ENGINEERING SCIENCE - CSEE 2012

Solutions from: Maktaba by TETEA

By Yohana Lazaro

1.

i	ii	iii	iv	v	vi	vii	viii	ix	x
E	D	306 kJ	D	B	A	C	A	B	E

2(a) (i) Used to measure internal and external diameters.

(ii)-Can measure up-to 0.01mm, smallest measurement than Vernier caliper

-can measure diameter of thin wires than Vernier caliper.

(b)- main scale reading = 17.80 cm

-verner scale reading = + 0.05 cm

Total reading 17.85 cm.

3(a) Volume expansivity is the fraction increase in volume of a substance when its temperature increases by 1K

(b) Since coefficient of volume expensivity = 3 x coefficient of liner expensivity

v.expensivity = 3 x (9×10^{-6})

Hence, abs. volume expensivity = 27×10^{-6} /^{0}C

4(a) Acceleration is the rate of change of velocity while velocity is the rate of change of displacement.

(b)-u = 36km/h = 10 m/s

a = 2 m/s^2

t = 5s

from, v = u + at,

= 10 + (2 x 5) = 20 m/s

= 72 km/h

5(a) Torque is the product of force and its distance from the axis of rotation.

(b) Force, F = 2.8 kN = 2800 N.

Radius,= 600mm/2 = 300mm

Recall that, torque = force x radius of rotation

$= 2800 \times 300 \times 10^{-3}$

Hence, torque = 840 NM

6(a) Frequency is the number of complete revolutions done per seconds.

(b) Let, l_1 = 60cm for which f_1 = 256 Hz

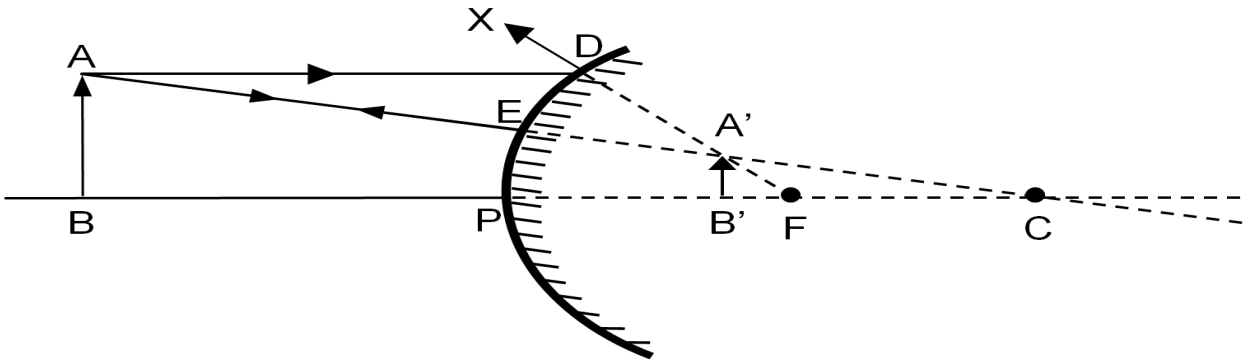
If, l_2 = 40cm, then f_2 =?

Since, length and frequency are inversely related, then by cross multiplication, f_2 = 256 x 60/40

Required frequency will be = 375Hz.

7. (a) Real is positive is the convention which indicates that any distance taken from the pole of mirror towards left side, is taken to be positive.

(b) Data given, f=+18cm v=-6cm



From, 1/f = 1/u + 1/v, on solving for u,

U = vf/ (v-f)

= (-6) (18)/ (-6-18)

Object distance = 4.5cm

8. Preference of mercury than alcohol is due to the following points;-

-it is opaque, i.e it is visible

-it has high melting point than alcohol

-it cannot wet the bulb.

9(a) (i) faraday's law of electromagnetic induction states that;-

''electromotive force is induced whenever there is change in magnetic flux linking the conductor''

(ii)Lenz's law of electromagnetic induction states that;-

''the direction of induced emf is such that to oppose the cause produced it''

(b)Fleming's right hand rule states that;-

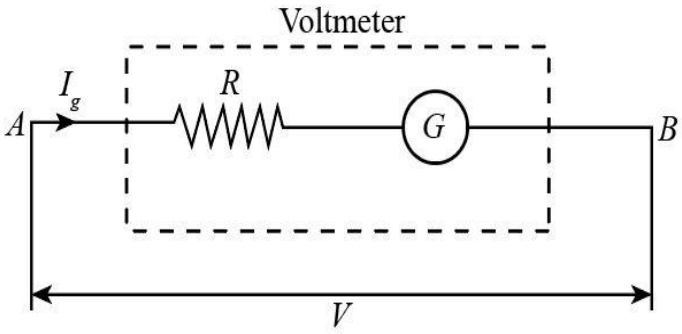
''when the first fingure, the second and thumb of a right hand are held mutually perpendicular to each other such that, first fingure points to direction of magnetic fields, thumb to direction of force, then second fingure will point to direction of induced current''

10(a) Galvanometer is an electrical device used to detect small amount of electric current.

(b) Let resistance of galvanometer be G = 5Ω, its current be I_g=15mA

Required, multiplier for p.d = 1.5V,

-since we are required to connect in series a multiplier



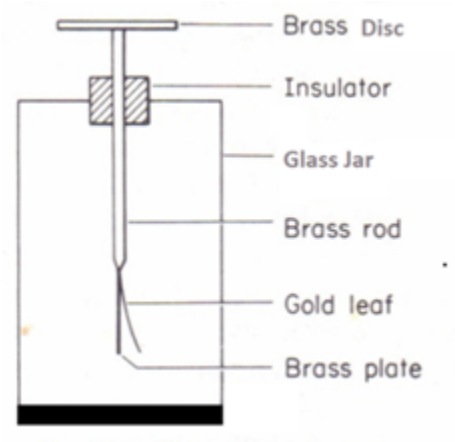
since the resistors are in series then

, V = I_g(R + G), R = V/I_g - g

= 1.5/0.015 - 5Ω

Hence, required multiplier is 95Ω

11. **The diagram of Gold-leaf electroscope**



-The function of gold-leaf electroscope is to detect the presence charge on a substance.

12(a)(i) Resistivity of a material is the tendency of that material to resist the flow of electric current.

(ii)-area of wire = $\pi(0.0016)^2/4 = 2.01 \times 10^{-6}\ m^2$

From, resistivity = RA/L

$R = 9.71 \times 10^{-8} \times 0.5/ (2.01 \times 10^{-6})$

Resistance will be 0.024Ω

Also, since p.d = 9V, R = 0.024Ω

Then I = 9/0.024 = 372.6 A

(b)(i)Hot wire ammeter is an ammeter used to measure the effective value of Alternating Current, AC.

(ii) ***Consider the*** **given** ***circuit below;-***

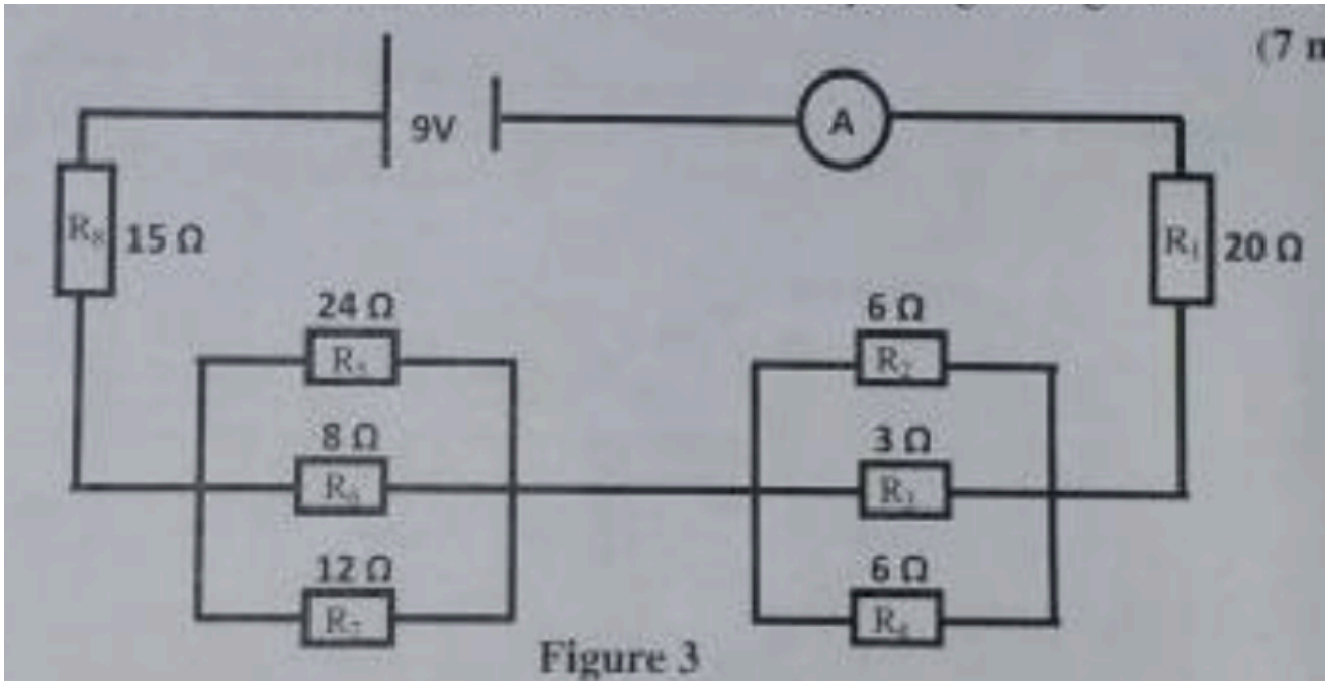


Figure 3

-total resistance between R5,R6 and R7, are in parallel so,

1/R = 1/24 + 1/8 + 1/12, R = 4Ω

-total resistance between R2, R3 and R4

1/R = 1/6 + 1/3 + 1/6, R = 1.5Ω

Total resistance of a circuit = 4 + 1.5 +15 + 20 = 40.5Ω

So total current = 9 / 40.5

Hence total current is 0.22 A.

Also, the pd between R2,R3 and R4 is given by 0.22 x 1.5 = 0.33 V.

Then, current at 3Ω = 0.33V/ 3 = 0.1 A

(c)(i)Secondary coil is the coil where electric current goes out the transformer while primary coil is where electric current enters the transformer.

(ii) Since no.of turns directly proportional to the voltage, then

$\frac{Np}{Vp} = \frac{Ns}{Vs}$, $V_s = \frac{Vp\ x\ Ns}{Np}$

= (12 x 10000)/100

Voltage across secondary coil is 1200V.

Also since efficiency = $\frac{work\ output}{work\ input}$ x 100%

0.9 = (1200 x I)/ (5 x 12), on solving

Current at secondary coil is 0.045 A

13(a) (i)Work is the force that causes the movement or displacement of an object, Energy is the capacity of doing a work.

(ii)-time = 240s, speed = 12m/s

Find distance first d= 240 x 12 =2880m then work done = distance x force

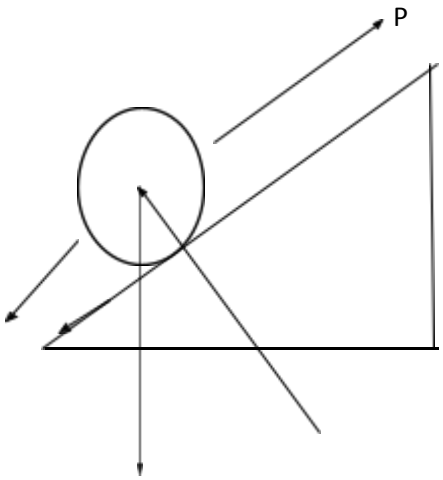
= 2880m x 25000N

= 72MJ.

(b)(i)Newton's second law of motion states that;- '' the rate of changing momentum of the body is directly proportional to the applied force, and moving to the direction of force.

- Third law states that, ''Actions and reactions are equal and opposite''

(ii)Consider the figure bellow;-



5 x 9.81 mgcosθ

At equilibrium, the opposing forces equals to the projecting force,

$(Mg\sin\theta + F_r) = Ma$, where a is acceleration is mass of a body, Fr is friction force then,

$a = (Mg\sin\theta + F_r)/M$

$= ((5 \times 9.81 \times \sin 30^0) + 4.5)/5$

Hence, acceleration of a body is 5.805 m/s^2

So $a = 5.805\ m/s^2$, $u = 6m/s$, $v = 0m/s$

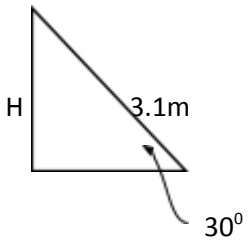
From $v^2 = u^2 - 2as$

$S = u^2/2a$,

$= 36/(2x5.805)$

Hence the distance is 3.1m

Also, PE = Mgh find first the height

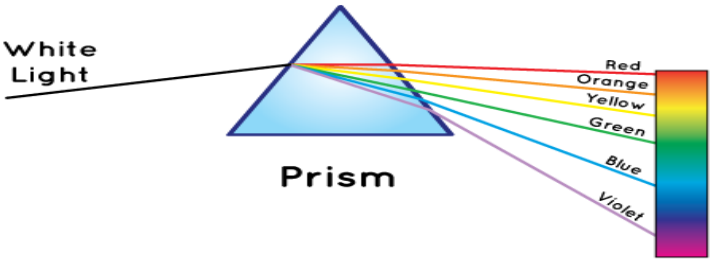


Then.$\sin 30^0 = H/3.1$, height = 1.55m

Then, PE = 5 x 9.81 x 1.55 = 76.05N.

14. (a) i . Components of white light

-red
-orange
-yellow
-green
-blue
-violet



(ii)

(iii) They can be separated by a glass prism.

(b)(i) Magnification is the process of enlarging the apparent size of the body.

(ii)Principle focus is the point where image is formed.

(iii) Using real is positive, u=30cm,f=12cm v=?

From, 1/f=1/v +1/u, v= (uf)/(u-f)

= (30x12)/(30-12)

V = 20 cm.

Position; in front mirror

Nature inverted.

(c) -refractive index,∏ = 1.5

- Angle of refraction=(90^0-60^0)=30^0

From, refractive index = sin i/sin r

So, i = $\sin^{-1}$(∏sin r)

=$\sin^{-1}$(1.5 x $\sin 30^0$)

Hence, angle of incidence is 48.59^0

(d)-given,apparent height=13.2cm,

Refractive index, ∏= 1.47

From, ∏= $\frac{real\ depth}{apparent\ depth}$

Real depth = apparent height x ∏

= 1.47 x 13.2

Hence, real depth = 19.404cm

15(a)

Heat	***Temperature***

(i)measured in JOULES	Measured in KELVINS, CELCIUS or FERNHAIT.
(ii) Transfers from one point to another due to temperature difference.	Is the degree of hotness or coldness of a body
(iii)is the form of energy	Not form of energy.

(b)(i)It is due to rapidly cooling which forces it to contract very fast as it lose heat, hence breaks.

(ii)Tensile strain is the ratio between the increase in length of a substance and its original length. Young's modulus of elasticity is the ratio between tensile stress and tensile stain of a material.

(iii) -length=3m

-diameter=3.15mm

-extension, e=0.9mm

-force =200N

-stress=200/ $(\pi (3.15x10^{-3})^2/4)=25.66x10^6 N/M^2$

-strain=0.9/ $(3x10^3) = 3x10^{-3}$

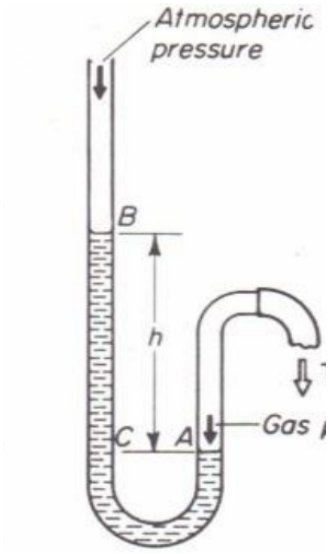
Then, young's modulus=stress/strain

$= 25.66 \times 10^6 / 3x10^{-3}$

Hence, $Y= 8.55 \times 10^9$

(c)(i)Standard atmospheric pressure is the pressure at which standardized measurements equals to 10^5 Pascal's or 1Atmosphere.

(ii) Consider the figure below;-



Recall thatP = density x g x height,

(P_a-P) = (density of mercury – density of water) x g height

(101325 – 34000) = (13600 – 1000) x 9.81 x h

Hence, the height difference is 0.54m

16(a) (i) Angular Displacement is the distance in a specific direction moved by the body when moving a circular motion.

(ii)No.of revolutions = 25, time t =14sec

From, 1rev = 2πrad, so 25rev =50πrad

Then, rotation speed = 50π/14s

= 11.22 rad/s

Also, Angle turned θ = Average angular seed x time

= (11.22/2) x 5s

= 28.05 radians

(b)(i)-Centripetal force is the force which tends to pull inward the body towards its center as it moves circular motion.

-centrifugal force is the force which opposes the centripetal force.

(ii)-speed of car=60km/h = 16.67m/s, radius=25m,

From, angular velocity, ω=V/r

= 16.67/25

=0.67rad/s

Also,-radius 0f wheel, r=0.6/2 = 0.3m at 100km/h = 27.8m/s

Then, ω = 27.8/0.3 = 92.6rad/s.

Then, from 1rev = 2πrad, so 92.6 rad = 15revolutions

Hence angular velocity of wheels = 15 rev/sec

(c)(i)The overall work done becomes greater than work output due to wastage of work input due to frictions when a machine works.

(ii) From, efficient, Ƞ=workoutput/workinput x 100%

Work done input = work done output/Ƞ

= 450 x9/0.75

= 5400 J

Then, Overall workdone = workdone output + workdone input

= 5400J + 4050J

=9450J.

Also effort = workdone input/distance moved by effort

= 5400/45

E = 120 N.

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