IMPORTANT PROBLEMS IN PHYSICS FOR SSC MARCH – 2017

1. What would be the final temperature of a mixture of 50 g of water at 20°C temperature and 50 g of water at 40°C temperature?

A. Mass (m_1) = 50 gm

Temperature (T_1) = 20°C

Mass (m_2) = 50 gm

Temperature(T_2) = 40°C

Final temperature as per Method of mixtures

$(T) = \frac{m_1T_1+m_2T_2}{m_1+m_2} = \frac{50X20+50X40}{50+50} = \frac{1000+2000}{100}$

$= \frac{3000}{100}$ = 30°C

2. Answer these.

a) How much energy is transferred when 1gm of boiling water (steam) at 100°C condenses to water a 100°C?

b) How much energy is transferred when 1gm of boiling water at 100°C cools to water at 0°C?

c) How much energy is released or absorbed when 1 gm of water at 0°C freezes to ice at 0°C?

d) How much energy is released or absorbed when 1 gm of steam at 100°C turns to ice at 0°C?

A. a) 1gm of boiling water at 100°C condenses to water at 100°C.

Heat transferred (Q_1) = mL

= 1x540 = 540 cal

The latent heat of vaporization of water is (L) = 540 cal/gm.

b) 1gm of boiling water at 100°C cools to water at 0°C.

Heat transferred (Q_2) = m.s.ΔT

= 1x1x100 = 100 cal

c)1gm of water at 0°C freezes to ice at 0°C.

Heat transferred (Q_3) = mL

= 1x80 = 80 cal

The latent heat of fusion of ice is (L) = 80 cal/gm.

d) 1gm of steam at 100°C turns to ice at 0°C.

Heat transferred (Q) = Q_1+ Q_2+ Q_3

= 540+100+80

= 720 cal

3. Convert 20°C into Kelvin scale.

A. t°C = (t + 273)K

20°C = (20 + 273)K = 293K

4. Find the distance of the image when an object is placed on the principal axis at a distance of 10cm in front of a concave mirror whose radius of curvature is 8cm.

A. Distance of the object (u) = -10cm

Radius of curvature (R) = -8cm

Focal length (f) = $\frac{R}{2} = -\frac{8}{2}$ = -4cm

Distance of the image (v) = ?

Formula : $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-4} - \frac{1}{-10} = \frac{-10+4}{40} = \frac{-3}{20}$

$\frac{1}{v} = \frac{-3}{20}$

$v = \frac{-20}{3}$ = - 6.6 cm (on the object side)

5. A convex mirror with a radius of curvature of 3m is used as rear view in an automobile. If a bus is located at 5m from this mirror, find the position, nature and size of the image.

A. (for convex mirror u taken with negative sign)

Distance of the object (u) = -5m

Radius of curvature (R) = 3m

Focal length (f) = $\frac{R}{2} = \frac{3}{2}$ = 1.5m

Distance of the image (v) = ?

Formula : $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{1.5} - \frac{1}{-5} = \frac{2}{3} + \frac{1}{5} = \frac{10+3}{15} = \frac{13}{15}$

$\frac{1}{v} = \frac{13}{15}$

$v = \frac{15}{13}$ = 1.15 m

Image formed behind the mirror and it is virtual, erect, diminished.

6. An object is placed at a distance of 10cm a convex mirror of focal length 15cm. Find the position and nature of the image.

A. (for convex mirror u taken with negative sign)

Distance of the object (u) = -10cm

Focal length (f) = 15cm

Radius of curvature (R) = 2f = 30cm

Distance of the image (v) = ?

Formula : $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{15} - \frac{1}{-10} = \frac{10+15}{150} = \frac{25}{150}$

$v = \frac{150}{25}$ = 6cm

Image formed behind the mirror and it is virtual, erect, diminished.

7. The speed of the light in a diamond is 1, 24, 000 km/s. Find the refractive index of diamond if the speed of light in air is 3,00,000 km/s.

A. Speed of light in air (v_1) =300000km/s

Speed of light in diamond (v_2) =124000km/s

Refractive index of diamond = $\frac{v_1}{v_2}$

$= \frac{300000}{124000}$ = 2.42

8. Refractive index of glass relative to water is 9/8. What is the refractive index of water relative to glass?

A. Refractive index of glass relative to water is

$n_{gw} = \frac{n_g}{n_w} = \frac{9}{8}$

Refractive index of water relative to glass is

$n_{wg} = \frac{n_w}{n_g} = \frac{8}{9}$

9. The absolute refractive index of water is 4/3. What is the critical angle?

A. Absolute refractive index of water (n) = $\frac{4}{3}$

Critical angle (c) = ?

Sin C = $\frac{1}{n}$

Sin C = $\frac{3}{4}$ = 0.75 = Sin 48^o36^l

➔ C = 48^o36^l

10. Determine the refractive index of benzene if the critical angle is 42^0.

A. Refractive index of Benzene (n) = ?

Critical angle (c) = 42^o

Sin C = $\frac{1}{n}$

n = $\frac{1}{\text{Sin C}}$

= $\frac{1}{\text{Sin } 42}$

= $\frac{1}{0.6691}$

= 1.4945

11. A light ray is incident on air-liquid interface at $45^0$and is refracted at 30^0. What is the refractive index of the liquid?

A. Case(i) : angle of incidence (i) = 45^o

angle of refraction (r) = 30^o

Refractive index (n) = $\frac{Sin\ i}{Sin\ r}$

$= \frac{Sin\ 45}{Sin\ 30} = \frac{\frac{1}{\sqrt{2}}}{\frac{1}{2}}$

$= \frac{2}{\sqrt{2}} = \sqrt{2}$

= 1.414

12. The focal length of a converging lens is 20cm. An object is 60cm from the lens. Where will the image be formed and what kind of image is it?

A. Converging lens means convex lens.

For convex lens 'u' taken as negative.

Focal length (f) = 20cm

Object distance (u) = -60cm

Image distance (v) = ?

Lens formula : $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

➔ $\frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{20} + \frac{1}{-60} = \frac{1}{20} - \frac{1}{60}$

➔ $\frac{1}{v} = \frac{60-20}{20\ X\ 60} = \frac{40}{1200}$

➔ $\frac{1}{v} = \frac{1}{30}$ ➔ v = 30cm

Here Object is placed beyond C. So image is formed between F and C. It is real, inverted and diminished.

13. Find the refractive index of the glass which is a symmetrical convergent lens if its focal length is equal to the radius of curvature of its surface.

A. For symmetrical convergent lens $R_1 = R_2 = R$

Focal length of lens (f) = R

Lens maker's formula : $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

for double convex lens

R_1 is positive and R_2 is negative.

$\Rightarrow \frac{1}{f} = (n-1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$

$\Rightarrow \frac{1}{R} = (n-1)\left(\frac{1}{R} + \frac{1}{R}\right)$

$\Rightarrow \frac{1}{R} = (n-1)\left(\frac{2}{R}\right)$

$\Rightarrow 1 = 2n - 2 \Rightarrow 2n = 3 \Rightarrow n = \frac{3}{2} = 1.5$

Refractive index of lens (n) = 1.5

14. Find the radii of curvature of a convexo – concave convergent lens made of glass with refractive index n=1.5 having focal length of 24cm. One of the radii of curvature is double the other.

A. Let the centre of curvatures of convexo-concave lens are R_1 and R_2

Given that $R_2 = 2R_1$

Focal length of lens (f) = 24cm

Refractive index of the lens (n) = 1.5

Lens maker's formula : $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

for convexo-concave lens

R_1 is positive and R_2 is positive.

$\Rightarrow \frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\Rightarrow \frac{1}{24} = (1.5-1)\left(\frac{1}{R_1} - \frac{1}{2R_1}\right)$

$\Rightarrow \frac{1}{24} = (0.5)\left(\frac{2-1}{2R_1}\right)$

$\Rightarrow 2R_1 = 12 \Rightarrow R_1 = 6\text{cm}$

$R_2 = 2R_1 = 12\text{cm}$

Radii of curvatures are R_1=6cm,R_2=12cm

15. Doctor advised Ramu to use 2D lens. What is the focal length of the lens?

A. Power of lens (P) = 2D

Formula : $P = \frac{100}{f\ (in\ cms)}$

$f = \frac{100}{P} = \frac{100}{2} = 50$ cm

Focal length of the lens = 50 cm.

16. Two bulbs have ratings 100W, 220V and 60W, 220V. Which one has the greater resistance?

A. Power of electricity : $P = \frac{V^2}{R} \Rightarrow R = \frac{V^2}{P}$

Case(i) For first bulb P = 100 W,

V = 220 V

$R = \frac{V^2}{P}$

$= \frac{220\ X\ 220}{100}$

$= 484\ \Omega$

Case(ii) For second bulb P = 60 W

V = 220 V

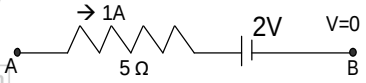
$R = \frac{V^2}{P}$

$= \frac{220\ X\ 220}{60}$

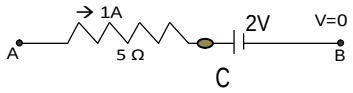
$= 806.66\ \Omega$

Second bulb has greater resistance.

17. In the given figure, the potential at A is ……. When the potential at B is zero.



A. Potential difference is divided between A & B



$V_{BA} = V_{BC} + V_{CA}$

$V_A - V_B = +2 + (1x5)$

$V_A - 0 = 2 + 5$

$V_A = 7\ V$

18. If the resistance of your body is 100000Ω, what would be the current that flows in your body when you touch the terminals of a 12V battery?

A. Resistance (R) = 100000 Ω

Potential of the battery (V) = 12 V

Ohm's law : $V = I R$

$I = \frac{V}{R} = \frac{12}{100000} = 12 \times 10^{-5}$ A

The flow of current through the body is 12×10^{-5} Ampere

19. A house has 3 tube lights, two fans and a television. Each tube light draws 40W. The fan draws 80W and the television draws 60W. On the average, all the tube lights are kept on for five hours, two fans for 12 hours and television for five hours every day. Find the cost of electric energy used in 30 days at the rate of Rs. 3.00 per KWH.

A. Energy consumed in a day = $\frac{Wattage\ X\ Number\ of\ devices\ X\ usage\ hours\ per\ day}{1000}$

Device	Wattage	Number of devices	Usage hours per day	Consumed energy in KWH
Tube light	40	3	5	$\frac{40X3X5}{1000}$ = 0.6
Fan	80	2	12	$\frac{80X2X12}{1000}$ = 1.92
TV	60	1	5	$\frac{60X1X5}{1000}$ = 0.3

Energy consumed in a day = 0.6 +1.92 + 0.3
= 2.82 KWH

Energy consumed in 30 days = 30 X 2.82
= 84.6 KWH

Rate of current for 1 KWH = Rs. 3-00

Total cost (Current bill) = 84.6 X 3-00
= Rs. 253-80

20. An unknown circuit draws a current of 2A from a 12 V battery then find its equivalent resistance.

A. Flow of current (I) = 2 A

Voltage of battery (V) = 12 V

Ohm's law : V = IR

$R = \frac{V}{I} = \frac{12}{2}$ = 6 Ω

Resistance (R) = 6 Ω

21. Three resistors of values 2 Ω, 4 Ω ,6 Ω are connected in series then find the equivalent resistance of that combination.

A. R_1 = 2 Ω, R_2 = 4 Ω, R_3 = 6 Ω

Let the resultant resistance in series combination is R.

$R = R_1 + R_2 + R_3 = 2 + 4 + 6 = 12$ Ω

22. Three resistors of values 2 Ω, 4 Ω ,6 Ω are connected in parallel then find the equivalent resistance of that combination.

A. R_1 = 2 Ω, R_2 = 4 Ω, R_3 = 6 Ω

Let the resultant resistance in series combination is R

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R} = \frac{1}{2} + \frac{1}{4} + \frac{1}{6}$$

$$\frac{1}{R} = \frac{6+3+2}{12}$$

$$\frac{1}{R} = \frac{11}{12}$$

$$R = \frac{12}{11} = 1.09\ \Omega$$

23. The value of magnetic field induction which is uniform is 2T. What is the flux passing through a surface of area 1.5m^2 perpendicular to the field?

A. Magnetic field induction B = 2T

Surface area A = 1.5 m^2

Magnetic flux Φ = ?

Formula: $B = \frac{\phi}{A}$ → ϕ = BA = 2x1.5 =3 Weber

24. An 8N force acts on a rectangular conductor 20cm long placed perpendicular to a magnetic field. Determine the magnetic field induction if the current in the conductor is 40A.?

A. Force on conductor (F) = 8N

Length of conductor (l) = 20cm = 20 x 10^{-2} m

Current in the conductor (i) = 40 A

Magnetic field induction (B) = ?

Formula: F = B i l

$B = \frac{F}{i\,l} = \frac{8}{40\ X\ 20\ X\ 10^{-2}} = \frac{8\ X\ 10^2}{800} = \frac{800}{800}$ = 1 Tesla

25. Find the length of a conductor which is moving with 20 m/s in the direction perpendicular to the direction of magnetic field of induction 0.6 T, if it induces an emf of 8V between the ends of the conductor.

A. Speed (v) = 20 m/s

Magnetic field induction (B) = 0.6 T

Induces emf (Ɛ) = 8 V

Length of conductor (l) = ?

Formula: Ɛ = B l v

$l = \frac{\varepsilon}{B\,v} = \frac{8}{0.6\ X\ 20} = \frac{8}{12} = \frac{2}{3}$ = 0.67 m

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