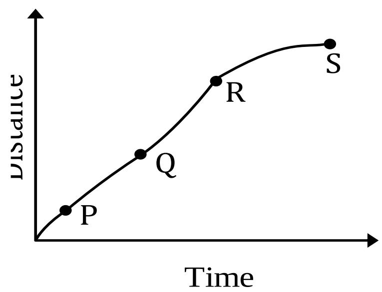
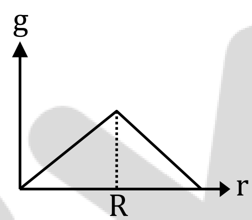
KCET-2018 (Physics)

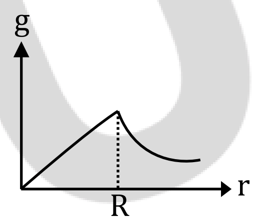
1. A particle show distance-time curve as shown in the figure. The maximum instantaneous velocity of the particle is around the point.

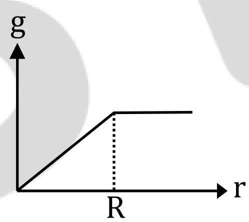


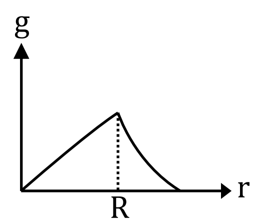
a. P
b. S
c. R
d. Q

2. Which of the following graphs correctly represents the variation of 'g' on the Earth?

a. 

b. 

c. 

d. 

3. A cup of tea cools from 65.5°C to 62.5°C in 1 minute in a room at 22.5°C. How long will it take to cool from 46.5°C to 40.5°C in the same room?

a. 4 minutes
b. 2 minutes
c. 1 minute
d. 3 minutes

4. The dimensions of the ratio of magnetic flux (ϕ) and permeability (μ) are

a. $[M^0L^1T^0A^1]$
b. $[M^0L^{-3}T^0A^1]$
c. $[M^0L^1T^1A^{-1}]$
d. $[M^0L^2T^0A^1]$

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5. A mass 'm' on the surface of the Earth is shifted to a target equal to the radius of the Earth. If 'R' is the radius and 'M' is the mass of the Earth, then work done in this process is

a. $\frac{mgR}{2}$
b. mgR
c. 2 mgR
d. $\frac{mgR}{4}$

6. First overtone frequency of a closed pipe of length 'l_1' is equal to the 2nd harmonic frequency of an open pipe of length 'l_2'. The ratio $\frac{l_1}{l_2}$ =

a. $\frac{3}{4}$
b. $\frac{4}{3}$
c. $\frac{3}{2}$
d. $\frac{2}{3}$

7. The resistance R = $\frac{V}{I}$ where V = (100 ± 5) V and I = (10 ± 0.2) A.

The percentage error in R is

a. 5.2%
b. 4.8%
c. 7%
d. 3%

8. A block rests on a rough inclined plane making an angle of 30° with the horizontal. The coefficient of static friction between the block and the plane is 0.8. If the frictional force on the block is 10 N, the mass of the block is ($g = 10\ ms^{-2}$)

a. 1 kg
b. 2 kg
c. 3 kg
d. 4 kg

9. Two particles of masses m_1 and m_2 have equal kinetic energies. The ratio of their moments is

a. $m_1 : m_2$
b. $m_2 : m_1$
c. $\sqrt{m_1} : \sqrt{m_2}$
d. $m_1^2 : m_2^2$

10. The pressure at the bottom of a liquid tank is not proportional to the

a. Acceleration due to gravity
b. Density of the liquid
c. Height of the liquid
d. Area of the liquid surface

11. A Carnot engine takes 300 calories of heat from a source at 500 K and rejects 150 calories of heat to the sink. The temperature of the sink is

a. 125 K
b. 250 K
c. 750 K
d. 1000 K

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12. Pressure of an ideal gas is increased by keeping temperature constant. The kinetic energy of molecules
    a. Decreases
    b. Increases
    c. Remains same
    d. Increases or decreases depending on the nature of gas

13. A man weighing 60 kg is in a lift moving down with an acceleration of 1.8 ms^{-2}. The force exerted by the floor on him is
    a. 588 N
    b. 480 N
    c. Zero
    d. 696 N

14. Moment of inertia of a body about two perpendicular axes X and Y in the plane of lamina are 20 kg m^2 respectively. Its moment of inertia about an axis perpendicular to the plane of the lamina and passing through the point of intersection of X and Y axes is
    a. 5 kg m^2
    b. 45 kg m^2
    c. 12.5 kg m^2
    d. 500 kg m^2

15. Two wires A and B are stretched by the same load. If the area of cross-section of wire 'A' is double that of 'B' , then the stress on 'B' is
    a. Equal to that on A
    b. Twice that on A
    c. Half that on A
    d. Four times that on A

16. The magnitude of point charge due to which the electric field 30 cm away has the magnitude 2 NC^{-1} will be
    a. 2×10^{-11}C
    b. 3×10^{-11} C
    c. 5×10^{-11}C
    d. 9×10^{-11}C

17. A mass of 1 kg carrying a charge of 2 C is accelerated through a potential of 1 V. The velocity acquired by it is
    a. $\sqrt{2}$ ms^{-1}
    b. 2 ms^{-1}
    c. $\frac{1}{\sqrt{2}}$ ms^{-1}
    d. $\frac{1}{2}$ ms^{-1}

18. The force of repulsion between two identical positive charges when kept, with a separation 'r' in air is 'F'. Half the gap between the two charges is filled by a dielectric slab of dielectric constant = 4. Then, the new force of repulsion between those two charges becomes
    a. $\frac{F}{3}$
    b. $\frac{F}{2}$
    c. $\frac{F}{4}$
    d. $\frac{4F}{9}$

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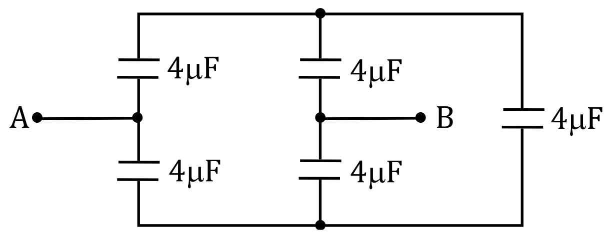
19. For the arrangement of capacitors as shown in the circuit, the effective capacitance between the point A and B is (capacitance of each capacitor is 4 μF)



a. 4 μF
b. 2 μF
c. 1μF
d. 8μF

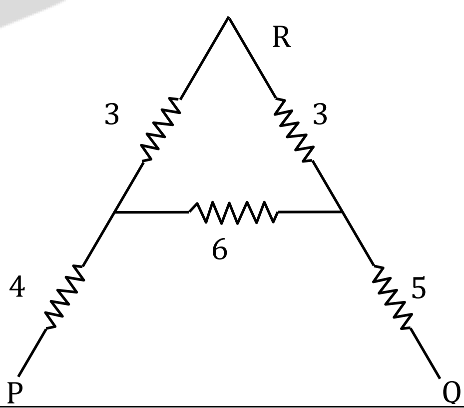
20. The work done to move a charge on an equipotential surface is
a. Infinity
b. Less than 1
c. Greater than 1
d. Zero

21. Two capacitors of 3 μF and 6μF are connected in series and a potential difference of 900 V is applied across the combination. They are then disconnected and reconnected in parallel. The potential difference across the combination is
a. Zero
b. 100 V
c. 200 V
d. 400 V

22. Ohm's Law is applicable to
a. Diode
b. Transistor
c. Electrolyte
d. Conductor

23. If the last band on the carbon resistor is absent, then the tolerance is
a. 5 %
b. 20 %
c. 10 %
d. 15 %

24. The effective resistance between P and Q for the following network is



a. $\frac{1}{12}\,\Omega$
b. 21Ω

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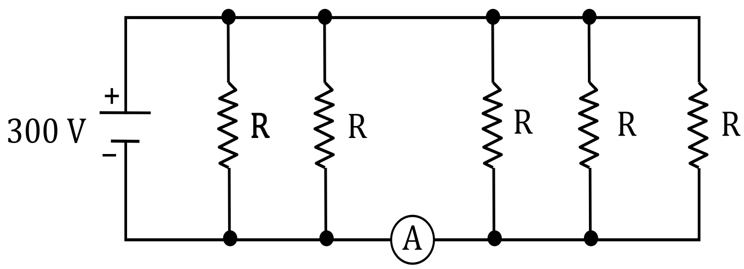
c. 12 Ω	d. $\frac{1}{21}$ Ω

25. Five identical resistors each of resistance R = 1500 Ω are connected to a 300 V battery as shown in the circuit. The reading of the ideal ammeter A is

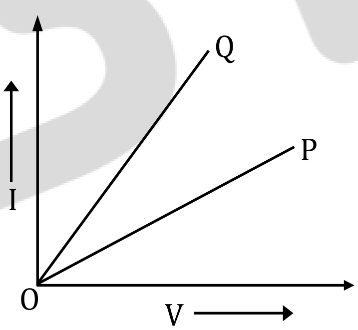


a. $\frac{1}{5}$ A
b. $\frac{3}{5}$ A
c. $\frac{2}{5}$ A
d. $\frac{4}{5}$ A

26. Two cells of internal resistances r_1 and r_2 and of same emf are connected in series, across a resistor of resistance R. If the terminal potential difference across the cells of internal resistance r_1 is zero, then the value of R is

a. $R = 2(r_1 + r_2)$
b. $R = r_2 - r_1$
c. $R = r_1 - r_2$
d. $R = 2(r_1 - r_2)$

27. The I – V graphs for two different electrical appliances P and Q are shown in the diagram. If R_P and R_Q be the resistances of the devices, then



a. $R_P = R_Q$
b. $R_P > R_Q$
c. $R_P < R_Q$
d. $R_P = \frac{R_Q}{2}$

28. The correct Biot-Savart law in vector form is

a. $d\vec{B} = \frac{\mu_0}{4\pi}\frac{I(d\vec{l} \times \vec{r})}{r^2}$
b. $d\vec{B} = \frac{\mu_0}{4\pi}\frac{I(d\vec{l} \times \vec{r})}{r^3}$

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c. $d\vec{B} = \frac{\mu_0}{4\pi}\frac{Id\vec{l}}{r^2}$

d. $d\vec{B} = \frac{\mu_0}{4\pi}\cdot\frac{Id\vec{l}}{r^3}$

29. An electron is moving in a circle of radius r in a uniform magnetic field B. Suddenly, the field is reduced to $\frac{B}{2}$. The radius of the circular path now becomes

a. $\frac{r}{2}$

b. 2r

c. $\frac{r}{4}$

d. 4r

30. A charge q is accelerated through a potential difference V. It is then passed normally through a uniform magnetic field, where it moves in a circle of radius r. The potential difference required to move it in a circle of radius 2r is

a. 2 V

b. 4 V

c. 1 V

d. 3 V

31. A cyclotron's oscillator frequency is 10 MHz and the operating magnetic field is 0.66 T. If the radius of its dees is 60 cm, then the kinetic energy of the proton beam produced by the accelerator is

a. 9 MeV

b. 10 MeV

c. 7 MeV

d. 11 MeV

32. Needles N_1 , N_2 and N_3 are made of a ferromagnetic, a paramagnetic and a diamagnetic substance respectively. A magnet when brought close to them will

a. Attract all three of them

b. Attract N_1 strongly, N_2 weakly and repel N_3 weakly

c. Attract N_1 strongly but repel N_2 and N_3 weakly

d. Attract N_1 and N_2 strongly but repel N_3

33. The strength of the Earth's magnetic field is

a. Constant everywhere

b. Zero everywhere

c. Having very high value

d. Varying from place to place on the Earth's surface

34. A jet plane having a wing-span of 25 m is travelling horizontally towards east with a speed of 3600 km/hour. If the Earth's magnetic field at the location is 4×10^{-4} T and the angle of dip is 30° , then, the potential difference between the ends of the wing is

a. 4 V

b. 5 V

c. 2 V

d. 2.5 V

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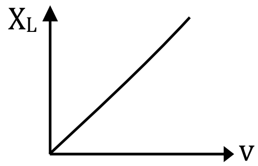
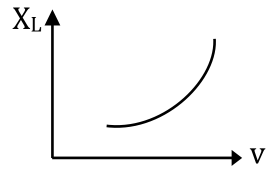
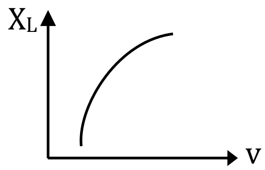
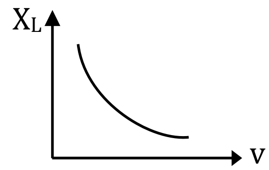
35. Which of the following represents the variation of inductive reactance (X_L) with the frequency of voltage source (v)?

a. 

b. 

c. 

d. 

36. The magnetic flux linked with a coil varies as $\phi = 3t^2 + 4t + 9$. The magnitude of the emf induced at t = 2 seconds is

a. 8 V
b. 16 V
c. 32 V
d. 64 V

37. A 100 W bulb is connected to an AC source of 220 V, 50 Hz. Then the current flowing through the bulb is

a. $\frac{5}{11}$ A
b. $\frac{1}{2}$ A
c. 2 A
d. $\frac{3}{4}$ A

38. In the series LCR circuit, the power dissipation is through

a. R
b. L
c. C
d. Both L and C

39. In Karnataka, the normal domestic power supply AC is 220 V, 50 Hz. Here 220 V and 50 Hz refer to

a. Peak value of voltage and frequency
b. Rms value of voltage and frequency
c. Mean value of voltage and frequency
d. Peak value of voltage and angular frequency

40. A step-up transformer operates on a 230 V line and l load current of 2 A. The ratio of primary and secondary windings is 1:25. Then the current in the primary is

a. 25 A
b. 50 A

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c. 15 A
d. 12.5 A

41. The number of photons falling per second on a completely darkened plate to produce a force of 6.62×10^{-5} N is 'n'. If the wavelength of the light falling is 5×10^{-7} m, then n = _____$\times 10^{22}$. ($h = 6.62 \times 10^{-34}$ J–s)

a. 1
b. 5
c. 0.2
d. 3.3

42. An object is placed at the principal focus of a convex mirror. The image will be at

a. Centre of curvature
b. Principal focus
c. Infinity
d. No image will be formed

43. An object is placed at a distance of 20 cm from the pole of a concave mirror of focal length 10 cm. The distance of the image formed is

a. + 20 cm
b. + 10 cm
c. –20 cm
d. – 10 cm

44. A candle placed 25 cm from a lens forms an image on screen placed 75 cm on the other side of the lens. The focal length and type of the lens should be

a. + 18.75 cm and convex lens
b. – 18.75 cm and concave lens
c. + 20.25 cm and convex lens
d. –20.25 cm and concave lens

45. A plane wavefront of wavelength λ is incident on a single slit of width a. The angular width of principal maximum is

a. $\frac{\lambda}{a}$
b. $\frac{2\lambda}{a}$
c. $\frac{a}{\lambda}$
d. $\frac{a}{2\lambda}$

46. In a Fraunhofer diffraction at a single slit, if yellow light illuminating the slit is replaced by blue light, then diffraction bands

a. Remain unchanged
b. Become wider
c. Disappear
d. Become narrower

47. In Young's double slit experiment, two wavelengths λ_1 = 780 nm and λ_2 = 520 nm are used to obtain interference fringes. If the n^{th} bright band due to λ_1 coincides with $(n + 1)^{th}$ bright band due to λ_2, then the value of n is

a. 4
b. 3

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c. 2 d. 6

48. In Young's double slit experiment, slits are separated by 2 mm and the screen is placed at a distance of 1.2 m from the slits. Light consisting of two wavelengths 6500 Å and 5200 Å are used to obtain interference fringes. Then the separation between the fourth bright fringes of two different patterns produced by the two wavelengths is

a. 0.312 mm b. 0.123 mm
c. 0.213 mm d. 0.412 mm

49. The maximum kinetic energy of emitted photoelectrons depends on

a. Intensity of incident radiation
b. Frequency of incident radiation
c. Speed of incident radiation
d. Number of photons in the incident radiation

50. A proton and an α particle are accelerated through the same potential difference V. The ratio of their de Broglie wavelengths is

a. $\sqrt{2}$ b. $2\sqrt{2}$
c. $\sqrt{3}$ d. $2\sqrt{3}$

51. The total energy of an electron revolving in the second orbit of hydrogen atom is

a. – 13.6 eV b. –1.51 eV
c. –3.4 eV d. Zero

52. The period of revolution of an electron in the ground state of hydrogen atom is T. The period of revolution of the electron in the first excited state is

a. 2 T b. 4 T
c. 6 T d. 8 T

53. The energy equivalent to a substance of mass 1 g is

a. 18×10^{13} J b. 9×10^{13} J
c. 18×10^{6} J d. 9×10^{6} J

54. The half-life of tritium is 12.5 years. What mass of tritium of initial mass 64 mg will remain undecayed after 50 years?

a. 32 mg b. 8 mg
c. 16 mg d. 4 mg

55. In a CE amplifier, the input ac signal to be amplified is applied across

a. Forward biased emitter-base junction
b. Reverse biased collector-base junction
c. Reverse biased emitter-base junction

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d. Forward biased collector-base junction

56. If A = 1 and B = 0, then in terms of Boolean algebra, A + B =

a. B
b. $\bar{B}$
c. A
d. $\bar{A}$

57. The density of an electron-hole pair in a pure germanium is 3×10^{16} m^{-3} at room temperature. On doping with aluminium, the hole density increases to 4.5×10^{22} m^{-3}. Now the electron density (in m^{-3}) in doped germanium will be

a. 1×10^{10}
b. 2×10^{10}
c. 0.5×10^{10}
d. 4×10^{10}

58. The dc common emitter current gain of a n-p-n transistor is 50. The potential difference applied across the collector and emitter of a transistor used in CE configuration is, V_{CE} = 2 V. If the collector resistance, R_C = 4 kΩ, the base current (I_B) and the collector current (I_C) are

a. I_B = 10 μA, I_C = 0.5 mA
b. I_B = 0.5 μA , I_C = 10 mA
c. I_B = 5 μA, I_C = 1 mA
d. I_B = 1 μA, I_C = 0.5 mA

59. The radius of the Earth is 6400 km. If the height of an antenna is 500 m, then its range is

a. 800 km
b. 100 km
c. 80 km
d. 10 km

60. A space station is at a height equal to the radius of the Earth. If 'V_E' is the escape velocity on the surface of the Earth, the same on the space station is ______ times V_E.

a. $\frac{1}{2}$
b. $\frac{1}{4}$
c. $\frac{1}{\sqrt{2}}$
d. $\frac{1}{\sqrt{3}}$

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KCET-2018 (Physics)

ANSWER KEYS

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

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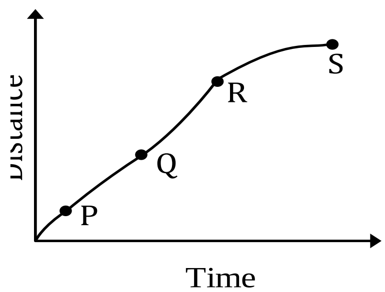
KCET-2018 (Physics)

Solution

1. [C]

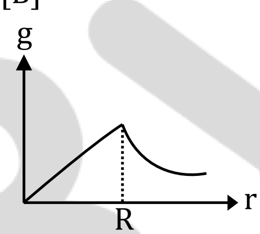


$V_{max} = \frac{dx}{dt}$ = maximum slope

From the figure, at point R the slope is maximum, hence at this point velocity is maximum.

∴ Maximum instantaneous velocity of the particle is around the point 'R'.

2. [B]



For an isothermal process,

B = $\frac{1}{P}$ c

Graph will be rectangular hyperbola

3. [A]

$T_1 = 65.5°C$, $T_2 = 62.5°C$

Room temperature (T_0) = 22.5°C

<u>I[st] Case: -</u>

Using Newton's law cooling

$$\frac{T_1 - T_2}{t} = -k\left[\frac{T_1 - T_2}{t} - T_0\right]$$

$$\frac{65.5 - 62.5}{1} = -k\left[\frac{65.5 - 62.5}{2} - 22.5\right]$$

3 = - k [64 – 22.5]

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$3 = -k\,[41.5]$ ------- (1)

IInd Case: -

$T_1 = 46.5°C$, $T_2 = 40.5°C$

$$\frac{46.5-40.5}{t} = -k\left[\frac{46.5+40.5}{2} - 22.5\right]$$

$$\frac{6}{t} = -k\left[43.5-22.5\right]$$

$$\frac{6}{t} = -k\,[21] \text{ --------- (2)}$$

Eq. (1) dividing by Eq. (2)

$$\frac{3}{\frac{6}{t}} = \frac{-k[41.5]}{-k[21]}$$

$$\frac{t}{2} = \frac{41.5}{21}$$

After solving

$t = 4$ min.

4. [A]

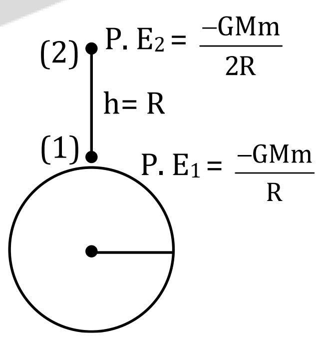
Magnetic flux (φ) = BA

Permeability (μ) = B/H

$\Phi = B.A \times \mu_0 \frac{1}{d} A \Rightarrow \frac{0}{\mu} = \frac{IA}{d}$

$\Rightarrow IL \Rightarrow [M^0L^1A^1T^0]$

5. [A]



P.E. of the earth surface ($P.E_1$) = $-\frac{GMm}{R}$

P.E. of h height on the surface of earth

BYJU'S

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$P.E._2 = \frac{-GNM}{R+R} \Rightarrow -\frac{GMm}{2R}$

$\therefore$ W = $U_f - V_i \Rightarrow P.E._2 - P.E._1 \Rightarrow \left(-\frac{GMm}{2R}\right) - \left(-\frac{GMm}{R}\right)$

After solving

$W = -\frac{MgR}{2}$

6. [A]
First overtone frequency for closed
Organ pipe f = $3V/4L_1$
Frequency for open pipe f = $\frac{2u}{2L_2}$

$\Rightarrow \frac{L_1}{L_2} = \frac{3}{4}$

7. [C]
$R = \frac{V}{I}$

V = (100 ±5) V, I = (10± 0.2) A.

$R = \frac{100}{10}$ = 10

$\frac{\Delta R}{R} = \pm(\frac{\Delta V}{V} + \frac{\Delta I}{I})$

$(\frac{\Delta R}{R} \times 100) = \pm(\frac{\Delta V}{V} \times 100) + (\frac{\Delta I}{I} \times 100)$

$= \pm\left[\frac{5}{100} \times 100 + \frac{0.2}{10} \times 100\right]$

R = ± 7 %

8. [B]
N = mg cosθ
Mg sin θ = f_s
M × 10 × sin 30 = 10
$\therefore$ m = 2 kg

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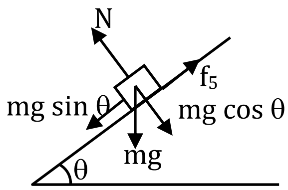


9. [C]

Kinetic energy, k = $\frac{P^2}{2M}$

$\therefore$ $P^2 = 2\,mK$

$P = \sqrt{2mK}$

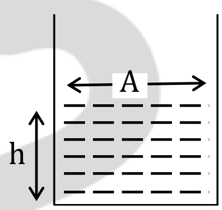
$\frac{P_1}{P_2} = \sqrt{\frac{2m_1K}{2m_2K}}$

$= \sqrt{\frac{m_1}{m_2}}$

$\therefore$ $P_1 : P_2 = \sqrt{m_1} : \sqrt{m_2}$

10. [D]

The pressure depends on acceleration, height of the liquid and the density of liquid. Pressure does not depend on the area of the liquid surface.



Force $(\mathrm{F}) = (h.A)\,\rho.g$

$\boxed{\mathrm{F} = hA\rho g}$

Pressure (P) = $\frac{\mathrm{F}}{\mathrm{A}}$

$\boxed{\mathrm{P} = h\rho g}$

11. [B]

Given: -

$T_1 = 500$ k

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Q_1 = 300 calories
Q_3 = 150 calories
T_2=?

$$\frac{Q_2}{Q_1} = \frac{T_2}{T_1}$$

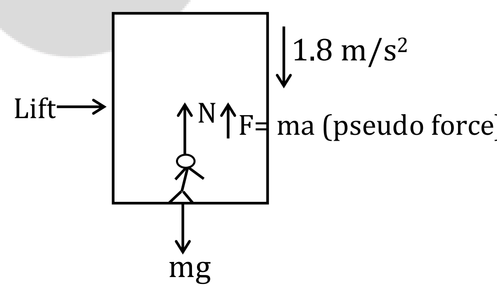
$$T_2 = \frac{Q_2 \times T_1}{Q_1}$$

$$T_2 = \frac{150 \times 500}{300}$$

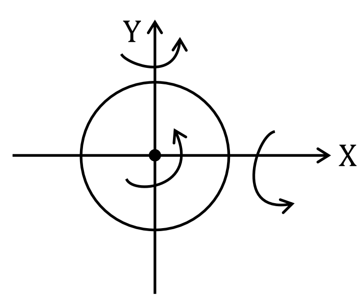
T_2 = 250 K

12. [C]
PV = nRT
Hence $P \propto V$
Temperature is constant there is no change in Kinetic energy of molecules.

13. [B]
Lift –
Now – N + F = mg
[Where F is a Pseudo force]
N = mg – F
= mg – ma
= m (g-a)
= 60 (9.8 – 1.8)
= 60 × 8
N = 480 N



14. [B]
Using perpendicular axis theorem: -
$I_z = I_x + I_y$ ... (1)
Given: -
$I_x = 20$ kg m^2
$I_y = 25$ kg m^2
Substitute values in Eq^n (1)
$I_2 = 20 + 25$
$I_2 = 45$ kg m^2



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15. [B]

Stress = F/A

$$\frac{StressA}{StressB} = \frac{\frac{F}{A_A}}{\frac{F}{A_B}} = \frac{A_B}{A_A}$$

Given: -

Area of cross section of wire ‘A’ is double that of ‘B’

∴ $A_A = 2A_B$

$$\frac{StressA}{StressB} = \frac{A_B}{2A_B} = \frac{1}{2}$$

∴ Stress B = twice on stress ‘A’

16. [A]

Magnitude of electric field is 2 N/C.

Distance r = 30 cm $\Rightarrow 30\times10^{-2}$ m

Apply formula of E.F.

$$E = \frac{Kq}{r^2}$$

$$2 = \frac{9\times10^9\times q}{\left(30\times10^{-2}\right)^2}$$

$$q = \frac{2\times\left(30\times10^{-2}\right)^2}{9\times10^9}$$

$$q = \frac{2\times\left(900\times10^{-4}\right)}{9\times10^9}$$

After solving

$Q = 2 \times 10^{-11}$ C

17. [B]

Given: -

m = 1 kg

q = 2C

Potential (V) = 1 V

Electrostatic Potential Energy = K.E.

$q \times V = \frac{1}{2} MV^2$

$2 \times 1 = \frac{1}{2}\times1 \times V^2$

V = 2 m/s

18. [D]

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Case I[st]: -

Force (f) = $\frac{kq_1q_2}{r^2}$ .... (1)

F = $\frac{1}{4\pi\in_0}\frac{q_1q_2}{r^2}$

Case 2[nd]: - New distance after dielectric slab is inserted between 2 changes,

$d_{new} = \left[\frac{r}{2}+\frac{r}{2}\sqrt{4}\right]$

$\Rightarrow \frac{r}{2}+r \Rightarrow \frac{3r}{2}$

Thus,

New force [F^1] = $\frac{1}{4\pi\in_0}\frac{q_1q_2}{\left(\frac{3r}{2}\right)^2}$ ....(2)

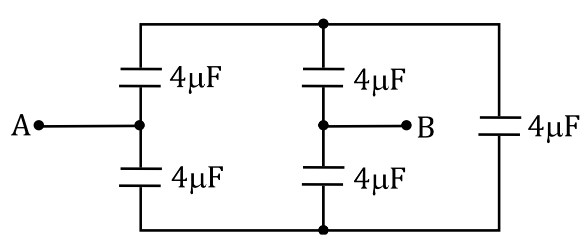
Equation (ii) dividing by equation (i)

$$\frac{F^1}{F}=\frac{\frac{1}{4\pi\in_0}\frac{q_1q_2}{\left(\frac{9r^2}{4}\right)}}{\frac{1}{4\pi\in_0}\frac{q_1q_2}{r^2}}$$

After solving,

$$F'=\frac{4F}{9}$$

19. [A]



From balanced wheat stone bridge,

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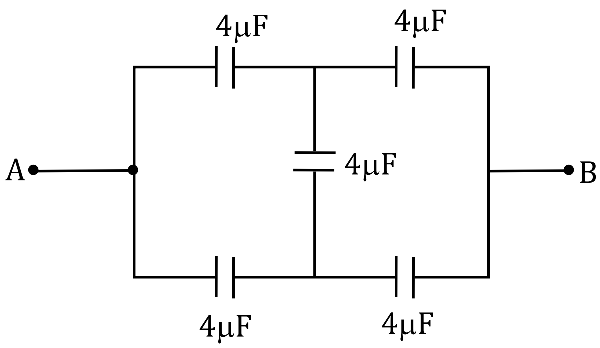
KCET-2018 (Physics)



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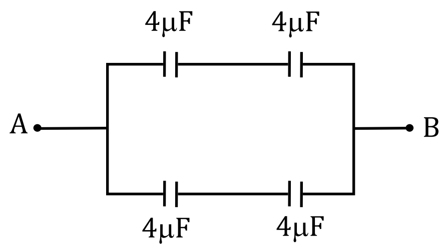

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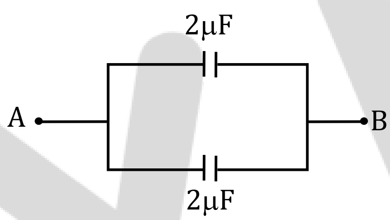

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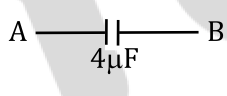

20. [D]
An equipotential surface is one in which all the points are at the same electric potential so, the work done to move a charge on an equipotential surface is zero.
According to the formula
dw = q.dv

21. [C]

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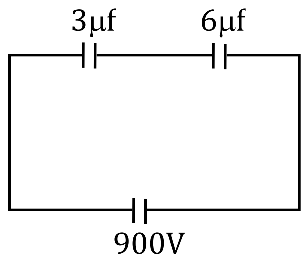

$C_1 = 3\mu F,\ C_2 = 6\mu F$

The series combination charge on

Both capacitors is same

$\therefore\ C_1V_1 = C_2V_2 \Rightarrow Q$ ...(1)

$\frac{V_1}{V_2} = \frac{C_2}{C_1} = \frac{6}{3} \Rightarrow 2$ ..(2)

$V_1 + V_2 = 900\ V$ ... (3)

From Eq^n (2) & (3)

$V_2 = 300\ V,\quad V_1 = 600\ V$

Charge on each capacitor

$Q = CV \Rightarrow 300\times 6$

$\Rightarrow 600\times 3$

$= 1800\ \mu C$

When there capacitor disconnected

& reconnected in parallel the

charge & P.D. is same

$\therefore\ \frac{Q_1}{C_1} = \frac{Q_2}{C_2} = V$ ...(4)

$\frac{Q_1}{Q_2} = \frac{C_1}{C_2} = \frac{1}{2}$ ... (5)

$Q_1 + Q_2 = Q \Rightarrow 1800\ \mu C$ ... (6)

Hence Eq^n (5) & (6)

$Q_1 = 600\ \mu C$ & $Q_2 = 1200\ \mu C$

P.D.

$V_1 = \frac{600}{3} = 200\ V$

$V_2 = \frac{1200}{6} = 200\ V$

22. [D]
Ohm's law is applicable only to conductors.

23. [B]
If the last bond on the carbon resistor is absent, there is no tolerance band, it is 20%.

24. [C]

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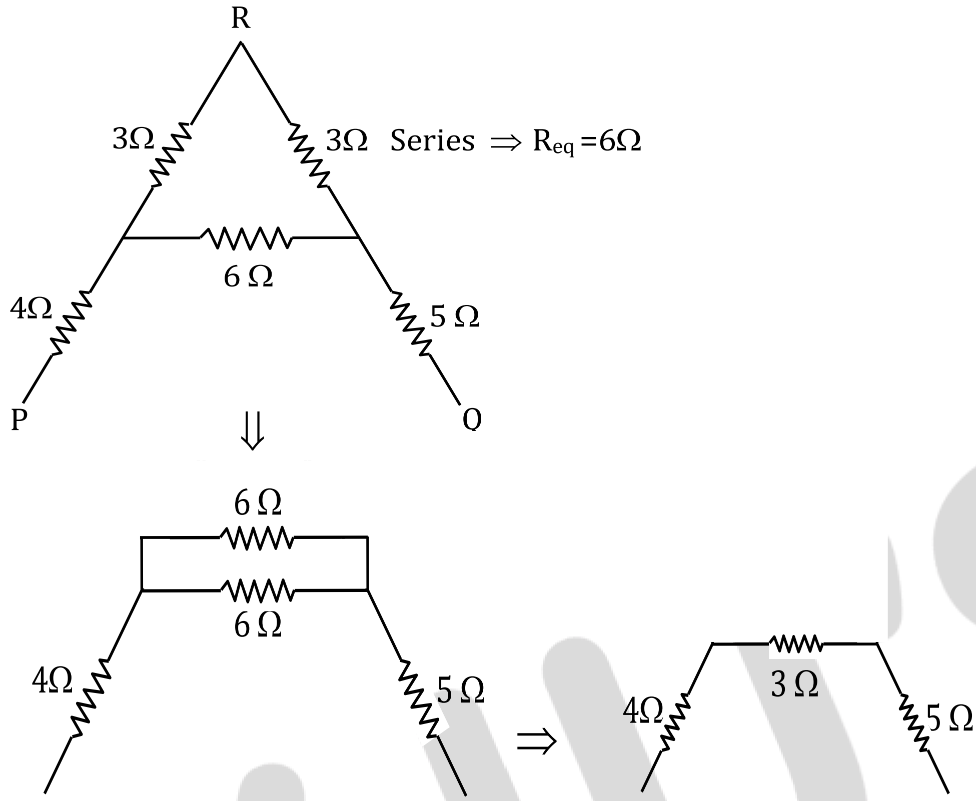
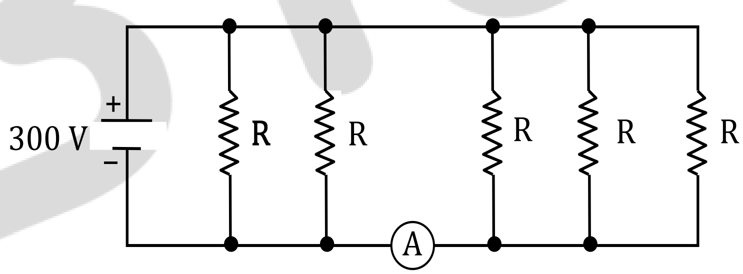


$R_{eq.} = 4 + 3 + 5 = 12\Omega$

25. [B]



Using formula

$V = IR$

$I = V/R$

All resistances are in parallel.

$\therefore \quad I = \dfrac{V}{R/5} = \dfrac{300 \times 5}{R}$

Given:- $R \Rightarrow 1500$

Current through (A) = $\dfrac{3}{5}$ A.

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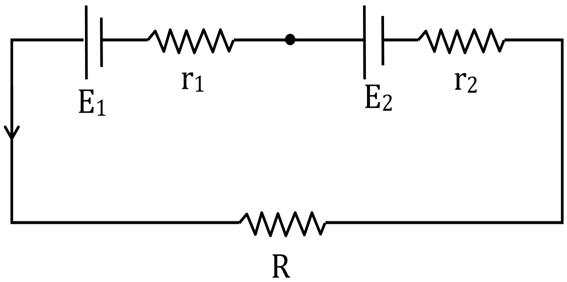
26. [C]



According to Ohm's law

$V = IR$

$E + E = 2I (r_1 + r_2 + R)$

$I = \dfrac{2E}{R + r_1 + r_2}$

Terminal potential difference across the cells of Internal resistance $r_1 = 0$

$V = E - Ir_1$

$0 = E_1 - Ir$

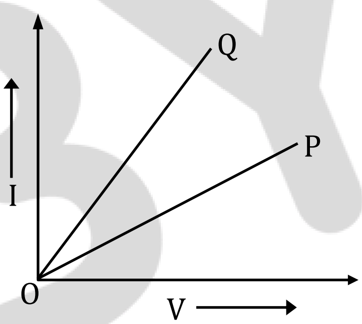
$I = \dfrac{E_1}{r_1}$

$$\frac{2E}{R + r_1 + r_2} = \frac{E}{r_1}$$

$2r_1 = R + r_1 + r_2$

$R = r_1 - r_2$

27. [B]



Slope of this graph is reciprocal of resistance

Q (slope) > P (slope)

$\dfrac{1}{R_Q} > \dfrac{1}{R_P}$ $\quad\therefore\quad$ $R_P > R_Q$

28. [B]

Biot–Savart law: -

$dB = \dfrac{\mu_0}{4\pi}\dfrac{Idl\sin\theta}{r^2}$

Vector form: -

Now we know,

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$\hat{r} = \frac{\vec{r}}{r}$, Using this

$$\overrightarrow{dB} = \frac{\mu_0}{4\pi}\frac{Idl\sin\theta}{r^2}\times\hat{r}$$

$$\overrightarrow{dB} = \frac{\mu_0}{4\pi}\frac{I\left(d\vec{l}\times\vec{r}\right)}{r^3}$$

29. [B]

Radius of circular path,

$$R = \frac{mV}{qB}$$

Thus,

$r_1 B_1 = r_2 B_2$

$r.\ B = r^1.\frac{B}{2}$

$r^1 = 2r$

30. [B]

Radius of circular path

$$r = \frac{mV}{qB}$$

For acceleration energy

$ev = \frac{1}{2} mv^2$

$$v^2 = \frac{2eV}{m}$$

$$v = \sqrt{\frac{2eV}{m}}$$

$r \propto \sqrt{V}$

$V \propto r^2$

So,

$$\frac{V_2}{V_1} = \left(\frac{r_2}{r_1}\right)^2$$

After solving

$V_2 = 4V_1$

31. [C]

Frequency, $\nu = 10$ MHz $\Rightarrow 10^7$Hz

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Magnetic field: -

$$B = \frac{2\pi mv}{q}$$

$$\therefore \quad B = \frac{2\times\frac{22}{7}\times1.6\times10^{-27}\times10^{7}}{1.6\times10^{-19}} \Rightarrow \frac{10.4876}{1.6}$$

After solving

B = 0.656 T

Now energy: -

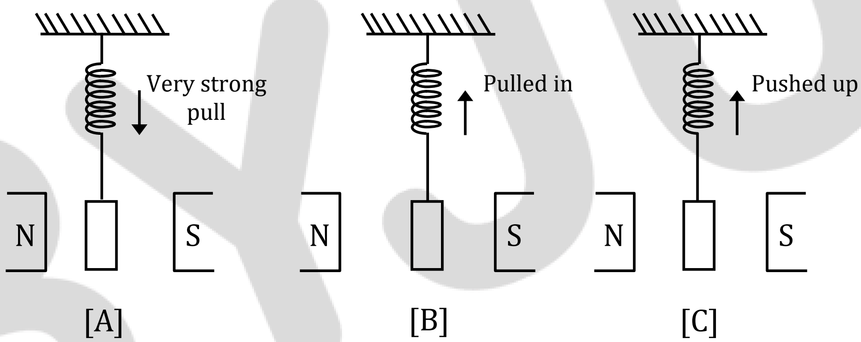
$$E_{max} = \frac{B^2q^2R^2}{2M}$$

$$= = \frac{(0.656)^2\times\left(1.67\times10^{-27}\right)^2\times\left(60\times10^{-2}\right)^2}{2\times1.67\times10^{-27}}$$

After solving,

= 7 MeV

32. [B]



a) These are strongly attracted in an external magnetic field [In ferromagnetic substance]

b) These are feebly attracted in an external magnetic field (in Paramagnetic substance).

c) These are repelled in an external magnetic field. (In diamagnetic Substance)

So,

A magnet will attract N_1 strongly, N_2 weakly and repel N_3 weakly.

33. [D]

A magnetic field extends infinitely. The strength of the earth's magnetic field is not constant. It varies from one place to other place on the surface of earth.

34. [B]

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Length (l) = 25 m
Speed (V) = 3600 KM/hour

$= 3600 \times \frac{5}{18}$

$= 200 \times 5$

V = 1000 m/s
Magnetic field $B = 4 \times 10^{-4}$ T

$\theta = 30°$

Vertical component of earth (B_V)

$B_V = B. \sin \theta$

$E = (B_V) \times l \times V \Rightarrow B. \sin \theta \times l \times V$

$= 4 \times 10^{-4} \times ½ \times 25 \times 1000$

After solving,
E = 5 Volt

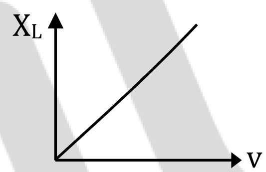
35. [A]
We know that
Inductive reactance

$X_L = \omega_L$

Frequency = ν

$X_L = 2\pi\nu_L$

$X_L = 2\pi L \times \nu$



This equation can be compared to the equation of straight line

$Y = m \times C$

36. [B]
$e = \frac{d\varphi}{dt}$

$\varphi = 3t^2 + 4t + 9$

So,

e = 6t + 4
t = 2 sec.
e = 6 × 2 + 4
e = 16 v

37. [A]
Power (P) = 100 w
V = 220

We know that

P = VI

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I = P/V $\Rightarrow \frac{100}{220}$

I = $\frac{5}{11}$ Amp

38. [A]
Formula used power dissipated in an LCR circuit
$P = V_{rms}.\ I_{rms}\cos\phi$

39. [B]

$i_{rms} = \frac{V_0}{\sqrt{2}}$

rms value of voltage & frequency

40. [B]
No. of primary winding = 1
No. of secondary winding = 25
Used formula
$\frac{N_P}{N_S} = \frac{I_S}{I_P}$
So,
$I_P = I_S \times \frac{N_S}{N_P}$
Substitute values
$I_P = 2 \times \frac{25}{1}$
$I_P = 50$ A

41. [B]
Wavelength (λ) = 5×10^{-7}
Force (F) = 6.62×10^{-5} N
h = 6.62×10^{-34} J.S
Used formula
$P = \frac{n}{t}.\frac{hc}{\lambda}$
$Fc = \frac{n}{t}.\frac{hc}{\lambda}$

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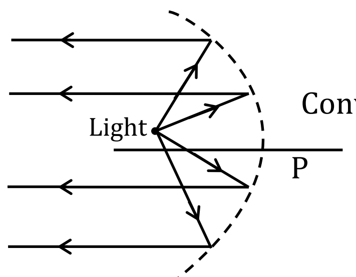
$$\frac{n}{t} = \frac{F\lambda}{h}$$
$$= \frac{6.62\times10^{-5}\times5\times10^{-7}}{6.62\times10^{-34}}$$
$$= 5\times10^{22} V$$

42. [C]



When the object is placed at the focus the image is formed at infinity & highly emerged.

43. [A]
Apply mirror formula

u = - 20 cm
F = 10 cm

$$\boxed{\frac{1}{f} = \frac{1}{v} + \frac{1}{u}}$$

44. [A]
Using mirror formula
$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$
Given: -
Object initial distance (u) = – 25 cm
Image distance (V) = +75 cm
Substitute values
$$\frac{1}{f} = \frac{1}{75} - \frac{1}{-25}$$
$$\frac{1}{f} = \frac{1}{75} + \frac{1}{25} \Rightarrow \frac{1}{f} = \frac{1+3}{75} \Rightarrow \frac{1}{f} = \frac{4}{75}$$
After solving
f = + 18.75 cm and convex lens

45. [A]

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Fringe width $\Rightarrow \beta = \frac{\lambda D}{d}$

Angular width $\theta \Rightarrow \frac{\beta}{D}$

$\therefore \quad \theta = \frac{\lambda D}{dD}$

$\theta = \frac{\lambda}{d}$

d = a (given)

Angular width $\theta = \frac{\lambda}{a}$

46. [D]
When a blue light is used instead of yellow, decreases & hence, diffraction bands become narrower.

47. [C]
λ_1 = 780 nm

λ_2 = 520 nm

We know that,
The distance from the central maxima to nth bright band

$y_n = \frac{n\lambda D}{d} \qquad \frac{n\lambda_1 D}{d} = \left(n+1\frac{\lambda_2 D}{d}\right)$

$n_1 \lambda_1 = (n + 1) \lambda_2$

$\frac{n+1}{n} = \frac{\lambda_1}{\lambda_2} \Rightarrow \frac{780}{520}$

$\frac{n+1}{n} = \frac{78}{52}$

52 n + 52 = 78 n
26 n = 52
n = 2

48. [A]
$\lambda_1 = 6500 A^\circ$

$\gamma_1 = \frac{4\lambda_1 D}{d}$

$\lambda_2 = 5200 A^\circ$

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$$\gamma_2 = \frac{4\lambda_2 D}{d}$$

$$\gamma_1 - \gamma_2 = \frac{4D}{d}(\lambda_1 - \lambda_2)$$

$$= \frac{4\times1.2}{2\times16^{-3}}(6500-5200)$$

$$= \frac{4\times1.2\times1300\times10^{-10}}{2\times10^{-3}}$$

After solving

= 0.312 mm.

49. [B]

By Einstein's photoelectric equation

K.E. of photoelectron is

½ $mv^2 = h\nu$

K.E. of emitted photoelectrons depends on frequency of incident radiations.

50. [B]

De-Broglie wavelength

$$\lambda = \frac{h}{m\nu} \quad [\therefore P = m\nu]$$

De-Broglie wavelength of a proton: -

Mass = m_1

$$\lambda_1 = \frac{h}{\sqrt{2m_1k}} \quad \left[\therefore P = \sqrt{2mk}\right]$$

[k = qv]

$$\therefore \quad \lambda_1 = \frac{h}{\sqrt{2m_1k\nu}} \quad \text{... (i)}$$

For an α-particle

Mass = m_2

Charge = q_0

$$\therefore \quad \lambda_2 = \frac{h}{\sqrt{2m_2q_0\nu}}$$

For α – particle

$${}_2^4He \Rightarrow q_0 = 2q$$

$M_2 = 4m_1$

$$\therefore \quad \lambda_2 = \frac{h}{\sqrt{2\times4m_1\times2q\times V}} \quad \text{... (ii)}$$

Eq^n (i) & (ii)

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$$\frac{\lambda_1}{\lambda_2} = \frac{h}{\sqrt{2m_1qv}} = \frac{\sqrt{2\times m_1\times 4\times 2qv}}{h}$$

After solving,

$$\frac{\lambda_1}{\lambda_2} = 2\sqrt{2}$$

51. [C]

Energy: -

$E_n = \frac{-13.62}{n^2}$

For hydrogen atom

Z = 1; n = 2

$E_n = \frac{-13.6\times 1^2}{2^2}$

$= \frac{-13.6}{4}$

=-3.4eV

52. [D]

Time period (T) = $\frac{2\pi r}{v}$

$= r\times\frac{n^2}{Z}$

So,

$T\times\frac{n^3}{z^2}$

First excited state, n = 2

$\frac{T_2}{T_1} = \left(\frac{n_2}{n_1}\right)^3 = \left(\frac{2}{1}\right)^3$

T_2 = 8T

53. [B]

M = 1g $\Rightarrow 10^{-3}$ kg

Using Einstein's equation: -

$E = mc^2$

$=10^{-3}\times(3\times10^8)^2$

$=10^{-3}\times 9\times10^{16}$

$E = 9\times10^{13}$

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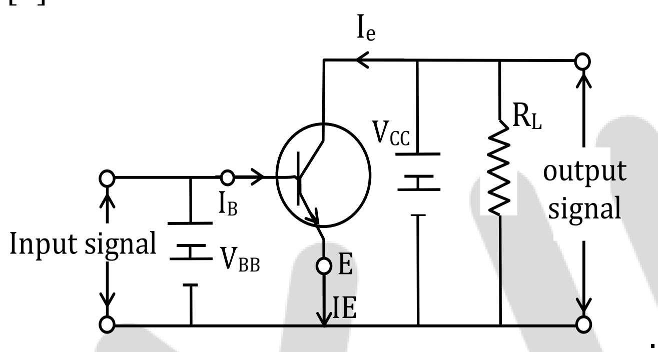
54. [D]
Un-decayed
$$\frac{N}{N_0} = \frac{1}{2x}$$
$$X = \frac{50}{12.5} = 4$$
$$N = \frac{N_0}{16} = \frac{64}{16} = 4mg$$

55. [A]



The input ac signal to be amplified is applied across forward biased emitter – base junction.

56. [A]
A = 1, B = 0
$$\bar{A} + B = \bar{I} + 0 = 0 + 0 = 0$$
$$\bar{A} + B = B$$

57. [B]
$n_1 = 3\times 10^{16}\ m^{-3}$
$n_n = 4.5 \times 10^{22} m^{-3}$
$n_1^2 = n_n n_e$
$$n_e = \frac{n_1^2}{n_n}$$
$$= \frac{\left(3\times10^{16}\right)^2}{4.5\times10^{22}}$$
$$n_e = \frac{9\times10^{32}}{4.5\times10^{22}}$$

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$n_e = 2\times 10^{10}$

58. [B]

$$I_C = \frac{V_{CE}}{R_C}$$

Given; -

$V_{CE} = 2V$

$R_C = 4$ K

Substituting values

$$I_C = \frac{2}{4\times 10^3} = 0.5\times 10^{-3} A$$

$I_C = 0.5$ mA

$$\beta = \frac{I_C}{I_B} \Rightarrow I_B = \frac{I_C}{\beta}$$

$$= \frac{0.5\times 10^{-3}}{50} = 10^{-5} A$$

$I_B = 10$ μA

59. [C]

Range $= \sqrt{2Rh}$

$= \sqrt{2\times 6400\times 10^3 \times 500}$

$= 80 \times 10^3$

= 80 cm

60. [C]

$$\frac{-GMm}{(R+R)} + \frac{1}{2}mv^2 = 0$$

$$\frac{1}{2}mv^2 = \frac{-GMm}{2R}$$

$$V' = \sqrt{\frac{GM}{R}} \Rightarrow \sqrt{gR}$$

$$V_E = \sqrt{2gR}$$

$$\frac{V^E}{V'} = \sqrt{\frac{2gR}{gR}}$$

$$V' = V_E \times \frac{1}{\sqrt{2}}$$

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