535/2
PHYSICS
Paper 2
AUGUST, 2014
$2\frac{1}{4}$ *hours*

JJEB

JINJA JOINT EXAMINATIONS BOARD

Uganda Certificate of Education

MOCK EXAMINATIONS AUGUST, 2014

PHYSICS

Paper 2

2 hours 15 minutes

INSTRUCTIONS:

Attempt any **FIVE** *questions.*

Mathematical tables, slide rules and silent non-programmable electronic calculators may be used.

These values of physical constants may be useful to you.

Acceleration due to gravity	=	$10\ ms^{-2}$
Density of water	=	$1000\ kgm^{-3}$
Density of air	=	$1.25\ kgm^{-3}$
Specific heat capacity of water	=	$4200\ J\ kg^{-1}K^{-1}$
Speed of light in air	=	$3.0 \times 10^{8}\ ms^{-1}$

1. (a) (i) Distinguish between the terms scalar and vector quantities. Give two examples of each. (3 marks)

(ii) State the conditioned under which a body can be in mechanical equilibrium. (2 marks)

(iii)

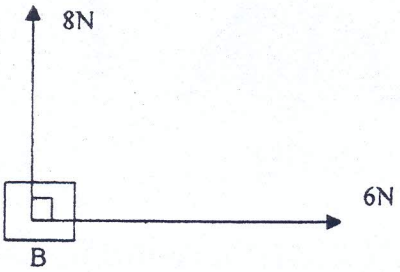

Fig I

A body B is acted on by two forces 8N and 6N at right angles as shown in Fig. I above. Find the magnitude of the third force needed to keep the body in equilibrium. (3 marks)

(b) What do you understand by the term acceleration due to gravity? (1 mark)

(c) A 5kg mass is dropped from a height above the ground and hits the ground after 4.5s.

(i) Find the velocity of the mass as it hits the ground. (2 marks)

(ii) Calculate the kinetic energy of the mass as it hits the ground. (1 mark)

(iii) Determine the height from which the mass was dropped. (2 marks)

(iv) State the energy changes of the mass. (2 marks)

2. (a)

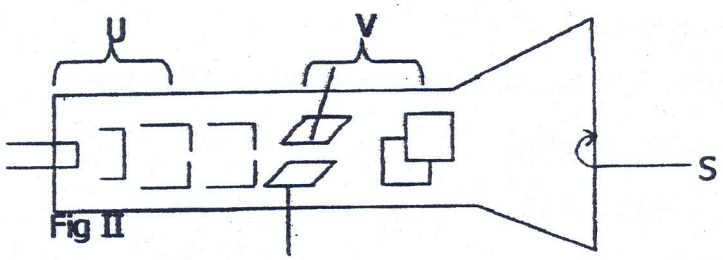

Fig II

Figure II above shows the main parts of a cathode ray oscilloscope.

(i) Identify the parts labeled U, V and S (3 marks)

(ii) Briefly describe the functions of each of the parts labeled in (i) above. (3 marks)

(b) (i) Name the particles emitted by radio active materials. (2 marks)

(ii) Draw diagrams to show the paths of the particles named in (b)(i) above in a cloud chamber and describe the paths. (3 marks)

(c)

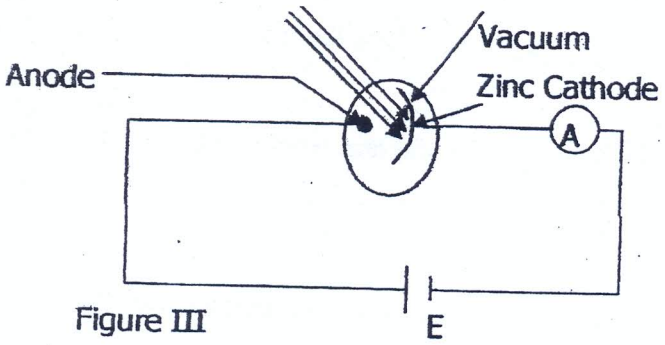

Figure III

A zinc Cathode was enclosed in an evacuated glass bulb as shown in figure III above. The anode and cathode were then connected to an ammeter (A) and source of emf E. When the cathode was irradiated with ultraviolet radiations and the ammeter gave a reading.

(i) Explain why the ammeter gave a reading. (3 marks)

(ii) A gas was gradually introduced into the glass buld. Explain what happened. (2 marks)

3. (a) Explain the difference between transverse and longitudinal waves. Give one example of each. (4 marks)

(b)

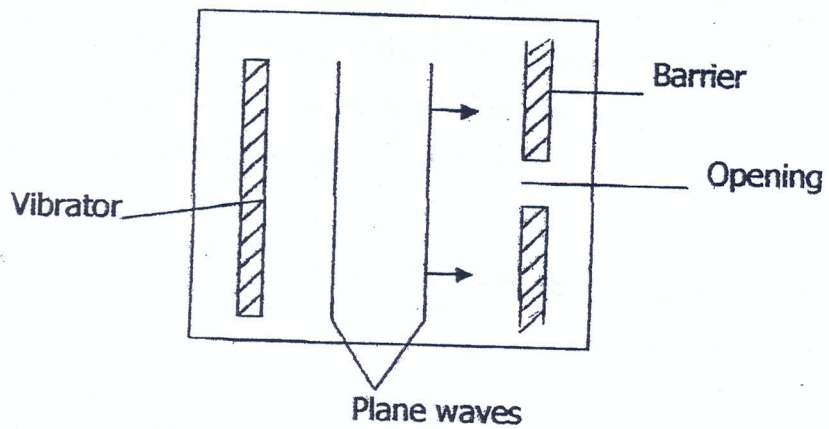

Fig (iv)

Fig iv above shows a vibrator generating plane water waves in a ripple tank. The waves are incident on a barrier with an opening as shown.

(i) Re-sketch a diagram to show the water waves after passing through the opening. (1 mark)

(ii) Explain with aid of a diagram what would happen to the waves if the opening is narrowed. (3 marks)

(c) An object of height 4cm is placed perpendicular on the principal axis at a distance of 45cm from a converging lens of focal length 15cm. By graphical method, determine;

(i) the position of the image. (6 marks)

(ii) the magnification (2 marks)

4. (a) Sketch the electric field pattern for the following:-

(i) two negative charges close to each other. (2 marks)

(ii) a positively charged hollow conducting sphere. (2 marks)

(iii) Two oppositely charged parallel metal plates. (2 marks)

(b) Explain the following observations:-

(i) the leaves of a positively charged electroscope fall when the cap is touched. (2 marks)

(ii) When a positively charged conductor is lowered into an ice-pail placed on the cap of an uncharged electroscope, the leaves diverge. When the conductor touches the inside of the pail, the divergence of the leaves does not change, but when the conductor is removed and tested, it shows no charge. (3 marks)

(c) Explain how a lightening conductor safeguards a building against lightening. (5 marks)

5. (a) State the energy change which takes place in;

(i) A dry cell (1 mark)

(ii) A thermopile (1 mark)

(b) With the help of a well labeled diagram, explain how a simple d.c generator works. (8 marks)

(c)

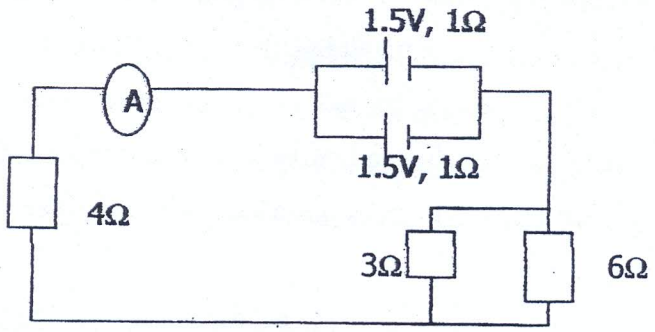

Figure (V)

Figure five above shows two cell of emf 1.5v and internal resistance 1Ω each connected to a circuit of resistance, 3Ω and 5Ω.

(i) What is the reading of the ammeter A (4 marks)

(ii) Calculate the power dissipated in the 4Ω resistor. (2 marks)

(a) Define the following terms as applied to machines.

(i) Mechanical advantage. (1 mark)

(ii) Efficiency (1 mark)

(b) (i) State two reasons why the efficiency of a machine is always less than 100% (2 marks)

(ii) Write down two ways you can use to improve the efficiency of a machine. (2 marks)

(c)

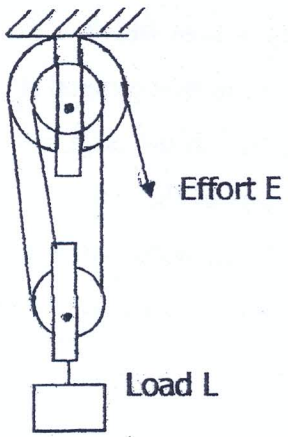

Fig VI

Figure VI shows a pulley system in which an effort is applied to raise a load L.

(i) Copy the diagram and indicate the forces acting on the strings. (2 marks)

(ii) What is the velocity ratio of the system (1 mark)

(iii) How far will the load move if the effort moves through 2.4m? (2 marks)

(iv) What effort will just raise a load of 960N if the mechanical advantage is 2.4. (2 marks)

(v) Use your results above to calculate the efficiency of the system. (3 marks)

7. (a)

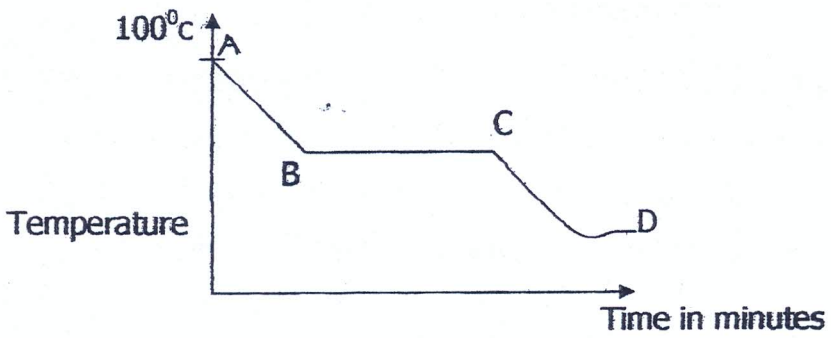

Figure VII

Figure VII shows a cooling curve for a substance which is in liquid form at 100°c.

(i) In what states is the substance over the regions AB, BC and CD of the curve? (3 marks)

(ii) Use the kinetic theory of matter to explain the difference between the states of the substance over the regions AB and CD. (3 marks)

(b) (i) Define specific heat capacity. (1 mark)

(ii) The same amount of heat which raises the temperature of 0.1kg of water from 25°c to 60°c is used to heat a metal rod of mass 1.7kg and specific heat capacity $300JKg^{-1}K^{-1}$. If the original temperature of the rod is 20°c, calculate the final temperature of the rod. (3 marks)

(c) (i) What is meant by a saturated vapour? (2 marks)

(ii) Explain why the boiling point of a liquid depends on attitude. (4 marks)

8. (a) Define the term displacement. (1 mark)

(b) two vehicles A and B accelerate uniformly from rest. Vehicle A attains a maximum velocity of $30ms^{-1}$ in 10 seconds while vehicle B attains a maximum velocity of $40ms^{-1}$ in the same time. Both vehicles maintain these velocities for 6 seconds. They are then decelerated such that A comes to rest after 6 seconds while B comes to rest after 4 seconds.

(i) Sketch on the same axes a velocity-time graph for the motion of the vehicles. (4 marks)

(ii) calculate the velocity of each 18 seconds after the start. (4 marks)

(iii) How far will the vehicles be from one another during this moment. (4 marks)

(c) (i) State the principle of conservation of linear momentum. (1 mark)

(ii) A moving trolley of mass 100g collides with a stationary trolley of mass 200g. After collision the two trolleys move together with a velocity of $2ms^{-1}$. Determine the initial velocity of trolley P. (2 marks)

 End

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Q1.(a)(i) A scalar quantity has only magnitude but no direction while a vector quantity has both magnitude and direction.

Scalar quantity: speed, mass, temperature etc (any two)

vector quantity: velocity, acceleration

3

(ii) Net force on the body is zero.

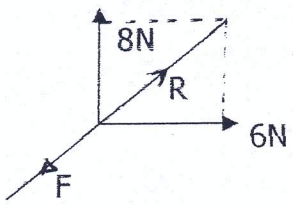
Sum of clockwise moments about any point balance the sum of the anticlockwise moments about the same point.

2

(iii) $R^2 = 8^2 + 6^2$

$R = \sqrt{64 + 36}$

$= 10N$



3

F = 10N in direction opposite to R

(b) Acceleration due to gravity is the rate of change of velocity of a body falling freely under gravity.

1

(c)(i) From $V = u + at$

$u = 0$

$a = g = 10ms^{-1}$

$t = 4.5\ s$

$\therefore V = 10 \times 4.5$

$= 45ms^{-1}$

2

(ii) $KE = \frac{1}{2} mv^2 = \frac{1}{2} \times 5 \times (45)^2$

$= 5,062.5\ J.$

1

(iii) From $S = ut + \frac{1}{2} at^2$

$S = h$

$u = 0$

$a = g = 10ms^{-1}$

$t = 4.5s.$

$\therefore h = \frac{1}{2} \times 10 \times (4.5)^2 = 101.25m.$

2

(iv) Potential energy → Kinetic energy → sound + heat

2

16

Qn. 2.(a)(i) u – Electron gun
V – deflecting system
S – display system (screen).

3

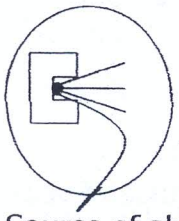
(iii) u – produces electrons by thermionic emission and accelerates them through the tube.
V – two pairs of metal plates; one pair deflects the electrons vertically, the other pair deflects the electrons horizontally.
S – Screen is coated with a material which fluoresces when hit by the electrons rendering them visible.

3

(b)(i) alpha particles and
beta particles

2

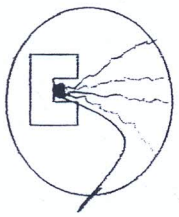
(ii)



Source of alpha particles

Short, thick straight paths

3



Source beta particles

Long wavy thin paths

(c) (i) Electrons are ejected from the zinc cathode by the UV light.
- The electrons are accelerated towards the anode which is at a high positive potential.
- These electrons complete the circuit and current flows through the circuit hence the deflection on the ammeter.

3

(ii) When a gas is introduced into the bulb the reading of the ammeter gradually falls as most of the electrons are deflected on collision with the gas molecules so they can not reach the anode.

2

16

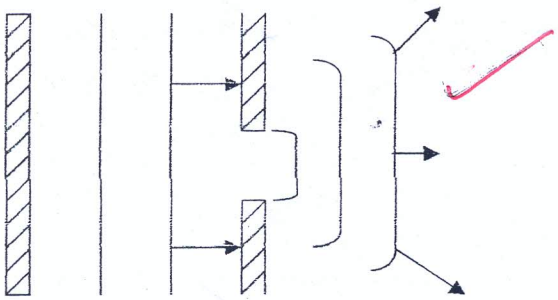
3.(a) In a transverse wave, the particles of the transmitting medium vibrated perpendicular to the direction of travel of the wave but in a longitudinal wave the particles of the transmitting medium vibrate parallel to the direction of travel of the wave.

Transverse wave – water waves ✓ electromagnetic → e.g. radio,

Longitudinal wave – sound wave. ✓, waves on strings

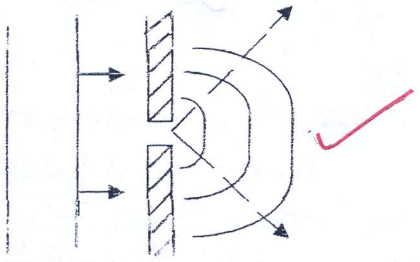
4

(b) (i)



1

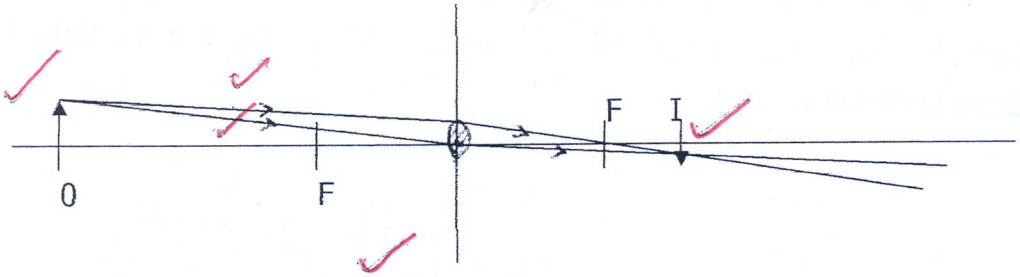
(ii)



When the opening is narrowed, the curvature of emergent waves increases until the plane waves change into circular waves when the opening is approximately equal to the wave length of the incident waves.

3

(c) Let 1cm represent 5cm. ✓



6

(i) Image is 4 x5 = 20cm from the lens

(ii) Magnification $= \frac{20}{45} = \frac{4}{9} = 0.44$

2

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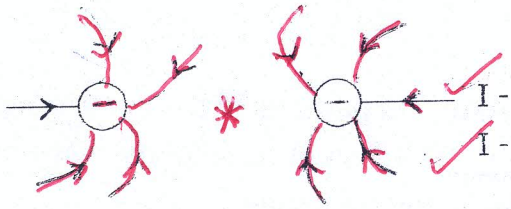
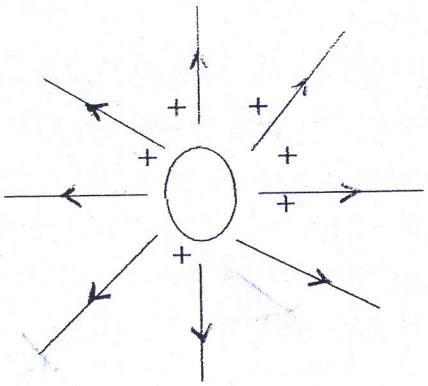
Qn. 4 (a)(i)



I - pattern
I - direction

2

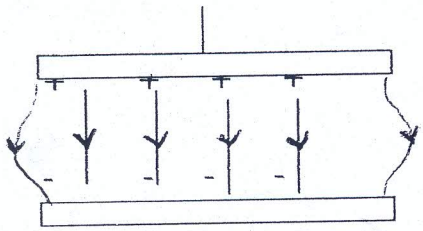
(ii)



I - Shape
I - direction
(charge on surface not inside)

2

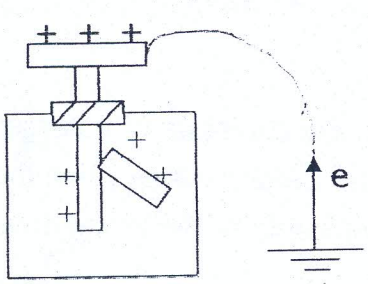
(iii)

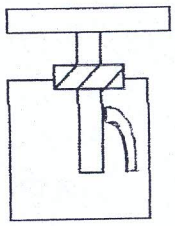


I - Pattern
I – direction

2

(b) (i)

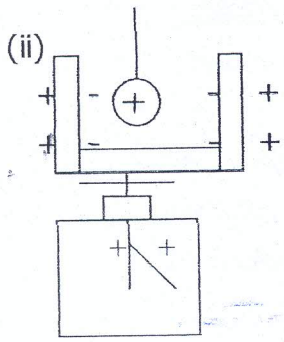


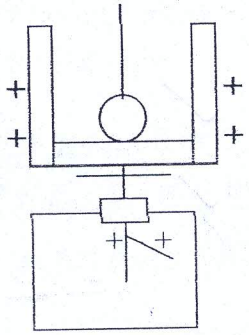


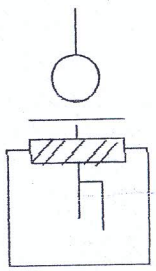
When the cap of a positively charged gold leaf electroscope is earthed, electrons flow from the earth and neutralize the positive charge on the electroscope hence the electroscope looses all its charge.

2

(ii)

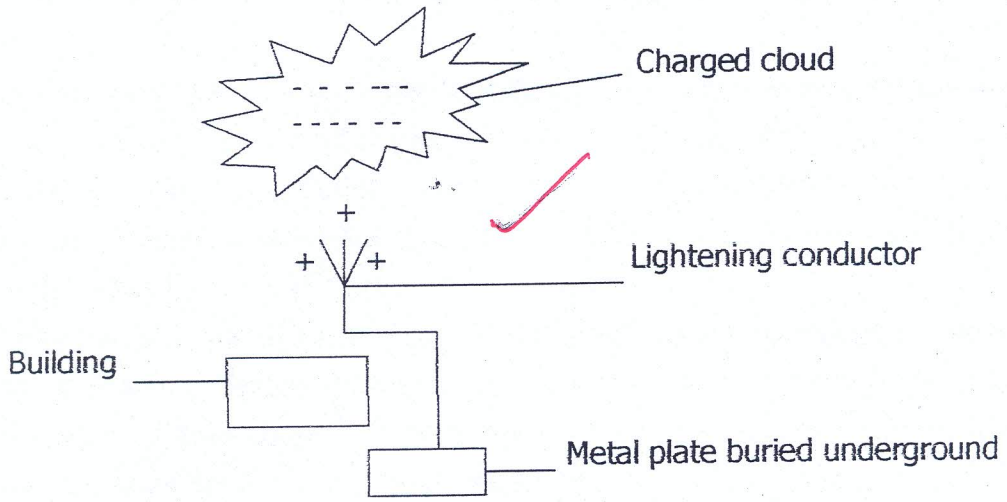






Before the conductor touches inside, electrostatic induction takes place, equal but opposite charge is induced on the inside of the ice pail, equal and similar charge is induced on the outside and the electroscope hence the divergence when the conductor touches the inside of the ice pail, the charge on the conductor is neutralized by the equal but opposite charge on the inside, charge on the outside remains hence when the conductor is tested for charge with a neutral gold leaf electroscope, it has no charge. 3

(c)



When a charged cloud passes over the sharp points of the lightening conductor it induces an opposite charge on the sharp points. The intensity of the charge at the sharp points is very high and ionizes the air molecules between the cloud and the sharp points. Ions similar to those on the sharp points are repelled towards the cloud, those opposite are attracted to the sharp points, providing a safe passage of the charge to the ground without a discharge. 5

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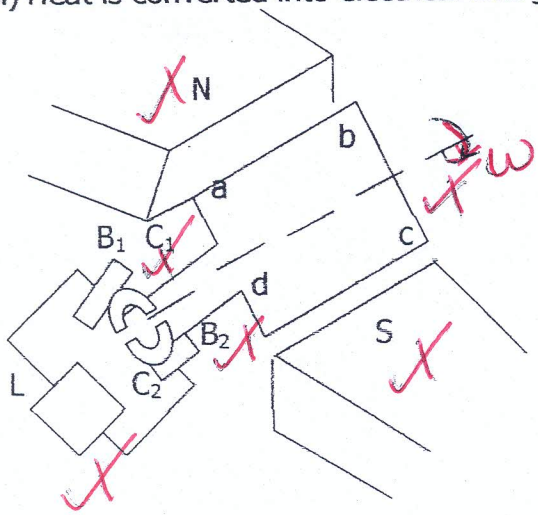
Qn. 5 (a) (i) Chemical energy is converted to electrical energy. 1

(ii) Heat is converted into electrical energy. 1



3

abcd - Rectangular coil of copper wire

N – S pole pieces of a permanent magnet

$C_1 – C_2$ Commutator

$B_1 – B_2$ Carbon brushes

L - Load

The rectangular coil of copper wire is rotated between two pole pieces of a permanent magnet.

As ab is moving upwards, it cuts magnetic flux and a current is induced in it,which according to Fleming's right hand rule is in the direction ab. At the same time cd is moving downwards also cutting magnetic flux and a current is induced in it in the direction cd. Current is picked up through the carbon brushes B_1 B_2 which press against the commutators C_1 and C_2. Current flows through L.

When the coil is in the vertical position the sides change directions of movement from upwards to downwards and vice versa, at this instant current through the coil is zero and the commutators inter change contacts with the carbon brushes. In this way current is always in the same direction through L hence dc.

Effective emf = 1.5V

Effective resistance $= 4 + \frac{1x1}{1+1} + \frac{3 \times 6}{3+6}$

$= 4 + \frac{1}{2} + \frac{18}{9}$

$= 4 + \frac{1}{2} + 2$

$= 6.5V$

:- Current through A is given by

$V = IR$

$I = \frac{V}{R} = \frac{1.5}{6.5} = 0.23\ A$

From $P = IV = I^2R$

$= (0.23)^2 \times 4$

$= 0.21\ W$

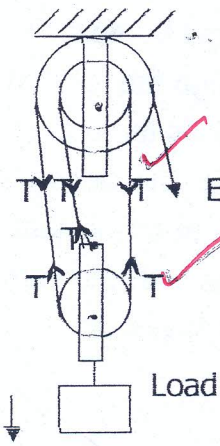
Qn. 6 (a) (i) Mechanical advantages is the ratio of load to effort. 01

(ii) efficiency is the ratio of power output to power input expressed as a percentage. 1

(b) (i) Some energy is wasted in overcoming friction and some is wasted in lifting the movable parts of the machine. 2

(ii) Minimizing friction by
Lubricating, using rollers, smoothening, minimizing the movable weight of the machine. any 2 2

(c)(i)



T – tension in the string 2

(ii) Velocity ration of the system is 3. 1

(iii) Load moves up by 1/3 of distance moved by effort
= 1/3 x 2.4 = 0.8m 2

(iv) by definition

$MA = \frac{L}{E}$

$\therefore E = \frac{L}{MA} = \frac{960}{2.4} = 400N$ 2

(v) Efficiency $= \frac{MA}{VR} \times 100\% = \frac{2.4}{3} \times 100\% = 80\%$ 3

16

Qn. 7 (a) (i) Over AB – Liquid only
Over BC – both liquid and solid
Over CD – Solid only

(ii) In the liquid state, the cohesive forces between the molecules are too weak and the molecules are moving randomly through very large distances.
In the solid state, the cohesive forces between molecules are too great and the molecules are just vibrating about their mean positions.

(b)(i) Specific heat capacity is the quantity of heat required to raise the temperature of 1kg mass of a substance by 1^0c.

(ii) Quantity of heat = $MC\theta$

$Q = 0.1 \times 4200 \times (60 - 25)$

$= 14{,}700$J.

When used to head the rod

$Q = MC\theta$

$14700 = 1.7 \times 300 (\theta_2 - 20)$

$\theta_2 - 20 = \dfrac{14700}{1.7 \times 300}$

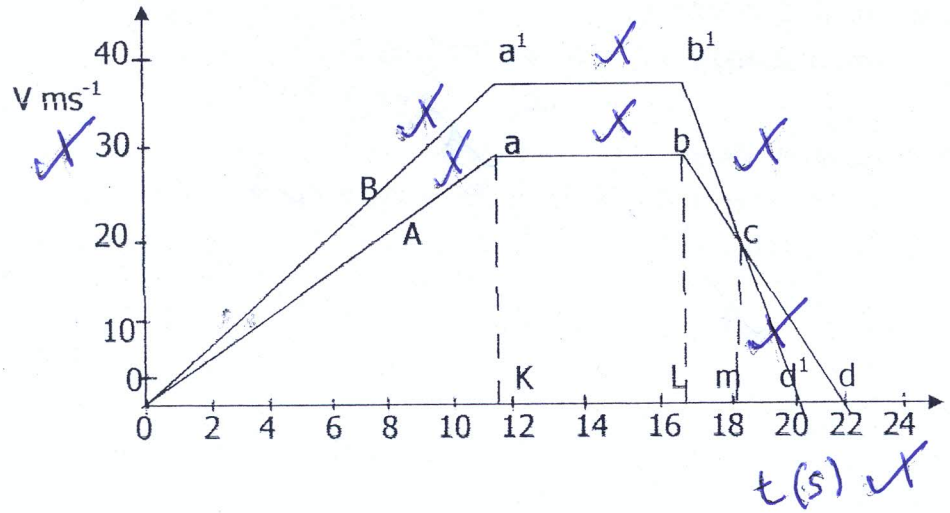
$= 20 + \dfrac{14700}{1.7 \times 300} = 48.82^0$C

(c)(i) A saturated vapour is one in contact with its own liquid in a closed environment.

(ii) A liquid boils when its vapour pressure just balances the external pressure. Atmospheric pressure is due to the weight of the air molecules. As altitude increases the atmosphere reduces and atmospheric pressure reduces

:- the boiling point of a liquid reduces as altitude increases.

Qn. 8(a) (i) Displacement is distance covered in a specified direction.



For A, at 18 s it is decelerating;

$U = 30ms^{-1}$ $V = 0ms-1$

$t = 6s$ $a = ?$

From $V = U + at$

$0 = 30 + 6a$

$a = -5ms^{-2}$

when $t = 2s$, $u = 30ms^{-1}$, $V = ?$

From $V = u + at$

$V = 30 - 5X2$

$= 20ms^{-1}$

:- Velocity of A after 18s $= 20ms^{-1}$

For B at 18s, also decelerating

$U = 40ms^{-1}$, $V = 0ms^{-1}$

$t = 4s$, $a = ?$

From $V = u + at$, $0 = 40 + 4a$

$a = -10ms^{-2}$

When $t = 2s$, $U = 40ms^{-1}$, $V = ?$

$V = 40 - 10 \times 2 = 20ms^{-1}$

:- Velocity of B after 18 s $= 20ms^{-1}$

(iii) Distance covered by A after 18s

= area under curve A

= area of triangle oak + area of rectangle

abik + Triangle bdl

Area of trapezium bcmlb

$= \frac{1}{2} \times 10 \times 30 + 6 \times 30 + \frac{1}{2} (30 + 20) \times 2$

$= 150 + 180 + 50$

$= 380m.$

Distance covered by B after 18 S

= area under curve B

= area △ oa1k + area □ ka1b1L + area ⌓ Lb1mL

= ½ (10x40) + 6 x 40 + ½ (40 + 20) x 2

= 200 + 240 + 60

= 500m

:- The vehicles are 500 – 380

= 120m apart

C(i) Principle of conservation of linear momentum states that if no external forces act on a system of colliding bodies total momentum is always conserved.
(Accept momentum before collision is equal to momentum after collision).

(ii) Let U be the initial velocity

Total momentum before collision

$= \frac{100}{1000} u$

Total momentum after collision

$= \left[\frac{100 + 200}{1000}\right] \times 2$

By the principle of conservation of momentum

$\frac{100}{1000} u = \frac{300}{1000} \times 2$

:- u = $6ms^{-1}$

END