KCET-2016 (Physics)

1. A body falls freely for 10 sec. Its average velocity during this journey (take g = 10 ms^{-2})
   a. 100 ms^{-1}
   b. 10 ms^{-1}
   c. 50 ms^{-1}
   d. 5 ms^{-1}

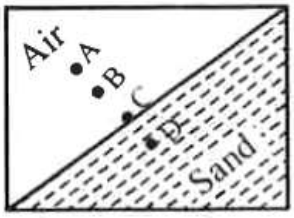
2. Three projectiles A, B and C are projected at an angle of 30°, 45°, 60° respectively. If R_A, R_B, and R_C are ranges of A, B and C respectively, then (velocity of projection is same for A, B & C).
   a. $R_A = R_B = R_C$
   b. $R_A = R_C > R_B$
   c. $R_A < R_B < R_C$
   d. $R_A = R_C < R_B$

3. The component of a vector $\vec{r}$ along x – axis have a maximum value if
   a. $\vec{r}$ is along + ve x - axis
   b. $\vec{r}$ is along + ve y - axis
   c. $\vec{r}$ is along – ve y - axis
   d. $\vec{r}$ makes an angle of 45° with the x – axis

4. Maximum acceleration of the train in which a 50 kg box lying on its floor will remain stationary (Given : Co-efficient of static friction between the box and the trains floor is 0.3 and g = 10 ms^{-2})
   a. 5.0 ms^{-2}
   b. 3.0 ms^{-2}
   c. 1.5 ms^{-2}
   d. 15.0 ms^{-2}

5. A 12 kg bomb at rest explodes into two pieces of 4 kg and 8 kg piece is 20 Na, the kinetic energy of the 8 kg piece is -
   a. 25 J
   b. 20 J
   c. 50 J
   d. 40 J

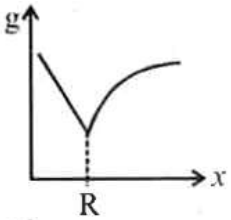
6. Which of the points is likely position of the centre of mass of the system shown in the figure?

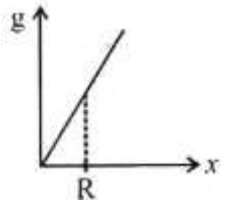


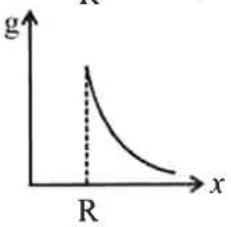
   a. A
   b. D
   c. B
   d. C

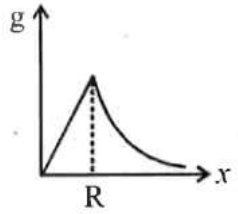
7. Three bodies a ring (R), a solid cylinder (C) and a solid sphere (S) having same mass and same radius roll down the inclined plane without slipping. They start from rest if v_R, v_C, and v_S are velocities of respective bodies on reaching the bottom of the plane, then -
   a. $v_R = v_C = v_S$
   b. $v_R > v_C > v_S$
   c. v_R , $v_C < v_S$
   d. $v_R = v_C > v_S$

8. Variation of acceleration due to gravity (g) with distance x from the centre of the earth is best represented by (R → Radius of the earth)

a. 

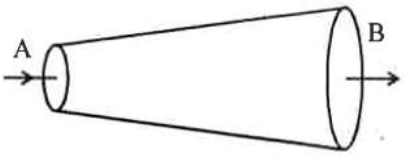
b. 

c. 

d. 

9. A spring is stretched by applying load to its free end. The strain produced in the spring is –
   a. Volumetric
   b. Shear
   c. Longitudinal & Shear
   d. Longitudinal

10. An ideal fluid flow through a pipe of circular cross section with diameters 5 cm and 10 cm as shown. The ratio of velocities of fluid at A and B is –



   a. 4 : 1
   b. 1 : 4
   c. 2 : 1
   d. 1 : 2

11. A pan filled with hot food from 94°C to 86°C in 2 minutes. When the room temperature is 20°C. How long will it cool from 74°C to 66°C?
   a. 2 minutes
   b. 2.8 minutes
   c. 2.5 minutes
   d. 1.8 minutes

12. Four rods with different radii r and length ℓ are used to connect to heat reservoirs at different temperature. Which one will conduct most heat?
   a. r = 1 cm, ℓ = 2 m
   b. r = 1 cm, $\ell = \frac{1}{2}$ m
   c. r = 2 cm, ℓ = 2 m
   d. r = 2 cm, $\ell = \frac{1}{2}$ m

13. A Carnot engine working between 300 K and 400 K has 800 J of useful work. The amount of heat energy supplied to the engine from the source is –
   a. 2400 J
   b. 3200 J
   c. 1200 J
   d. 3600 J

14. A particle executing SHM has a maximum speed of 0.5 ms^{-1} and maximum acceleration of 1.0 ms^{-2}. The angular frequency of oscillation is –
    a. 2 rad s^{-1}
    b. 0.5 rad s^{-1}
    c. 2π rad s^{-1}
    d. 0.5π rad s^{-1}

15. A source of sound is moving with a velocity of 50 ms^{-1} towards stationary observer. The observer measures the frequency of sound as 500 Hz. The apparent frequency of sound as heard by the observer when source is moving away from him with the same speed is (Speed of sound at room temperature 350 ms^{-1}) –
    a. 400 Hz
    b. 666 Hz
    c. 375 Hz
    d. 177.5 Hz

16. If there are only one type of charge in the universe, then

    ($\vec{E} \rightarrow$Electric field, $\overrightarrow{ds} \rightarrow$Area vector)

    a. $\oint \vec{E}.\overrightarrow{ds} \neq 0$ on any surface
    b. $\oint \vec{E}.\overrightarrow{ds}$ could not be defined
    c. $\oint \vec{E}.ds = \infty$ if charge is inside
    d. $\oint \vec{E}.ds = 0$ if charge is outside, inside= $\frac{q}{\in_0}$ if charge is

17. An electron of mass m, charge e falls through a distance h meter in a uniform electric field E. Then time of fall –
    a. $t = \sqrt{\frac{2hm}{eE}}$
    b. $t = \frac{2hm}{eE}$
    c. $t = \sqrt{\frac{2eE}{hm}}$
    d. $t = \frac{2eE}{hm}$

18. If $\vec{E}_{ax}$ and $\vec{E}_{eq}$ represents electric field at a point on the axial and equatorial line of a dipole. If points are at a distance r from the centre of the dipole, for r>>a –
    a. $\vec{E}_{ax} = \vec{E}_{eq}$
    b. $\vec{E}_{ax} = -\vec{E}_{eq}$
    c. $\vec{E}_{ax} = -2\vec{E}_{eq}$
    d. $\vec{E}_{eq} = 2\vec{E}_{ax}$

19. Nature of equipotential surface for a point charge is –
    a. Ellipsoid with charge at foci.
    b. Sphere with charge at the centre of the sphere
    c. Sphere with charge on the surface of the sphere
    d. Plane with charge on the surface.

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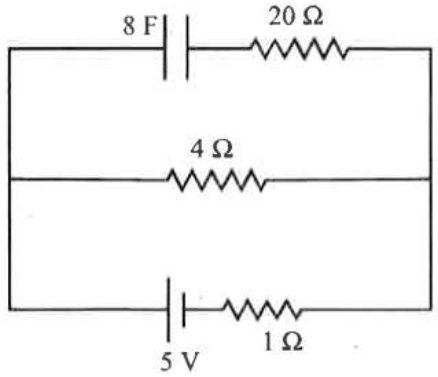
20. A particle of mass 1 gm and charge 1 μC is held at rest on a frictionless horizontal surface at distance 1 m from the fixed charge 2 mC. If the particle is released, it will be repelled. The speed of the particle when it is at a distance of 10 m from the fixed charge –

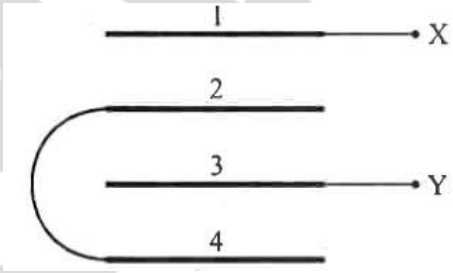
a. 60 ms^{-1}
b. 100 ms^{-1}
c. 90 ms^{-1}
d. 180ms^{-1}

21. A capacitor of 8F is connected as shown. Charge on the plates of the capacitor –



a. 32 C
b. 40 C
c. 0 C
d. 80 C

22. Four metal plates are arranged as shown. Capacitance between X and Y (A $\rightarrow$area of each plate, d $\rightarrow$distance between the plates)

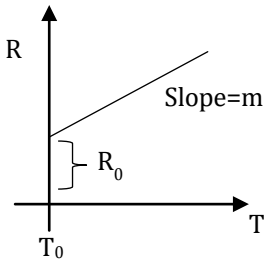


a. $\frac{3}{2}\frac{\epsilon_0 A}{d}$
b. $\frac{2\epsilon_0 A}{d}$
c. $\frac{2}{3}\frac{\epsilon_0 A}{d}$
d. $\frac{3\epsilon_0 A}{d}$

23. Mobility of free electrons in a conductor is –

a. Directly proportional to electron density.
b. Directly proportional to relaxation time.
c. Inversely proportional to electron density.
d. Inversely proportional to relaxation time.

24. Variation of resistance of the conductor with temperature is as shown



The temperature co-efficient (α) of the conductor is –

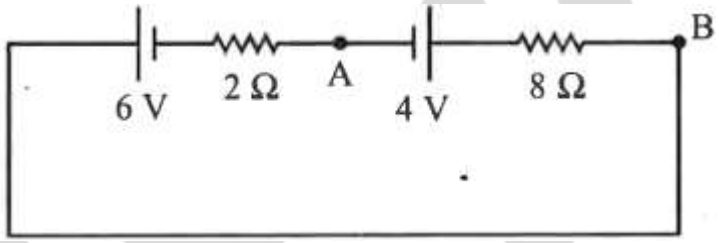
a. $\frac{R_0}{m}$

b. mR_0

c. m^2R_0

d. $\frac{R_0}{m}$

25. Potential difference between A and B in the following circuit –



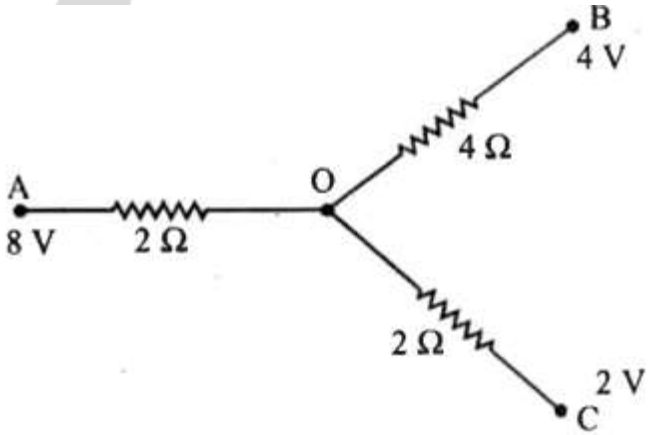
a. 4 V

b. 5.6 V

c. 2.8 V

d. 6 V

26. In the following network potential at 'O'



a. 4 V

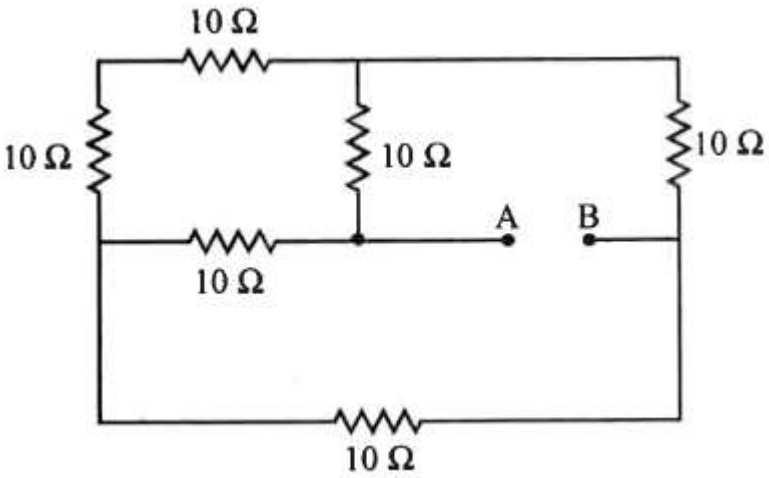
b. 3 V

c. 6 V

d. 4.8 V

KCET-2016 (Physics)

27. Effective resistance between A and B in the following circuit



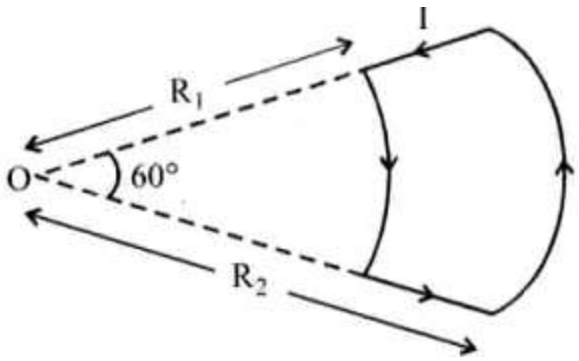
a. 10 Ω
b. 20 Ω
c. 5 Ω
d. $\frac{20}{3}\Omega$

28. Two heating coils of resistances 10 Ω and 20 Ω are connected in parallel and connected to a battery of emf 12V and internal resistance 1 Ω. The power consumed by them are in the ratio –
a. 1 : 4
b. 1 : 3
c. 2 : 1
d. 4 : 1

29. A portion is projected with a uniform velocity 'v' along the axis of a current carrying solenoid, then –
a. The proton will be accelerated along the axis
b. The proton path will be circular about the axis
c. The proton moves along helical path.
d. The proton will continue to move with velocity 'v' along the axis.

30. In the cyclotron, as radius of the circular path of the charged particle increases (ω = angular velocity, v = linear velocity)
a. both ω and v increases
a. ω only increases, v remains constant
b. v increases, ω remains constant
c. v increases, ω decreases

31. A conducting wire carrying current is arranged as shown. The magnetic field at 'O'



a. $\frac{\mu_0 i}{12}\left[\frac{1}{R_1}-\frac{1}{R_2}\right]$

b. $\frac{\mu_0 i}{12}\left[\frac{1}{R_1}+\frac{1}{R_2}\right]$

c. $\frac{\mu_0 i}{6}\left[\frac{1}{R_1}-\frac{1}{R_2}\right]$

d. $\frac{\mu_0 i}{6}\left[\frac{1}{R_1}+\frac{1}{R_2}\right]$

32. The quantity of a charge that will be transferred by a current flow of 20 A over 1 hour 30 minutes period is –
    a. 10.8×10^3C
    b. 10.8×10^4C
    c. 5.4×10^3C
    d. 1.8×10^4C

33. A galvanometer coil has a resistance of 50 Ω and the meter shows full scale deflection for a current of 5 mA. This galvanometer is converted into voltmeter of range 0 – 20 V by connecting.
    a. 3950 Ω in series with galvanometer
    b. 4050 Ω in series with galvanometer
    c. 3950 Ω in parallel with galvanometer
    d. 4050 Ω in parallel with galvanometer

34. x_1 and x_2 are susceptibility of a paramagnetic material at temperatures T_1K and T_2K respectively, then
    a. $x_1 = x_2$
    b. $x_1T_1 = x_2T_2$
    c. $x_1T_2 = x_2T_1$
    d. $x_1\sqrt{T_1} = x_2\sqrt{T_2}$

35. At certain place, the horizontal component of earth's magnetic field is 3.0 G and the angle dip at the place is 30°. The magnetic field of earth at that location.
    a. 4.5 G
    b. 5.1 G
    c. 3.5 G
    d. 6.0 G

36. The process of super imposing message signal on high frequency carrier wave is called –
    a. Amplification
    b. Demodulation
    c. Transmission
    d. Modulation

37. A long solenoid with 40 turns per cm carries a current of 1 A. The magnetic energy stored per unit volume is _____ J/m^3
    a. 3.2π
    b. 32π
    c. 1.6π
    d. 6.4π

38. A wheel with 10 spokes each of length 'L' m is rotated with a uniform angular velocity 'ω' in a plane normal to the magnetic field 'B'. The emf induced between axle and the rim of the wheel.
    a. $\frac{1}{2}N\omega BL^2$
    b. $\frac{1}{2}\omega BL^2$
    c. ωBL^2
    d. N ωBL^2

39. The rms value of current in a 50 Hz AC circuit is 6 A. The average value of AC current over a cycle is –
    a. $6\sqrt{2}$
    b. $\frac{3}{\pi\sqrt{2}}$
    c. Zero
    d. $\frac{6}{\pi\sqrt{2}}$

40. A capacitor of capacitance 10 μF is connected to an AC source and an AC ammeter. If the source voltage varies as V = 50 $\sqrt{2}$ sin 100t, the reading of the ammeter is -
    a. 50 mA
    b. 70.7 mA
    c. 5.0 mA
    d. 7.07 mA

41. In a series L.C.R circuit, the potential drop across L, C and R respectively are 40 V, 120 V and 60 V. Then the source voltage is –
    a. 220 V
    b. 160 V
    c. 180 V
    d. 100 V

42. In a series L.C.R. circuit an alternating emf (v) and current (i) are given by the equation

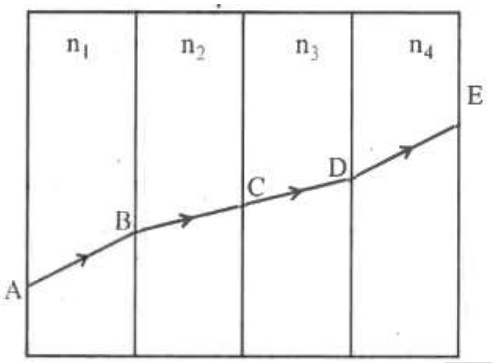
    $v = v_0 \sin\omega t, i_0 \sin\left(\omega t + \frac{\pi}{3}\right)$

    The average power dissipated in the circuit over a cycle of AC is –
    a. $\frac{v_0 i_0}{2}$
    b. $\frac{v_0 i_0}{4}$
    c. $\frac{\sqrt{3}}{2}v_0 i_0$
    d. Zero

43. Electromagnetic radiation used to sterilise milk is –
    a. X-ray
    b. Y-ray
    c. UV ray
    d. Radiowaves

44. A plane glass plate is placed over a various coloured letters (violet, green, yellow, red). The letter which appears to raised more.
    a. Red
    b. Yellow
    c.
    d. Green
    e. Violet

45. A ray of light passes through four transparent media with refractive index n_1, n_2, n_3 and n_4 as shown. The surfaces of all media are parallel.



If the emergent ray DE is parallel to incident ray AB, then

    a. $n_1 = n_4$
    b. $n_2 = n_4$
    c. $n_3 = n_4$
    d. $n_1 = \frac{n_2 + n_3 + n_4}{3}$

46. Focal length of a convex lens is 20 cm and its RI is 1.5. It produces an erect, enlarged image if the distance of the object from the lens is –
    a. 40 cm
    b. 30 cm
    c. 15 cm
    d. 20 cm

47. A ray of light suffers a minimum deviation when incident on an equilateral prism of refractive index $\sqrt{2}$. The angle of incidence is –
    a. 30°
    b. 45°
    c. 60°
    d. 50°

48. In Young's double slit experiment the source is white light. One slit is covered with red filter and the other with blue filter. There shall be –
    a. Alternate red & blue fringes
    b. Alternate dark & pink fringes
    c. Alternate dark & yellow fringes
    d. No interference

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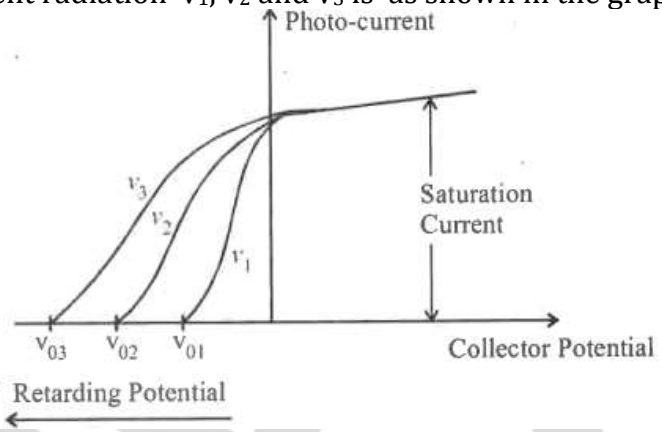
49. Light of wavelength 600 ηm is incident normally on a slit of width 0.2 mm. The angular width of central maxima in the diffraction pattern is (measured from minimum to maximum).
    a. 6×10^{-3} rad
    b. 4×10^{-3} rad
    c. 2.4×10^{-3} rad
    d. 4.5×10^{-3} rad

50. For what distance is ray optics is good approximation when the aperture is 4 mm and the wavelength of light is 400 ηm?
    a. 24 m
    b. 40 m
    c. 18 m
    d. 30 m

51. The variation of photo – current with collector potential for different frequencies of incident radiation v_1, v_2 and v_3 is as shown in the graph, then-



    a. $v_1 = v_2 = v_3$
    b. $v_1 > v_2 > v_3$
    c. $v_1 < v_2 < v_3$
    d. $v_3 = \frac{v_1 + v_2}{2}$

52. The de Broglie wavelength of an electron accelerated to a potential of 400 V is approximately –
    a. 0.03 nm
    b. 0.04 nm
    c. 0.12 nm
    d. 0.06 nm

53. Total energy of electron in an excited state of hydrogen atom is – 3.4 eV. The kinetic and potential energy of electron in this state –
    a. K = -3.4 eV U = - 6.8 eV
    b. K = 3.4 eV U = - 6.8 eV
    c. K = -6.8eV U = 3.4eV
    d. K = 10.2eV U = - 13.6eV

54. When electron jumps from n = 4 level to n = 1 level, the angular momentum of electron changes by –
    a. $\frac{h}{2\pi}$
    b. $\frac{2h}{2\pi}$
    c. $\frac{3h}{2\pi}$
    d. $\frac{4h}{2\pi}$

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55. A radio – active sample of half – life 10 days contains 1000 x nuclei. Number of original nuclei present after 5 days is –

a. 707 x
b. 750 x
c. 500 x
d. 250 x

56. An element X decays into element Z by two – step process.

$$X \rightarrow Y + {}^{4}_{2}He$$

$$Y \rightarrow Z + 2\bar{e}\ then$$

a. X & Z are isobars.
b. X & Y are isotopes.
c. X & Z are isotones.
d. X & Z are isotopes.

57. A nucleus of mass 20 u emits a γ photon of energy 6 MeV. If the emission assume to occur when nucleus is free and rest, then the nucleus will have kinetic energy nearest to
(Take $1u = 1.6 \times 10^{-27}$ kg)

a. 10 KeV
b. 1 KeV
c. 0.1 KeV
d. 100 KeV

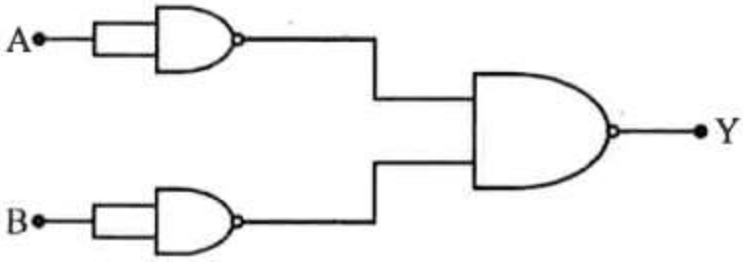
58. Constant DC voltage is required from a variable AC voltage. Which of the following is correct order of operation?

a. Regulator, filter, rectifier
b. Rectifier, regulator, filter
c. Rectifier, filter, regulator
d. Filter, regulator, rectifier

59. In a transistor, the collector current varies by 0.49 mA and emitter current varies by 0.50 mA. Current gain β measured is –

a. 49
b. 150
c. 99
d. 100

60. Identify the logic operation carried out by the following circuit.



a. AND
b. NAND
c. NOR
d. OR

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ANSWER KEYS

1. (c)	2. (d)	3. (a)	4. (b)	5. (a)	6. (b)	7. (c)	8. (d)	9. (c)	10. (a)
11. (b)	12. (d)	13. (b)	14. (a)	15. (c)	16. (G)	17. (a)	18. (c)	19. (b)	20. (d)
21. (a)	22. (c)	23. (b)	24. (d)	25. (b)	26. (d)	27. (a)	28. (c)	29. (d)	30. (c)
31. (a)	32. (b)	33. (a)	34. (b)	35. (c)	36. (d)	37. (a)	38. (b)	39. (b)	40. (a)
41. (d)	42. (b)	43. (c)	44. (d)	45. (a)	46. (c)	47. (b)	48. (d)	49. (a)	50. (abcd)
51. (c)	52. (d)	53. (b)	54. (c)	55. (a)	56. (d)	57. (b)	58. (c)	59. (a)	60. (d)

* G – Indicates One GRACE MARK awarded for the question number

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Solution

1. (c)

Given:- $g = 10\ m/s^2$

$t = 10 sec.$

Initial velocity (u) = 0 m/s

$S = ut + \frac{1}{2}gt^2$

$S = 0 + \frac{1}{2} \times 10 \times 10^2$

$V_{avg.} \Rightarrow \frac{500}{10} = 50\ m/s$

2. (d)

$R_A = R_C < R_B$

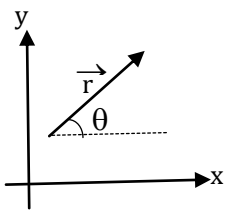
$$R = \frac{u^2 \sin 2\theta}{g}$$

$$R_A = \frac{u^2 \sin 60°}{g} = \frac{\sqrt{3}}{2}\frac{u^2}{g}, R_B = \frac{u^2 \sin 90°}{g} = \frac{u^2}{g}$$

$$R_C = \frac{u^2 \sin 120°}{g} = \frac{u^2}{g}\cos 30° \Rightarrow \frac{u^2}{g} \times \frac{\sqrt{3}}{2}$$

$$\therefore R_A = R_C < B_B$$

3. (a)



$\vec{r}_x = |r| \cos\theta$

$(r_x) = |r| \cos\theta \max$

$r_x = |r| \cos\theta$

$\therefore \cos\theta$ is maximum of $\theta = 0$

$\theta = 0$

$\vec{r} = ||-x-axis$

4. (b)
$\mu = 0.3$
m=50 kg
g= 10 m/s^2
$f = \mu mg$
The box kept on the floor of train remains stationary it the pseudo force acting on the box is balanced by frictional force
$\therefore$ ma = μ mg
a= μ g = 0.3×10 $\Rightarrow$ 3.0 m/s^2

5. (a)
As initial momentum of the system is zero
According to the law of conservation of momentum
Initial momentum = final momentum
So, final momentum of the system must also be zero
Hence, Momentum of 8kg piece must be equal, opposite to the momentum of 4kg piece.
$\Rightarrow$8kg. piece, P = 20 NS
K.E. of 8kg piece, $K = \frac{P^2}{2m}$
$\Rightarrow \frac{(20)^2}{2\times 8} \Rightarrow 25$ J

6. (b)
The centre of mass lies towards the heavier mass, from the above diagram, the mass is more at the point D.

7. (c)
Let the body start from rest
Using work-energy equation
W = Δ K.E
= K.E$_f$ – K.E$_i$
= K.E.$_f$ [$\because$ K.E$_i$ = 0]
$mgh = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$
But V= rω
I = kmr^2
$\therefore mgh = \frac{1}{2}mv^2 + \frac{1}{2}kmv^2$
$mgh = \frac{1}{2}mv^2[1+k]$
$v = \sqrt{\frac{2gh}{1+k}}$
As we know; k_R =1, k_C= 0.5, k_S=0.4
$\therefore K_S < K_C < K_R$
$\Rightarrow V_R < V_C < V_S$

8. (d)

Acceleration due to gravity at a depth d

$$g = g_0 = \left(1 - \frac{d}{R}\right)$$

Distance from earth centre x=R-d

d = R-x

$$\Rightarrow g = g_0 \frac{x}{R}$$

Thus acceleration due to gravity increases linearly with the increase in distance from centre of earth

Acceleration due to gravity at a height h

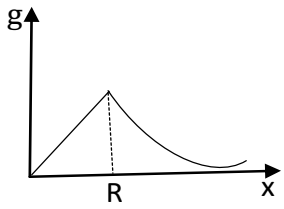
$$g = g_0 \left(\frac{R}{R+h}\right)^2$$

Distance from earth centre x = R+h

h = x–R

$$g = g_0 \left(\frac{R}{x}\right)^2$$

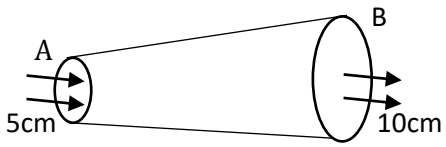
So acceleration due to gravity decreases as $\frac{1}{x^2}$ with the increase in distance from centre of earth.



9. (c)

The length and shape of the spring changes and the weight of the load behaves as a deforming force. The change in length corresponds to longitudinal strain and change in shape corresponds to shearing strain.

10. (a)



$D_A = 5cm$, $D_B = 10cm$

From continuity equation

$A_1V_1 = A_2V_2$

Where,

$V_1 = V_A$

$V_2 = V_B$

$$\therefore \frac{\pi D_A^2}{4} V_A = \frac{\pi D_B^2 V_B}{4}$$

$$\frac{V_A}{V_B} = \frac{D_B^2}{D_A^2} = \frac{(10)^2}{(5)^2}$$

On solving

$$\frac{V_A}{V_B} = \frac{4}{1}$$

11. (b)

Using newton's law of cooling with approximation

$$\frac{dT}{dt} = \frac{-k}{ms}(T_{avg} - T_{surrounding}) \quad \ldots (1)$$

Case I:- dt=2min, $T_s = 20°C$

$$T_{avg} = \frac{94+86}{2} = 90°C$$

$dT = 94-86 = 8°C$

$$\frac{-k}{ms} = \frac{dT}{dt} \times \frac{1}{(T_{avg.} - T_s)} \Rightarrow \frac{8}{2} \times \frac{1}{(90-70)}$$

$$\frac{-k}{ms} = 0.05714$$

Case II:-

$T_s = 20°C$, $T_{avg} = \frac{74+66}{2} \Rightarrow 70°C$

$dT = 74-66 = 8°C$

Now value's putting in equation (1)

$$\frac{8}{dt} = 0.05714 \times (70-20)$$

$\therefore dt = 2.8$ min

12. (d)

Heat conducted by Rod

$$Q = \frac{KAt\Delta T}{\ell}$$

$A = \pi r^2$

So,

The rate of the flow of heat

$$\frac{d\theta}{dt} \propto \frac{A\Delta T}{\ell}$$

On considering above relation

The option $\Rightarrow$ r=2cm, $\ell = \frac{1}{2}$m

13. (b)

Given:-

$T_M = 400k$

$T_L = 300k$

$W = 800J$

We know

$$\text{Efficiency } (\eta) \Rightarrow 1 - \frac{T_L}{T_H} = \frac{W}{Q}$$

$$1 - \frac{300}{400} = \frac{800}{Q}$$

On solving

$$\boxed{Q = 3200J}$$

14. (a)

Maximum velocity, $V_{max} = \omega A \Rightarrow 0.5$ m/s

Maximum acceleration, $a_{max} = \omega^2 A \Rightarrow 1$ m/s^2

$$\text{Angular frequency } \omega = \frac{a_{max}}{v_{max}}$$

$$\omega = \frac{1}{0.5}$$

$\boxed{\omega = 2\text{rad/s}}$

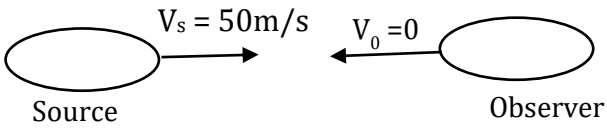
15. (c)

Speed of source, $V_s = 50\text{m/s}$

$V = 350\text{m/s}$ [speed of sound]

Using Doppler formula:-

$$f' = \left[\frac{v + v_0}{v - v_s}\right] f \qquad ..(1)$$



Given:- Frequency Heard by observer (f") = 500Hz

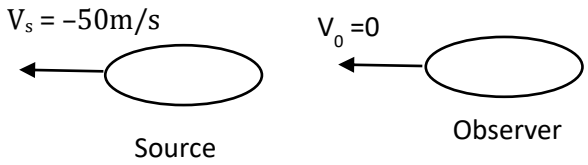
From equation (1)

$$500 = \left[\frac{350 + 0}{350 - 50}\right] f$$

$$500 = \left(\frac{35}{30}\right) f$$

$$f = \frac{15{,}000}{35}$$

$f = 428.6$



Frequency heard observer is $(f'') = \left[\frac{350 + 0}{350 + 50}\right] 428.6$

$$\Rightarrow \left[\frac{35}{40}\right] 428.6 = 375\text{Hz}$$

16. (G) BONUS

17. (a)

Distance S=h

Electrostatic force F=eE

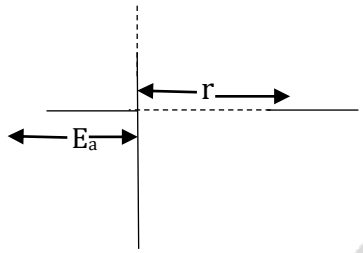
$a=\frac{F}{m}=\frac{eE}{m}$

$S = ut+\frac{1}{2}at^2$

$\therefore h=0+\frac{1}{2}\times\frac{eE}{m}t^2$

$t=\sqrt{\frac{2hm}{eE}}$

18. (c)



E.F. on axial line of dipole is

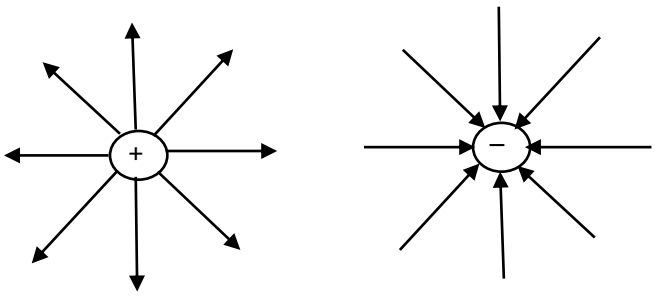
$\vec{E}_{ax}=\frac{2\vec{p}}{4\pi\varepsilon_0 r^3}$, r>>a

E.F. on equatorial line of dipole is

$\vec{E}_{eq}=\frac{\vec{p}}{4\pi\varepsilon_0 r^3}$, r>>a

So, $\boxed{\vec{E}_{ax}=-2\vec{E}_q}$

19. (b)



For a point charge, equipotential surface are concentric spherical shells with centre at the point charge.

20. (d)

Given:-

$r_1 = 1\ m, \quad r_2 = 10m$

$q_1 = 1\ \mu$

$q_2 = 2mc$

$$U_i = \frac{kq_1q_2}{r_1} = \frac{9\times10^9\times10^{-6}\times2\times10^{-3}}{1}$$

On solving

$U_i = 18J$

$K_i = 0$

$$U_f = \frac{9\times10^9\times10^{-6}\times2\times10^{-3}}{10} \Rightarrow 1.8J$$

$$K_f = 0 + \frac{1}{2}mv^2$$

$$K_f = \frac{1}{2}\times(0.001)\times v^2$$

$K_f = 0.0005\times v^2$

Now Apply Energy Conservation

$\therefore K_f + U_f = K_i + U_i$

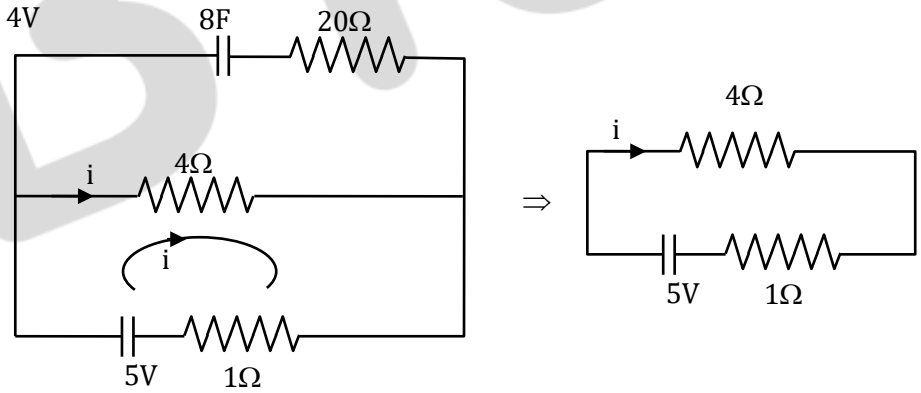
$0.0005v^2 + 1.8 = 0+18$

$0.0005v^2 = 16.2$

On solving

$\boxed{v = 180m/s}$

21. (a)



No current through 20Ω

$v_{4\Omega} = 4\Omega\times1A \qquad i = \frac{5v}{(4+1)} = 1A$

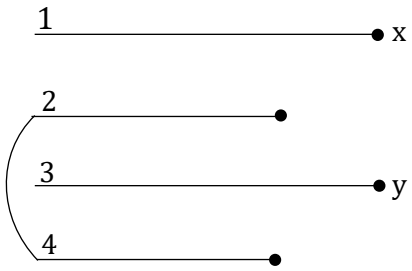
$= 4V$

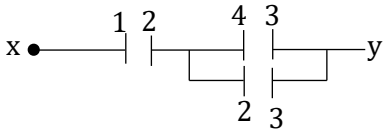
$V_C = 4V \Rightarrow Q = C\times VV$

$= 8F\times4V$

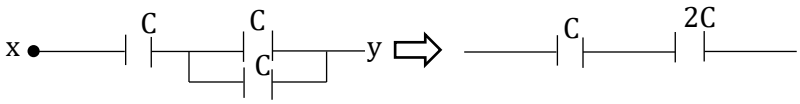
$Q = 32C$

22. (c)





Capacitance of each capacitor; $c = \frac{A\varepsilon_0}{d}$



Equation capacitance between x and y

$C_{eq} = \frac{C \times 2C}{C + 2C} = \frac{2}{3}C$

$C_{eq} = \frac{2}{3}\frac{A\varepsilon_0}{d}$

23. (B)

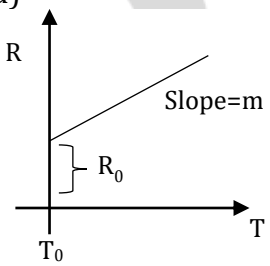
Mobility of free – e^-, $\mu = \frac{q\tau}{m}$

$\mu = \tau$ [q & m are constant]

Hence,

Mobility of free $e^- \propto$ relation time

24. (d)



Resistance of conductor, $R = R_0(1 + \alpha\Delta T)$ ... (1)

$\Delta T = T - T_0$

From graph

$R = R_0 + m(T - T_0)$

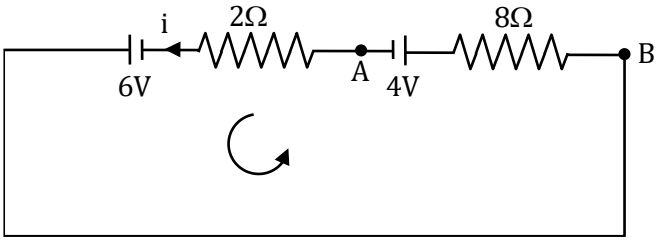
$= R_0 + m\Delta T$ ... (2)

Equation (1) & (2)

$R_0 + \alpha(\Delta T) = m(\Delta T)$

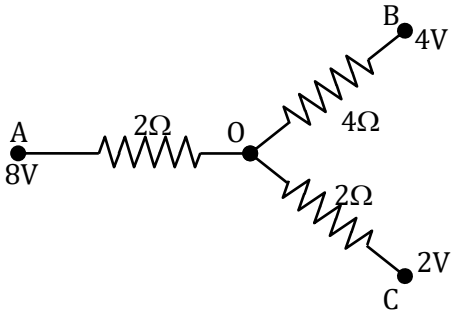
So, $\alpha = m/R_0$

25. (b)



Using kirchhoff's second law from A to B in direction of Anti-clock wise.

26. (d)



Apply K.V.L.

$$\frac{8-v}{2}=\frac{v-4}{4}+\frac{v-2}{2}$$

$$\frac{8-v}{2}=\frac{v-4+2v-4}{4}$$

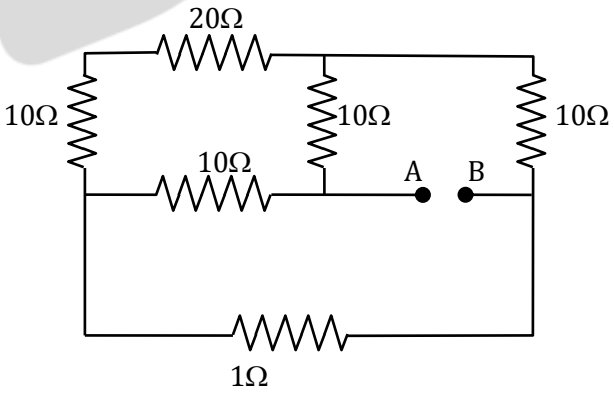
On solving

16-2v = 3v-8

5v=24

$$v=\frac{24}{5}\Rightarrow 4.8v$$

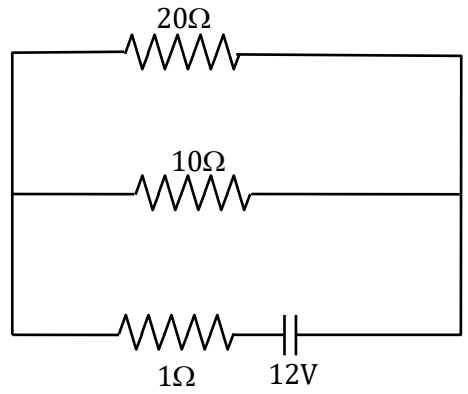
27. (a)



The given circuit represents a balanced wheat stone bridge and each resistance is equal to $10\,\Omega$

So, Reg = $10\,\Omega$

28. (c)



Let, potential drop across $10\,\Omega$ and $20\,\Omega$ resistor is V

$$p_1 = \frac{V^2}{R} = \frac{V^2}{10}\text{watts}$$

$$p_2 = \frac{V^2}{R} = \frac{V^2}{20}\text{watts}$$

$$\therefore p_1:p_2 = \frac{V^2}{R}:\frac{V^2}{20}$$

$$p_1:p_2 = 2:1$$

29. (d)

The magnetic field due to a solenoid at the axis is along the axis.

Hence, if a proton projected with a velocity 'v' along the axis, its velocity will be parallel to the magnetic field.

If there is no component of velocity of proton $\perp$ to the magnetic field, net force on the proton will be zero and proton will continue to move along the axis with velocity 'v'

30. (c)

$$v = \frac{Bqr}{m}$$

$$v \propto r$$

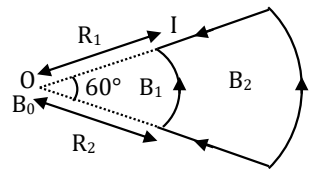
Angular velocity $\omega = \frac{Bq}{m}$

ω=constant

Hence,

v increases, ω remains constant.

31. (a)



Magnetic field at point 'O'

$B=\frac{\mu_0}{4\pi}\frac{0_1}{r}(\alpha)$

$\alpha = 60° = \frac{\pi}{3}\sim$

$B \propto \frac{1}{R}$

$B_1 = \frac{\mu_0 I}{4\pi R_1}\times\frac{\pi}{3}\Rightarrow\frac{\mu_0 I}{12R_1}$

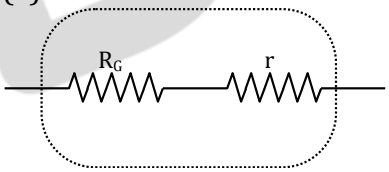
$B_2 = \frac{\mu_0 I}{4\pi R_2}\times\frac{\pi}{3}\Rightarrow\frac{\mu_0 I}{12R_2}$

So, magnetic field at point 'O' $B = B_1 - B_2 = \frac{\mu_0 I}{12}\left[\frac{1}{R_1}-\frac{1}{R_2}\right]$

32. (b)

Given:-
Current, I= 20A
Time, T = 1hr 30min
= 1.5 ×3600
T= 5400 sec.
q = I × t
= 20×5400
On solving
$q = 10.8\times10^4$ c

33. (a)



I_g = 5mA = 0.005A
V = 20 volts
$R_G = 50\,\Omega$
$\therefore V = I_g(R_G+r)$
$20 = 0.005(50+r)$
$\frac{20}{0.005} = 50+r$
$4000 = 50+r$
$R = 4000-50 \Rightarrow 3950\,\Omega$
In series with galvanometer

34. (b)

According to curie's law

$$x \propto \frac{1}{T}$$

$$\therefore \frac{x_1}{x_2} = \frac{T_2}{T_1}$$

$x_1 T_1 = x_2 T_2$

35. (c)

Magnetic field of earth, $B = \frac{B_H}{\cos\theta}$

Given:-

Magnetic field of horizontal component of earth

$B_H = 3.0G$

$\theta = 30°$

Now, value putting in equation (1)

$$B = \frac{3.0}{\cos 30°}$$

$B = 3.5G$

36. (d)

The process of super imposing message signal on carrier wave is modulation.

High frequency signals on the other hand can be sent over large distances with small dissipation in power.

37. (a)

I=1A

No. of turns, n=40 turns per cm $\Rightarrow$4000 per m.

Now,

Apply formula

Energy stored per unit volume, (u) = $\frac{\mu_0 n^2 I^2}{2}$

$$\therefore u = \frac{4\pi \times 10^{-7} \times (400)^2 (1)^2}{2}$$

On solving

$u=3.2\,\pi\,J/m^3$

38. (b)
Angular velocity is constant
V=0, increase to V = ωL

$V_{avg.} = \frac{0+\omega L}{2}$

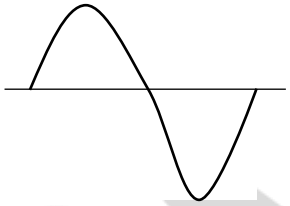
$V_{avg.} = \frac{\omega L}{2}$

We know that

$\varepsilon = BV_{avg}L$

$= B\left(\frac{\omega L}{2}\right)^2 \quad \varepsilon = \frac{1}{2}\omega BL^2$

39. (c)
F=50Hz
I_{rms} = 6A
$I_{avg.}$ = ?
I_{avg} = 0



As, current is negative for same amount of time for which it is positive.
So, Average value of AC current over a cycle is zero.

40. (a)
Given:-
C= $10\,\mu \Rightarrow 10^{-5}$F
V = $50\sqrt{2}$ sin 100t
On comparing
$V=V_0 \sin\omega t$
$V_0 = 50\sqrt{2}$
ω = 100
Now,

$V_{rms} = \frac{50\sqrt{2}}{\sqrt{2}}$ =50volts

$Irms = \frac{V_{rms}}{x_c}$

$\left[\because x_c = \frac{1}{\omega_c}\right]$

$I_{rms} = \frac{V_{rms}}{1/\omega c} \Rightarrow \omega_c V_{rms}$

$I_{rms} = 100\times10^{-5}\times50$

$= 50\times10^{-3}A$
$= 50mA$

41. (d)
Given:-
$V_L = 40V$
$V_C = 120$
$V_R = 60$
Source voltage, $(V_s) = \sqrt{(C_C - V_L)^2 + V_R^2}$
$V_s = \sqrt{(120-40)^2 + (60)^2}$
$= \sqrt{(80)^2 + (60)^2}$
$= \sqrt{6400+3600} = \sqrt{10,000}$
$V_s = 100V$

42. (b)

Power dissipated in A.C. circuit is

$$P = \frac{V_0}{\sqrt{2}} \times \frac{i_0}{\sqrt{2}} \times \cos\phi$$

$$\theta = 60°$$

$$P = \frac{V_0}{\sqrt{2}} \times \frac{i_0}{\sqrt{2}} \times \cos 60°$$

$$\Rightarrow \frac{V_0 i_0}{\sqrt{2}} \times \frac{1}{2}$$

$$\Rightarrow \frac{V_0 i_0}{4}$$

43. (c)
The electromagnetic radiation used to sterilise the milk in dairy is ultraviolet

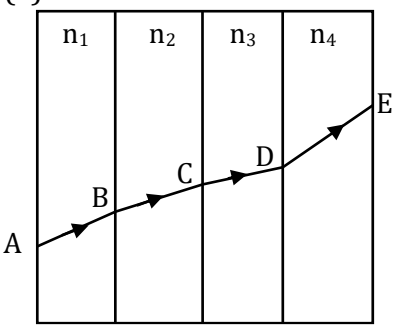
44. (d)
Normal shift through plate of thickness t

$$d = t\left[1 - \frac{1}{\mu}\right]$$

Now, Refractive index (μ) is related to wavelength (λ) of light as

$$\mu = A + \frac{B}{\lambda^2}$$

45. (a)



Angle of incidence = Angle of refraction

$i = r$ ... (1)

Using snell's law of refraction

$n_1 \sin i = n_4 \sin i$

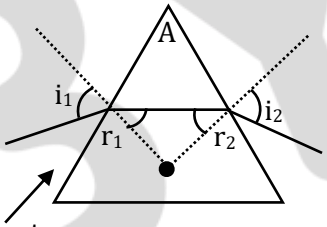
$\therefore n_1 = n_4$

46. (c)

A convex lens forms an erect and enlarged image when the object is placed between focus and the lens. So, object distance must be less then the focal length of the lens.

Thus, object distance must be 15cm.

47. (b)



$n_1 = 1$, $n_2 = \sqrt{2}$

$A = 60°$ (equilateral prism)

By geometry

$A = r_1 + r_2$ ... (1)

For min. deviation

$A = r_1 = r_2$ ... (2)

From equation (1) & (2)

$A = 2r_1$

$R_1 = \frac{60}{2} = 30°$

Using snell's law

$n_1 = \sin i_1 = n_2 \sin (r_1)$

$1.\sin i_1 = \sqrt{2} \times \frac{1}{2}$

After solving

$i_1 = 45°$

48. (d)

The light from two slits of young's double-slit experiment is of different colours, and having different wavelengths and frequencies.

Hence, there shall be no interference fringes.

49. (a)

$\lambda = 600 \text{ nm} \Rightarrow 600 \times 10^{-9}\text{m}$

Linear width of central maxima is $= \frac{2\lambda D}{a}$

Angular width $= \frac{2\lambda}{d}$

$d = 0.2\text{mm} = 0.2\times10^{-3}\text{m}$

So,

Angular width $= \frac{2(600\times10^{-9})}{0.2\times10^{-3}}$

After solving

Angular width $= 6\times10^{-3}$ rad

50. (abcd)

Aperture width a=4mm $\Rightarrow$ 4×10^{-3}m

Wavelength

$\lambda = 400\text{nm}$

$= 400\times10^{-9}\text{m}$

So,

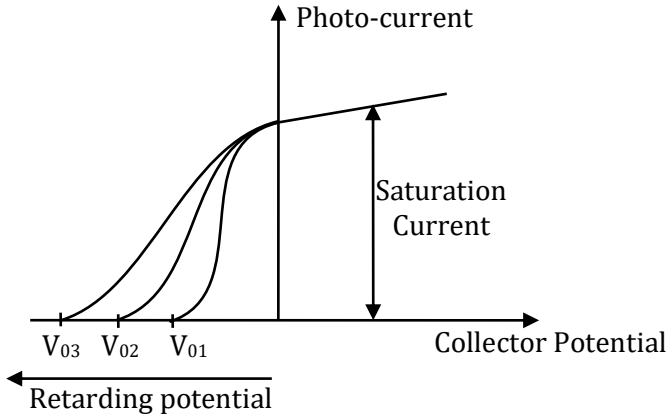
Fresnel distance:-

$D_f = \frac{a^2}{\lambda} \Rightarrow \frac{(4\times10^{-3})^2}{400\times10^{-9}}$

After solving

$D_f = 40\text{m}$

51. (c)



$V_{03}>V_{02}>V_{01}$ [stopping potential]
Minimum Energy of photon required for emission 'α' stopping potential
$E_3>E_2>E_1$
$E=h\nu$
So,
$V_3>V_2>V_1$

52. (d)
Using de-Broglie wavelength
$\lambda=\frac{123}{\sqrt{v}}\text{Å}$
Given:-
V=400v
$\lambda=\frac{12.3}{\sqrt{400}}\Rightarrow\frac{12.3}{20}\text{A}^\circ$
$= 0.615\text{A}^\circ$
$\lambda=0.0615\text{nm}$

53. (b)

$-3.4\text{ev} = \text{K.E}+\text{P.E.}$ ..... (i) [Given]

The relation b/w P.E. & K.E

P.E. = –2 K.E. ..... (ii)

Use the relation in equation (i)

$-3.4\text{ev} = \text{K.E.}-2\text{K.E.}$

K.E. =3.4ev

From equation (ii)

P.E. = –2(3.4ev)

P.E. = –6.8ev

54. (c)

From Bohr's postulate, the angular momentum is:-

$mvr = \frac{nh}{2\pi}$

For n=4

$mvr = \frac{4h}{2\pi}$ ...(i)

For n=1

$mvr = \frac{1h}{2\pi}$ ...(ii)

Thus, the change in angular momentum

$\Delta mvr = \frac{4h}{2\pi} - \frac{h}{2\pi}$

$\Delta mvr = \frac{3h}{2\pi}$

55. (a)

Nuclei present after 5 days, $n=No \exp\left(\frac{-0.693}{T_2/2}t\right)$ ... (1)

Given:-

$N_o = 1000x$

$T_{1/2} = 10days$

$t = 5days$

Substitute's values in equation (1)

$N=1000x \times \exp\left(\frac{-0.693\times 5}{10}\right)$

$N =1000x \times \exp.(-0.346)$

$N = 1000x \times 0.707$

$N = 707x$

56. (d)

A & Z = mass number

${}^{A}_{Z}x \rightarrow {}^{A-4}_{Z-2}y + {}^{4}_{2}He$

${}^{A-4}_{Z-2}y \rightarrow {}^{A-4}_{Z}Z \rightarrow +2e^{-}$

x & z are isotopes.

57. (b)

$E=6Mev \Rightarrow 6\times1.6\times10^{-13}J$

$m=20u \Rightarrow 20\times1.6\times10^{-27}\ kg$

Momentum of γ –photon, P=E/C

P=P=E/C [momentum of Nucleus]

$$K = \frac{P^2}{2m} \Rightarrow \frac{E^2}{2mc^2}$$

$$K = \frac{(6\times1.6\times10^{-13})^2}{2\times(20\times1.6\times10^{-27})\times(3\times10^8)^2}$$

After solving

K.E. = 1Kev

58. (c)

To convert AC to DC, a full wave rectifier is required the O/P of the full wave rectifier will be positive cycles of the applied input AC voltage. To convert the positive cycles to ripples a RC filter will be required.

59. (a)

Current gain $\beta = \frac{\Delta I_C}{\Delta I_b}$ ... (1)

Given:-

ΔI_c = 0.49mA

ΔI_e = 0.50mA [emitter current]

Change in base current:-

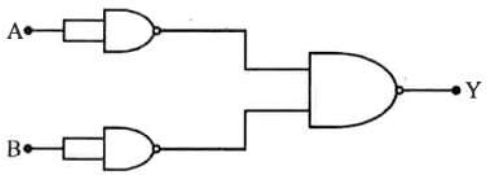
$\Delta I_b = \Delta I_e - \Delta I_c$

$= 0.50 - 0.49 \Rightarrow 0.01\text{mA}$

Substitute value in equation (1)

$$\therefore \beta = \frac{0.49}{0.01} = 49$$

60. (d)



$C = \overline{A}\,\overline{B} = \overline{A}$

$D = \overline{B}$

$Y = \overline{C}\,\overline{D}$

$= \overline{A} + \overline{B}$

A	B	C	D	Y	
0	0	1	1	0	
0	1	1	0	1	OR Gate
1	0	0	1	1	
1	1	0	0	1	