ENGINEERING SCIENCE - CSEE 2014

Solutions from: Maktaba by TETEA

By Yohana Lazaro

1.

i	ii	iii	iv	v	vi	vii	viii	xi	x
B	D	C	A	E	D	A	E	D	E

2. (a) circumferential speed is the speed of the body when moving on the circumferential path.

(b) Diameter=200mm

ω= 2100rev/min = 70π rad/s

Speed = ω x radius

= 70 x π x 0.1

Hence, speed = 21.99 m/s

3(a) Functions of gold-leaf electroscope

-to detect presence of charge on a body

-to indicate the approximate size of charge

-to test whether a body is a conductor or insulator

(b) A= stem

B=gold leaf

C=metal plate

4(a)

Force	Pressure
The push and pull action resulting in acceleration of the object	Force acting upon a certain area and acted upon something perpendicular to its surface
Its unit is Newton and is represented by N	Its unit is Pascal and is represented as Pa
The instrument to measure force is called as dynamometer	It instrument to measure pressure is called as manometer
Force is a vector quantity which means it also has direction	Pressure is a scalar quantity which means it does not have direction
Force can be acted upon on the face, edges, side or vertices of the object	Pressure only acts on the surface or face of the object
Velocity of object can be changed with the application of force in one direction	Pressure on the object won't change the direction of the object.

(b) h=700mm, A=2cm^2

(i) Pressure,P=density x h x g

=13600 x 700 x 10^{-3}x 9.81

= 93391.2 N/M^2

(ii)Force= P x A

=93391 x 2 x10^{-4}

= 18.6782 N.

5(a). Amplitude is the maximum displacement of the wave.

(b).*f*=2000kHz, V= 3.0 x 10^8m/s

Then, λ= V/f

= 3.0 x 10^8/2000 x 10^3

Wavelength will be 150m

6.-u=-5cm

-v=20cm,required f=?

From, 1/f = 1/u +1/v

-f = (-5 x 20)/(-5 +20)

= 4 cm.

7. Advantages of friction

-helps to walk

-helps to brakes

-provides fire on matchstikes

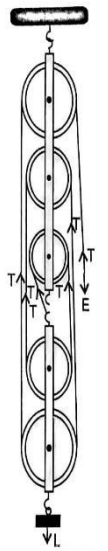
Disadvantages of friction

-cause wear of materials

-can cause unwanted fire

-noise and thunderstorms

8(a) *Diagram of block and tackle pulley system with V.R of 5*



Block and tackle for 5 pulleys

(b)(i) a=effort, b= fulcrum, c=load

(ii)a=load, b=fulcrum, c= effort

9(a)Density is the ratio between the mass of the substance and its volume.

(b)-volume of body,V=1m^3, its density =500kg/m^3

Density of liquid = 750 kg/m^3

Since, displaced weight fluid = weight of body in liquid

(500 x 1) = (750 x V)

Hence, required volume = 0.67 m^3.

10.

Mass	Weight
-the same everywhere	-varies due to location
-never be zero	-can be zero if no gravity acting on that body
-is scalar quantity	-is vector quantity

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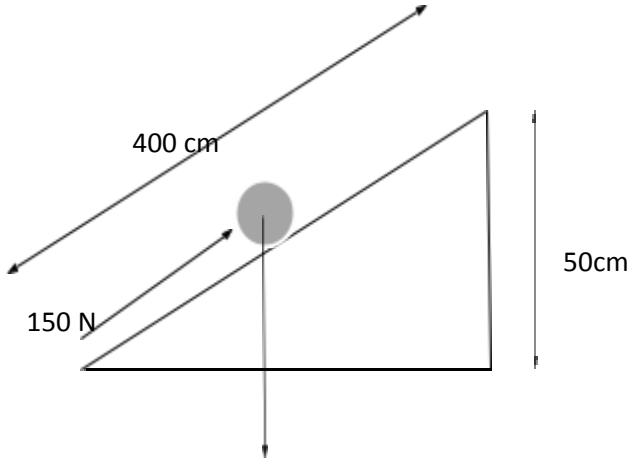


From VR = $\frac{distance\ moved\ by\ effort}{distance\ moved\ by\ load}$

= $\frac{400}{50}$ = 8

Also M.A = load /effort

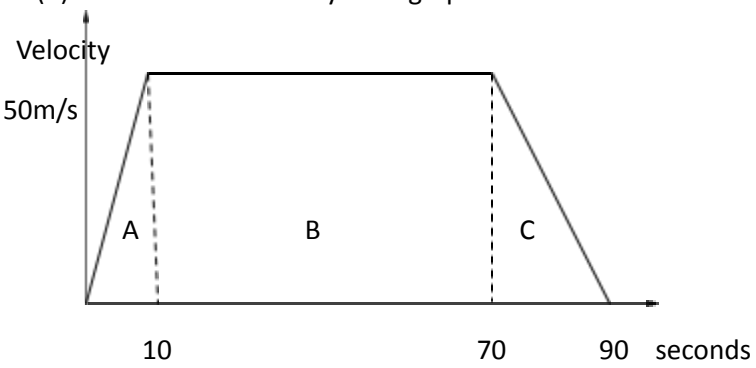
= 800/150

= 5.33

12(a)(i)Displacement is the distance moved in a specific direction.

(ii)Because velocity has direction while speed has no direction.

(b) Consider the velocity-time graph below.



Recall that, v = u + at

= 0 + (5 x 10)

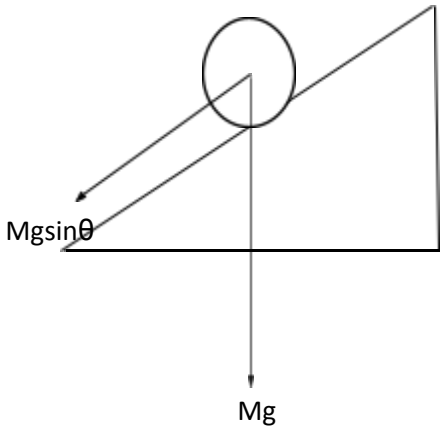
Max. Velocity = 50 m/s = 180 km/h

Since, total distance = total area of the figure

= (0.5 x 10 x50) + (60 x 50) + (0.5 x 20 x 50)

= 3600 m.

(c) Consider figure below;-



-at equilibrium, F = mgsinθ

Ma = Mgsinθ

So, a = gsinθ = 9.81 x sin 45

Hence acceleration is 6.94 m/s^2

(ii) Distance at t = 0.4 s

From $s = ut + 1/2at^2$

$= ½ \times 6.94 \times 0.4^2$

Distance = 0.555 m.

(iii)PE = mgh

But, from figure, height, h = 0.555sin45 = 0.39 m

Then, PE = $(100 \times 10^{-3}) \times 9.81 \times 0.39$

Hence, the potential energy will be 0.38 J.

13(a) Temperature is the measure of degree hotness 0r coldness of the body.

Heat is the form of energy that moves from the region of high temperature to that of low temperature.

(b)(i) Energy lost by heating coil = P x t_____ (i)

- Energy gained by water = MC (100 – 20) _____ (ii)

From principle of energy conservation, energy lost = energy gained

50 x t = 0.1 x 4200 x 80

Hence required time will be 672 seconds

(ii) Given time = 15 x 60 = 900 s

Case1; sensible heat of water = mcθ

= 0.08 x 4200 x (100 – 20)

= 26880 J

Case2; latent heat of vaporization = m L_v

= 0.08L_V

Case3;energy supplied = 50 x 900

= 45000 J

Then by conserving energy,

45000 = 26880 + 0.08 L_v,

Hence the latent heat of vaporization of water will be 226500 J/Kg.

(c)(i)Latent heat is amount of heat required to change the state of matter of a substance. J/kg

While specific heat capacity is the amount of heat required to rise the temperature of 1kg of a substance 1K. J/kg K.

(ii) Mass=2g, θ_1 =-6 ^oC

Case1; sensible heat from -6 to 0

= 2 x 2.1 x (0 – (-6))

= 25.2 J

Case2; latent heat of fusion

=0.00 2 x 336000

= 672 J

Case3; sensible heat to raise from 0 to 100

= 0.002 x 4200 x 100

= 840 J.

Case4; latent heat of vaporization

= 0.002 x 226000

= 452 J

Total energy = 25.2 + 672 + 840 + 452

Hence required energy will be 1989.2 J

14(a)(i)Inertial is the state of the body to be at rest or uniform motion.

(ii)Momentum is the product of mass and velocity of a body.

(iii) Kinetic energy is the energy possessed by a body due to its motion.

(b) m=1000kg,v=90km/h=25m/s, d=100m

(i) Momentum= mass x velocity

=1000x 25=25000 kg m/s

(ii)KE=$1/2mv^2$=1/2x1000x625

=312500J

(iii) From $v^2 = U^2 + 2as$

$0 = 625 + 2a(100)$

Acceleration is $-3.125\ m/s^2$

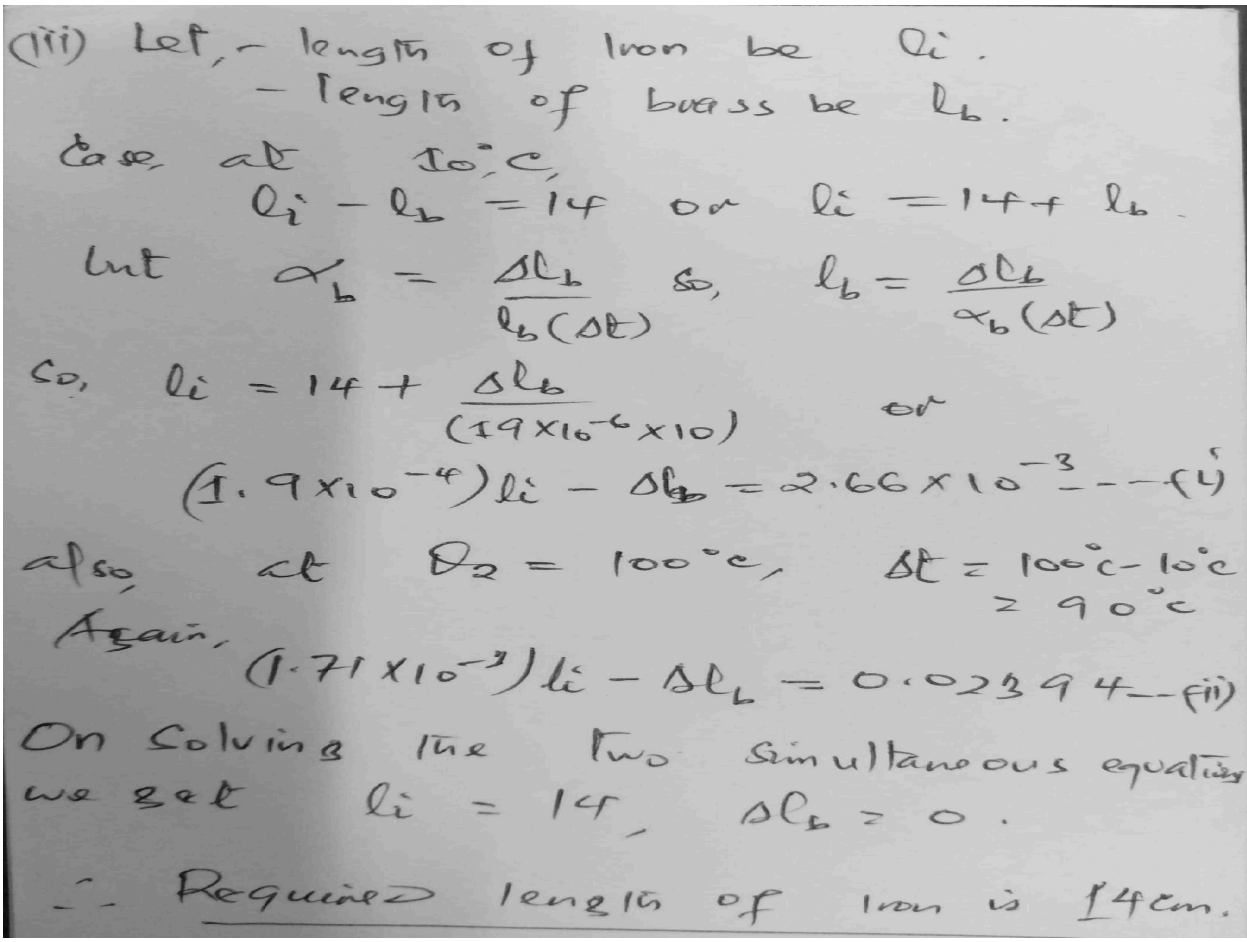
Then, from F = Ma

= 1000 x -3.125

Hence braking force is – 3125 N.

(c)(i)Linear expansivity is the fractional increase in length of substance when its temperature rises by 1K.

(ii) Pressure law; pressure of a gas is directly proportional to its absolute temperature at constant volume. Charles law, the volume of a given mass of a gas is directly proportional to absolute temperature at constant pressure.



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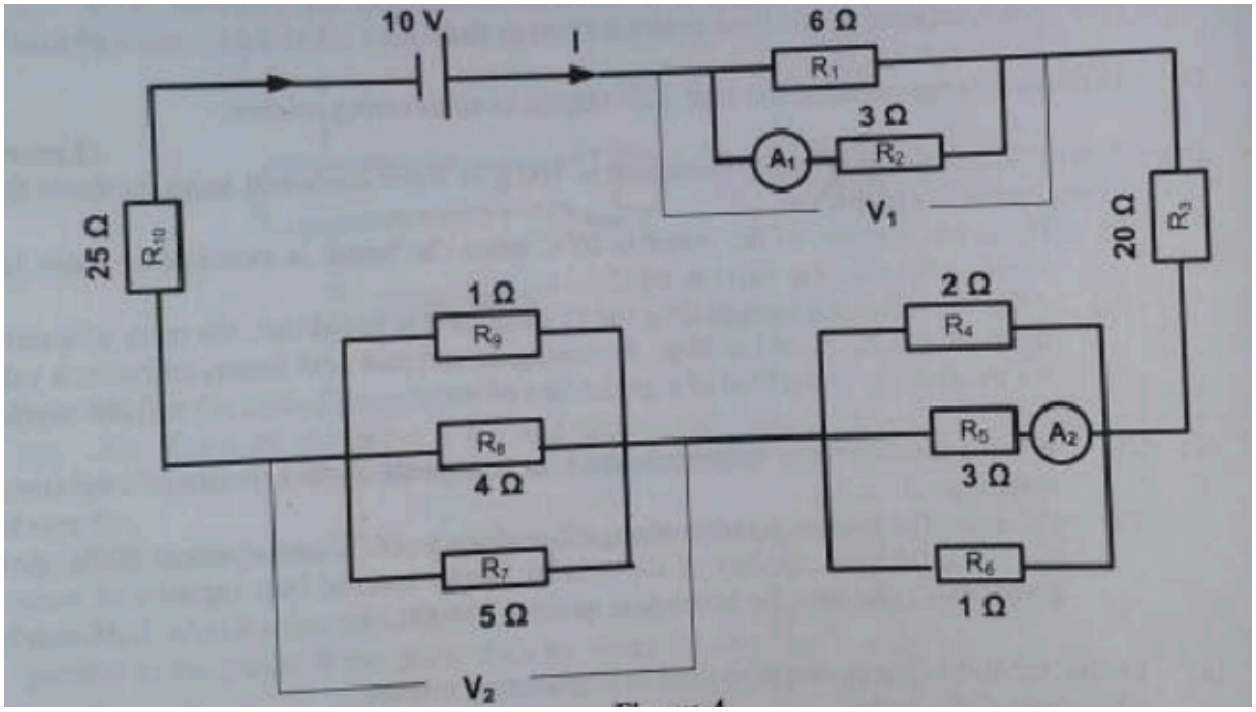
15. (a) (i) ohms law states that ''the p.d of the electric circuit is directly proportion to the electric current, at constant temperature.

(ii) Flemings-Left hand rule states that '' when the first, second and thumb of the left hand are held mutually perpendicular to each other such that the first figure points direction of magnetic field, second figure to current, then the thumb will point to direction of force''

(b)(i) Total current;



-between R7, R8 and R9

1/R = 1/5 + ¼ + 1, R = 0.69Ω

-between R1 and R2

R = (6 X 3)/ (6 + 3), R = 2Ω

-between R4, R5 and R6

=1/2 + 1/3 +1, R = 0.55Ω

Then, total resistance of circuit = 0.69 + 0.55 + 2 + 20 + 25

= 48.24Ω

(ii) at V1, total resistance = 2Ω,then V1 = 10 V

-at V2,

V total = 10 V. total resistance = 48.29Ω

Then total current = 10/48.29

= 0.21 A

At this voltmeter the total resistance = 0.69Ω

Then,V2 = 0.69 x 0.21 = 0.1449 V

(iii) at A1,p.d=10V, R = 3Ω

So, A1 = 10/3 = 3.33 A

At A2, pd= 0.21 x 0.55 = 0.1155 V.

So,A2 = 0.1155 / 3 = 0.0385 A.

(c) since are connected in parallel,

Recall that, P = VI

-for lamps, I = (100 x 6)/250 = 2.4 A

-for heaters, I = (2 x 2 x 1000)/250 = 16 A.

Also, total current = 2.4 + 16

= 18.4 A

Then, total resistance, R = V / I

= 250/18.4

Hence, total resistance= 13.59Ω

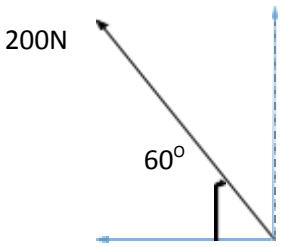
16(a) (i) Resultant force is the single force which represents a system of forces and has the same effect as the whole system at a point of action.

(ii)

SCALAR	VECTOR
Has only magnitude	both magnitude and direction
Fundamental physical quantity	derived physical quantity

(iii) Principle of parallelogram states that "if two vectors acting on a body at the same time be represented in magnitude and direction by two adjacent sides of a parallelogram drawn from a point, their resultant vector is represented in magnitude and direction by the diagonal of the parallelogram."

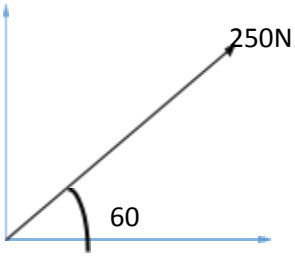
(b)-case1; for F = 200 N, $\theta = 180^0 - 120^0 = 60^0$



H.C = -200cos60

V.C = 200sin60

Case2; θ=60 F= 250 N,



H.C = 250cos60

V.C=250sin60

Case3; F = 150N, θ=(360-330) = 30

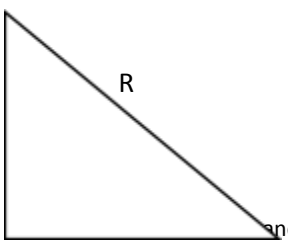
H.C = 150cos30

V.C = -150sin30

Consider the table below;-

Horizontal components,H.C	**Vertical component V.C**
-200cos60	200sin60
250cos60	250sin60
150cos30	-150sin30
TOTAL, 154.904 N	***314.711 N***

Consider triangle below,



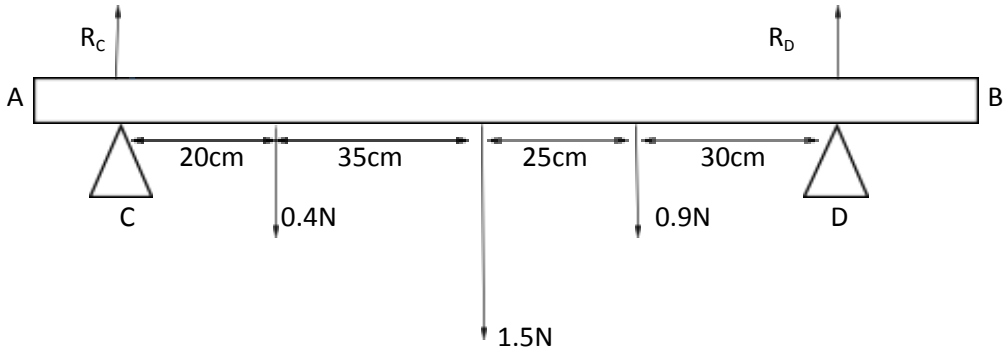
314.711 N

154.904 N

Apply Pythagoras theorem,

$R = \sqrt{(314.711)^2 + (154.904)^2}$

Hence resultant will be 350.77 N.



-Take moment at C

$(0.4 \times 20) + (1.5 \times 55) + (0.9 \times 80) = 110R_D$

$162.5Nm = 110R_D$

$R_D = 1.48N$

$R_C + R_D = (1.5 + 0.9 + 0.4)$

But $R_D = 1.48$

Then $R_C = 1.32N0$

Prepaid by;-

Yohana P. Lazaro

0624876331, 0756274618.