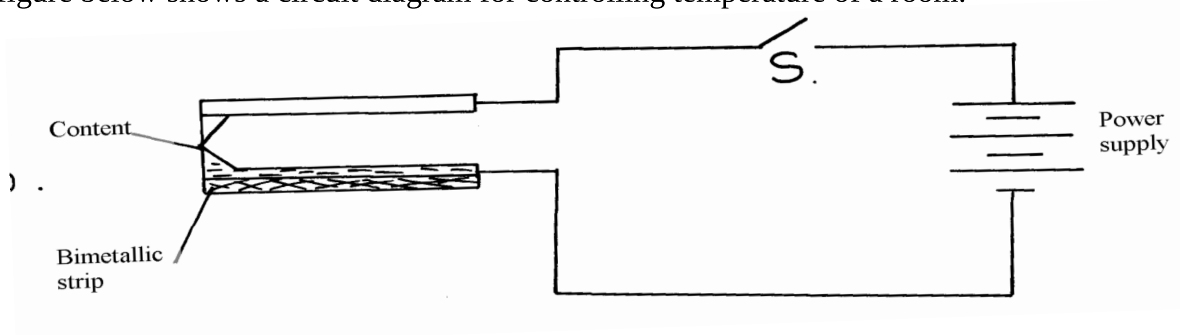
5. The diagram below shows a ball being whirled in a vertical plane.

Figure 7

(a) Sketch on the same diagram, the path followed by the ball if the string cuts when the ball
is at position shown in the diagram.

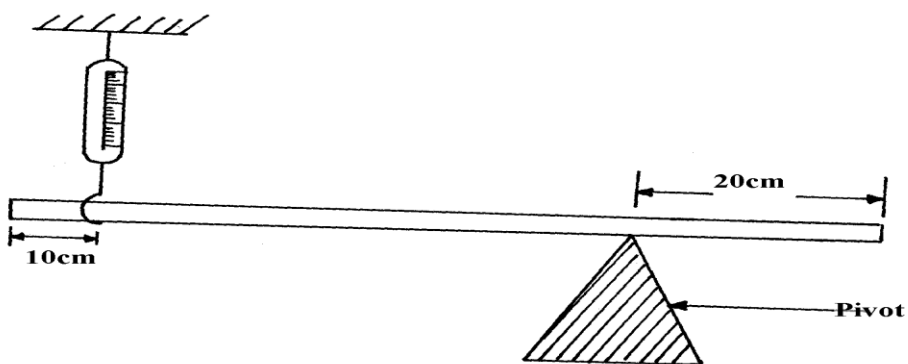
6. The figure below shows a circuit diagram for controlling temperature of a room.

Contact



(i) Explain the purpose of the strip.
(ii) Describe how the circuit controls the temperature when the switch S is closed.

7. The ***figure 5*** below shows a uniform bar of length 1.0m pivoted near one end. The bar is kept
in equilibrium by a spring balance as shown:



fiaure 5

Given that the reading of the spring balance is 0.6N, determine the reaction force at the pivot

8. The ***figure 8*** shows the motion of a train over a section of track which includes a sharp bend

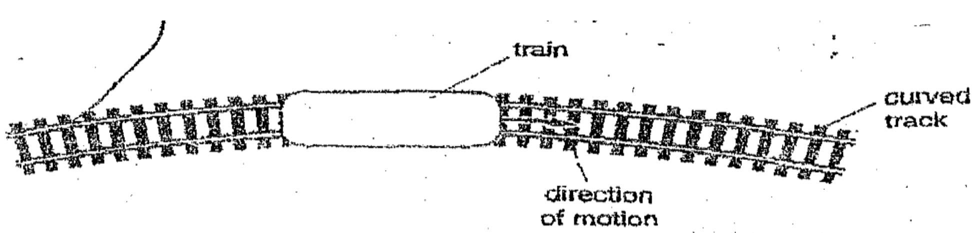
fiaure 8

(a) The section of the track with the sharp bend has a maximum speed restriction. The train decelerates approaching the bend so that at the start of the bend, it has just reached the maximum speed allowed. The train is driven around the bend at the maximum speed allowed and accelerates immediately on leaving the bend. Calculate the length of the bend

(b) The train has to slow down to go round the bend. Calculate the deceleration

(c) As the train is driven round the bend, there is an extra force acting, called the centripetal force.

(i) On the ***figure 9*** below, draw an arrow to show the direction of this force



fiaure 9

(ii) State the effect that this force has on the motion

(iii) State how this force is provided

(d) ***Figure 10*** below shows a car with a dummy driver before and after a collision test:

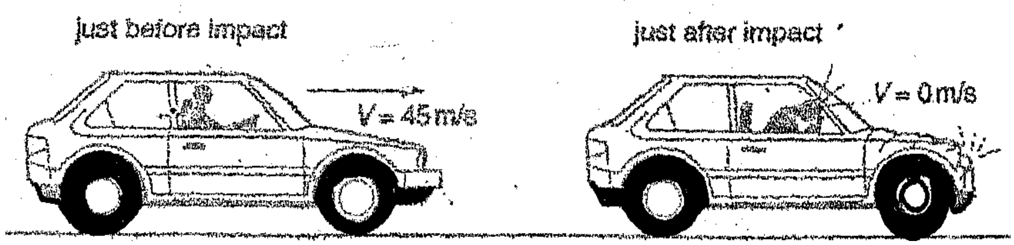


Figure 10

The mass of the dummy driver is 90kg. The impact time to reduce the dummy's speed from

$45ms^{-1}$ to zero is 1.2 seconds:

(i) Calculate the average force on the dummy during impact

(ii) State the main energy transformation during the collision

(iii) Calculate how much of the dummy's energy is transformed during the collision

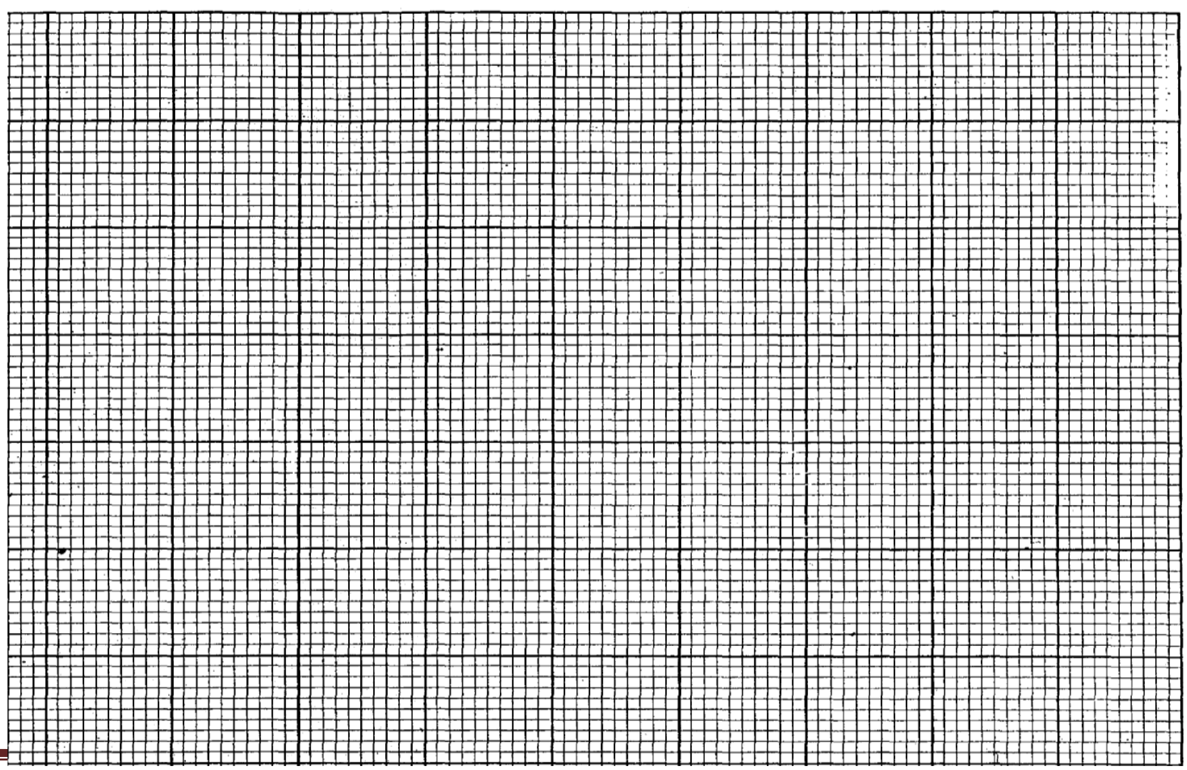
9. (a) The velocity-time graph in the figure below illustrates the motion of a ball which has been projected vertically upwards from the surface of the moon. The weight of the object on earth's surface is 20N, when the acceleration due to gravity is $10ms^{-2}$.

(i) State why the velocity becomes negative after 3seconds.

(ii) Determine the acceleration of free fall on the moon showing clearly your work

(iii) Determine the total distance travelled by the ball in 5.0sec

(iv) Find the weight of the ball on the moon



5

4

3

Velocity (m s^{-1})

1

0
1 2 3 4 5 6
-1
Time (s)
---2
--3
-4

(v) If the ball was projected vertically upwards on the earth with the same velocity. What difference would you expect to observe in the velocity-time graph above. Illustrate with a sketch on the same axis

(b) The figure below represents part of a tape pulled through a ticker-timer of frequency 50Hz moving down an inclined plane.

If the trolley was allowed to move down the inclined plane for 4 seconds, calculate the distance it covers

10. (a) State Boyle's law

(b) The volume of a bubble at the base of a container of water is 3cm^3. The depth of water is 30cm. The bubble rises up the column until the surface ;

(i) Explain what happens to the bubble as it rises up the water column

(ii) Determine the volume of the bubble at a point 5cm below the water surface

(c) A faulty thermometer records 11^{o}C instead of 0^{o}C and 98^{o}C instead of 100^{o}C. Determine the reading on the thermometer when dipped in liquid at a temperature of 56^{o}C

11. Figure 9 is a velocity- time graph describing the motion of a particle

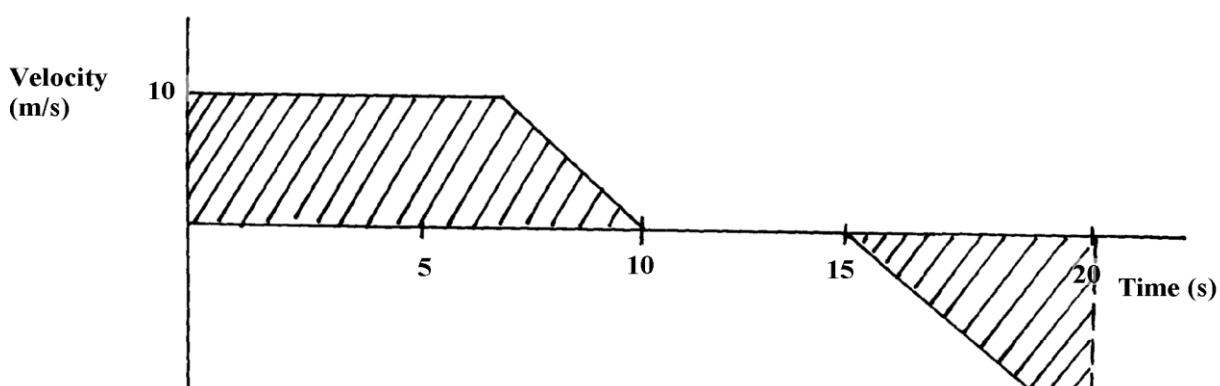


Fig. 9

What does the shaded area represent?

12. a) State Newton's first law of motion

b) A parcel is to be dropped from an aeroplane traveling horizontally at $120ms^{-1}$, at an altitude

of 720m, to fall into a certain village.

Determine:

i) The time taken for the parcel to reach the ground

ii) How far ahead of the plane, the village should be when the parcel is released

c) A small stone, $M_1$of mass 20g is attached to a string which in turn is passed through a smooth

thin cylinder. The other end of the string is tied to mass M_2. The mass M_1 is whirled in a horizontal circle of radius 1m and mass M_2 remains stationary as shown in figure 10

i) State **two** forces acting on the system other than the tension in the thread on M_2

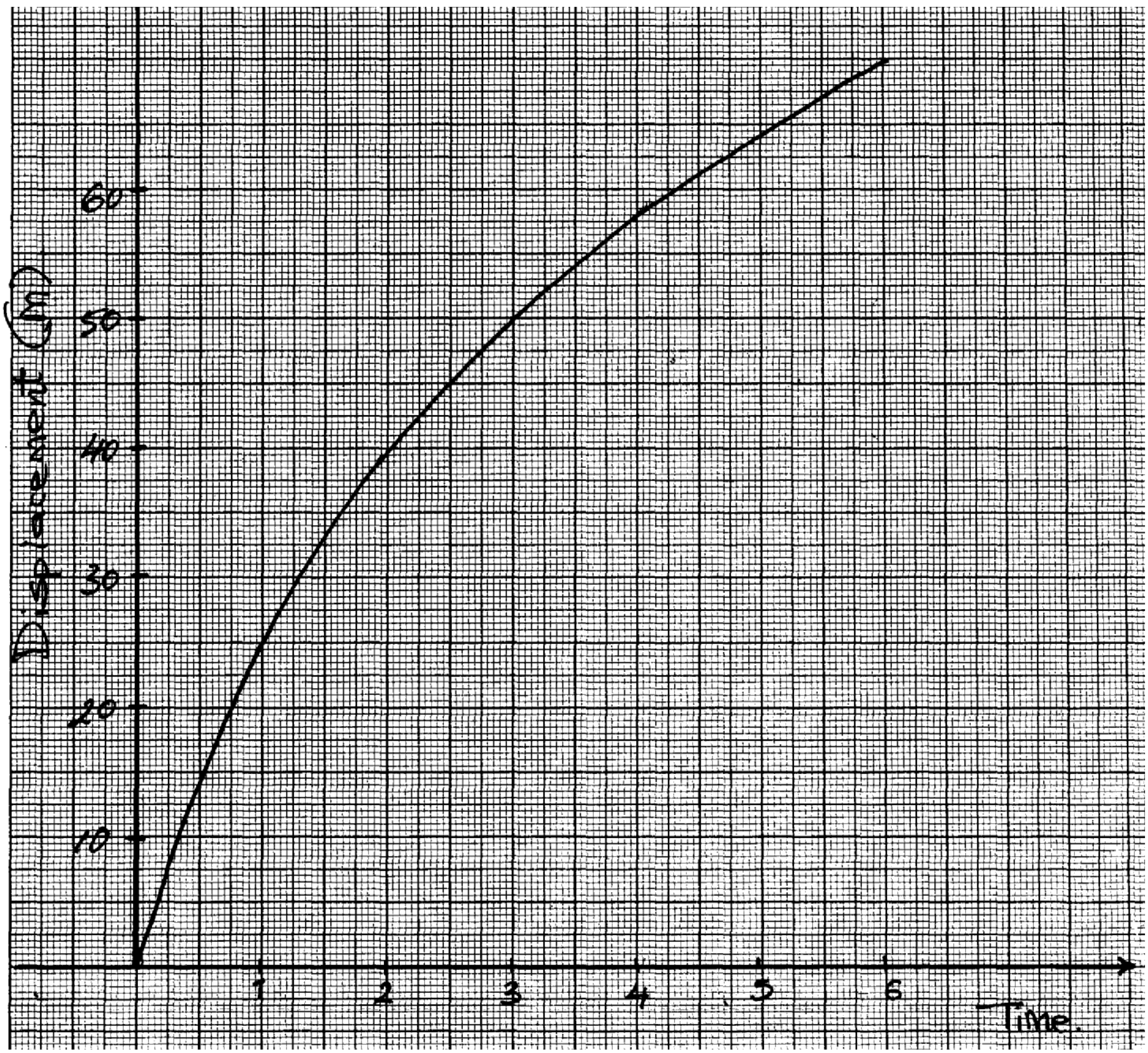
ii) Explain the observation made on mass M_2 if the speed of M_1, is increased

iii) Calculate the velocity of M_1, if the mass M_2 is 50g and the radius of the circle is 1m

13. (a) Define uniform velocity

(b) The graph ***figure 10*** below shows displacement –time graph of **a** in motion

fig 10



(i) Determine the instanteous velocities at **t = 1second** and at **t = 4 seconds**

(ii) Use the results in **(b)(i)** above to determine the acceleration of the body

14. A ball of mass 100g is kicked horizontally from the top of a cliff. If the ball takes 4 seconds to hit the ground, determine the height of the cliff

15. A ball is kicked vertically upward from the ground with a velocity of 60m/s and reaches a maximum height (h), it then falls freely back to the ground and bounces upwards to a height of 5M

(a) Sketch a velocity-time graph to represent the motion of the ball from the time it is kicked vertically upwards until it bounces to a height of 5M

(b) Determine:

(i) the time taken by the ball to reach the maximum height(h)

(ii) The maximum height (h) reached by the ball

(iii) The velocity with which it bounces after striking the ground for the first time

(c) State any assumption made in your calculations in **(b)** above

16. In an experiment on momentum, trolley **P** of mass 800g was attached to a ticker timer of frequency 50Hz. Trolley P, initially moving with a velocity of 0.5m/s, was made to collide with a stationary trolley **Q** of mass 400g. A copy of the tape as it appeared after the collision is presented in the figure below:-

(a) Determine the velocity of the trolley **P** after collision

(b) Calculate the impulsive force experienced by trolley **P**

(c) State the type of collision

17. I. (a) State the **three** equations of linear motion.

(b) A car is traveling uniformly at 100km/hr when the driver observes a road block ahead.

He takes 0.5 s before applying the brakes which brings the car to rest with a uniform deceleration of $4m/s^2$. Determine the distance traveled by the car from the time the driver observed the road block until the car comes to rest.

(c) A car moves at a constant speed of $20ms^{-1}$ for 50s and then accelerates uniformly to a speed of $25ms^{-1}$ over a period of 10s. This speed is maintained for 50 s before the car is brought to rest with uniform deceleration in 15s.

(d) Draw a graph of velocity (Y – axis) against time (graph paper to be availed)

(II) Calculate:

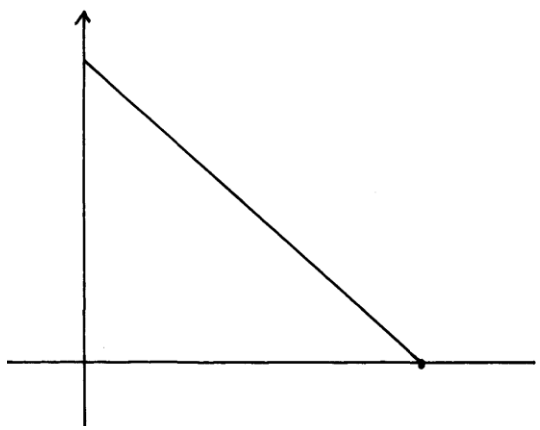
(i) The average speed for the whole journey.

(ii) The acceleration when the velocity changes from 20 ms^{-1} to $25ms^{-1}$.

m, show that $v^2=2as+u^2$

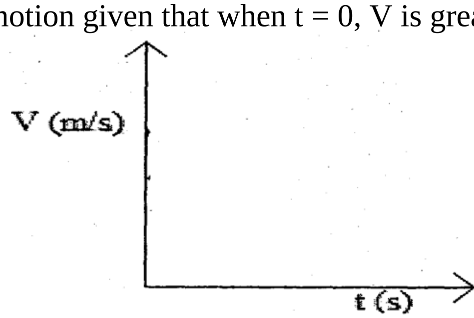
18. Sketch a velocity-time graph for a body moving with zero acceleration

19. The figure below shows a velocity –time graph of a ball bouncing vertically upward from the ground. The velocity upward is taken positive.



Determine the maximum height when the ball rises.

20. (a) On the axes provide below, sketch a graph of velocity V versus time (t) for uniformly accelerated motion given that when t = 0, V is greater than zero.



(b) A car is brought to Rest from a speed of 20 ms^{-1} in time of 2 seconds. Calculate the deceleration.

21. (a). State the law of **linear momentum**

(b). A marble of mass 50g moving on a horizontal surface at a velocity of V collides with another glass marble of mass 75g resting on same horizontal surface. After collision, the marble bounces back a long the path at a speed of 3.5m/s while the other marble moving with a speed of 3.0m/s .Forward .

Determine the speed V.

(c). The paper below was attached to a trolley and pulled through a ticker tape times of frequency 50Hz. Determine the acceleration of the trolley.

(d). Study the figure below

Calculate the pressure in the steam in the cylinder which would just raise the piston if area of of the piston in contact with steam is $2cm^2$ and Atmospheric pressure is1.0×10^5 Nm^{-2}.

(e) State a reason why the earth is colder at night than daytime during a sunny

21. A block of mass 20kg slides downward a plane inclined of 6o0 with the horizontal. The coefficient of friction between the plane and the block is 0.4.

Calculate the acceleration of the block.

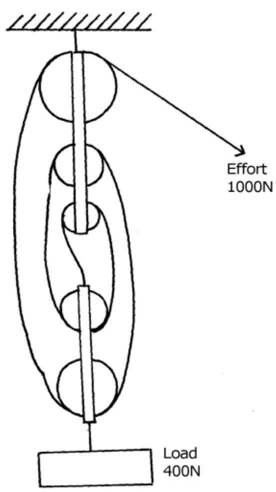
22. A body accelerates uniformly from initial velocity of U m/s to a final velocity of V m/s in time t seconds. If acceleration during the motion is a m/s^2 and the distance covered is S

Machines & inclined planes

1. An inclined plane of length 5m is used to raise a body of mass 60kg to the back of a lorry. If the plane is inclined at an angle 25° from the horizontal, calculate the efficiency of the system given that a constant force of 650 N is used to push the body up the plane

2. Vicky performed an experiment using a pulley system as shown in the figure.

Figure 13



Effort 1000N

LOAD **4000N**

(a) What is the V.R. of the system?

(b) Determine the M.A. of the system.

*

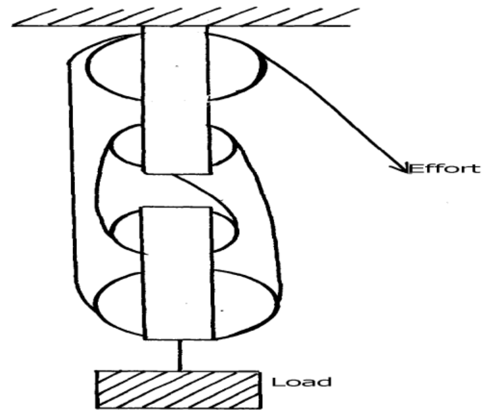
(c) Calculate the efficiency of the system.

(d) Explain why efficiency of a practical machine is always less than 100%

(e) If the load moves a distance of 5 cm. Find the work done on the load.

3. The figure below shows a pulley system being used to raise a load. Use the information given in the figure to answer questions (**a**) and **(b**)

fig. 3

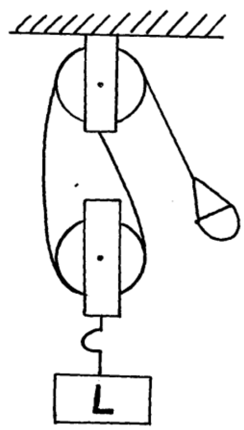


(ii) If a load of 100N is raised by applying an effort of 48N, determine the efficiency of the system.

4. (a) (i) Define the term **velocity ratio (V.R)**

(ii) Name **one** machine that has a velocity ratio of less than one (V.R < 1)

(b) The figure below shows a set-up used to find the mechanical advantage of a pulley system



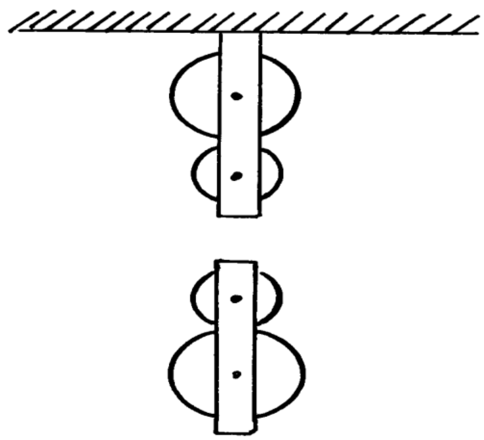
On the axes provided sketch a graph of mechanical advantage (M.A) against load (L)

(c) A hydraulic machine is used to raise a load of 100kg at a constant velocity through a height of 2.5m. The radius of the effort piston is 1.4cm while that of the load piston is 7.0cm. Given that the machine is 80% efficient, calculate:-

(i) The effort needed

(ii) The energy wasted in using the machine

5. (i) complete the diagram below to show how the pulley can be used to raise a load **L** by applying an effort **E**

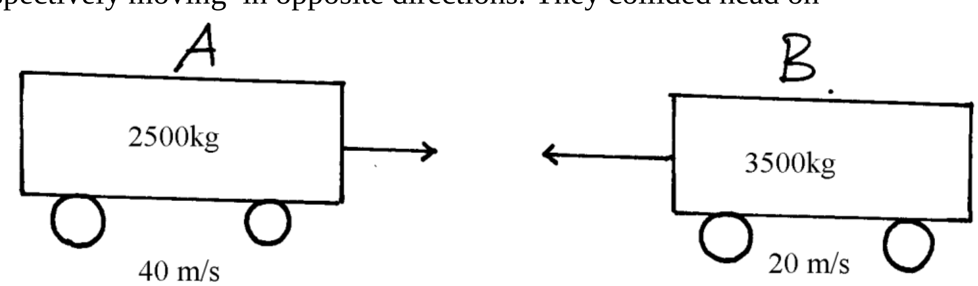


(ii) The pulley system above has a mechanical advantage of 3. Calculate the total work done when a load of 60N is raised through a height of 9M

Newton's law

1. (a) State Newton's first law of motion
   (b) Distinguish between elastic collision and inelastic collision
   (c) A minibus of mass 2000kg traveling at a constant velocity of 36km/h collides with a stationary car of mass 1000kg. The impact takes 2 seconds before the two move together at a constant velocity for 20 seconds. Calculate:
   (i) The common velocity
   (ii) The distance moved after impact
   (iii) The impulse force
   (iv) The change in kinetic energy
2. State Newton's second law of motion
3. State the law of inertia
4. A footballer kicks a ball of 600g initially at rest using a force of 900N. If the foot was in contact with the ball for 0.1sec. What was the take off speed of the ball?
5. State Newton's third law of motion

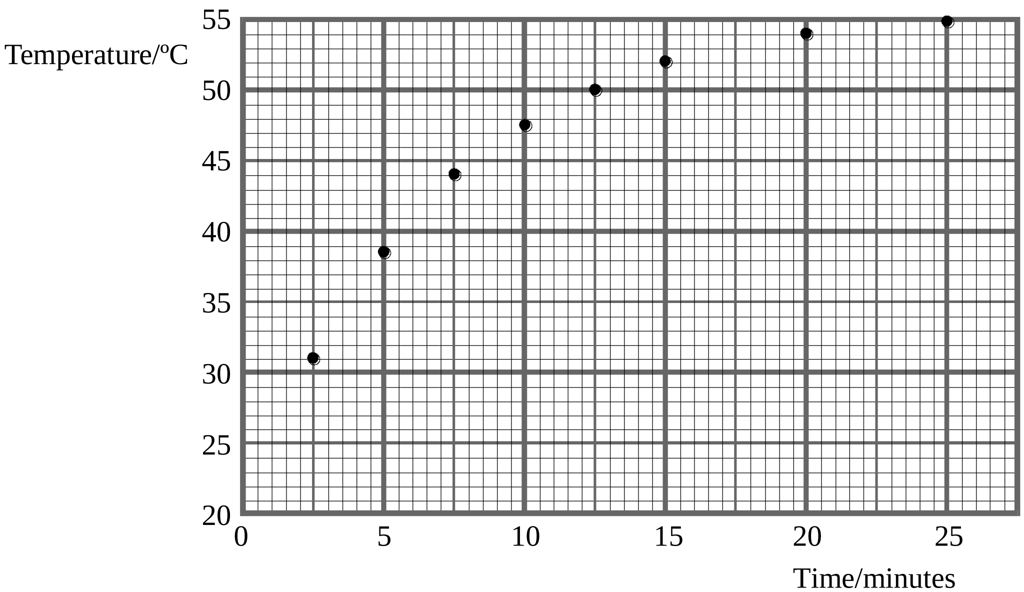
6. (a) State **Newton's second law** of motion
   (b) The figure below shows two mini buses **A** and **B** at a speed of 40m/s and 20m/s respectively moving in opposite directions. They collided head on



Determine the common speed of the vehicles if they stuck to each other

HEAT ENERGY

1. A student pours 500 g of water into an aluminium saucepan of mass 1.20 kg, heats it over a steady flame and records the temperature as it heats up. The temperatures are plotted as shown below.



Calculate the total heat capacity of the saucepan and water.

Specific heat capacity of water = 4200 J kg^{-1} K^{-1} Specific heat capacity of aluminium = 900 J kg^{-1} K^{-1}

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Heat capacity = ...

(3) Find the rate of rise of water temperature at the beginning of the heating process.

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Rate of rise of temperature = ...

(2)

Hence find the rate at which energy is supplied to the saucepan and water.

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Rate of energy supply = ...

(2)

Explain why the rate at which the temperature rises slows down progressively as the heating process continues.

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(2)
(Total 9 marks)

2. You are asked to measure the specific heat capacity of aluminium using a cylindrical block of aluminium which has been drilled out to accept an electrical heater.
Draw a complete diagram of the apparatus you would use.

(3)

Describe how you would carry out the experiment and list the measurements you would take.

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(5)

Explain how you would calculate the specific heat capacity of aluminium from your measurements.

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(3)
(Total 11 marks)

3. A container holding 2.3 litres of milk at 15 □C is put into a freezer. Calculate the energy that must be removed from the milk to reduce its temperature to the freezer temperature of –30 □C. Assume that the milk behaves like ice and water.

Specific heat capacity of water = 4.2 kJ kg^{-1} K^{-1}
Specific heat capacity of ice 2.1 kJ kg^{-1} K^{-1}
Specific latent heat (enthalpy) of fusion of ice = 330 kJ kg^{-1}
Density of water = 1.0 kg $litre^{-1}$

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Energy removed = ...…

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6) It costs 8.2 p per kWh to remove energy from the freezer. What is the cost of freezing the milk?

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Cost = ...…

(2)
(Total 8 marks)

4. A small house uses a tank containing 1.2 m^3 water as a thermal store. During the night its temperature rises to 98 ^oC. During the day, its temperature drops as the water is pumped round, the house radiators to keep the house warm.

The density of water is 1 000 kg m^{-3} and its specific heat capacity is 4200 J kg^{-1} K^{-1}. Calculate the energy given out by the water on a day when its temperature drops from 98 $^\circ C$ to 65 °C.

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Energy = ...

(3)

The six radiators in the house give out an average power of 1.5 kW each. For how long can they all operate at this power before the water temperature drops to 65□C?

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Time = ...

(3)

Explain why this heating system operates more effectively early in the morning than towards the evening.

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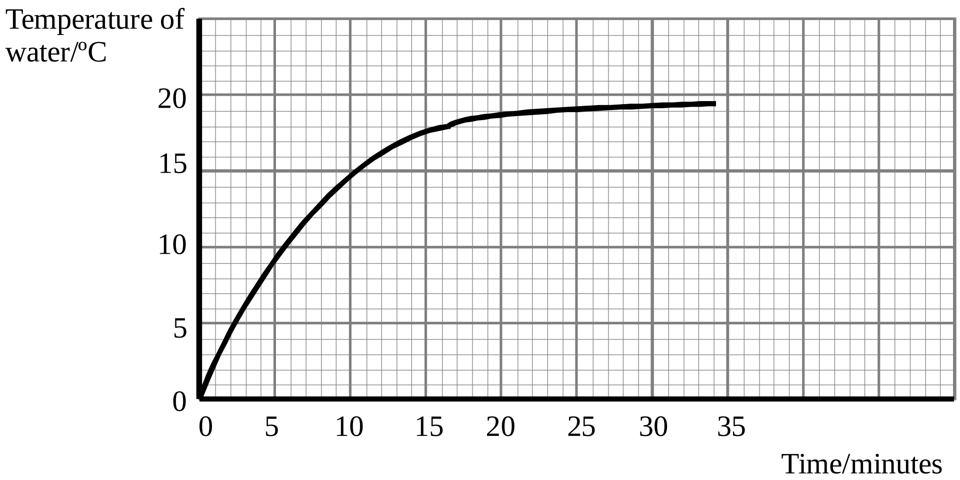
(2)
(Total 8 marks)

5. A thin beaker is filled with 400 g of water at 0°C and placed on a table in a warm room. A second identical beaker, filled with 400 g of an ice-water mixture, is placed on the same table at the same time. The contents of both beakers are stirred continuously.

The graph below shows how the temperature of the water in the *first* beaker increases with time.



Use the graph to find the initial rate of rise of water temperature. Give your answer in Ks^{-1}.

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Rate of rise = ………........……..............

(2)

The specific heat capacity of water is 4200 J kg^{-1} K^{-1}. Use your value for the rate of rise of temperature to estimate the initial rate at which this beaker of water is taking in heat from the surroundings.

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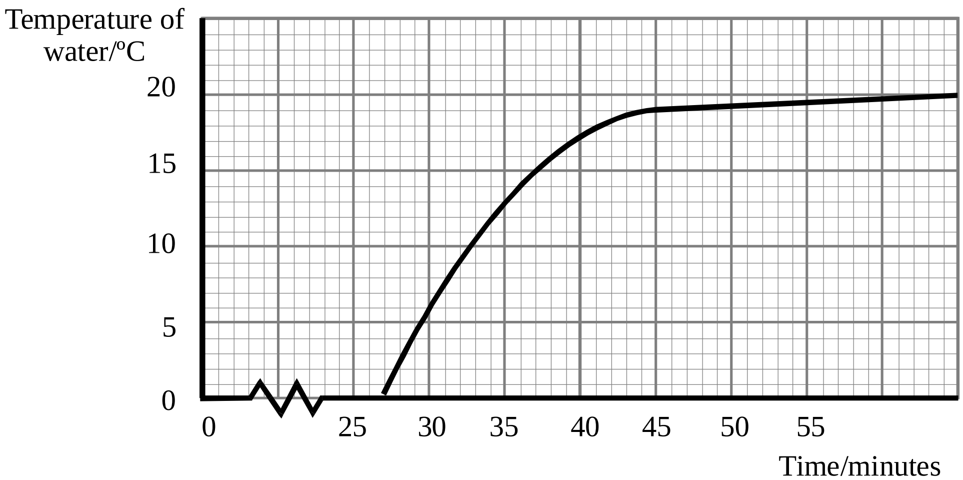
Rate of heat input = ………........……..............

(3)

The graph below shows the temperature of the water in the second beaker from the moment it is placed on the table.



How do you explain the delay of twenty-seven minutes before the ice-water mixture starts to warm up?

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(2)

The specific latent heat (enthalpy) of ice is 2.27 MJ kg^{-1}. Estimate the mass of ice initially present in the ice-water mixture.

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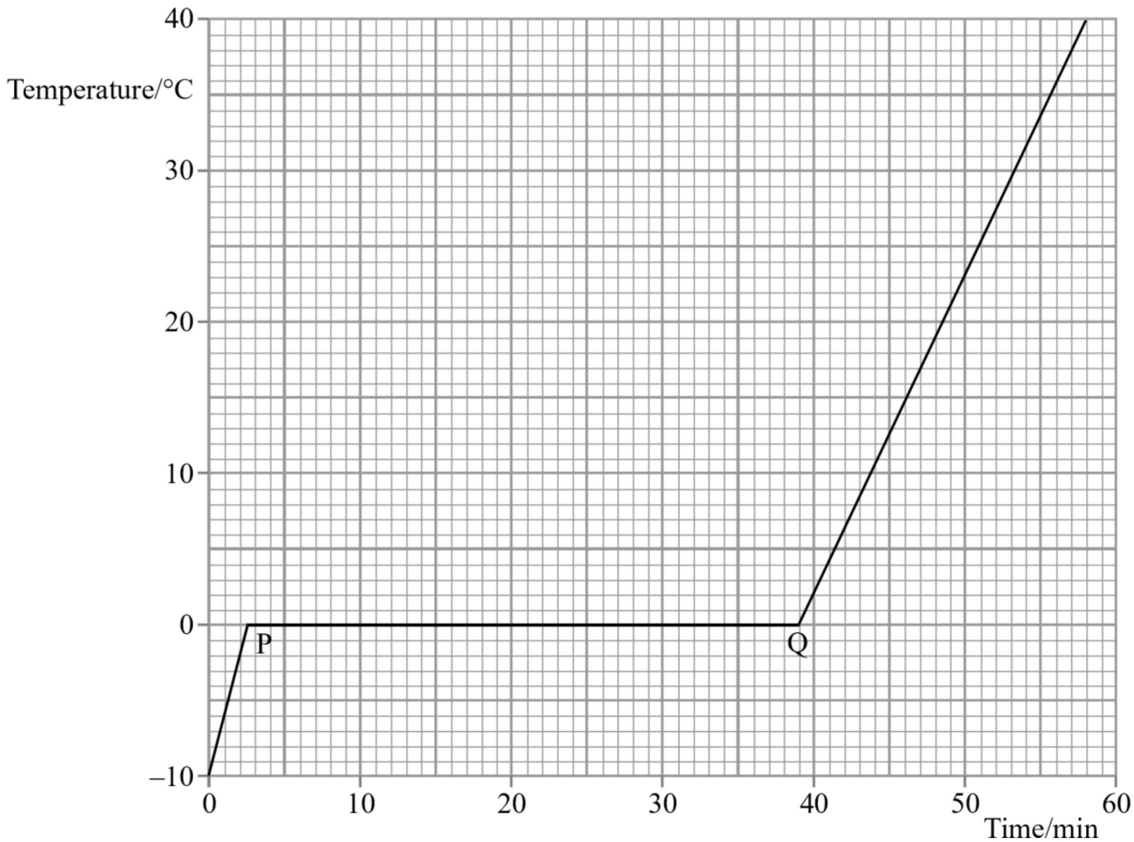
Mass =……….........……...............

(4)
(Total 11 marks)

6. A well-insulated vessel contains 0.20 kg of ice at –10 °C. The graph shows how the temperature of the ice would change with time if it were heated at a steady rate of 30 W and the contents were in thermal equilibrium at every stage.



Describe in terms of molecules the change which occurs between points P and Q.

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(2) Use the graph to determine the specific latent heat of fusion of water.

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Specific latent heat of fusion ....

(3)

A student tries to plot this graph experimentally. He places crushed ice at –10 °C in a wellinsulated beaker containing a small electric heater. What additional equipment would he need, and how should he use it, to obtain the data for his graph?
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(2)

Suggest one precaution he should take to try to get an accurate graph.
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(1)

Gallium is a metal with a melting point of 29 °C. Its specific heat capacity, in both the solid and liquid state, and its specific latent heat of fusion, are all smaller than those of water. Add to the graph above a second line showing the results you would expect if 0.20 kg of gallium, initially at –10 °C, was heated at the same rate of 30 W.

(3)
(Total 11 marks)

7. You are asked to measure the specific heat capacity of aluminium using a cylindrical block of aluminium which has been drilled out to accept an electrical heater and a thermometer.
Draw a complete diagram of the apparatus you would use.

(3)

List the measurements you would take and explain how you would calculate the specific heat capacity of aluminium from your measurements.

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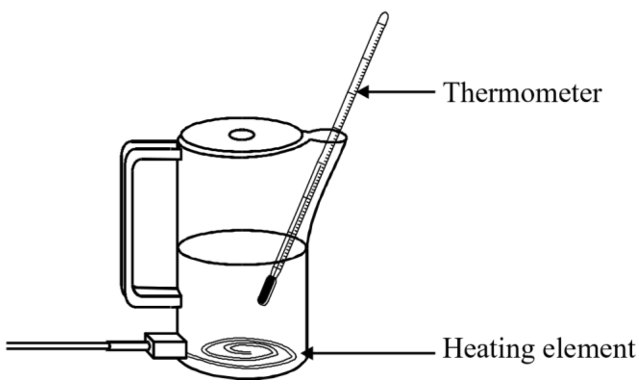
(6)
(Total 9 marks)

8. Water in a plastic kettle is heated by an electric element near the bottom of the kettle. The temperature of the water near its surface can be recorded on a thermometer.



A kettle contains 0.70 kg of water at an initial temperature of 20°C. It is calculated that about 250 kJ of thermal energy is needed to heat the water from 20°C to 100°C. Show how this value is calculated.
(The specific heat capacity of water is 4200 J kg^{-1} K^{-1}.)

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(2)

Calculate the time it should take for an element rated at 2.2 kW to supply this energy.

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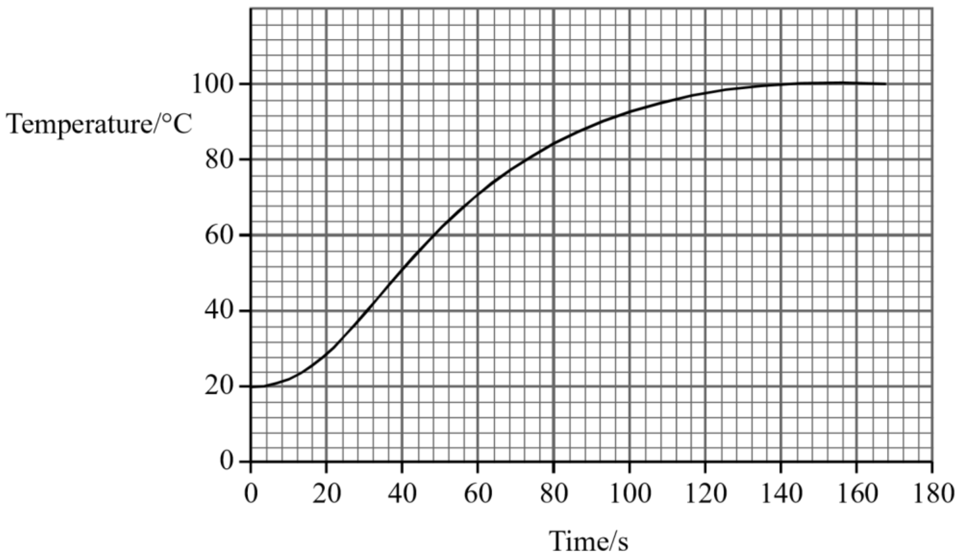
Time = ...

(3)

To check this calculation, the kettle is switched on at t = 0 s and temperature readings are taken as the water is heated. The graph shows how the temperature varies with time.



Use the graph to fully describe qualitatively how the temperature of the water changes during the first 160 s.

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(3) Estimate the efficiency of the electric heating element in bringing the water to the boil.

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Efficiency = ...

(2)
(Total 10 marks)

9. Define the term **specific latent heat of fusion**.

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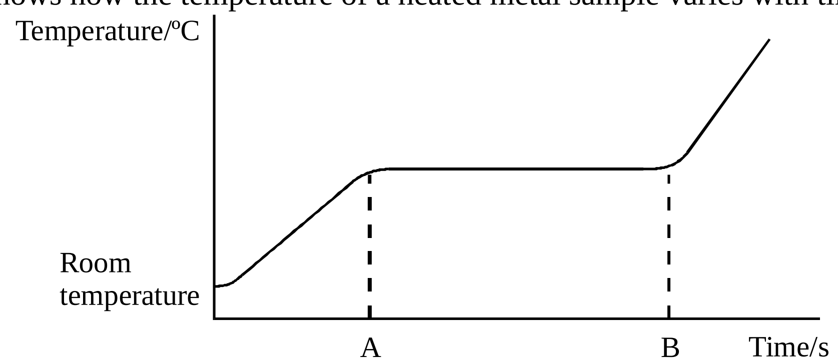
(3)

The graph shows how the temperature of a heated metal sample varies with time.



During the time interval AB, the metal changes from a solid to a liquid whilst still being heated. Explain, in molecular terms, what is happening to the energy being supplied during this time.

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(1)

Describe, in molecular terms, the main differences between the solid and liquid states. You may illustrate your answer with simple diagrams.

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(2)
(Total 6 marks)

10. Define the term **specific heat capacity**.

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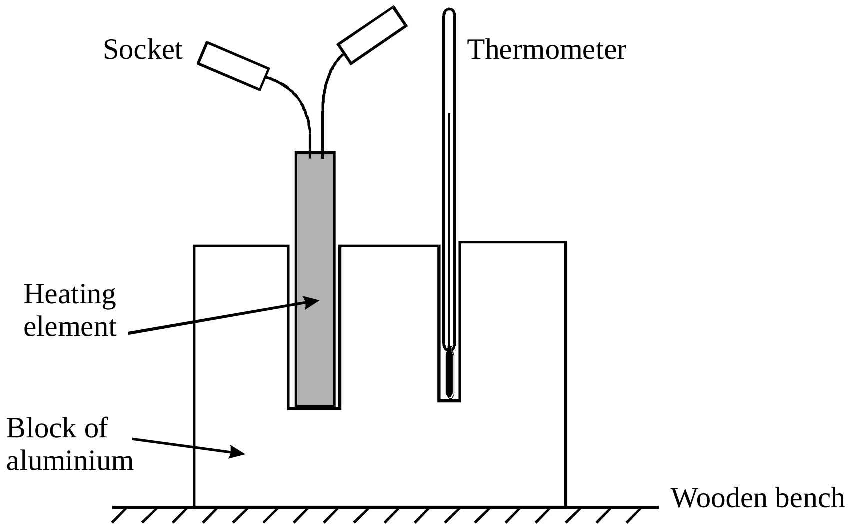
(2)

A student decides to measure the specific heat capacity of aluminium by an electrical method. He selects his apparatus and then assembles the aluminium block, the thermometer and the heating element as shown.



The student intends to substitute his results into the relationship

$$mc\Delta T = VIt$$

Draw a diagram of the electrical circuit he would need to set up in order to be able to carry out the experiment.

(3)

What other pieces of apparatus would he need?

....

....

(2)

He carries out the experiment and then calculates his value for the specific heat capacity of aluminium. He discovers that his value is higher than the accepted value of 900 J kg^{-1} K^{-1}.

Suggest why his result is higher than 900 J kg^{-1} K^{-1}.

....
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....
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(1)

With reference to the apparatus shown in the diagram, state two modifications that he should make in order to minimise the discrepancy.

1. ....
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2. ....
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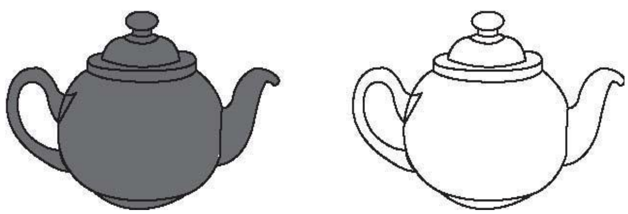
(2)
(Total 10 marks)

11. Two metal teapots are identical except that one is black on the outside and the other is white on the outside, as shown below.



The teapots each contain the same amount of hot water.

State and explain which teapot will cool down more quickly.

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.... [3]

[Total]

12. Fig. 3.1 shows a thermometer.

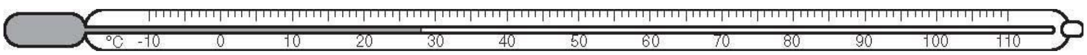

Fig. 3.1

(a) Explain how to calibrate a thermometer.

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....

[3]

(b) **(i)** State the range of the thermometer in Fig. 3.1.

.... [1]

(ii) State how you know that the scale of the thermometer in Fig. 3.1 is linear. ....

....

.... [1]

(c) Fig. 3.2 shows a thermometer which is more sensitive than the thermometer in Fig. 3.1. Only 0 °C is marked on this new thermometer.

On Fig. 3.2, draw the temperature markings for 10 °C and 20 °C. [1]

13 **(a)** State two differences between evaporation of water and boiling of water.

1...

2. ....[2]

(b) The specific latent heat of vaporisation of water is 2260 kJ / kg. Explain why this energy is needed to boil water and why the temperature of the water does not change during the boiling.

....

....

....

....[3]

(c) A laboratory determination of the specific latent heat of vaporisation of water uses a 120 W heater to keep water boiling at its boiling point. Water is turned into steam at the rate of 0.050 g / s. Calculate the value of the specific latent heat of vaporisation obtained from this experiment. Show your working.

……

……

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……

……

specific latent heat of vaporisation = ...[3]

14.A form IV student is investigating the temperature rise of water in beakers heated by different methods. The apparatus is shown in Fig. 4.1. Beaker A is heated electrically and beaker B is heated with a Bunsen burner.

fixed voltage

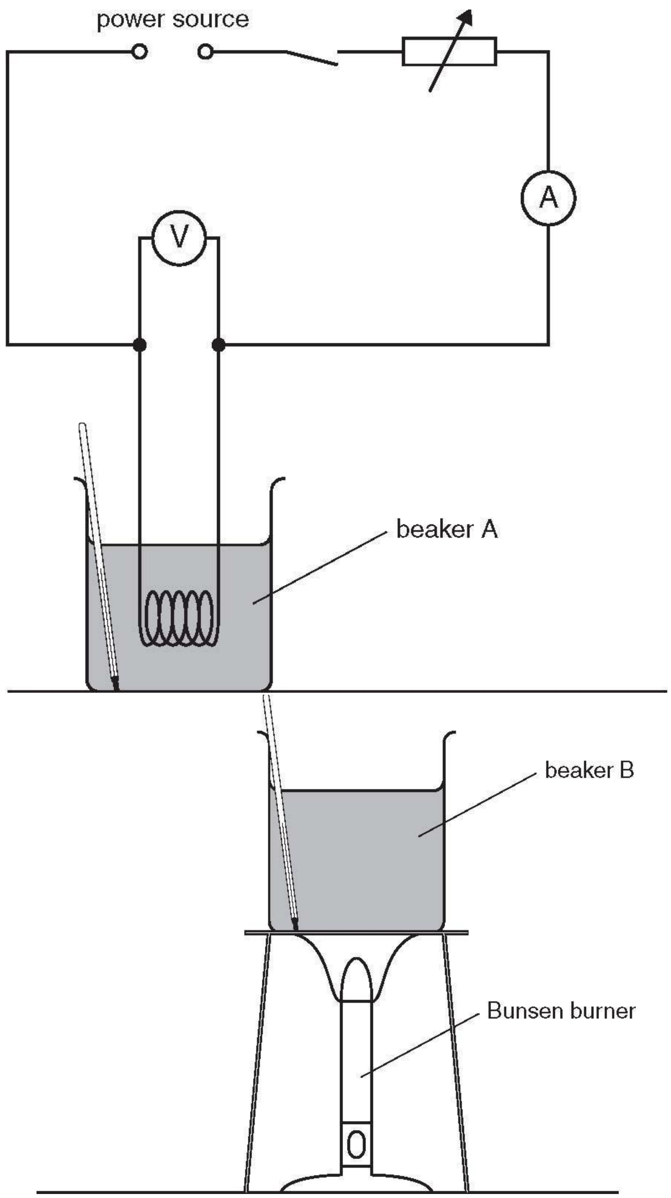


Fig. 4.1

The student first records room temperature.

(a) Fig. 4.2 shows the thermometer at room temperature.

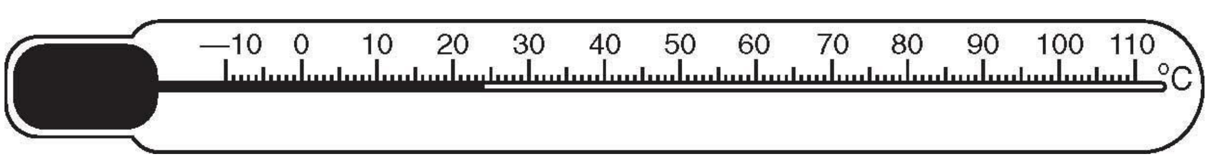


Fig. 4.2

(i) Write down the value of room temperature. room temperature = ... [1]

(ii) The two beakers are heated from room temperature for the same length of time. The new water temperature for beaker A is 30 °C and for beaker B is 28 °C. Calculate the temperature rise of the water in each beaker.

temperature rise in beaker A = ...

temperature rise in beaker B =

.... [1]

(b) The electrical heater and the Bunsen burner both have the same power and both beakers were heated from room temperature for the same length of time. Suggest why there is a difference in temperature rise between beaker A and beaker
B.

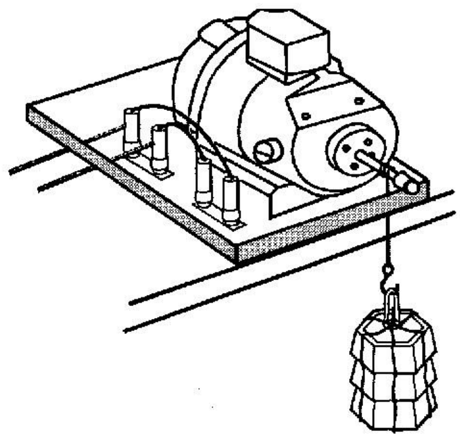
....
....
.... [2]

(c) In order to keep the heating effect of the electrical heater constant throughout the heating period, the student adjusts the current. Name the component in the circuit that the student uses for this purpose.

....
.... [1]

WORK,POWER,ENERGY & MACHINES

1. (a) An electric motor is used to raise a mass of 1.5 kg through a vertical height of 1.2 m. The load is raised at a steady speed.



(i) Calculate the increase in gravitational potential energy of the load when it is raised through 1.2 m.
The gravitational field strength is 10 N/kg.

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....

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(3)

(ii) The time taken to raise the load is 4.0 s.
Calculate the power output of the electric motor as it raises the load.

....

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(3)

(iii) The input power to the motor as it raises the load is 30W. Calculate the efficiency of the motor.

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....
(3) (b) Suggest a reason why the power given out by the motor is less than the power put in.

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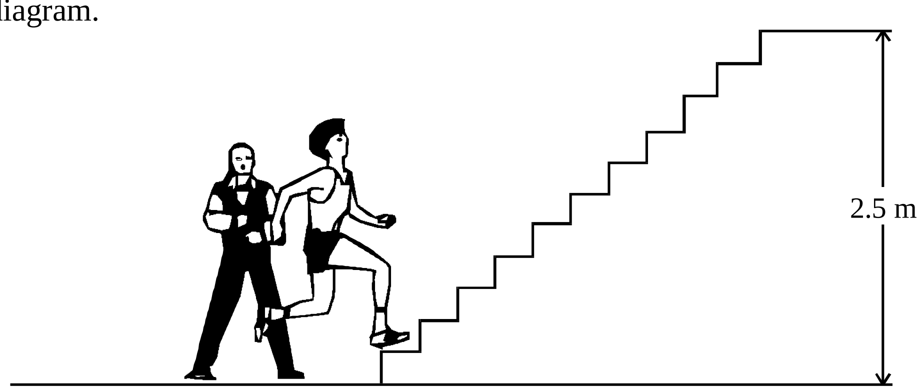
(1)
(Total 10 marks)

2. (a) Two friends are calculating the power needed to climb some steps.
The girl measures how long the boy takes to run up the steps shown in the diagram.



(i) The value of g is 10 N/kg. The mass of the boy is 50 kg.

Calculate his weight.

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....
....

(3) (ii) The vertical height of the steps is 2.5 m.

How much work did the boy do in climbing the steps?

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....
....

(3)

(iii) It took the boy 5 seconds to run up the steps. Using

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

calculate the power developed by the boy as he ran up the steps.

....

....

....

(2)

(b) The girl then tried the experiment and took 3 seconds to run up the steps.
Her weight is the same as the boy's.
Was her power output more or less than his?
Explain how you decided.
....
....
....
(2)
(Total 10 marks)

3. (a) A car is travelling along a straight flat road at 30 m/s.

(i) What type of energy does it have?

....
....
(1)

(ii) When the brakes are applied the car is brought to a stop. What has happened to the energy it had whilst moving?

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....
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....
(1)

(b) The car starts going up a hill. The driver notices that the speed of the car begins to decrease. He has not applied the brakes or altered the setting on the accelerator.

Explain in terms of energy why the car's speed begins to decrease.
....
....
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....
(2)

(c) When the driver brakes, the distance needed to stop the car moving at 30 m/s up a hill is less than the distance on a flat road.

Explain why.
....
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(1)

(d) A journey involving a lot of speeding up and slowing down uses more petrol than one where the speed remains fairly constant.

Explain this in terms of energy.

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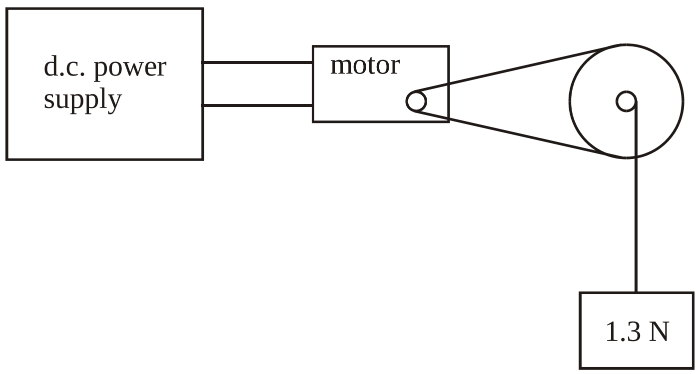
(3)
(Total 8 marks)

4. The diagram shows a small electric motor being used to lift a weight of 1.3 N.

The power input to the motor from the supply is 0.6 W.



(a) The gravitational potential energy of the weight increases by 1.04 J in 4 s.

(i) Calculate the rate at which the weight gains gravitational potential energy.

....

....

(2) (ii) Calculate the height through which the weight is lifted in 4 s.

State the equation you use in your calculation.

....

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....

(3)

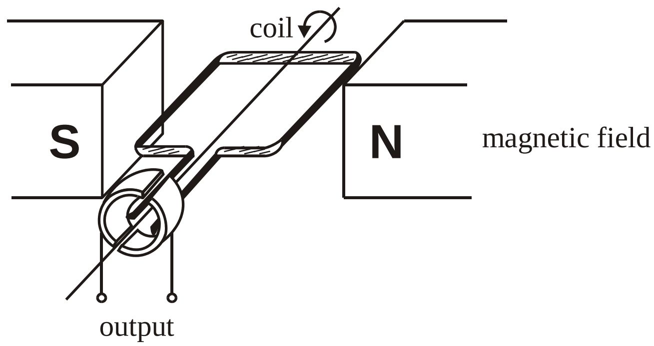
(iii) Calculate the efficiency of the motor.

....

....

(2)

(b) (i) The raised weight is held in place whilst the power supply is disconnected and a small lamp is connected across the output to the motor. The weight is released and the lamp lights.



Explain this with reference to the diagram of the motor.

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(2)

(ii) The brightness of the lamp is observed to increase as the weight falls.

Explain this.

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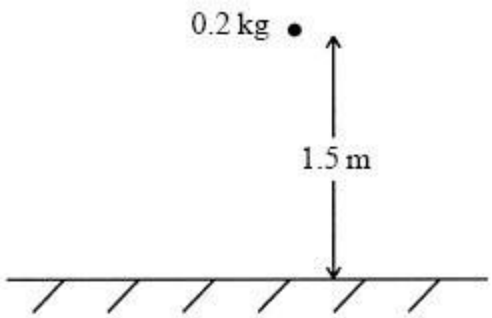
(2)

(Total 11 marks)

5. The diagram shows a ball of mass 0.2 kg held 1.5 m above the ground.



(a) Calculate the gravitational potential energy of the ball.

Assume that the gravitational field strength is 10 N/kg.

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(2) (b) State the value of the kinetic energy of the ball just as it reaches the ground.

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(1

) (c) Show that just as the ball reaches the ground it has a speed of approximately 5.5 m/s.

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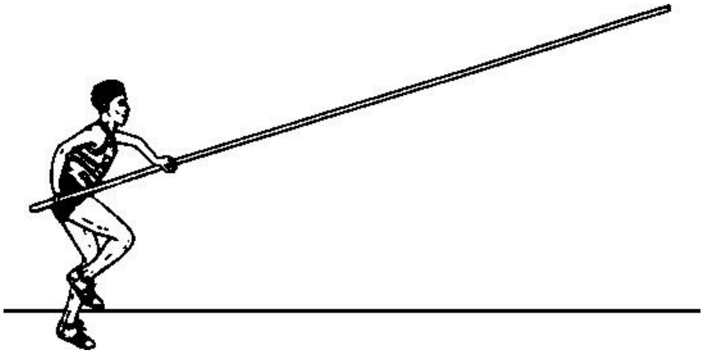
(2)
(Total 5 marks)

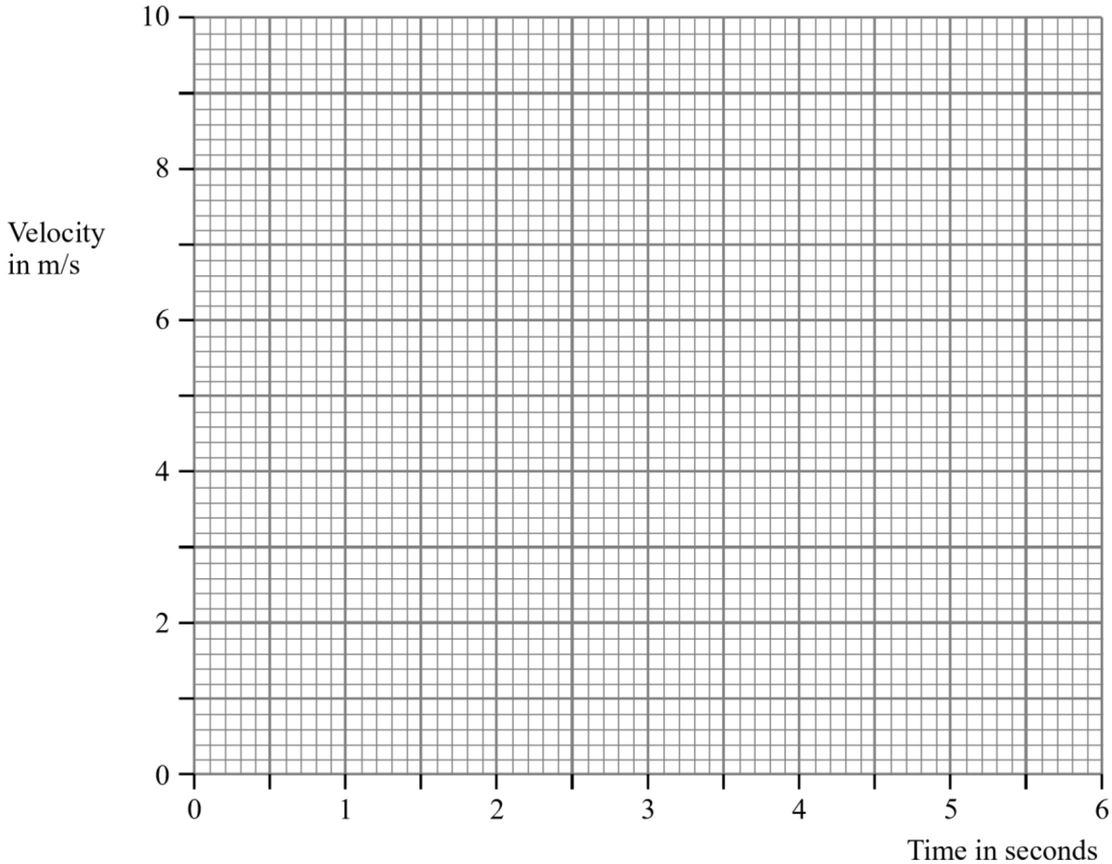
6. In an athletics competition, Tim competes in the pole vault.



The table shows how Tim's velocity changes during his run up.

Velocity (m/s)	0	2.8	5.0	6.8	8.0	8.6	8.6
Time (s)	0	1.0	2.0	3.0	4.0	5.0	6.0

(a) (i) Draw a graph of his velocity against time.

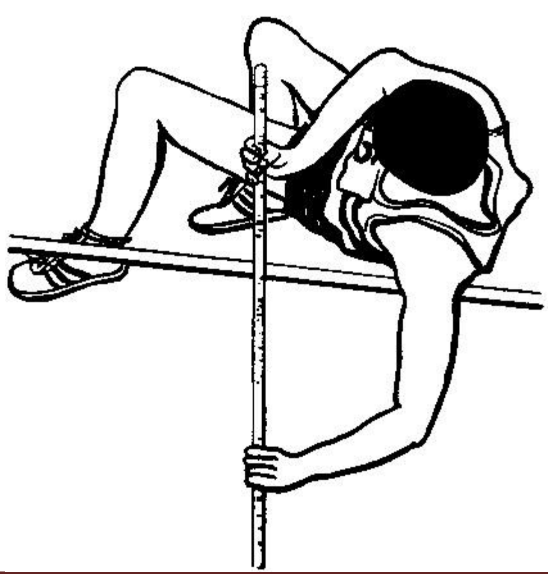


(3) (ii) Use your graph to find his velocity at 3.5 seconds.

………………………………………………………………………………………………….

(1)

(b) Tim weighs 750 N.



Calculate the work Tim would need to do to raise his body 4.0 m vertically. State the unit in your answer.

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(3)
(Total 7 marks)

GAS LAWS

1. (a) State Boyle's law

(b) A column of air 5cm is trapped by mercury thread of 10cm as shown in the figure below.

If the tube is laid horizontally as shown in **(b)**, calculate the new length of trapped air (atmospheric pressure =75.0cmHg and density of mercury = 13600kgm^{-3})

`

(c) Explain why:

(i) It is difficult to remove the lid from a preserving jar which was closed when the

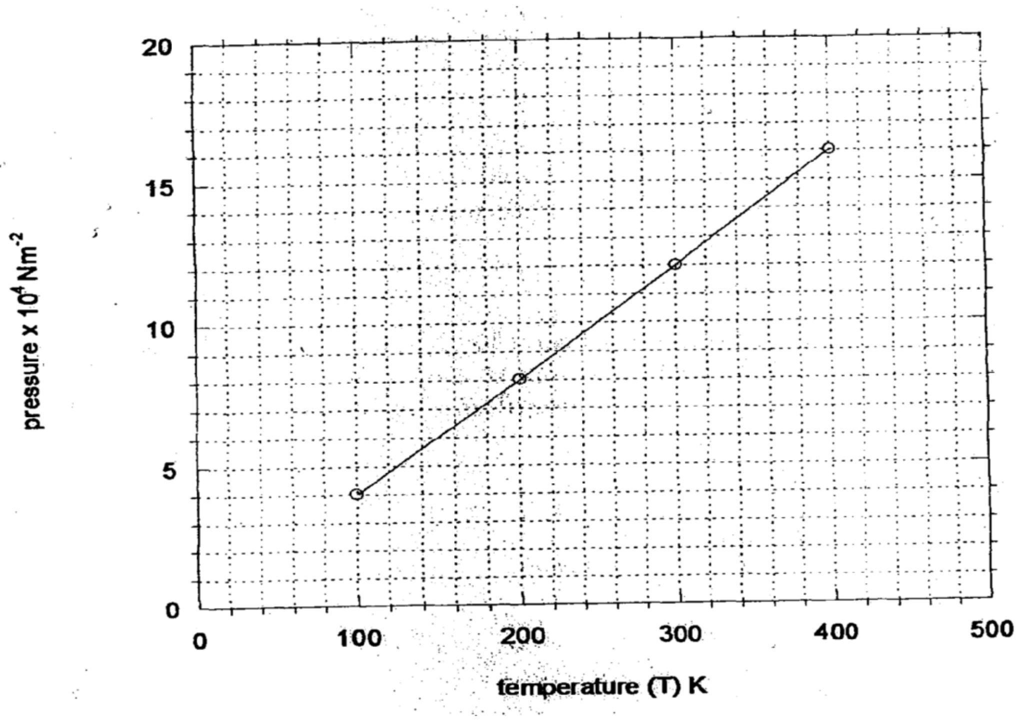
(ii) A force pump must be used instead of a lift pump to raise water from a deep well over 10m

2. The figure below shows a simple set up for pressure law apparatus:-

a) Describe how the apparatus may be used to verify pressure law

b) The graph in the figure below shows the relationship between the pressure and temperature

for a fixed mass of an ideal gas at constant volume



i) Given that the relationship between pressure, **P** and temperature, **T** in Kelvin is of the form

P = kT + C

Where **k** and **C** are constants, determine from the graph, values of **k** and **C**

ii) Why would it be possible for pressure of the gas to be reduced to zero in practice?

c) A gas is put into a container of fixed volume at a pressure of 2.1×10^5. Nm^{-2} and temperature 27°C. The gas is then heated to a temperature of 327°C. Determine the new pressure

3. (a) State Boyle's law

(b) The volume of a bubble at the base of a container of water is $3cm^3$. The depth of water is 30cm. The bubble rises up the column until the surface ;

(i) Explain what happens to the bubble as it rises up the water column

(ii) Determine the volume of the bubble at a point 5cm below the water surface

(c) A faulty thermometer records 11°C instead of 0°C and 98°C instead of 100°C. Determine the reading on the thermometer when dipped in liquid at a temperature of 56°C

4. (a) State Boyles law

Some students carried out an experiment to verify Boyle's law and recorded their results as shown in the table below:-

Pressure $^{KN}/_{M2}$	400	320	160	180
Volume (m^3)	2.0	2.5	5.0	10.0
$^1/_V$ (mm^{-3})				

(i) Complete the table
(ii) Plot a graph of pressure against $^1/_{volume}$
(c) Determine the gradient for the graph and state its units
(d) A sample of gas has a pressure of 1.0 x 10^5Pa when its temperature is 10^oC. What will be its pressure if its temperature is raised to 100^oC and its volume doubled

5. (a) State: (i) Boyle's Law

(ii) Charles' Law.

(b) A form three student carried out an experiment on one of the gas law. She obtained the following results.

Temperature (^{0}c)	10	35	60	80	90	110
Volume V(cm^3)	5	5.8	6.4	7.0	7.2	7.8

(i) Plot a graph of volume V against temperature.
(ii) From the graph, determine the volume of the gas at 0^oc.
(iii) Determine the slope of the graph.
(iv) The equation of the line obtained is of the form V = kT + c. What is the value of k and c?

6. (a) State **Charles' law**
(b) A mass of gas occupies a volume of 150cm^3 at a temperature of -73°C and a pressure of 1 atmosphere. Determine the 1.5 atmospheres and the temperature 227 °C

7. In an experiment to verity Boyle's law, two quantities were advised to be kept constant

(a). State the quantities.

(b). the results of experiment to verify Boyle's law were recorded in the table below.

Pressure(atmospheres)	1.0	1.2	1.4	1.6	1.8
Volume (litres)	0.62	0.521	0.450	0.391	0.351

Plot a suitable graph to verify the law.

(c). Determine the volume of the gas when the pressure is two atmospheres.

1. At a pressure of 2 atmospheres a fixed mass of hydrogen occupies a volume of 8 litres. What pressure must be maintained if the volume is to be increased to 10 litres, temperature remaining constant?

[Total 3m]

2. A certain mass of ammonia occupies 600 ml at a certain pressure. When the pressure is changed to 4 atmospheres it occupies a volume of 2.4 litres, temperature remaining constant. What was the initial pressure?

[Total 3m]

3. A bubble of air of volume $1cm^3$ is released by a deep-sea diver at a depth where the pressure is 4.0 atmospheres. Assuming its temperature remains constant ($T_1 = T_2$) **what** is its volume just before it reaches the surface where the pressure is 1.0 atmosphere?

(3mks)

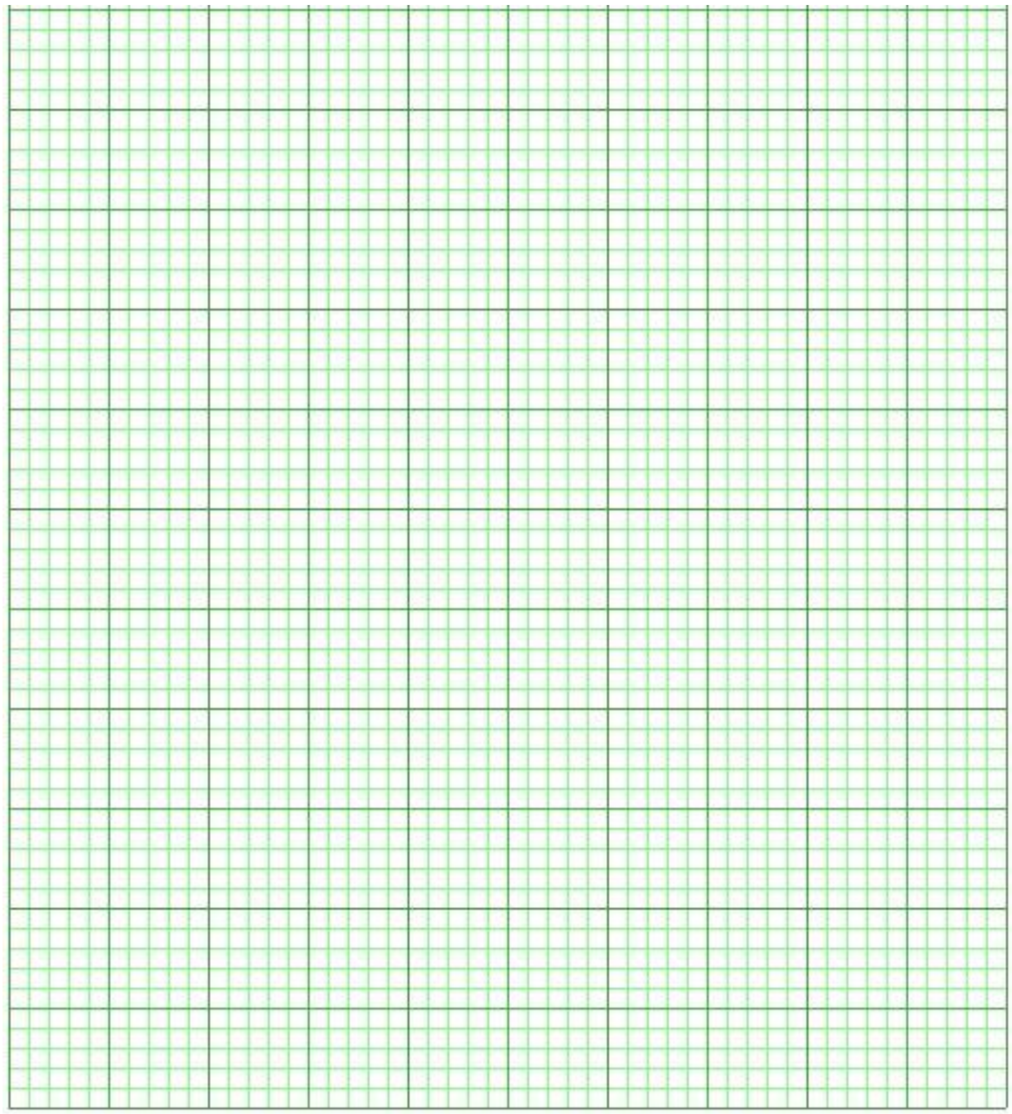
4. (a) **State** what is meant by absolute zero temperature. (1mk)

(b) **What** are the molecular differences between a real gas and ideal gas? (2mks)

(c) In an experiment to find the relationship between volume and temperature of a given mass of air at constant pressure the following results were obtained

Volume (cm^3)	31	33	35	38	40	43
Temperature(^0c)	0	20	40	60	80	100

(i) Plot an appropriate graph to show the relationship between volume and temperature.[3m]



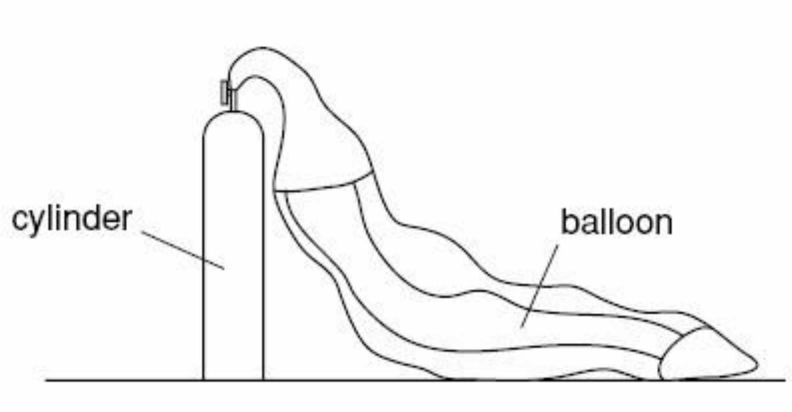
(ii) Use the graph to **calculate** the increase in volume of the air per unit rise in temperature.

(3mks)

(iii) **Give a reason** why the volume of a real gas can not be reduced to zero by cooling.

(1mk)

5. The figure shows a weather balloon. The balloon is shown partly filled with gas from a cylinder.



The balloon contains no gas initially. When it is connected to the cylinder, gas enters the balloon. The pressure in the cylinder decreases.

(a) Explain why the molecules inside the cylinder

(i) Exert a large pressure initially,

[2]

(ii) Exert a smaller pressure in the cylinder when the balloon is filled.

[1]

(b) The volume of the cylinder is $0.0020m^3$. The pressure inside the cylinder is initially 200 atmospheres.
When the cylinder is connected to the balloon, the final pressure in the cylinder and the balloon is 1.0 atmosphere. The temperature of the gas remains constant.
Calculate the final volume of gas in the balloon. State the equation that you use.

[3]

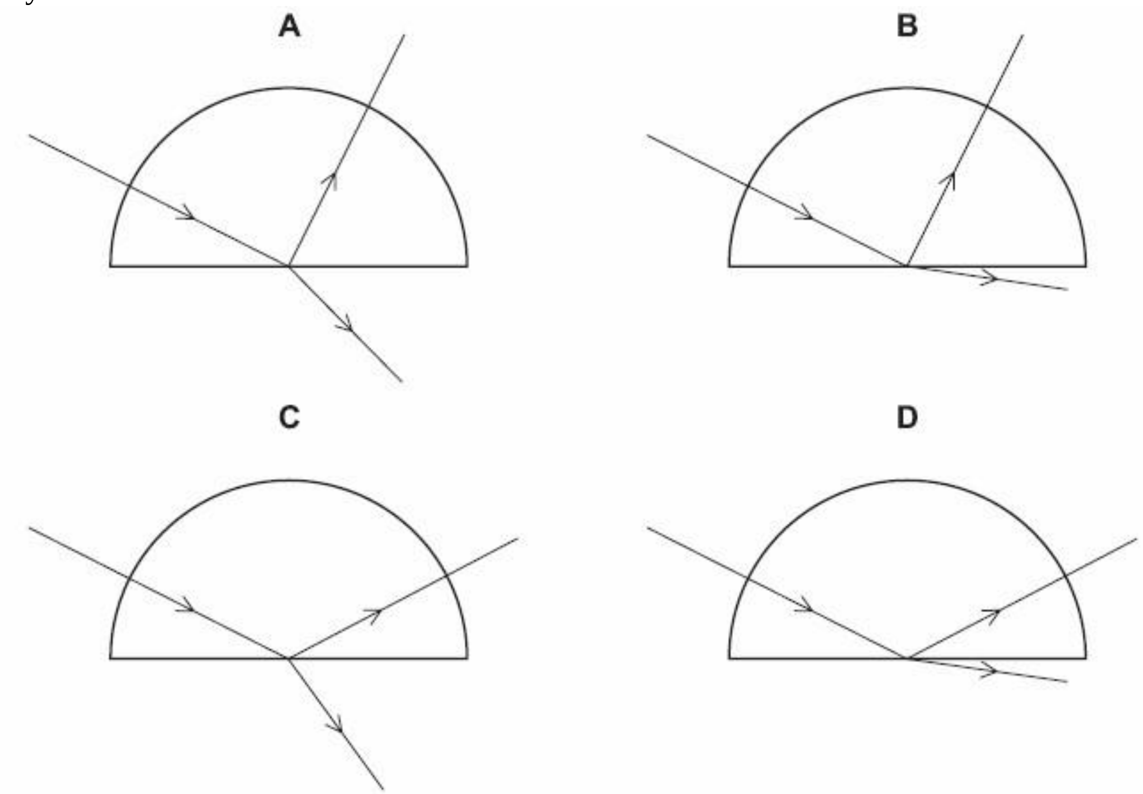
6. The volume of a given mass of gas, at 150^oC is 400 ml. At what temperature, will it occupy a volume of 600 ml at the same pressure?

[Total 4m]

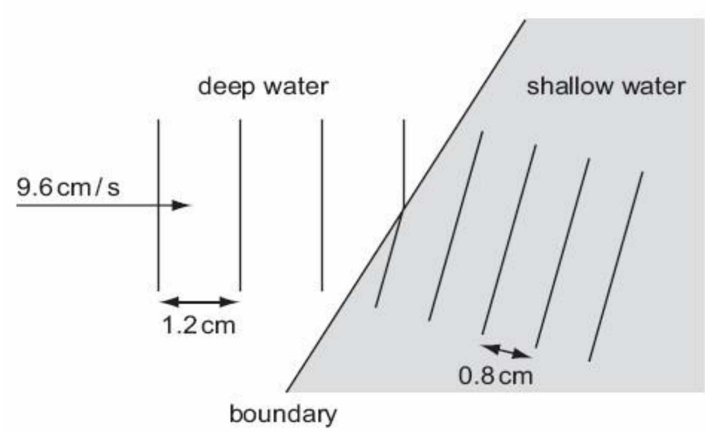
7. 400 ml of a gas at 227^oC is to be reduced to a volume of 300 ml. By what degrees Celsius, must the temperature be altered, keeping pressure constant?

REFRACTION

1. A ray of red light enters a semi-circular glass block normal to the curved surface.
   Which diagram correctly shows the partial reflection and refraction of the ray?



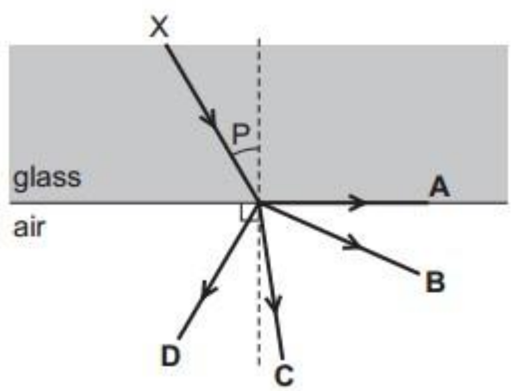
2. A ripple tank is used to demonstrate refraction of plane water waves.



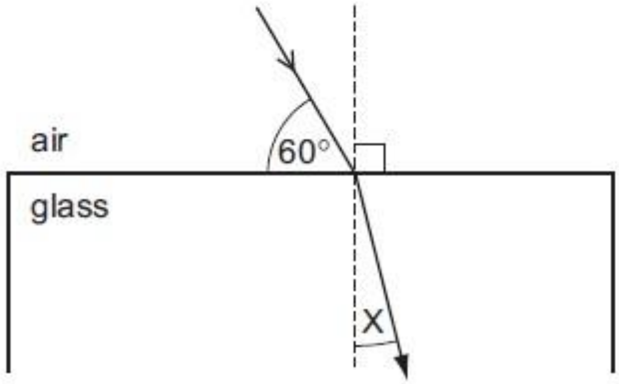
Waves in deep water have a wavelength of 1.2 cm and a speed of 9.6 cm / s. The wavelength of the waves in shallow water is 0.8 cm. What is the speed of the waves in the shallow water?

A 6.4 cm / s
B 8.0 cm / s
C 9.6 cm / s
D 14.4 cm / s

3. The diagram shows a ray of light travelling from X. Angle P is less than the critical angle.
In which direction does the ray continue?



4. A ray of light passes into a glass block of refractive index 1.5.



What is the value of the angle marked X?

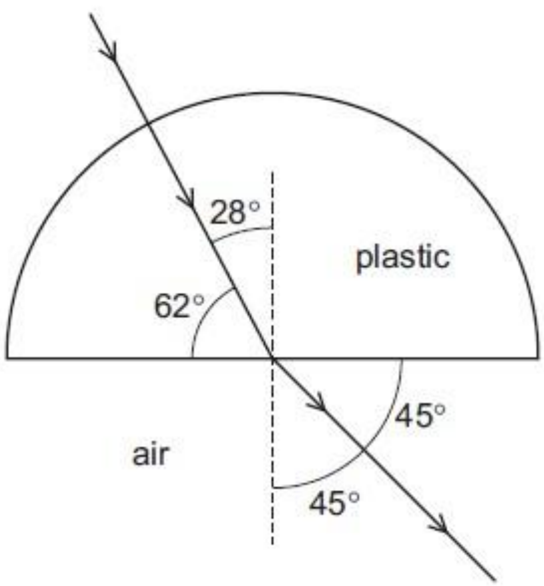
A. 19.5^0

B. 25.0^0

C. 35.3^0

D. 48.6^0

5. A semi-circular block is made from a plastic. A ray of light passes through it at the angles shown.



To two decimal places, what is the refractive index of the plastic?

[3m]

6. Fig. 6.1 shows a ray of white light from a ray-box passing into a glass prism.
A spectrum is formed between P and Q on the screen.

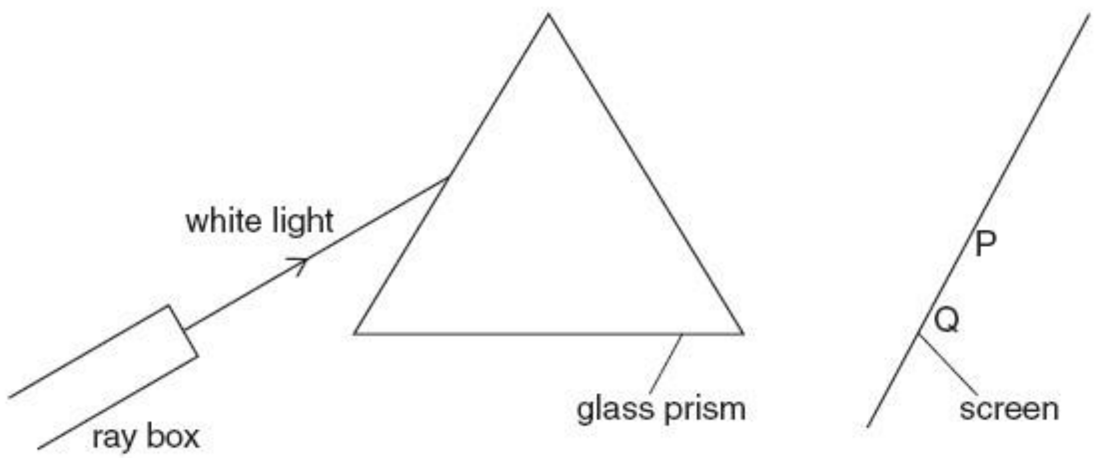


Fig. 6.1

(a) State the colour of the light at end P of the spectrum.

[1] (b) State whether the value of each of these properties for blue light is greater than, equal to or less than the value for red light.

(i) Speed in a vacuum.. [1]

(ii) Wavelength.. [1]

(c) Fig. 6.2 shows the ray passing through a red filter before it reaches the prism.

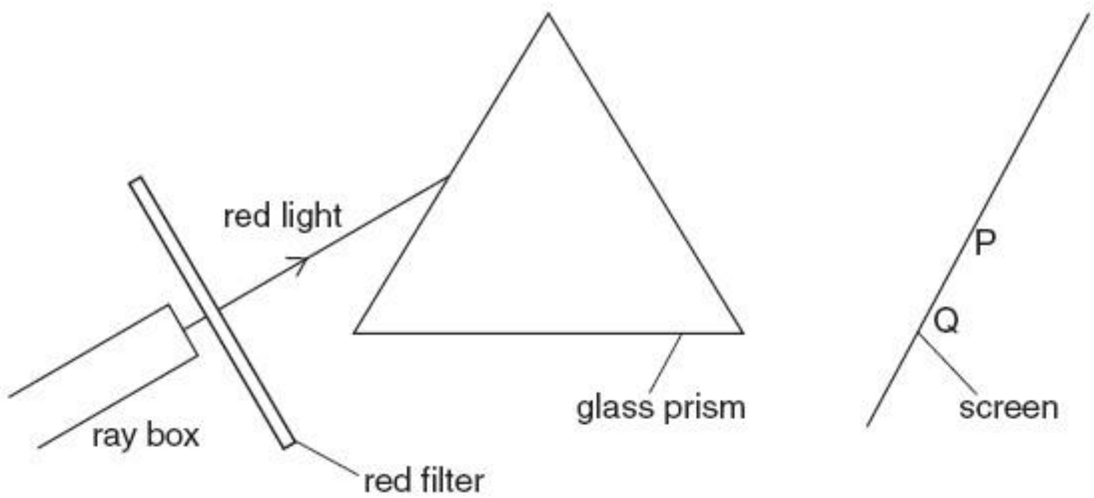
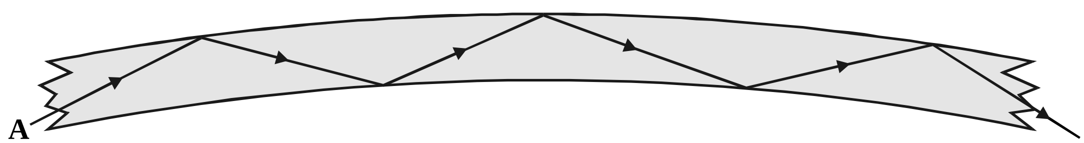


Fig. 6.2 Complete Fig. 6.2 to show the ray of red light passing through and emerging from the prism. [2]

7. (a) The diagram shows the passage of light beam A travelling down an optical fibre.

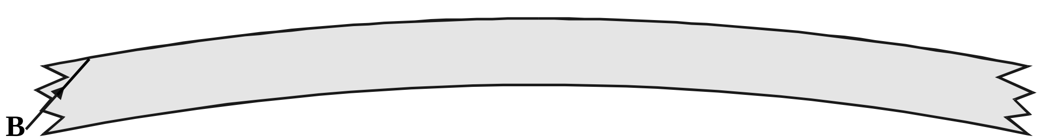


(i) State the name of the process that takes place as the light A beam travels down the optical fibre.

....

(1)

(ii) Complete the diagram to show the passage of the light beam B down the same optical fibre.



(1)

(iii) Suggest why beam B will take slightly longer to travel down the fibre than beam A.

....

....

....

....

(2)

(b) Optical fibres are used to carry information. The information is carried by the light beam in the form of a digital signal.

(i) Draw a diagram to show what is meant by a digital signal.

(1)

(ii) The signal from a microphone is an analogue signal. How does an analogue signal differ from a digital signal?

....

....

(1)

(c) When signals are sent through optical fibres they lose energy.

(i) State what happens to the brightness of the light beam as it loses energy.

....

(1)

(ii) State one disadvantage of losing energy as the light beam travels through the optical fibre.

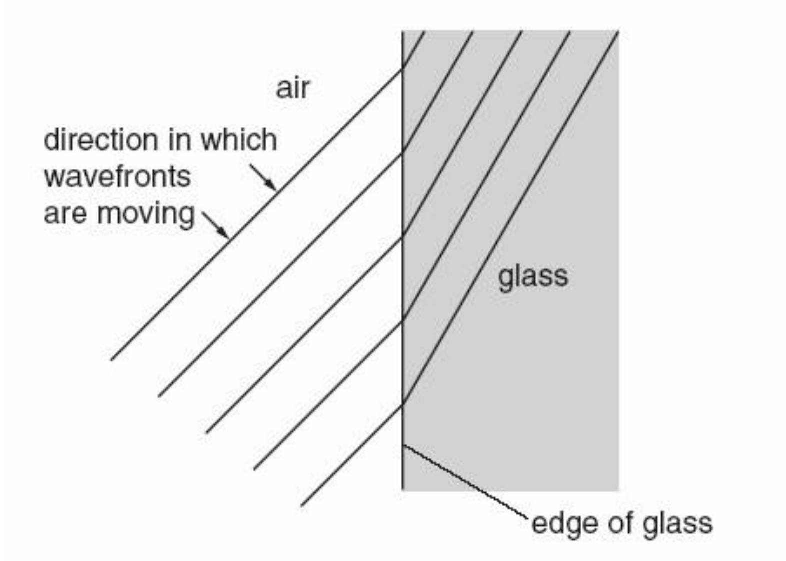
....

....

(1)

(Total 8 marks)

8. The figure below shows wavefronts of light crossing the edge of a glass block from air into glass.



(a) On the figure:

(i) draw in an incident ray, a normal and a refracted ray that meet at the same point on the edge of the glass block,

(ii) label the angle of incidence and the angle of refraction, (iii) measure the two angles and record their values.

Angle of incidence = ...

Angle of refraction = ...

[4] (b) Calculate the refractive index of the glass.

Refractive index = ...[3]

[Total 7m]

9. Fig. 7.1 and Fig. 7.2 show wavefronts of light approaching a plane mirror and a rectangular glass block, respectively.

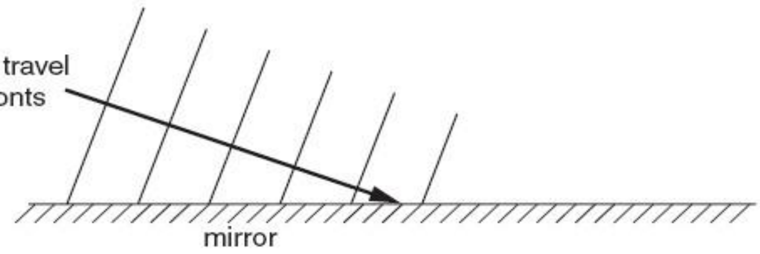

direction of travel
of wavefronts
mirror

Fig. 7.1

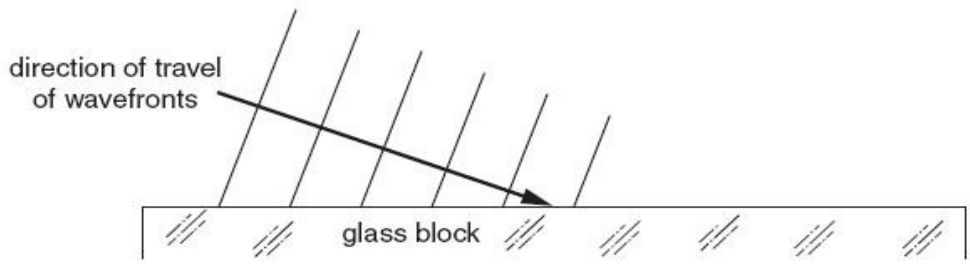

direction of travel
of wavefronts
glass block

Fig. 7.2

(a) On Fig. 7.1 and on Fig. 7.2 draw wavefronts to show what happens after the waves strike the surface. [4]

(b) In Fig. 7.2, the waves approaching the block have a speed of 3.0×10^8 m/s and an angle of incidence of 70°. The refractive index of the glass of the block is 1.5. (i) Calculate the speed of light waves in the block.

Speed = ... [2]

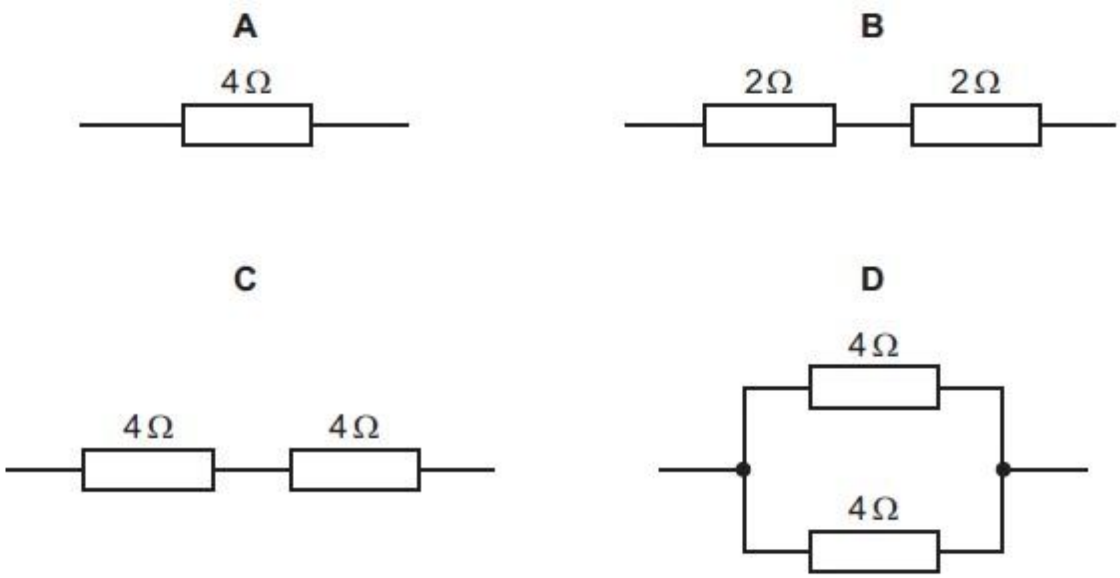
(ii) Calculate the angle of refraction in the block.

Angle =... [2]

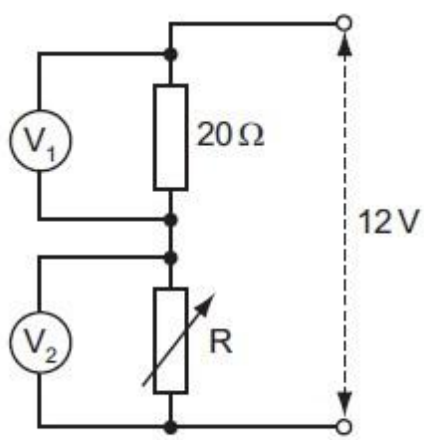
[Total: 8]

CURRENT ELECTRICITY

1. The diagrams show four arrangements of resistors.
Which arrangement has the smallest total resistance?



2. The potential divider shown is connected across a constant 12 V supply.

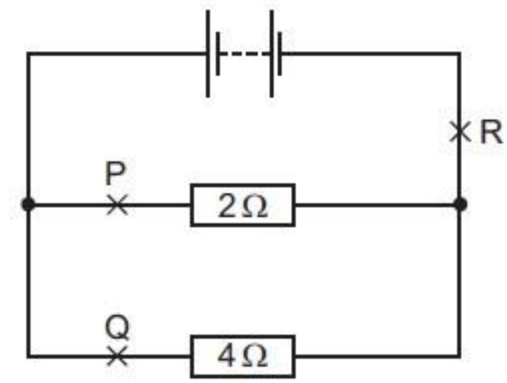


When R has a value of 20 f¶, the voltmeter readings are equal.

How do these readings change when the value of R is reduced to 10 ƒ¶?

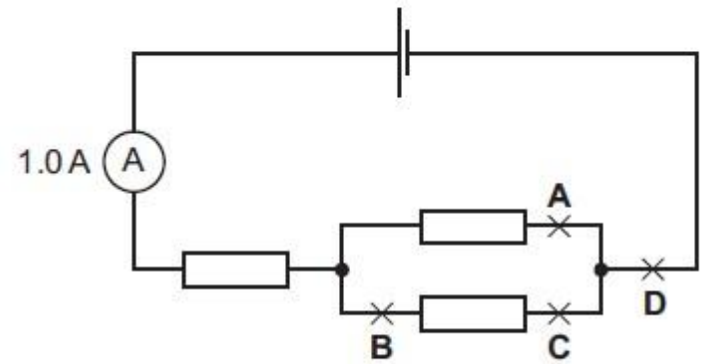
	reading on V_1	reading on V_2
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

3. A circuit contains two resistors connected in parallel with a battery.



Which of the following statements about the currents at P, Q and R is true?
A. The current at P is the greatest.
B. The current at Q is the greatest.
C. The current at R is the greatest.
D. The current is the same at points P, Q and R.

4. The reading on the ammeter in the circuit is 1.0 A. A second ammeter is connected in the circuit. It also reads 1.0 A. At which labelled point is it connected?



5. Distinguish between the electromotive force (e.m.f.) of a cell and the potential difference (p.d.) across a resistor.

[3]

6. Three resistors are connected in series across a 75-V potential difference. R_1 is 170Ω and R_2 is 190Ω. The potential difference across R_3 is 21 V.

a. Find the current in the circuit. [2m]

b. Find the resistance of R_3.[1m]

[3m]

7. A cell has electromotive force (e.m.f.) E and internal resistance r. It is connected in series with a variable resistor R, as shown in Fig. 6.1.

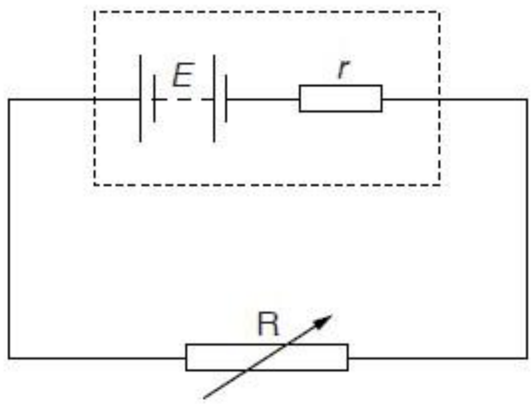


Fig. 6.1

(a) Define electromotive force (e.m.f.).

[2]

(b) The variable resistor R has resistance X. Show that;

$$\frac{\text{power dissipated in resistor R}}{\text{power produced in cell}} = \frac{X}{X + r}$$

[3]

(c) The variation with resistance X of the power P_R dissipated in R is shown in Fig. 6.2.

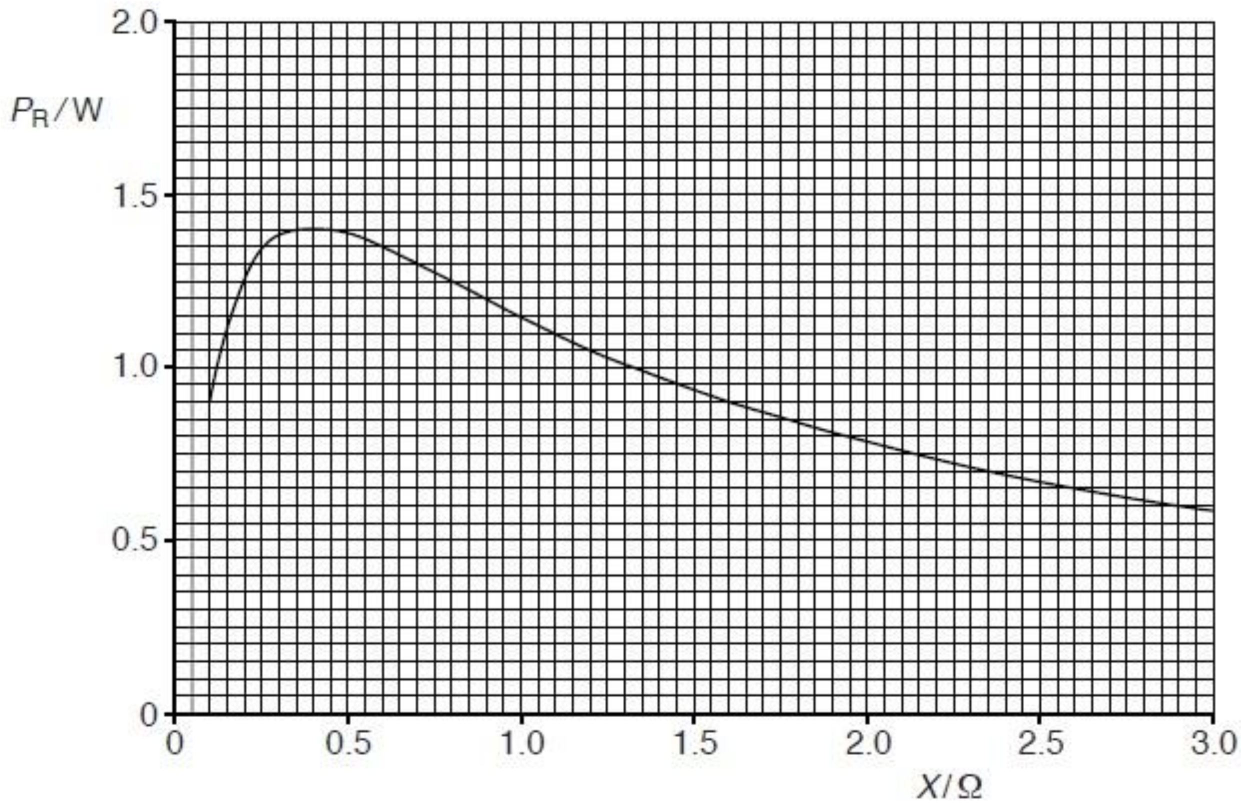


Fig. 6.2

(i) Use Fig. 6.2 to state, for maximum power dissipation in resistor R, the magnitude of this power and the resistance of R.

Maximum power = ... W

Resistance = ... Ω

[2] (ii) The cell has e.m.f. 1.5 V.

Use your answers in (i) to calculate the internal resistance of the cell.

internal resistance = ... Ω [3]
(d) In Fig. 6.2, it can be seen that, for larger values of X, the power dissipation decreases. Use the relationship in (b) to suggest one advantage, despite the lower power output, of using the cell in a circuit where the resistance X is larger than the internal resistance of the cell.

[1]

8. A car battery has an internal resistance of 0.060 Ω. It is re-charged using a battery charger having an
e.m.f. of 14 V and an internal resistance of 0.10 Ω, as shown in Fig. 6.1.

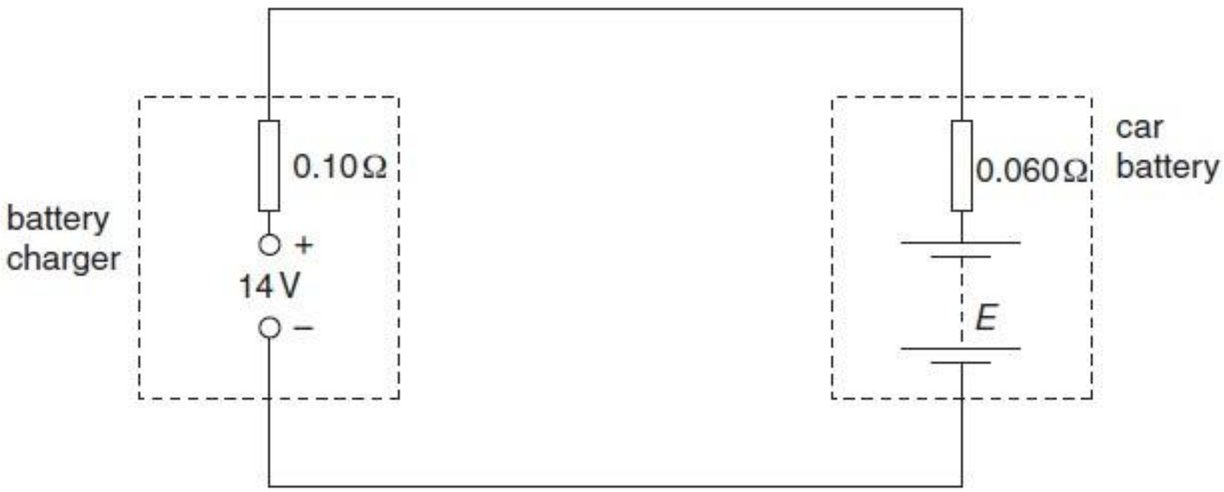


Fig. 6.1

(a) At the beginning of the re-charging process, the current in the circuit is 42 A and the e.m.f. of the battery is E (measured in volts). (i) For the circuit of Fig. 6.1, state

1. the magnitude of the total resistance,

Resistance = ... Ω

2. the total e.m.f. in the circuit. Give your answer in terms of E.

e.m.f. = ... V

[2] (ii) Use your answers to (i) and data from the question to determine the e.m.f. of the car battery at the beginning of the re-charging process.

e.m.f. = ...V [2]

(b) For the majority of the charging time of the car battery, the e.m.f. of the car battery is 12 V and the charging current is 12.5 A. The battery is charged at this current for 4.0 hours.

Calculate, for this charging time,

(i) The charge that passes through the battery,

Charge = ...C [2] (ii) The energy supplied from the battery charger,

Energy = ...J [2] (iii) the total energy dissipated in the internal resistance of the battery charger and the car battery. energy = ...J [2] (c) Use your answers in (b) to calculate the percentage efficiency of transfer of energy from the battery charger to stored energy in the car battery.

efficiency = ...% [2]

WAVES

1. A double-slit interference experiment is set up using coherent red light as illustrated in Fig. 5.1.

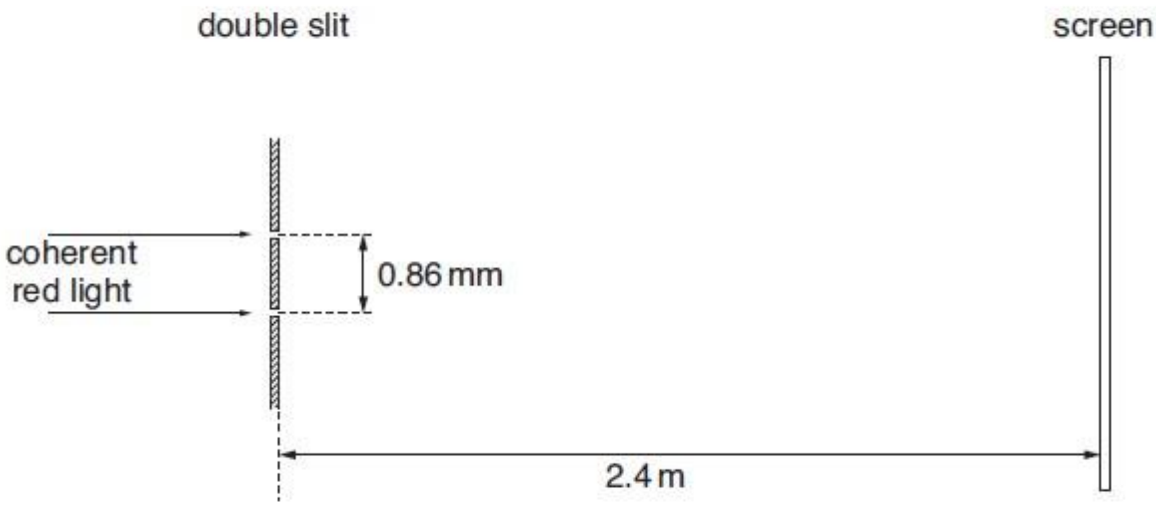


Fig. 5.1 (not to scale)

The separation of the slits is 0.86 mm.
The distance of the screen from the double slit is 2.4 m.
A series of light and dark fringes is observed on the screen.

(a) State what is meant by *coherent* light.[1m]

(b) Estimate the separation of the dark fringes on the screen. [3m]

Separation = ...mm

(c) Initially, the light passing through each slit has the same intensity.
The intensity of light passing through one slit is now reduced.

Suggest and explain the effect, if any, on the dark fringes observed on the screen.

[2m]

2. (a) Define *refractive index*.

....
....

(1)

(b) In a certain medium, the speed of light of a particular frequency is 2.1×10^{8} m s^{-1}. Calculate the refractive index of the medium for this frequency.

....
....
....

(2)

(c) With reference to your answer in (b), describe what is meant by optical dispersion.

....
....
....
....
....

(3)

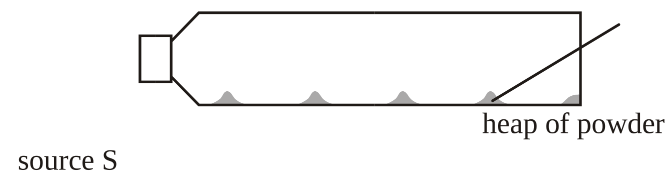
(Total 6 marks)

3. (i) Outline the conditions necessary for the formation of a standing (stationary) wave.

....
....
....

(2)

(ii) A horizontal tube, closed at one end, has some fine powder sprinkled along its length. A source S of sound is placed at the open end of the tube, as shown below.



The frequency of the source S is varied. Explain why, at a particular frequency, the powder is seen to form small equally-spaced heaps in the tube.

....
....
....

(2)

(iii) The mean separation of the heaps of powder in (b)(ii) is 9.3 cm when the frequency of the source S is 1800 Hz. Calculate the speed of sound in the tube.

....
....
....

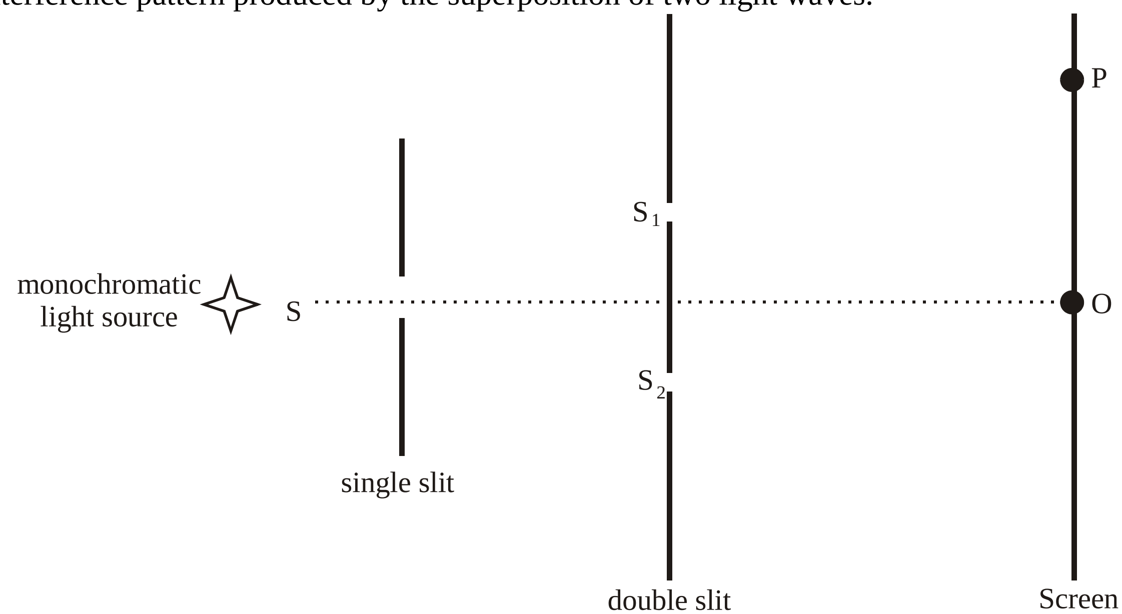
(2)

(c) The experiment in (b)(ii) is repeated on a day when the temperature of the air in the tube is higher. The mean separation of the heaps is observed to have increased for the same frequency of the source S. Deduce qualitatively the effect, if any, of temperature rise on the speed of the sound in the tube.

....
....
....

(2)

4. The diagram below shows an arrangement (not to scale) for observing the interference pattern produced by the superposition of two light waves.



S1 and S2 are two very narrow slits. The single slit S ensures that the light leaving the slits S1 and S2 is coherent.

(i) Define *coherent*.

....

....

(1)

(ii) Explain why the slits S1 and S2 need to be very narrow.

....

....

....

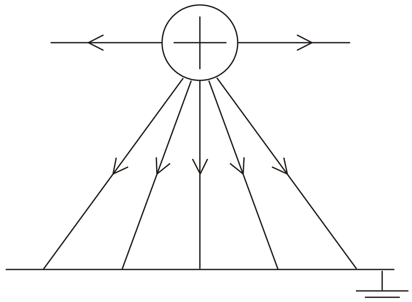
……………………………………………………………………………

(2)

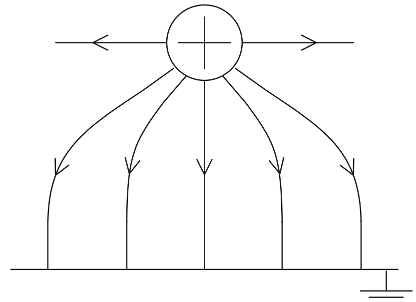
ELECTROSTATICS II

1. Which diagram below best represents the electric field pattern between a positively charged conducting sphere and an earthed metal plate?

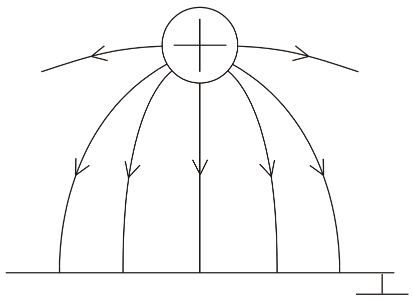
A.



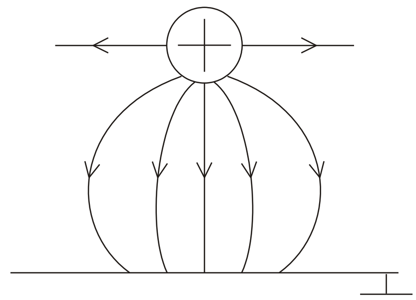
B.



C.

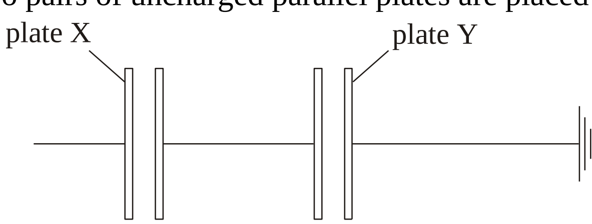


D.



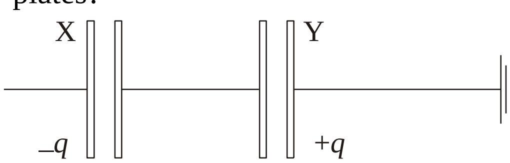
(1)

2. Two pairs of uncharged parallel plates are placed in a vacuum and are connected as shown.

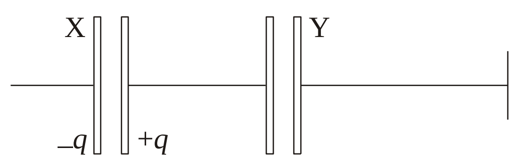


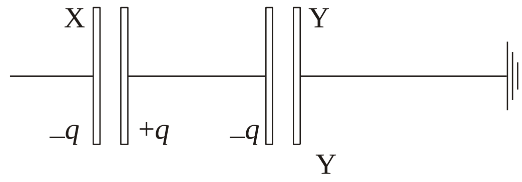
A negative charge of magnitude q is placed on plate X. Plate Y is connected to earth. Which **one** of the following diagrams shows the distribution of charge on the plates?

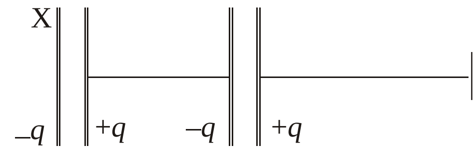
A.



B.



C. 

D. 

(1)

3. Which of the following is the correct value of the electronvolt, measured in SI Units?

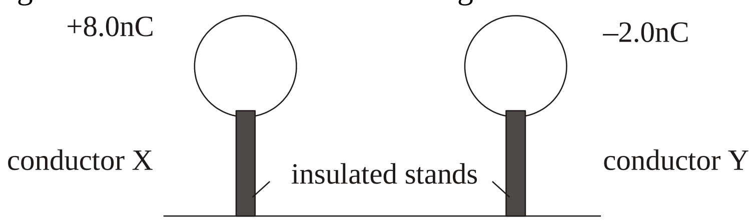
A 1.6×10^{-19} N

B 1.6×10^{-19} J

C 9.1×10^{-31} N

D 9.1×10^{-31} J

4. Two identical spherical conductors X and Y are mounted on insulated stands. X carries a charge of +8.0 nC and Y carries a charge of –2.0 nC.



The two conductors are brought into contact and are then separated. Which of the following gives the charge on each conductor?

Charge on X	Charge on Y
0.0 nC	0.0 nC
+8.0 nC	–2.0 nC
+5.0 nC	+5.0 nC
+3.0 nC	+3.0 nC

A B. C.

D.

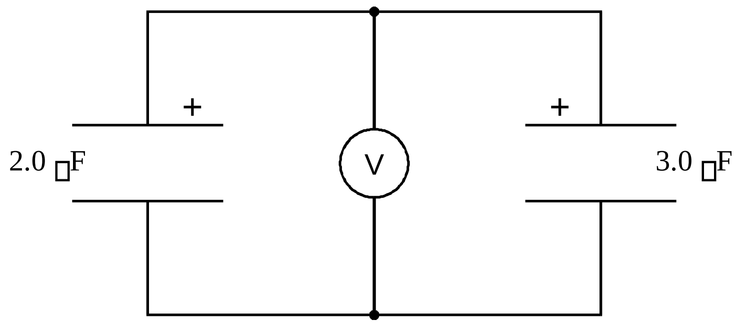
5. A 2.0 μF capacitor is charged to a potential difference (p.d.) of 50 V and a 3.0 μF capacitor is charged to a p.d. of 100 V.

Calculate the charge on the plates of each capacitor.
Write your answers in the table below.

Capacitor	2.0 μF	3.0 μF
P.d.	50 V	100 V
Charge		

(2)

The capacitors are then joined together **in parallel** with their positive plates connected together.



What is the equivalent capacitance of this combination?

....

Equivalent capacitance = ... μF (1)

[Total 3m]

6. A 3.0 mF and a 5.0 mF capacitor are connected in series with a 12 V battery.

a. Find the equivalent capacitance.

[3m] b. Find the charge on each capacitor.

[3m]

c. Find the potential drop (or voltage) across each capacitor. 3m

[3m]
[Total 9m]

7. This 8.0 μF 6.0 μF and 5.0 μF capacitors are connected in series. Calculate the total capacitance for this arrangement.

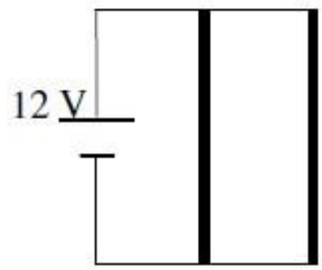
[3m]

HEATING EFFECT OF ELECTRIC CURRENT

1. A car heater has two identical heating elements. The car battery can send 15000 C through the circuit in an hour.

(i) What is the current in each heating element?

(ii) How much heat is generated by the circuit in an hour?

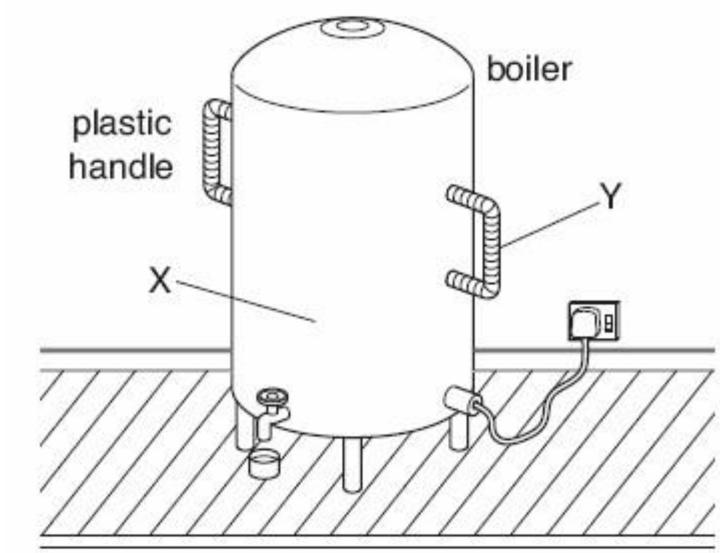


[3m]

2. Calculate the amount of energy possessed by 1.25×10^{-19} electrons at a point where the electric potential is 3.20 volts.

[2m]

3. The Fig. below shows an electric boiler in a school kitchen.



The boiler contains 35 kg of water at 22 °C. The specific heat capacity of water is 4200 J / (kg °C).

(a) **(i)** Calculate the thermal energy (heat) needed to raise the temperature of the water from 22 °C to its boiling point.

[3] **(ii)** The water in the boiler is heated with a 2600 W immersion heater. Calculate the minimum time for the heater to bring the water to its boiling point.

[

2] **(iii)** Suggest **one** reason why the actual time is greater than the time calculated in **(ii)**.

[

1] **(b)** **(i)** The immersion heater is placed in the water at the bottom of the boiler. Explain in detail how this ensures that the thermal energy (heat) is transferred throughout the water.

[

4] **(ii)** The boiler is made of steel and has two large plastic handles. When the water is boiling, the steel surface at X is hot while the plastic handle at Y is cool. Explain why.

[

2] **(c)** Before the water reaches boiling point, water vapour is seen escaping from the boiler.

(i) State the name of the process that produces this water vapour.

[1] **(ii)** State **two** differences between this process and boiling.

[2]

4. Andrew is set the task of measuring the current-voltage (I-V) characteristics of a filament lamp. The following equipment and information are available.

	Information
Battery	emf = 3.0 V, negligible internal resistance
Filament lamp	marked "3 V, 0.2 A"
Voltmeter	resistance = 30 kW, reads values between 0.0 and 3.0 V
Ammeter	resistance = 0.1 W, reads values between 0.0 and 0.5 A
Potentiometer	resistance = 100 W

(a) For the filament lamp operating at normal brightness, calculate (i)

its resistance;

....

....

(1)

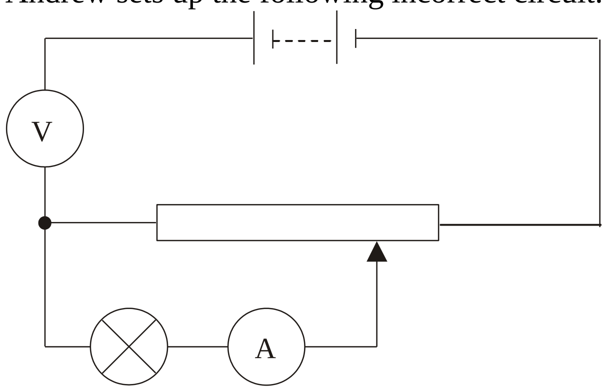
(ii) its power dissipation.

....

....

(1)

Andrew sets up the following incorrect circuit.



(b) (i) Explain why the lamp will not light.

....

....

....

(2)

(ii) State the approximate reading on the voltmeter. Explain your answer.

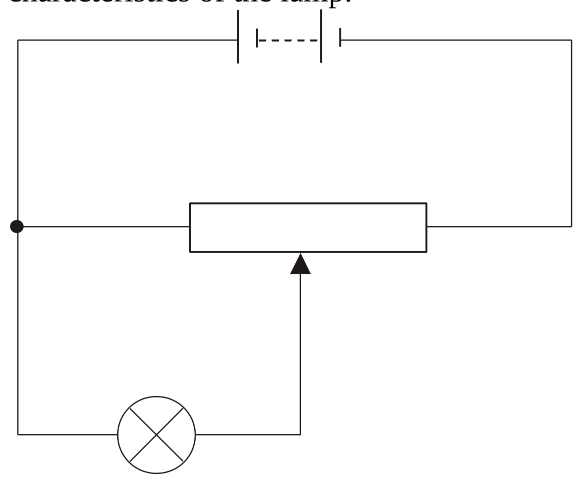
....

....

....

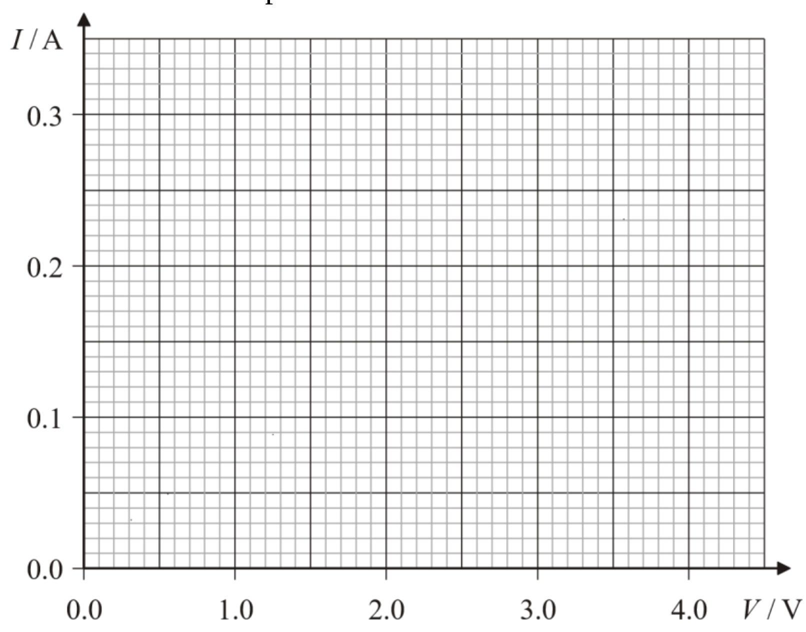
(2)

(c) On the circuit diagram below, add circuit symbols to show the correct position of the ammeter and of the voltmeter in order to measure the I-V characteristics of the lamp.



(2)

(d) On the axes below draw a sketch graph to show the I-V characteristics for this filament lamp.



(4)

(e) Explain the shape of the graph that you have drawn in (d).

....

....

....
....

(2)
(Total 14 marks)

5. A student places a small electrical heater inside a cup of water, as shown in Fig. 11.1.

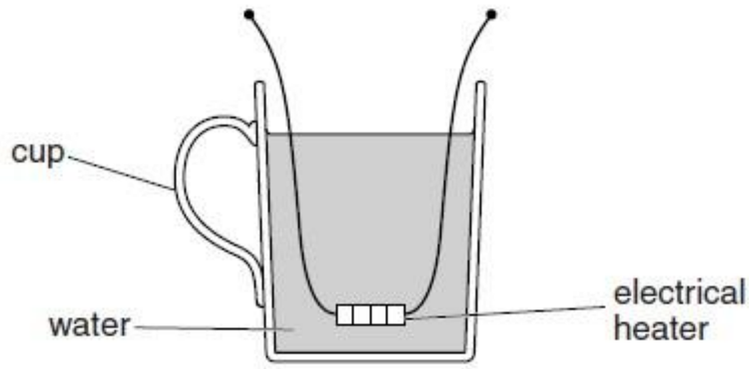


Fig. 11.1

The student determines the electrical power of the heater.

(a) In the space above the cup on Fig. 11.1, draw the electrical circuit that the student uses.

Include an ammeter, a voltmeter and a power supply. [2]

(b) The voltage of the power supply is 12 V and the current is 4.2 A.

(i) Calculate the electrical power input to the heater.

Power = ... [2]

(ii) Calculate the energy input to the heater in 8.0 minutes. Give your answer in kW h.

Energy = ... kW h [3]

(c) During heating, the student notices that some of the water evaporates from the cup.

(i) Describe, using ideas about molecules of water, what happens during evaporation.

[2]

(ii) The student finds that the amount of evaporation increases when the temperature of the water is higher.

State and explain one other change that increases the amount of evaporation.

[2] **(iii)** State two differences between evaporation and boiling.

[2]

(d) The student turns off the power supply and the water cools.

Describe and explain how convection in the air causes the water to cool.

[2]

[15 Marks]

6. Fig. 9.1a shows a room heater. Fig. 9.1b is a diagram of the electric circuit of the heater.

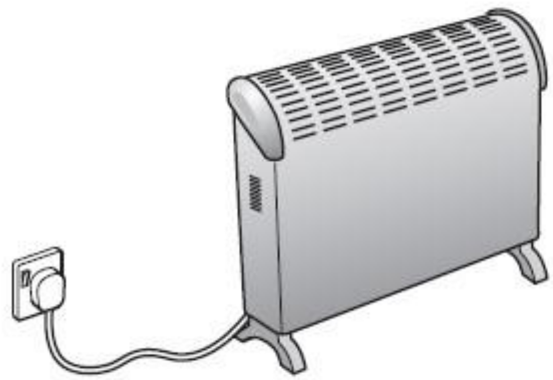


Fig. 9.1a

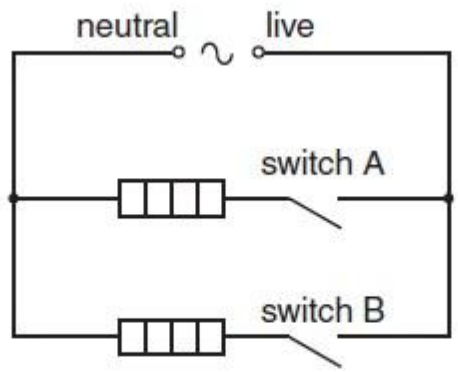


Fig. 9.1b

The fuse has not been drawn on the circuit diagram in Fig. 9.1b.
(a) (i) On Fig. 9.1b, draw the symbol for a fuse in the correct position. [2] **(ii)** State the part of the room heater to which the earth wire is connected.

....[1]

(iii) The earth wire reduces the chance of an electric shock if a fault develops in the room heater.

1. State one fault that causes an electric shock when a person uses the room heater without an earth connection.

[1]

2. Explain how using an earth connection prevents an electric shock.

[2]

(b) (i) This type of room heater is very efficient. Explain what this means.

[1]

(ii) The room heater is a convector heater. Describe and explain how thermal energy (heat) passes around a room by convection.

[3]

(c) Fig. 9.2 shows the power output of the room heater when each switch is closed.

	power / W
switch A only closed	600
switch B only closed	
both switches closed	2100

Fig. 9.2

(i) Determine the power output of the room heater when only switch B is closed.

power output = ... [1]

(ii) The room heater is used with both switches closed for 2.5 hours.

Calculate the energy output of the room heater

1. in kilowatt-hours,

energy = ... kW
h [2] **2.** in joules.

Page

energy = ... J [2]

QUANTITY OF HEAT

1. (a) Define the term specific heat capacity.

(b) A block of metal of mass 300g at 100^0c is dropped into a logged calorimeter of heat capacity $40Jk^{-1}$, containing 200g of water at 20^0c. The temperature of the resulting mixture is 34^0c.

(Specific heat capacity of water = $4200Jkg^{-1}k^{-1}$)

Determine:

(i) Heat gained by calorimeter.

(ii) Heat gained by water.

(iii) Heat lost by the metal block.

(iv) Specific heat capacity of the metal block.

2. (a) State **two** differences between boiling and evaporation.

(b) 200g of a solid was uniformly heated by a 0.2 kw heater for sometime. The graph in the figure below shows how the temperature of the solid changed with time

(i) Explain what is happening between **OA** and **AB**.

(ii) Calculate the specific heat capacity of the solid.

(iii) Calculate the specific latent heat of fusion **k** of the solid.

3. (a) Define the term **heat capacity**

(b) A block of metal of mass 150g at 100^oC is dropped into a logged calorimeter of heat capacity $40Jk^{-1}$ containing 100g of water at 25^oC. The temperature of the resulting mixture is 34^oC.

(Specific heat capacity of water = 4200J/KgK)

Determine;-

(i) Heat gained by calorimeter

(ii) Heat gained by water

(iii) Heat lost by the metal block

(iv) Specific heat capacity of the metal block

4. (a) Distinguish between evaporation and boiling

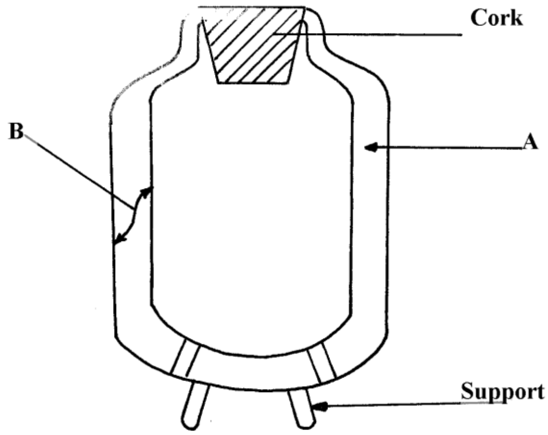
(b) A jet delivering 0.44g of dry steam per second, at 100^oC is directed on to crushed ice at 0.0^oC contained in an unlagged copper can which has a hole in the base. 4.44g of water at 0.0^oC flow out of the hole per second

(i) How many joules of heat are given out per second by condensing steam and cooling to 0.0^oC of water formed?(Latent heat of vaporization of steam = $2.26 \times 10^6 JKg^{-1}$, c for water = 4200$JKg^{-1}K^{-1}$)

(ii) How much heat is taken in per second by the ice which melts?

(iii) Suggest why these amounts above are different

(c) ***Figure 7*** below shows a cross-section of a vacuum flask



(i) Name the parts labelled **A** and **B** on the diagram

(ii) Explain how the heat losses are minimized when hot liquid is poured into the flask

5. (a) Figure 2 shows two identical thermometers. Thermometer **A** has a blackened bulb while thermometer **B** has a silvery bulb. A candle is placed equidistant between the two thermometers

Fig. 2

State with a reason the observations made after some time

5. (b) ***Figure 3*** shows a test tube partially filled with water. An ice wrapped in wire gauze is placed at the bottom of the test-tube. It is then held in the flame of a bunsen burner as shown below

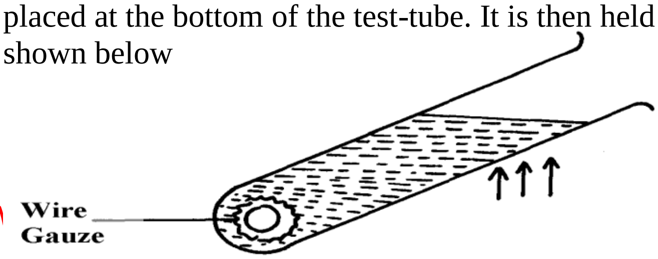


fig. 3

State and explain what will be observed after some time

6. Give any **two** differences between evaporation and boiling
7. Explain why steel feels colder than wood at the same temperature

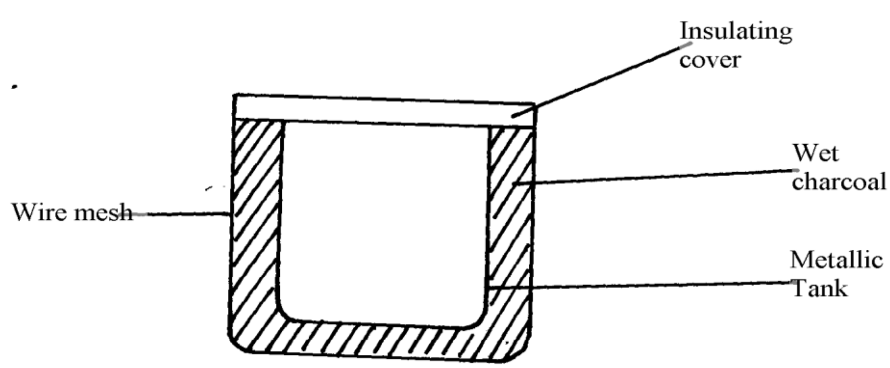
8. An electric heater 1KW 240V is used to raise the temperature of a 5kg copper block from 15°C to 33°C. If the specific heat capacity of copper is **$400JKg^{-1}K^{-1}$** and assuming no heat is lost to the surrounding,
Calculate the time taken

9. (a) Define specific latent heat of fusion

(b) 0.5kg of naphthalene contained in an aluminium can of mass 0.4kg is melted in a water bath and raised to a temperature of 100°C . Calculate the total heat given out when the can and its contents are allowed to cool to room temperature, 20°C . Neglect losses by evaporation during heating process and give your answer to the nearest kilojoule.
(For naphthalene melting point = 80°C , Specific heat capacity for both liquid and solid =2100J/KgK; specific latent heat of fusion = 170000J/Kg.
For aluminium: specific heat capacity = 900J/Kgk

(c) Briefly explain **two** ways other than direct heating by which quantity of liquid may be made to evaporate more quickly

(d) The diagram below shows a charcoal refrigerator



(i) Explain why charcoal is used and why it is sprinkled with water
(ii) What is the role of the metallic tank and the wire mesh

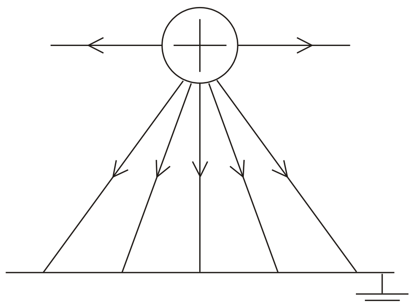
10. An electric kettle with a shinny outer surface would be more efficient than one with a dull outer surface. Give a reason for this

11. A heating element rated 2.5 KM is used to raise the temperature of 3.0 kg of water through
50^oC. Calculate the time required to Effect this. (*Specific heat capacity of water is 4200J/kgK*).

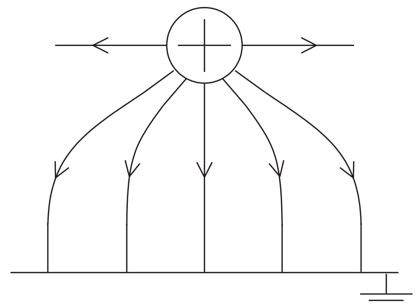
ELECTROSTATICS II

1. Which diagram below best represents the electric field pattern between a positively charged conducting sphere and an earthed metal plate?

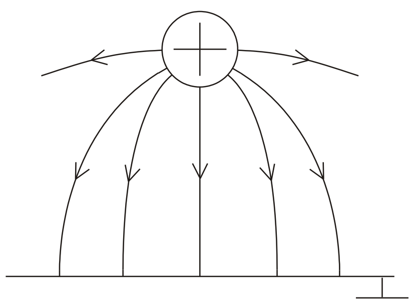
A.



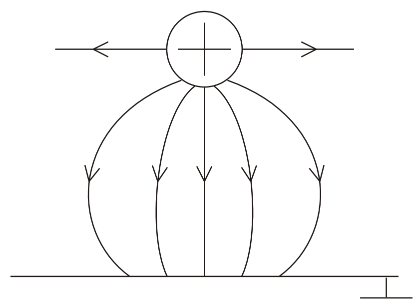
B.



C.

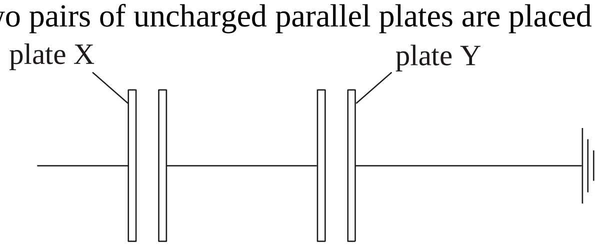


D.

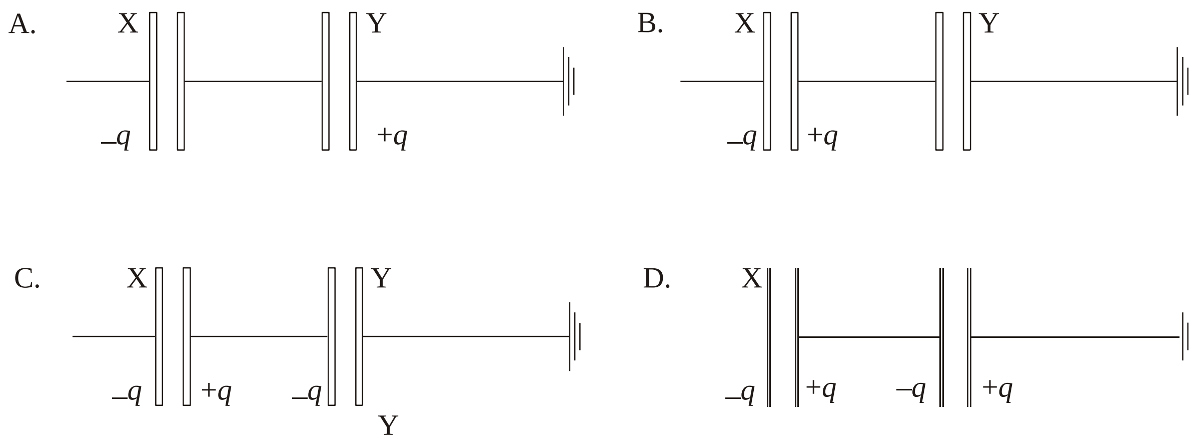


(1)

2. Two pairs of uncharged parallel plates are placed in a vacuum and are connected as shown.



A negative charge of magnitude q is placed on plate X. Plate Y is connected to earth. Which **one** of the following diagrams shows the distribution of charge on the plates?



(1)

3. Which of the following is the correct value of the electronvolt, measured in SI Units?

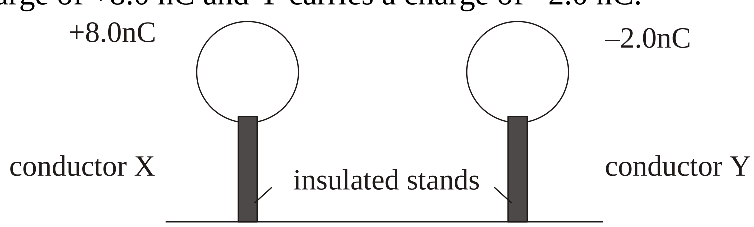
A 1.6×10^{-19} N

B 1.6×10^{-19} J

C 9.1×10^{-31} N

D 9.1×10^{-31} J

4. Two identical spherical conductors X and Y are mounted on insulated stands. X carries a charge of +8.0 nC and Y carries a charge of –2.0 nC.



The two conductors are brought into contact and are then separated. Which of the following gives the charge on each conductor?

	Charge on X	Charge on Y
A	0.0 nC	0.0 nC
B.	+8.0 nC	–2.0 nC
C.	+5.0 nC	+5.0 nC
D.	+3.0 nC	+3.0 nC

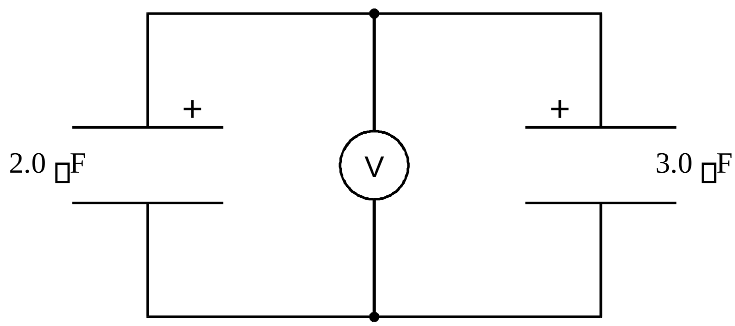
5. A 2.0 μF capacitor is charged to a potential difference (p.d.) of 50 V and a 3.0 μF capacitor is charged to a p.d. of 100 V.

Calculate the charge on the plates of each capacitor.
Write your answers in the table below.

Capacitor	2.0 μF	3.0 μF
P.d.	50 V	100 V
Charge		

(2)

The capacitors are then joined together **in parallel** with their positive plates connected together.



What is the equivalent capacitance of this combination?

....

Equivalent capacitance = ... μF (1)

[Total 3m]

6. A 3.0 mF and a 5.0 mF capacitor are connected in series with a 12 V battery.

a. Find the equivalent capacitance.

[3m] b. Find the charge on each capacitor.

[3m]

c. Find the potential drop (or voltage) across each capacitor. 3m

[3m]

[Total 9m]

7. This 8.0 µF 6.0 µF and 5.0 µF capacitors are connected in series. Calculate the total capacitance for this arrangement.