Solutions To GCE Questions

A Note to Users

Meetlearn Foundation

Douala Cameroon

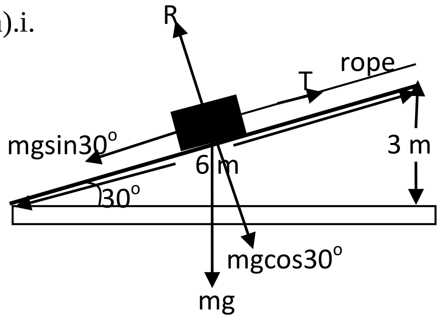
+237697802309

Meetlearn.com

4/1/2013

JUNE 2007

1(a).i.



ii. - It is more convenient to lift the load through the inclined plane than lifting it up vertically.

- Less effort is used along the plane than in lifting load vertically.

iii. Change in P.E, $\Delta P.E = mg\Delta h = 120\ kg\ x\ 10\ ms^{-2} x\ 3m$

$= \mathbf{3600\ \ J\ or\ 3.6\ kJ}$

iv. Efficiency of an inclined plane = $\frac{useful\ work\ output}{useful\ work\ innput} x\ 100\%$

$= \frac{mgh}{E\ x\ distance\ moved\ by\ effort} x\ 100\% = \frac{120\ x\ 10\ x\ 3}{800\ N\ x\ 6\ m} x\ 100 = \frac{3600}{4800} x100$

$= \mathbf{75}\ \%$

v. - Part of the input energy is used to do work against friction between the mass and the plane as it moves up.

- Energy is also wasted in stretching the rope.

(b).i.

Speed	Velocity
It is a scalar quantity	It is a vector quantity
It is defined as distanced moved divided by time taken	It is the rate of change of displacement

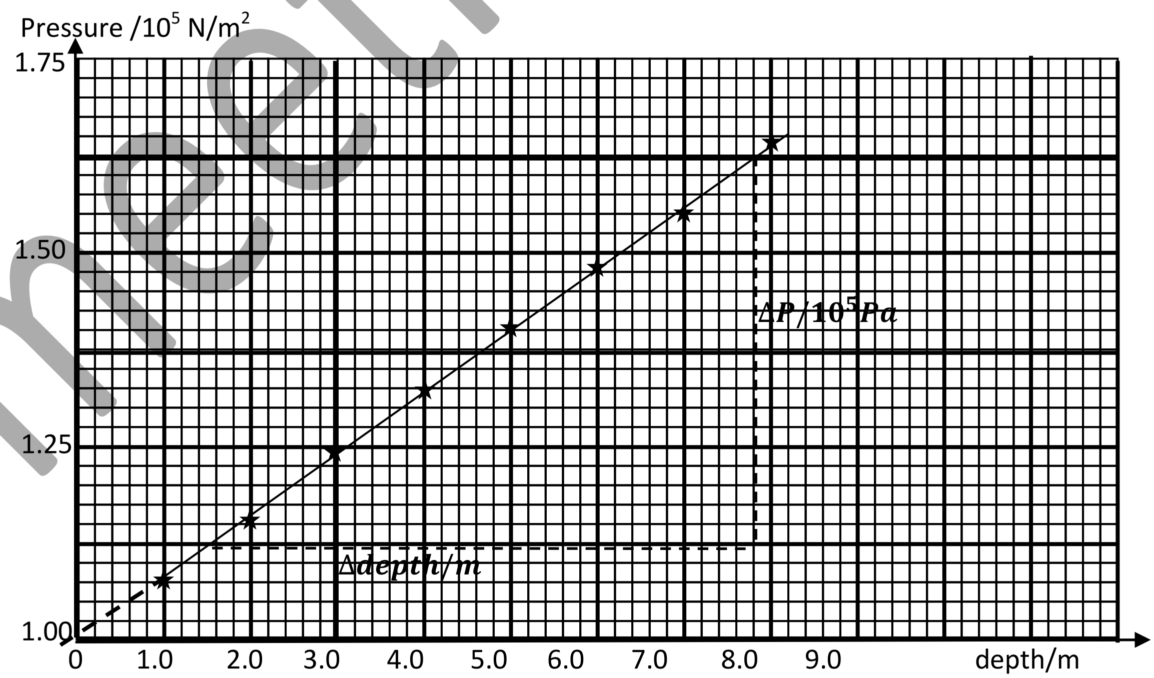
ii. The force of gravity on an object is smaller at the equator than at the poles. This is because:

The equatorial regions are further away from the earth's centre than the polar regions gravity($g \propto \frac{1}{r^2}$)

A greater component of g is used to provide for centripetal force around the equator since a body rotates faster at the equator than around the poles hence causing the weight of the object to be smaller. ***Any one.***

iii. The inertia of a body is the resistance that body offers to any external force that attempts to change its state of rest or of uniform motion in a straight line. The advantage is that; A sheet (*of small mass hence small inertia*) beneath some objects *(of greater mass hence greater inertia)* can quickly be pulled out without really displacing objects.

2(a).i.



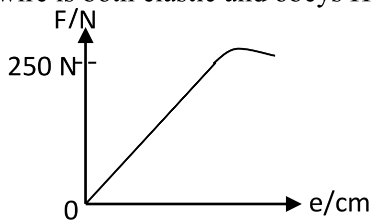
ii. $Gradient = \frac{\Delta \boldsymbol{P/10^5 Pa}}{\Delta \boldsymbol{depth/m}} = \frac{(1.625 - 1.125)/10^5 Pa}{(7.8 - 1.4)/m} = \frac{0.5 \times 10^5}{6.4} = 7812.5 = \boldsymbol{7.8 \times 10^3\ N/m^3}$

iii. By extrapolation as shown on graph, when depth is zero, pressure is 1.00 x 10^5 Pa. This value represents atmospheric pressure.

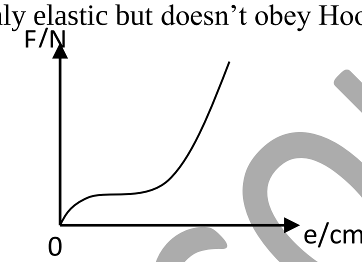
iv. $Gradient = \rho g \Rightarrow \rho = \frac{gradient}{g} = \frac{\boldsymbol{7.8 \times 10^3\ N/m^3}}{10\ m/s^2} = \boldsymbol{7.8 \times 10^2\ kg/m^3}$

(b).i. Elasticity or both wire and rubber are elastic.

ii. Equal stretching forces added to lengths of wire produce corresponding equal extensions (i.e. $F \alpha\ e$) implying wire is both elastic and obeys Hooke's law while rubber is only elastic but doesn't obey Hooke's law.



Copper wire.
Copper wire obeys Hooke's law



Rubber band.
Rubber is elastic but does not obey Hooke's law

iii. The elastic limit of the wire is the maximum force with which the wire can be stretched without suffering permanent deformation. Its value from question or graph is 250 N.

3.(a).i. - Graph **b** uses the displacement of one particle of the medium while graph **a** uses the displacement of two particles of the medium.

ii. The periodic time, T **= 0.04 s** (i.e. time taken to make a complete cycle. Read from graph b)**.**
Wavelength, $\lambda = \boldsymbol{0.8\ m}$ (i.e. distance between two successive crests or troughs. See graph **a**)

iii. $Wave\ speed, v = \lambda f\ but\ f = \frac{1}{T} = \frac{1}{0.04} = 25\ s^{-1} \Rightarrow v = \lambda f = 0.8\ m \times 25\ s^{-1} = \boldsymbol{20\ m/s}$

iv. For transverse waves, direction of vibrating particles is perpendicular to direction of wave motion while with longitudinal waves, direction of vibrating particles is parallel to direction of wave motion.

(b).i..- Different strings of guitars of same lengths have different thicknesses (or mass per unit length , m) and so when plucked would produce notes of different frequencies(f) since $f\ \alpha \frac{1}{\sqrt{m}}$.
Or The tensions produced in the strings when plucked could be different and hence the frequencies of notes produce would be different since $f \propto \sqrt{T}$.

ii. – ***<u>Tightening the string</u>*** increases the tension in the string and hence frequency increases. $f \propto \sqrt{T}$.
- ***<u>Pressing down the string</u>*** reduces the length of vibrating string hence frequency increases. $f \propto \frac{1}{l}$.

(c). i. – E.M waves e.g. visible light is used by some animals to see. ***Choose any one.***
- Micro and radio waves are used in communication and X-rays used in taking photographs of internal organs.

ii. - Mechanical waves e.g. sound waves helps animals in hearing and communication.
- Vibrations in construction companies ….. ***Choose any one.***

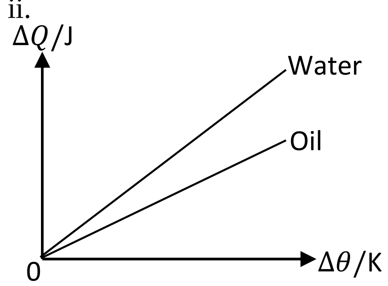
iii. Reflection, refraction, diffraction. ***Choose any one***.

4.(a).i. Temperature is the measure of the average kinetic of the molecules in a substance. Since 2 kg mass of substance has more molecules than 1 kg mass of same substance, more thermal energy would be needed to raise its temperature by the same amount as that of the 1 kg mass of substance.

ii. The supplied heat increases the kinetic energy of molecules (or weaken bonds between molecules) so molecules now vibrate with larger amplitudes(faster) hence melting (change to liquid) occurs.

(b).i. Water is used as a coolant in car radiators. Water is also used for boiling e.g. the boiling of plums.

ii.



iii. Gradient of graphs represents heat capacities of 2 kg masses of water and oil.

iv. Gradient = 5000 J/K = heat capacity

$But\ specific\ heat\ capacity(c)\ = \frac{heat\ capacity(C)}{mass(m)} = \frac{5000\ J/K}{2\ kg}$

$= \mathbf{2500\,J/kg/K}$

(c).i. This is the quantity of heat energy required to change a unit mass of a liquid into gas at its boiling point.

ii. Specific latent heat of vaporization is the energy needed to break liquid bonds and do work against atmospheric pressure(hence greater) while latent heat of fusion is the heat needed to only break solid bonds.

iii. Choose any two.

Evaporation	Boiling
Takes place at all temperatures	Takes place at boiling point
Takes place only at the surface	Takes place through out the liquid
Bubbles do not appear	Bubbles appear
The remaining liquid may cool down	No temperature change occurs

iv. By increasing surface area of the body, blowing over the evaporating surface, increasing temperature ….

5.(a).i. – 273 ^{o} C = 0 K

ii. The pressure at – 273 ^{o} C should be zero (absolute zero).

iii. $P_o(pressure\ at\ 0\ degree\ celsius)\ = 2\ x\ 10^5,\ \Delta P(change\ in\ pressure\ for 100\ o_C\ ) = (\frac{1}{273}\ x\ P_o)x\ 100$

$= (\frac{1}{273}\ x\ 2\ x\ 10^5)x\ 100\ = 0.73\ x\ 10^5\quad but\ P_{100} = \ P_o + \ \Delta P\ = \ 2\ x\ 10^5 + 0.73\ x\ 10^5\ = \ \mathbf{2.73\ x10^5 Pa}$

Hint: $For\ every$ 1 ^{o} C change in temperature, the pressure change $\Delta p\ = \frac{1}{273}\ x\ P_o\ then\ for$ 100 ^{o} c change in temperature,

$\Delta P\ = (\frac{1}{273}\ x\ P_o)\ x\ 100$

(b).i. Decreasing volume, reduces distance gas molecules have to move before colliding with walls of vessel so more collisions with walls are made per unit time (greater force or increase in rate of change of momentum) leading to an increase in pressure since $P\ = \frac{F}{A}$.

ii. Increasing the temperature of the gas increases the kinetic energy of the gas molecules hence increased speed and so gas molecules move faster.

iii. Hydraulic lift, brakes, jack, hoist…. Any hydraulic machine.

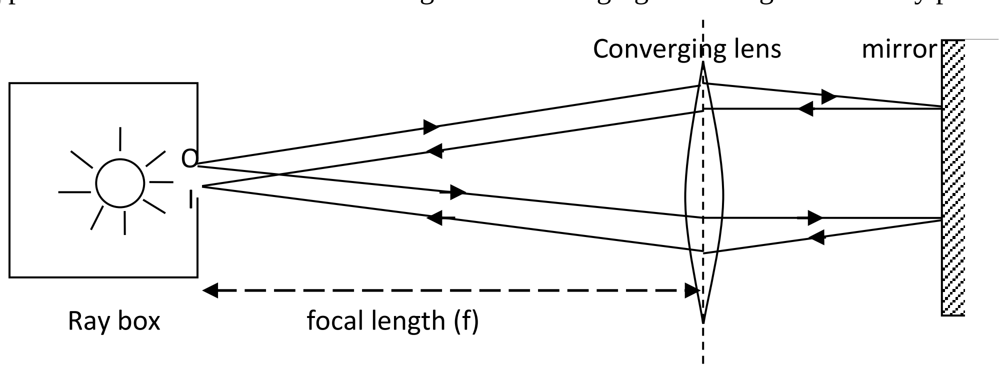
(c). i. When the temperature of the water at the surface drops to 4 ^{o} C , the water attains maximum density (since volume is minimum i.e. $\rho = \frac{m}{v}$) and so sinks to the bottom while ice at 0 ^{o} c and being less dense floats on top of water. Aquatic life in water can then survive at the bottom of water at higher temperatures of 4 ^{o} C even though the surface is covered with ice.

ii. – The freezing of water during winter cracks water pipes. Beer bottles kept in freezer for long crack off.

- Also freezing water in rock crevices cracks rocks. The freezing of water inhibits fishing ….. ***Any two.***

iii. Water has its maximum density at **4 ^{o} C**. $From\ \rho = \frac{m}{v}, \rho \propto \frac{1}{v}\ and\ since\ water\ has\ its\ minimum\ volume\ at$ 4 ^{o} C, its density becomes maximum at this temperature.

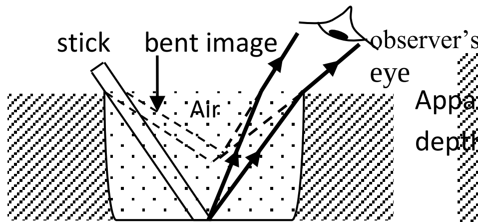
6.(a).i. An experiment to determine the focal length of a converging lens using the auxiliary plane mirror method.

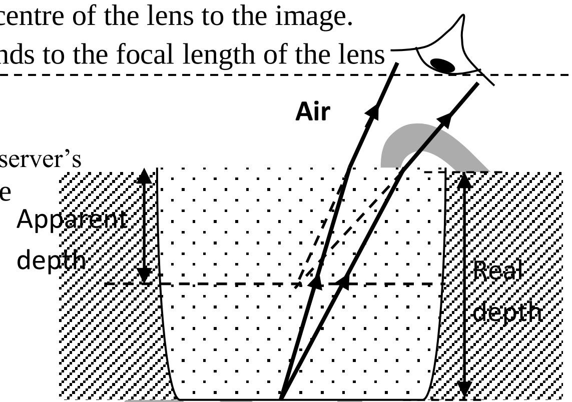


Object O is a pair of cross wires placed in a hole on the ray box as shown on diagram above.
The position of the ray box is adjusted until a sharp inverted real image I of the object cross wires appear alongside the object. A metre rule is used to measure the distance from the centre of the lens to the image.
This distance from the principle of reversibility of light corresponds to the focal length of the lens

---

(b).i.
- The apparent bending of stick partially immersed in Water
- Real and apparent depth of pool of water
- Rainbow, mirages





ii. It means when a light ray from water to air is incident at an angle of 48^o to the normal, the angle of refraction in air is 90^o.

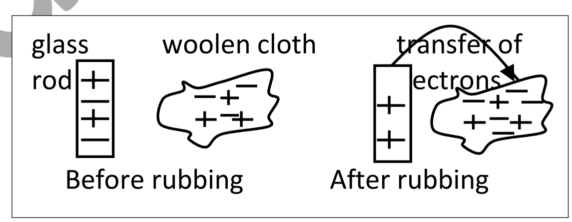
(c).i. Refractive index of a substance is defined as the ratio of the sine of the angle of incidence in air to the sine of angle of refraction in substance. Or the ratio of the speed of light in air (or vacuum) to the speed of light in medium

ii. Real or true depth of liquid = **9 cm**, apparent change in depth = 17.5 cm – 16 cm = 1.5 cm.

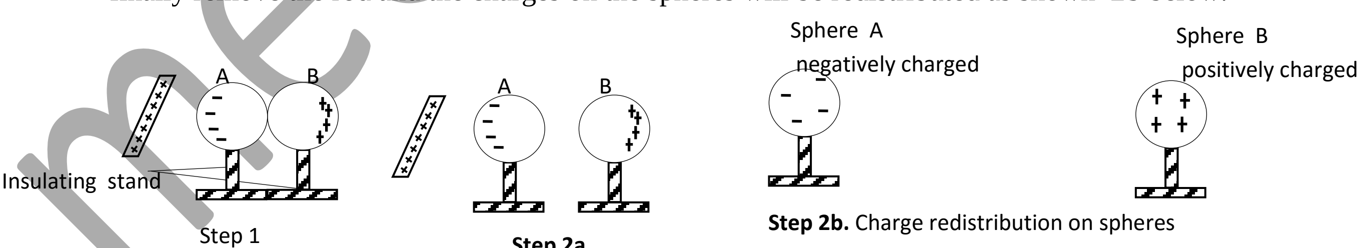
Apparent depth = Real depth – apparent change in depth = 9 cm – 1.5 cm = **7. 5 cm**

$Also\ Refractive\ index, n = \frac{real\ depth}{apparent\ depth} = \frac{9\ cm}{7.5\ cm} = \mathbf{1.2}$

7.(a).i.
The rod is rubbed with woolen cloth during which electrons are transferred from rod to cloth making the glass rod to acquire positive charges while the cloth acquire negative charges.



ii. **<u>Step 1.</u>** To give sphere A negative charge and B a positive charge, a positively charged rod is brought close to A and charge separation occurs on the spheres as shown in diagram 1 below
<u>Step 2.</u> While the rod is still in place, spheres A and B carefully separated as in **2a**.
finally remove the rod and the charges on the spheres will be redistributed as shown **2b** below.



iii. $Q = It = (3\ x\ 10^{-4}\ A)\ x\ (2\ x\ 10^{-2}) = \mathbf{6\ x\ 10^{-6}\ C}.$ Current will flow from sphere B to A i.e. from the positively charged sphere to negatively charged sphere.

(b).i. $When\ s\ is\ opened, R_T = 6\,\Omega + 3\,\Omega = 9\,\Omega. Reading\ of\ M_1(I_T) = \frac{V_T}{R_T} = \frac{12\ V}{9\ \Omega} = \mathbf{1.33\ A}\ and\ since\ the$

Current flows through M_1 and M_2 when switch is opened it implies reading of M_2 = **1. 33 A.**

Hint: M_1 and M_2 are ammeters (connected in series). When s is opened, the other 6 Ω resistor is cut off from circuit because no current flows through it.

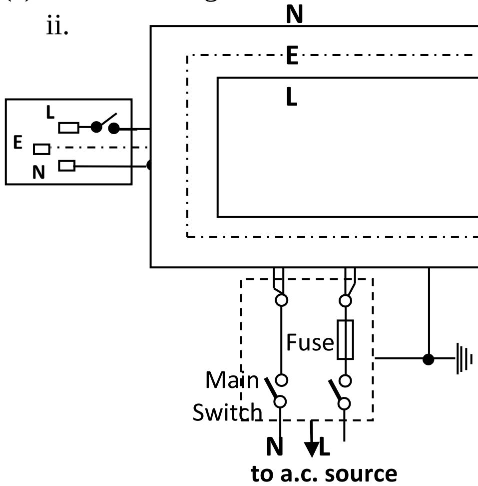
ii. $When\ s\ is\ closed, R_T = R_s + R_p = 3 + \frac{6\ x\ 6}{6+6} = 6\ \Omega. Reading\ of\ M_1(I_T) = \frac{V_T}{R_T} = \frac{12\ V}{6\ \Omega} = \mathbf{2\ A}$

$Reading\ of\ M_2 = \frac{reading\ of\ M_1}{2} = \frac{2\ A}{2} = \mathbf{1\ A}$ Hint: I_T hares equally through the 2 resistor since their resistances are equal..

iii. Battery would last longer with switch, s permanently opened. This is because when s is opened, less current is drawn from the battery.

8.(a).i. Mains voltage is between 220 V to 240 V and the frequency is 50 Hz.

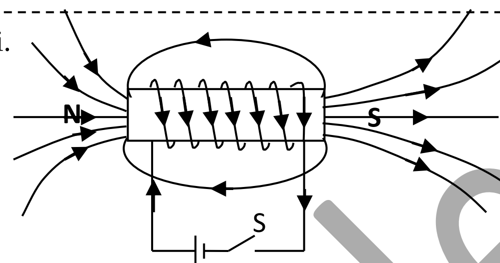
ii.



iii.

- It is less expensive as less wires are used compared to a linear circuit.
- It can take more appliances than the linear circuit since each appliance receives double current from two different pathways.
- Less power is lost here compared to a linear circuit
- The sockets are wired in parallel with each other hence appliances in this circuit can be switched on and off without affecting any other.

(b).i.



ii. When current flows through the coil, the soft iron becomes magnetized and so its field reinforces that of the coil.

iii. By increasing the current flowing through the coil or increase the number of turns of the coil.

iv. Electric bell, magnetic relay, telephone and loud speakers.

(c).i. When a 1 V a.c. supply is replaced by 1 V d.c. supply, the flux linking secondary coil from primary coil will not be changing hence no e.m.f. would be induced in the secondary coil and so the lamp would not light.

ii. $V_p = 1\ V,\ V_s = 2.5\ V, I_s = \frac{P}{V} = \frac{4\ W}{2.5\ V} = 1.6\ A. But\ I_pV_p = I_sV_s \Rightarrow I_p = \frac{I_sV_s}{V_p} = \frac{1.6\ x\ 2.5}{1} = \mathbf{4\ A}$

The assumption is that the transformer is a 100 % efficient i.e. work input = work output.

9(a).i. ${}^{14}_{6}C\ has\ more\ neutrons\ than\ {}^{12}_{6}C.$

$Hint: Note\ that\ N = A - z\ e.g\ for\ C - 14, N = 14 - 6 = 8\ and\ for\ C - 12, N = 16 - 6 = 6$

ii. Isotopes.

iii. N/Z for C-14 = 8/6 = 1.33 while N/Z for C-12 = 6/6 = 1. Since N/Z for C- 14 is greater than that of C-12 and above 1 which is the stability line, ${}^{14}_{6}C\ is\ is\ likely\ to\ be\ radioactive.$

iv. <u>*Constant half life*</u> means the time taken for the activity of the radioactive sample to reduce to half its original value is not changing (it is the same).

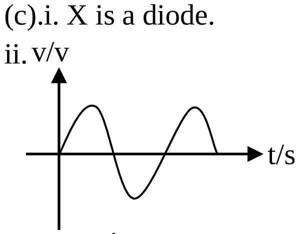
(b).i. The count rate reduces with time because the number of radioactive nuclides decay or reduce with time.

ii. Back ground count = count rate – corrected count rate = 120 – 95 = **25 counts / min.**

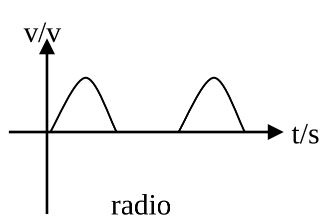
iii. From question table, original count rate, C_o = 240 and time take for 240 to drop to 120 (half of it) = **46 mins** = $t_{1/2}$

(c).i. X is a diode.

ii.



input



radio

iii. X rectifies current through radio so that radio receives only a half cycle current hence the radio functions, stops and then continues for every half cycle.