UGANDA ADVANCED CERTIFICATE OF EDUCATION
KAMSSA PHYSICS
PAPER 1 MARKING GUIDE

1. (a) (i) During free fall, the reaction of the support to the weight of the object is zero that is, as the objects fall, it appears weightless. This happens when the object falls at the acceleration due to gravity as the support.

Terminal velocity is the maximum uniform velocity a falling object acquires in the fluid when its weight equals the up thrust and the viscous force due to the fluid.

(ii)

- When the lift is accelerating downwards with an acceleration a, which is less than the acceleration due to gravity g, the body feels lighter. The new weight of the body is $m(g - a)$.
- When $a = g$, the object feels weightless, that is free fall.
- When $a > g$, the object exerts a weight $m(a - g)$ on the roof of the lift.
- When the lift accelerates upwards with acceleration a, the object feels heavier with a weight $m(a + g)$ which it exerts on the floor of the lift.

(b) (i) From definition, $a = \frac{v-u}{t}$ i.e. $v = u + at$

Again, from definition, distance moved = average velocity $\times$ time taken, for uniformly accelerated motion.

$$\therefore s = \frac{u+v}{2} \times t$$

$$s = \left(\frac{u+u+at}{2}\right)t$$

$$= ut + \frac{1}{2}at^2$$

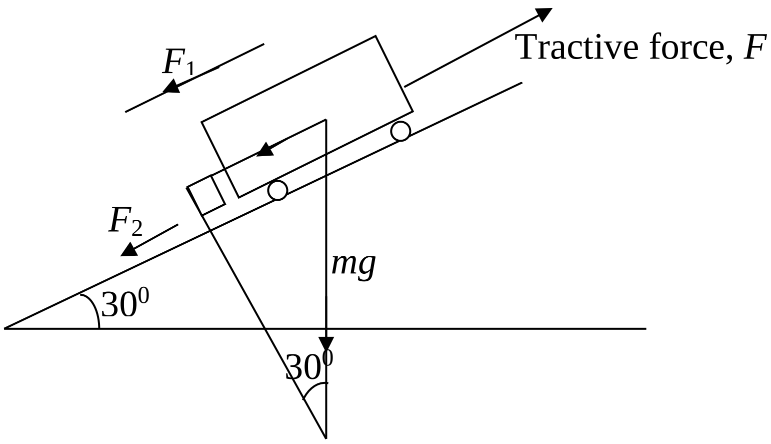
$$s = ut + \frac{1}{2}at^2$$

(ii) $[s] = L$, $[ut] = [u]\times[t] = L/T \times T = L$

$\left[\frac{1}{2}at^2\right] = [a]\times[t^2] = L/T^2 \times T^2 = L$

i.e. dimensions on LHS = dimensions on RHS. The equation is dimensionally correct since 3/2 is a constant.

(c) $m = 1.5 \times 10^3$ kg, $g = 9.81$ m s^{-2}, $\theta = 30^0$, $F = 3.5 \times 10^3$ N



Net accelerating force, $F_a = F - (F_1 + F_2)$

$F_a = 3.5 \times 10^3 - (1.5 \times 10^3 \times 9.81 \times \sin 30^0 + 1.5 \times 10^3 \times 9.81 \times \cos 30^0 \times 0.25)$

$F_a = -7.25 \times 10^3$ N

Use $F = $ ma, Hence, $-7.25 \times 10^3 = 1.5 \times 10^3 a \Rightarrow a = -4.83$ m s^{-2}

(i) Distance, x travelled along incline before the car comes to a halt is;

$v^2 = u^2 + 2ax$

$0 = 20^2 - 2 \times 4.83 \times x \Rightarrow \boldsymbol{x = 41.4}$ **m.**

(ii) use $v = u + at$

(iii) $0 = 20 - 4.83t \Rightarrow \boldsymbol{t} = \dfrac{20}{4.83} = \mathbf{4.14\ s.}$

(d) To get maximum height, H, use;

$$H = \frac{u^2 \sin^2 \theta}{2g}$$

$$H = \frac{35^2 \sin^2 30^0}{2 \times 9.81} = \frac{1225 \times 0.25}{19.62} = \mathbf{15.61\ m}$$

To get range; use;

$$R = \frac{u^2 \sin 2\theta}{g}$$

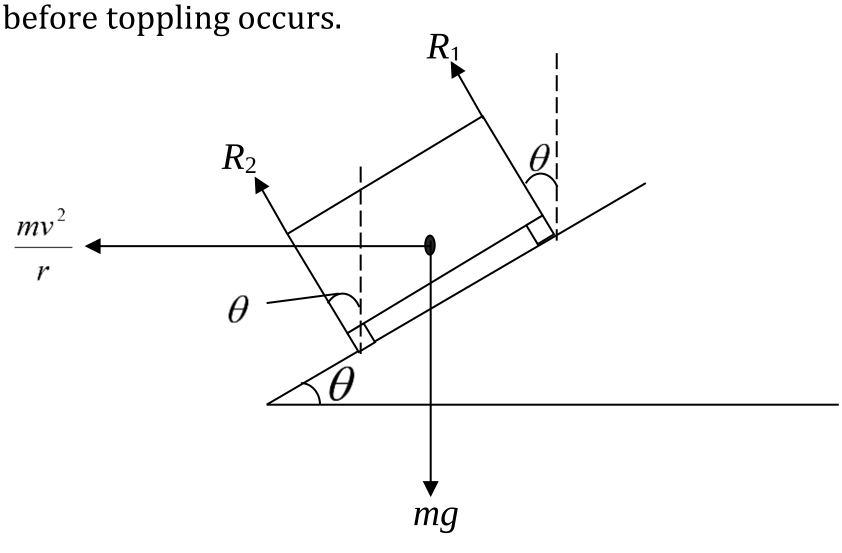
$$R = \frac{35^2 \sin 60^0}{9.81} = \frac{1225 \times 0.866}{9.81} = \mathbf{108\ m}$$

2. (a) (i) Angular velocity is the rate of change of angle swept out by a radius for a body moving in a circular path about the centre.

(ii) Centripetal acceleration is the one due to centripetal force and is towards the centre of the circular path.

(b) (i) On a flat horizontal track, the centripetal force is only provided by frictional force between the tyres and the track. If limiting friction is exceeded, the car will skid and topple over. When the track is banked, the centripetal force is provided by both the components of the normal reaction on the car and the frictional force, and this combination is larger, which implies a higher velocity before toppling occurs.

(ii)



For no side slip at wheels, resolve vertically;

$(R_1 + R_2)\cos\theta = mg$...(1)

Resolve horizontally;

$(R_1 + R_2)\sin\theta = \dfrac{mv^2}{r}$ ....(2)

Divide (2) by (1)

$$\tan\theta = \frac{v^2}{rg} \Rightarrow v = \sqrt{rg\tan\theta}$$

(c) Let mass of planet be m and that of the sun be M and earth's orbital radius be r.

Equating forces by Newton's law of gravitation and by circular motion;

$\dfrac{GMm}{r^2} = mr\omega^2 = \dfrac{4\pi^2 mr}{T^2}$ where ω is angular velocity and T is period of revolution of the earth.

$\therefore M = \frac{4\pi^2}{G} \times \frac{r^3}{T^2}$ Hence if T and r are known, the mass of the sun, M can be found, given the constant G.

(d) Potential energy, $V = -\frac{GM}{R}$. P.e. increases from $-\frac{GM}{R}$ to zero.

In order to escape, loss in k.e. = gain in p.e. = $\frac{GM}{R}$ where R is radius of earth, M is mass of earth and G is universal gravitational constant.

For speed of projection, u, $\frac{1}{2}mu^2 \geq \frac{GMm}{R}$

$\therefore u^2 \geq 2\frac{GM}{R}$, Hence $u = \sqrt{\frac{2GM}{R}}$

(e) T = 24 h = 24 $\times$ 3600 s

Using $\frac{r^3}{T^2} = k \Rightarrow \frac{r^3}{T^2} = \frac{GM}{4\pi^2} = \frac{gr^2}{4\pi^2}$

$\Rightarrow r^3 = 1.02 \times 10^{13} T^2 = 1.02 \times 10^{13}(24 \times 3600)^2 = 7.6 \times 10^{22}$

$\therefore r = 4.24 \times 10^7$ m.

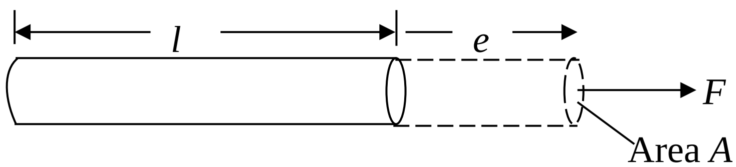
Height above the earth, $h = 42.4 \times 10^6 - 6.4 \times 10^6$

$h = 3.6 \times 10^7$ m.

3. (a) (i)

- Young's modulus is the ratio of tensile stress to tensile strain.
- Plastic deformation of a material is the deformation of a material in which the material does not regain its original shape/size when the deforming force is removed.
- Work hardening is the strengthening of a material due to interactions of dislocations that inhibit plastic flow.

(ii)



$E = \frac{Fl}{Ae} \Rightarrow F = \frac{EAe}{l}$ $\therefore$ work done by force, W = average force $\times e$

Average force $= \frac{F}{2}$ $\therefore W = \frac{EAe^2}{2l}$

Volume of wire Al $\therefore$ Energy stored per unit volume $= \frac{EAe^2}{2l \times Al} = \frac{1}{2}E\frac{e^2}{l^2}$ (b) (i) $mg = ke$

When mass is displaced downwards through a small distance, x; $mg + F = (ke + kx)$, i.e. $F = ke + kx - ke$

When released, resultant force, i.e. accelerating force is ma: where a is acceleration.

$ma = -kx \Rightarrow a = -\frac{k}{m}x$, which is simple harmonic motion since $a \propto x$, and is directed towards a fixed point.

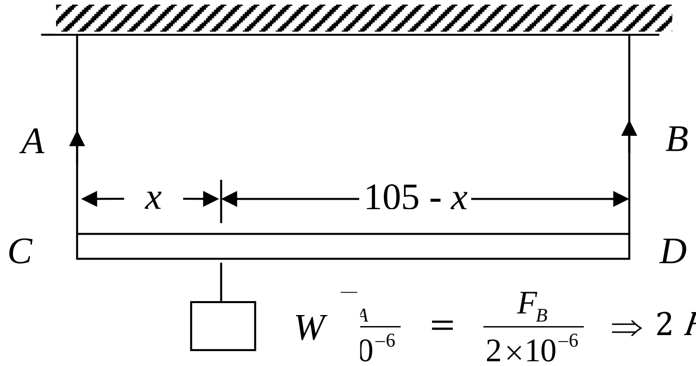
(ii) $E = 2.0 \times 10^{11} = \frac{Fl}{Ae} \Rightarrow F = 2.0 \times 10^{11}\frac{Ae}{l} = ke$

$k = 2.0 \times 10^{11}\frac{A}{l} = \frac{2.0 \times 10^{11} 3.14 \times (1.5 \times 10^{-4})^2}{0.8} = 1.77 \times 10^4$ N m^{-1}

(iii) $a = -\omega^2 x$, $\omega^2 = \frac{k}{m} = 4\pi^2 f^2$

$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}} = \frac{1}{2 \times 3.14}\sqrt{\frac{1.77 \times 10^4}{0.4}} = 33.5$ Hz

(c) (i)



$$\frac{4}{0^{-6}} = \frac{F_B}{2\times10^{-6}} \Rightarrow 2\,F_A = F_B$$

$$F_A x = F_B(105 - x)$$
$$F_A x = 2F_A(105 - x)$$
$$\Rightarrow x = 210 - 2x$$
$$3x = 210 \text{ i.e. } x = 70 \text{ cm from } C$$

(ii)

$$\frac{e_A}{l} = \frac{e_B}{l} \Rightarrow e_A = e_B$$

$$e = \frac{Fl}{EA} \Rightarrow \frac{F_A l}{E_A \times 1\times10^{-6}} = \frac{F_B l}{E_B \times 2\times10^{-6}} \Rightarrow 8F_A = 6F_B$$

$$F_A = \frac{3}{4}F_B$$

$$F_A x = \frac{4}{3}\mathrm{F_A}(105 - x) \Rightarrow x = 140 - \frac{4}{3}x \;\therefore x = 60 \text{ cm.}$$

4. (a) (i) *Coefficient of surface tension* is the force per metre length acting in the surface at right angles to one side of a line drawn in the surface.

(ii)

$$\gamma = \frac{Force}{length}$$

$[Force] = \mathrm{MLT^{-2}}$

$[Length] = \mathrm{L}$

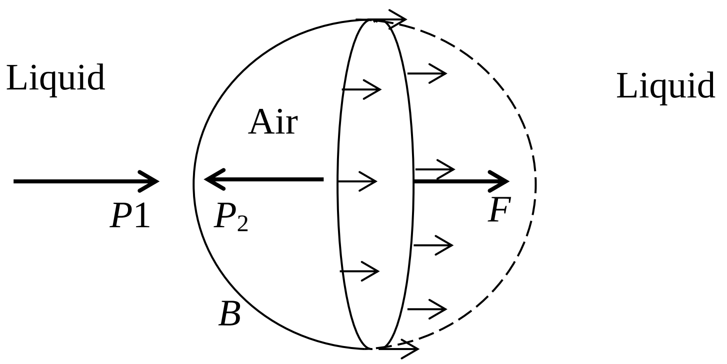
$\therefore [\gamma] = \mathrm{MLT^{-2}/L} = \mathrm{MT^{-2}}$

(b) Some insects e.g. pond skaters can move across the surface of water in a pond without getting wet. This is due to the fact that the surface of water is like a stretched skin which is able to support the insect.

A dry steel needle may be made, with care, to rest horizontally on the surface of water despite the higher density of steel than that of water. Same explanation as above.

Mercury gathers into small spherical droplets when spilt. This is because spheres are the objects with smallest surface areas for the same mass. This therefore reduces the surface energy of the object as a result of surface tension, making it most stable.

(c) Consider an air bubble of radius r formed inside a liquid.



Let the liquid pressure at the depth of the bubble be P_1 and *assume it is constant around the bubble*. Let the air pressure inside the bubble be P_2.

Consider horizontal equilibrium of forces for one-half, B of the bubble.

Surface tension force, F = $2\pi r\gamma$ where γ is the coefficient of surface tension of the liquid.

The force due to liquid pressure = $\pi r^2 P_1$ (in direction of P_1)

Force due to air pressure = $\pi r^2 P_2$ (in direction of P_2)

$$\therefore 2\pi r\gamma + \pi r^2 P_1 = \pi r^2 P_2$$

Hence, $P_2 - P_1 = \dfrac{2\gamma}{r}$ this is the excess pressure of air over the liquid pressure outside the bubble.

(d) γ = 0.5 N m^{-1}, Diameter of tube = 0.8 mm, or radius $r = 4 \times 10^{-4}$ m

Atmospheric pressure = 1.01×10^5 N m^{-2}, Angle of contact θ = 180^0

Density of mercury, θ = 13600 kg m^{-3}

(i) Depression, $h = \dfrac{2\gamma\cos\theta}{r\rho g}$ where g is acceleration due to gravity.

$$h = \frac{2\times 0.5\cos 180^0}{4\times 10^{-4}\times 13600\times 9.81} = -0.0187 \text{ m}$$

(ii) If the tube is closed to the atmosphere, and the pressure inside is $P_1 = 9.1\times 10^4$ N m^{-2} while the atmospheric pressure is 1.01×10^5 N m^{-2}, then

Using $P_2 - P_1 = \dfrac{2\gamma}{r}$, where P_2 is the pressure at depth of mercury depression,

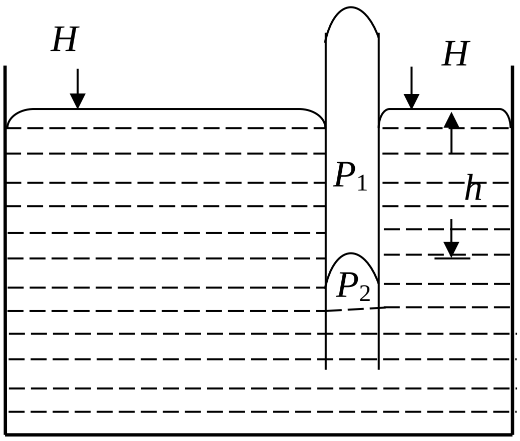
$$\rho g(h + H) - P_1 = \frac{2\gamma}{r}.$$

$$13600\times 9.81h + 1.01\times 10^5 - 9.1\times 10^4 = -\frac{2\times 0.5}{4\times 10^{-4}} = -0.25\times 10^4$$

$$133280h + 1\times 10^4 = -2500$$

$$133280\,h = -12500 \Rightarrow h = -\frac{12500}{133280} = 0.094 \text{ m} = 9.4 \text{ cm}$$

Therefore, mercury rises in the tube by 20 – 9.4 = 10.6 cm



5. (a) Assumptions:

- The forces of attraction between molecules are negligible except during collisions.
- The actual volume occupied by the molecules is negligible compared to the volume occupied by the gas.
- The molecules are perfectly elastic spheres (their collisions are perfectly elastic).
- The duration of collisions is negligible compared to the time between collisions.

(b) Let the mean velocity in the direction of motion of nitrogen molecules be v.

v = 480 m s^{-1}, mass of a molecule, $m = 2.32 \times 10^{-26}$ kg, length of cube,

l = 0.100 m, number of molecules, N = 2×10^{22}, pressure p=?

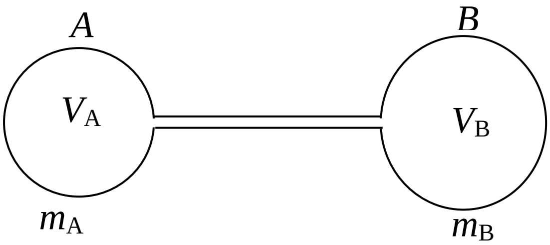
Use; $P = \frac{Nmv^2}{l^3}$

$$P = \frac{2\times10^{22}\times2.32\times10^{-26}\times480^2}{0.100^3} = 1.069\times10^5 \text{ Pa}$$

(c) (i) Dalton's law of partial pressures states that;

The pressure of a mixture of gases, (which do not react chemically), is the sum of the partial pressures of its constituents.

Alternatively; *In a mixture of gases, (which do not react chemically), each gas exerts the same pressure as it would exert if it were alone occupying the volume of the mixture at the same temperature.*



$$\frac{P_1V_A}{RT_1} + \frac{P_1V_B}{RT_1} = \frac{P_2V_A}{RT_{A2}} + \frac{P_2V_B}{RT_{B2}}.$$

$$\frac{P_1}{RT_1}(V_A + V_B) = \frac{P_2V_A}{RT_{A2}} + \frac{P_2V_B}{RT_{B2}}.$$

$$\frac{1\times10^3(3+6)\times10^{-3}}{300} = \frac{P_2\times3\times10^{-3}}{373} + \frac{P_2\times6\times10^{-3}}{273}$$

$$\frac{9\times10^3}{300} = \left(\frac{3}{373}+\frac{6}{273}\right)P_2 = \left(\frac{819+2238}{101829}\right)P_2$$

$$P_2 = \frac{9\times10^3}{300\times0.03} = 1000 \text{ Pa.}$$

(d) (i) The gas molecules are widely spaced resulting in the intermolecular forces of attraction being negligible or too weak. The molecules, therefore are able to move about randomly all over the container filling it completely.

(ii) When the volume of a saturated vapour is decreased, there is a **momentary increase in the density of the vapour** making the number of the vapour molecules striking and entering the liquid surface per second to rise.

The rate of condensation increases and becomes greater than the rate of evaporation. The quantity of liquid increases at the expense of the vapour.

As the vapour condenses, its density falls, and so does its rate of condensation.

When the rate of condensation and the vapour density have returned to their original values, dynamic equilibrium is restored and the original vapour pressure will have returned to its original value. This makes the saturated vapour pressure constant.

(iii) When a gas undergoes an adiabatic expansion, it does work against atmospheric pressure. The energy used comes from the internal energy of the gas, hence the gas molecules move more slowly and it therefore resulting in cooling.

6. (a) (i) Boyle's law states that the volume of a fixed mass of gas at constant temperature is inversely proportional to the pressure.

(ii) $P = \frac{1}{3}\rho\bar{c^2}$

$P = \frac{1}{3}\frac{M}{V}\bar{c^2} \Rightarrow PV = \frac{1}{3}M\bar{c^2}$ But $M = Nm =$ mass of the gas, where m mass of one molecule, and N is the number of molecules.

$$PV = \frac{2}{3}\text{N}\left(\frac{1}{2}m\bar{c^2}\right)$$

But $\frac{1}{2}m\bar{c^2} \propto T$. For a fixed mass of gas, N is a constant, therefore, if T is constant, PV = constant.

(b) (i) Oxygen and nitrogen are heavy gases. Therefore, the average speeds of their molecules at moderate temperatures are so low, yet the escape velocity for the earth is high (approximately 11 km h^{-1}). These gases can therefore not escape from the earth and, the molecules of such gases are close to the earth's surface.

(ii) *The heat energy, ΔQ supplied to a system is equal to the increase in the internal energy ΔU of the system plus the work done, ΔW by the system to its surroundings.*

(iii)

$\Delta Q = \Delta U + \Delta W$, first law of thermodynamics.

$n C_v \Delta T = \Delta U + P\Delta V$, for n moles of gas.

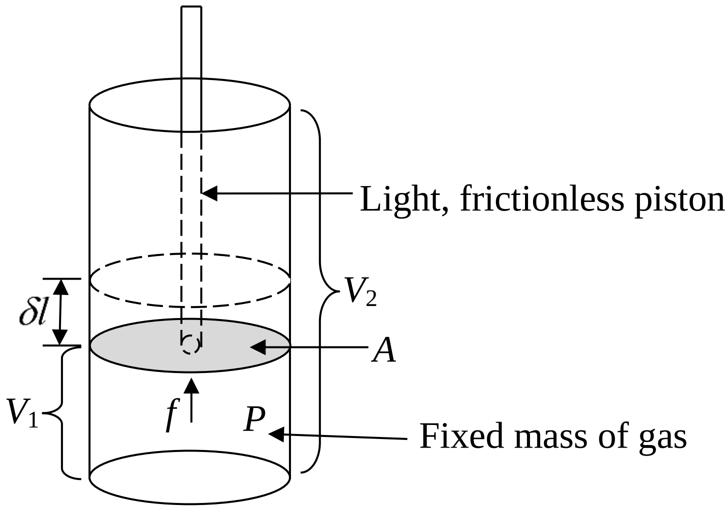
$n C_v \Delta T = \Delta U$, since $P\Delta V = 0$ at constant volume.

$n C_p \Delta T = n C_v \Delta T + P\Delta V$ (at constant pressure).

$\therefore n C_p \Delta T = n C_v \Delta T + n R_{mol} \Delta T$, using $P\Delta V = n R_{mol} \Delta T$

Hence $C_p = C_v + R_{mol}$

(c) Consider a fixed mass of gas of volume V_1 at pressure P.



A is cross-sectional area of the piston. The force on the piston due to the gas pressure, $f = PA$. The piston moves up as gas expands.

For small distance, δl, moved by piston, the work done, δw, is $\delta w = f\,\delta l$

$\Rightarrow \delta w = PA\,\delta l$ But $A\,\delta l = \delta v$, therefore,

Work = pressure × increase in volume (when pressure is constant). Total external work, $W = P(V_2 - V_1)$

(d) $V_1 = 1.0 \times 10^{-3}$ m^3, $T_1 = 273$ K, $P_1 = 1.0 \times 10^5$ Pa, $V_2 = 3.0 \times 10^{-3}$ m^3, $P_2 = 1.0 \times 10^5$ Pa, T_2 =?

(i) Work done, $W = P(V_2 - V_1)$

$W = 1.0 \times 10^5 (3.0 \times 10^{-3} - 1.0 \times 10^{-3})$

$\mathbf{W = 2.0 \times 10^2}$ **J**

(ii) Use $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ Charles's law

$$\frac{1.0 \times 10^{-3}}{273} = \frac{3.0 \times 10^{-3}}{T_2} \Rightarrow T_2 = 3.0 \times 273 = \mathbf{819\ K}.$$

7. (a) *A black body is the one that absorbs all the radiation of every wavelength incident on it, transmits and reflects none.*

(b) Assuming irradiative equilibrium, the power received by mars equals the power radiated by mars as a black body all over its surface.

Hence, $T^4 = \dfrac{T_s^4 R_s^2}{4d^2}$ where T_s is temperature of the sun, R_s is radius of the sun, d is distance of mars from the sun, T is temperature of mars.

$$\therefore\ T^4 = \frac{(7\times10^8)^2\times6000^4}{4\times(2.28\times10^{11})^2} = 3.054\times10^9 = 30.54\times10^8$$

$$T^2 = 5.526\times10^4$$

Hence $T = 2.351\times10^2$ K

(c) Actual solar constant at the earth is E:

$$\frac{90}{100}E = 1.4\times10^3 \Rightarrow E = \frac{1.4\times10^4}{9} = 1.56\times10^3\ \text{W m}^{-2}$$

$E \propto \dfrac{1}{R^2}$ where R is the radius of the earth's orbit.

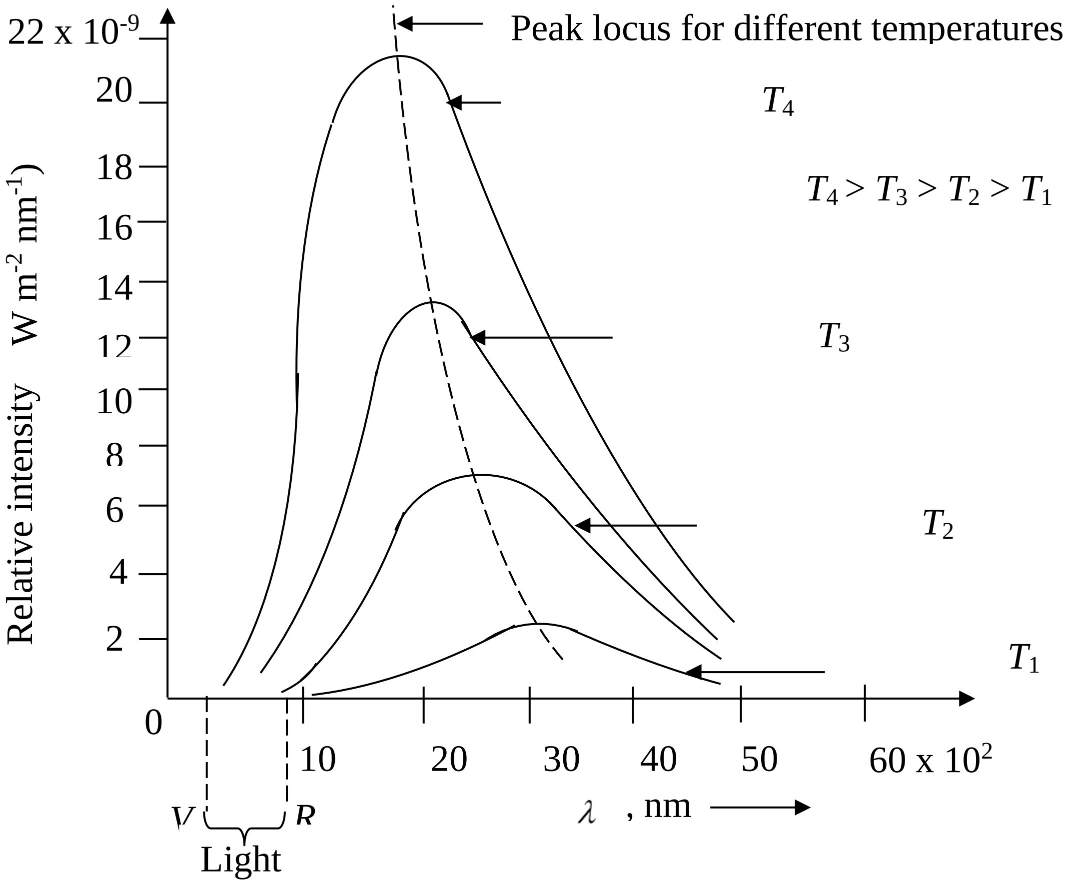
$$\therefore\ E = \frac{k}{R^2} \text{ or } k = ER^2$$

At the sun's surface, $\dfrac{k}{r^2} = \sigma T^4$ where r is the radius of the sun, σ is Stefan's constant.

$$T^4 = \frac{ER^2}{\sigma r^2}\quad \therefore\ T^4 = \frac{1.56\times10^3(1.5\times10^{11})^2}{5.67\times10^{-8}(7\times10^8)^2} = 12.64\times10^{14}$$

Hence $T = 5961$ K

(d) (i)



R = red; V = violet

(ii)

- Relative intensity of e ases as temperature rises.
- The relative intensity of shorter wavelengths increases more rapidly as temperature rises.
- At each temperature, there is a maximum energy intensity at a particular wavelength.

- The peaks of the curves which represent the most intense wavelength in the radiations at various temperatures go on shifting to shorter wavelength as temperature rises.

e(i) High*-grade energy is the energy, which is in a form from which it can easily be transformed to another form* while low-grade energy is the energy, which is in a form from which it cannot easily be converted to any other form.

Examples:

High grade; Electrical energy (Hydro, nuclear, etc.);

Chemical energy (in fuels, bodies, etc.);

Tidal energy (by seas and lakes);

Geothermal energy (by rocks, underground at high pressure);

Bio fuels energy (from organic materials, methane gas, alcohol, etc.);

Wind energy (by moving air);

Solar energy (from the sun's radiation);

Wave energy (Sea waves).

Low grade: Internal energy i.e,

Kinetic energy of molecules due to their random motion

Potential energy due to the gravitational forces between molecules.

(ii) Greenhouse effect is the process by which CO_2 in the atmosphere allows short wavelength radiation from the sun to pass through it to reach the earth and be absorbed warming it up. Consequently, the earth reradiates long wavelength radiation (infrared) as a black body owing to its low temperature. The radiation is trapped by CO_2 in the atmosphere, hence the accumulation of infrared results in the atmosphere warming up, i.e., global warming. It is called greenhouse effect because CO_2 in the atmosphere acts like glass for the green house by trapping infrared using their property of being transparent to short wavelengths and opaque to long ones especially infrared, causing warming.

8a) (i) It's defined as a process by which electrons are released from a clean metal surface when irradiated by electromagnetic radiations of high enough frequency. The electrons emitted this way are called photo electrons.

(ii)**EXPERIMENT TO DEMONSTRATE PHOTO ELECTRIC EFFECT.**

- A cleaned zinc plate is placed on a cap of a negatively charged gold leaf electroscope.
- When ultraviolet radiations are directed on to the plate, the leaf is seen to collapse gradually.
- This is because the plate and the cap lost charges. So, the magnitude of the negative charge at the leaf and gold plate decreases thereby decreasing the divergence of the leaf gradually.

(iii)

b) (i) Power = 100mW

= 100×10^{-3}W

Wavelength = 4.0×10^{-7}m

Energy of each photon = hf

= hc/λ

= $(6.63\times10^{-34} \times 3.0\times10^{8})/ 4.0\times10^{-7}$

= 4.9725×10^{-19}J

Number of photons emitted per second = Power of the metal surface/energy of each photon.

= $100\times10^{-3}/4.9725\times10^{-3}$

= 2.011×10^{17}

(ii) New number of photons = $0.7 \times 2.011\times10^{17}$

= 1.40774×10^{17}

But, I = ne

= $1.40774\times10^{17} \times 1.6\times10^{-19}$

= 2.25mA.

(iii) $W_o = 2.5eV$
$= 4.0x10^{-19}J$
But, $hf = W_0 + K.E$,
$K.E = hf - W_o$
$= 4.9725x10^{-19} - 4.0x10^{-19}$
= 0.608eV

9a) (i) Nuclear number is the number of nucleons and protons contained in the nucleus.
(ii) Binding energy of the nucleus is the energy required to break up the nucleus into its constituent nucleons.
b) $\Delta m =$ (mass of nucleons)– (mass of nucleus)
But number of protons = 92
number of neutrons = (238 – 92) = 146
$\Delta m = (146\ x\ 1.00867 + 92\ x\ 1.00728) - (238.05076)$ $=$ $239.93558 - 238.05076$
$\boldsymbol{\Delta m = 1.88482u}$
B.E per nucleon $=$ ***B E*/ Mass number**
B.E $= mass\ defect\ x\ 931MeV = 1.88482\ x\ 931 = 1754.77MeV$
B.E per nucleon = 1754.77 238/238 = 7.373*MeV*
(c) (i) Binding energy per nucleon is the ratio of the energy needed to split a nucleus into its constituent nucleons to the mass number.
(ii)
(iii)
- Binding energy per nucleon for very small and large nuclides is small.
- A few peaks for low mass numbers are for lighter nuclei that are comparatively stable.
- The binding energy per nucleon increases sharply to a maximum at mass number 56.
- For A> 56 binding energy per nucleon gradually decreases.

(d)
- When Ionising radiations enter the G.M tube through the thin mica window, argon atoms are ionised.
- The electrons move very fast to the anode and the positive ions drift to the cathode.
- When electrons reach anode, a discharge occurs and a current flow in the external circuit.
- A p.d is obtained across a large resistance which is amplified and passed to a scale.
- The magnitude of the pulse registered gives the extent to which ionisation occurred.

10 (a) Positive rays are produced when cathode rays in a discharge tube collide with gaseous atoms and strip off (knock out) some electrons from the atoms. The positive ions formed are accelerated to the cathode and these streams of positive ions constitute rays.
(b) Kinetic energy gained by the electron = work done on an electron by the accelerating p.d, V,
i.e; $\frac{1}{2} mu^2 = eV$
$u = \sqrt{\frac{2eV}{m}}$ As required
c) (i) $F = Ee = 2.4x10^3\ x\ 1.6x10^{-19} = 3.84x10^{-16}$ N
(ii) F = Ma and also F = Ee
Therefore, a = Ee/M
$= 3.84x10^{-16}/9.11x10^{-31} = 4.42x10^{15}\ ms^{-2}$

(iii) From, u = $\sqrt{\frac{2eV}{m}}$

$= \sqrt{\frac{2x90x1.6x10}{9.11x10}}$

$= 5.623 \times 10^{6} ms^{-1}$.

d) (i) Force on the electron; F= Ee = Ve/d......[1] Where E is electric field intensity, E= V/d, V- $p.d$ between the plates, d- distance of separation of plates.

By Newton's 2nd law; F=ma ------------------ [2] Equating 1 and 2

ma= Ve/d

a= $Ve/\,md$...............................3

Using $s = ut + \frac{1}{2}at^2$: [u=0m/s],

Y = $\frac{Ve}{2md}t^2$.........................4

t=$\frac{x}{u}$------------------ [5], put into equation 4

$y = \frac{Vex^2}{2mdu^2}$

$\boldsymbol{y} = \frac{1}{2m}(\frac{Ve}{du^2})x^2$ As required.

(ii) When an electron moves horizontally into a uniform electric field, it describes a parabolic path. This parabolic motion is brought by the electric force experienced by electrons in the direction of that of the field.