ENGINEERING SCIENCE - CSEE 2011

Solutions from: Maktaba by TETEA

By Yohana Lazaro

(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
C	C	E	D	C	B	A	C	C	A

2. Let mass of A = M_a, mass of B = M_b, and their specific heat capacities be C_a and C_b, respectively

Then, since $Q_a = Q_b$ but $C_a = 2C_b$ **then**

$M_a \times 2C_b = M_bC_b$

Hence, the ratio, $M_b/M_a = 2$.

3(a) Faraday's first law of electrolysis states that;-

''the deposited mass of a substance is directly proportional to the quantity of electricity passing through an electrolyte''

(b)-given mass = 1.55g, current I =0.45A, E.C.E =0.001118g/c

Case1, quantity of electricity used, Q = 1.55/0.001118 = 1386.404 C

Case2, then time = Q/I = 1386.404/0.45 = 3080.9seconds

Time taken = 3080.9 s

4

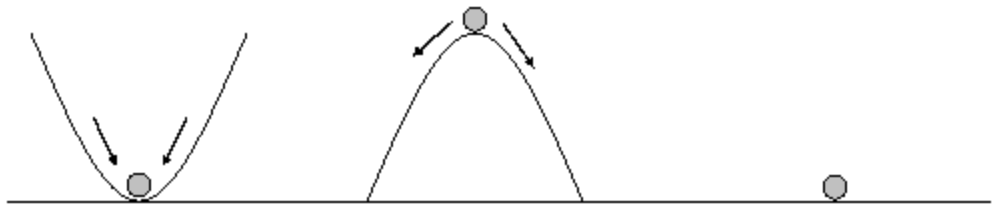
Fundamental quantity	instrument
time	Watch, clock
mass	Beam balance
ampere	ammeter

5-First class level, fulcrum is between load and effort

-Second class level, load is between effort and fulcrum

-Third class level, effort is between load and fulcrum

6. Diagrams for types of equilibriums



(a) Stable Equilibrium (b) Unstable Equilibrium (c) Neutral Equilibrium

Figure 1 – Three Types of Equilibria

7(a) conditions for a system to be at equilibrium

-total upwards forces equals to total downward forces

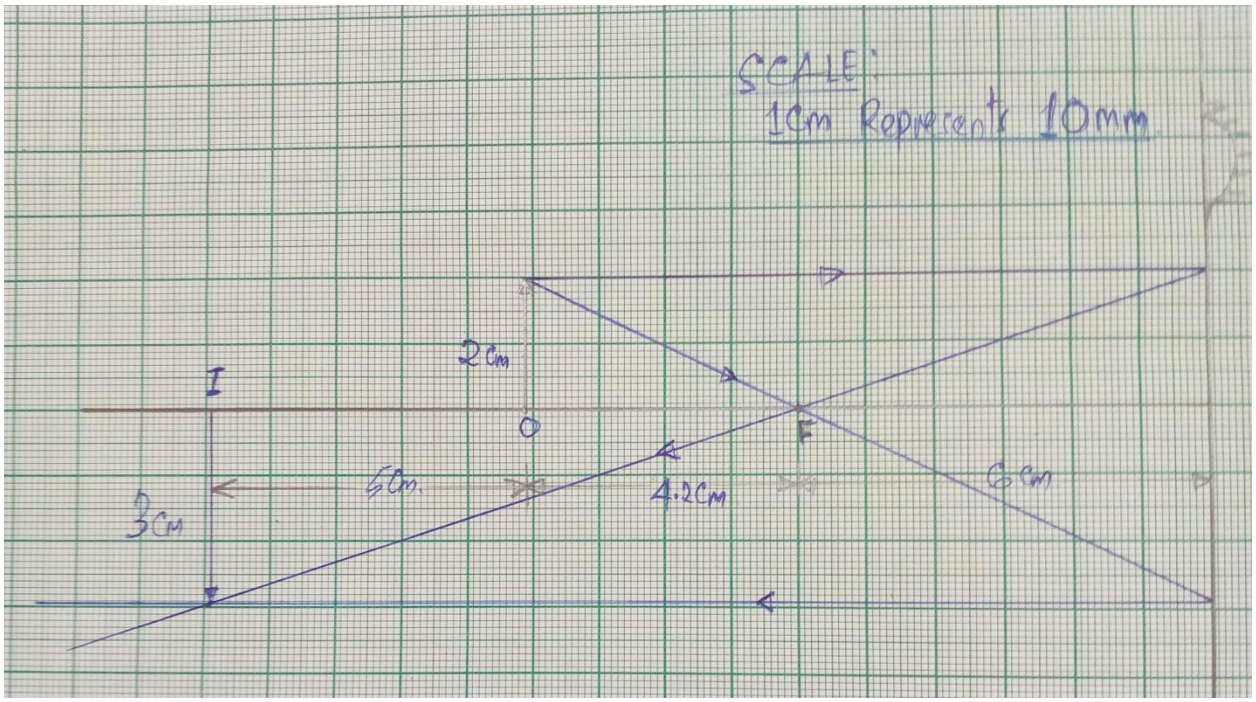
-clockwise moments equals to anticlockwise moments

(b)From the given figure, clockwise moment about fulcrum= anticlockwise moments

(150X2***x***)= (20 X***x***) + (80 X(***x*** +30)), on solving

X =12cm

8. Consider the graph below;-



-From graph,-positi0n of image = 155mm

-size of image = 30mm

-Nature of image is virtue.

9.-density of wood = 0.9g/cm^3, its volume=30$cm^{3,}$, density of liquid =1.2g/cm^3

(a)mass of liquid displaced

From mass = density x volume

= 1.2 x 30

Hence mass of liquid = 36g

(b) Volume of wood = mass of liquid/density of wood

= 36 /0.9

=40cm^3

10(a).The SI unit of force is newton.

(b)Let decrease in length be e=25mm

-applied force = 150N

From load directly proportional to e

Then If 150N = 25mm, then 90N=15mm

Then total shortened length = 15mm + 25mm =40 mm

11(a) unlike magnetic poles

(b) Like magnetic poles

12(a) (i) Principle of conservation of energy states that;-

''energy cannot be created or destroyed but can be transformed from one form to another''

(ii)The SI unit of work JOULES.

(iii)-from $V^2=U^2+2gs$, s=0.5m, u=0m/s then $V^2=9.81\ m^2/s^2$

Then KE = $1/2MV^2$

=1/2 x 2x9.81

Hence, KE = 9.81 J

(b)-time, t=2.5s, u =0m/s

(i) From v=u+gt

=0 + 9.81 x 2.5

Velocity to strike the ground is24.525m/s

(ii) From $v^2=u^2+2gs$, $s=v^2/2g = (24.525)^2/(2 \times 9.81)$ height = 30.66m

(iii)-v=0m/s, u=24.525m/s,s=12.5cm=0.125m, a=?

From $v^2=u^2-2as$, $a=u^2/2s = (24.525)^2/(2 \times 0.125)$

Hence retardation = $2.4m/s^2$

(c)-u=30m/s, s=20m, v=0m/s

(i) Time,from $s = ut -1/2gt^2$, $20=30t-1/2 \times 9.81t^2$,on solving

Time = 5.4s

(ii) Total time to reach ground = 5.4 x2 =10.8s

13(a) (i)Shunt is a small resistance connected in parallel with galvanometer to convert it to measure current.

(ii)Multiplier is the large resistance connected in series with galvanometer to convert it to measure voltage.

(b)-current of galvanometer,I_g=0.4A

-Resistance of galvanometer,G=1Ω

(i) At I= 3.0A, consider the figure below;-

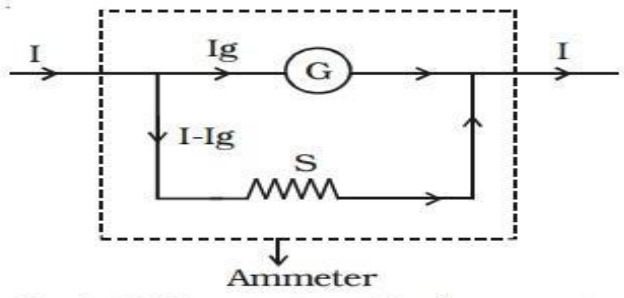


Fig 3.30 Conversion of galvanometer into an ammeter

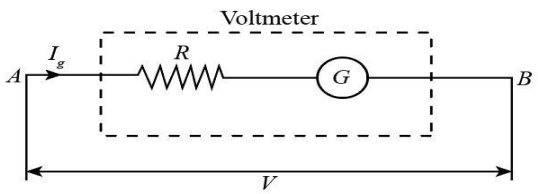
Then since are in parallel, $(I-I_g)\ R = I_gG$

So, $R= (I_g/ (I-I_g)) \times G$

$= 0.4/ (3-0.4) \times 1$

Hence shunt of 0.154Ω should be connected in parallel with galvanometer.

(ii) Voltage of 200V



Then, from=$I_g(R+G)$, $R=V/I_g-G$

$= 200/0.4 -1$

Hence multiplier of 499Ω should be connected in series with galvanometer.

(c)

14(a)-velocity ratio = distance moved by effort/distance moved by load

$= 800/100$

Velocity ratio = 8

-mechanical advantage = load/ effort

$= 1120/160$

Mechanical advantage = 7

-efficient = MA/VR x 100%

7/8 x 100%

Efficiency = 87.5%

(b)-velocity ratio of screw-jack = 2πr/pitch

$= (2 \times \pi \times 45)/0.6$

VR = 471.24

Efficiency = MA/VR x100%, MA = 471.24 x 0.5 = 235.6

Then, effort =load/Ma

$= 2500/235.6$

Effort = 10.6N

(c)-pressure at force pump = Force/Area

$= 100/ (\pi x\ 7^2)/4$

Hence, pressure =2.6 N/M^2

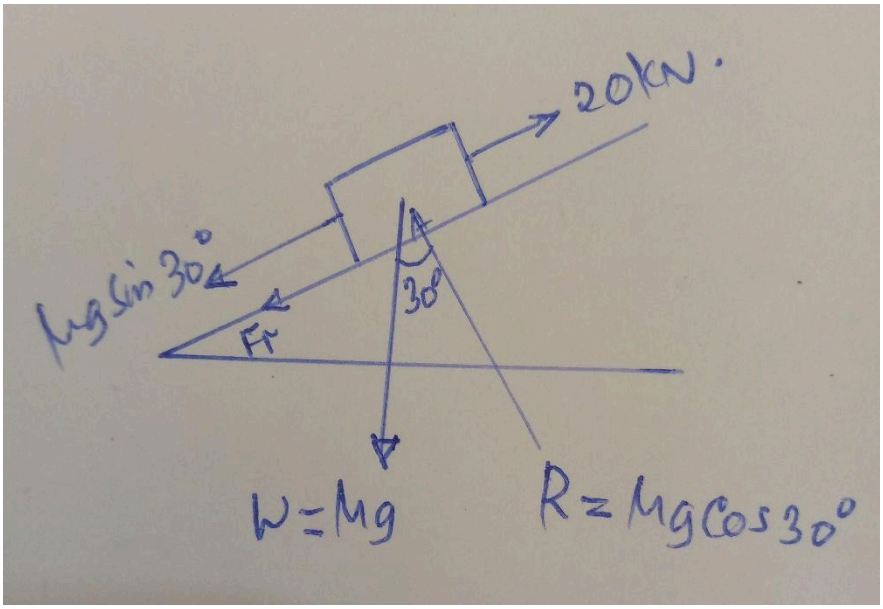
-Apply Pascal's law, pressure at larger piston = pressure at smaller piston

$F/ (\pi x\ 77^2/4) = 2.6$, on solving

Thrust at larger piston = 12100N

15(a) (i) Static friction is the friction which prevent the body to start to move.

(ii)Dynamic friction is the friction that opposes the body during in motion.



(b)-Normal reaction, R =Fcos30^0

=3000 x9.81 x cos 30^0

R = 25487.1N

-Coefficient of friction, = F_r/ R, but (mgsi30^0 + F_r) = pulling force at equilibrium

So, F_r = 20000 – 3000 x 9.81 x sin30^0

= 5285 N. then

Coefficient of friction = 5285/25487.1

= 0.21

(c)(i)Force is the pull or push of an object.

(ii)

FORCE	VERTICAL COMPONENT	HORIZONTAL COMPONENT
35N	35sin0^0	35cos0^0
40N	40sin30^0	40cos30^0
50N	50sin60^0	-50cos60^0
10N	-10sin45^0	-10cos45^0
20N	-20sin45^0	20cos45^0
TOTAL	-14.14N	51.71N

From R = $\sqrt{((14.14)2 + (51.71)2)}$

Resultant = 53.61 N

16(a) (i) Heat capacity is amount of heat required to rise the temperature of substance by 1K

(ii)Specific heat capacity is amount of heat required to rise the temperature of 1kg substance by 1K

(iii)Specific latent heat of vaporization is amount of heat required to change into vapour 1Kg 0f a substance.

(iv)Specific latent heat of fusion is amount of heat required to melt 1kg of substance

(v)Latent heat is amount of heat required to change the state of a substance.

(b) –heat gained by bath water = 100 x C x (60-45) = 1500 C J, where C specific heat capacity of water

- Heat lost by cold water = 20 x C x (45-10) = 700 C J/min

-heat lost by hot water = 20 x C x (70-45) =500 C J/min

Total heat lost = 700 + 500 = 1200C J/min

From heat lost = heat gained

1200C J/min = 1500C J, on solving for min, required time = 0.8 minutes.

(c)-Heat lost by copper metal = 0.04 x 400 x (200-t)

-Heat gained by copper calorimeter + water = (0.06 x 400 x (t-10)) + (0.05 x 4200 x (t-10))

From, heat gained = heat lost

0.04 x 400 x (200-t) = (0.06 x 400 x (t-10)) + (0.05 x 4200 x (t-10))

On solving, t = 22.16^0C is the final temperature.

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