FINAL NEET(UG)–2020 EXAMINATION

(Held On Sunday 13th SEPTEMBER, 2020)

PHYSICS

TEST PAPER WITH ANSWER & SOLUTION

1. The color code of a resistance is given below

The values of resistance and tolerance, respectively, are :

(1) 470 Ω, 5% (2) 470 kΩ, 5%

(3) 47 kΩ, 10% (4) 4.7 kΩ, 5%

Ans. (1)

Sol. $R = 47 \times 10^1 \pm 5\%$

$R = 470\ \Omega$, 5%

2. Find the torque about the origin when a force of $3\hat{j}$ N acts on a particle whose position vector is $2\hat{k}$ m :

(1) $6\hat{k}$ Nm (2) $6\hat{i}$ Nm

(3) $6\hat{j}$ Nm (4) $-6\hat{i}$ Nm

Ans. (4)

Sol. $\vec{F}\ \ 3\hat{j}N,\ \vec{r}\ \ 2\hat{k}$

$\vec{\tau} = \vec{r} \times \vec{F} = 2\hat{k} \times 3\hat{j} = 6(\hat{k} \times \hat{j})$

$= 6(-\hat{i})$

$\vec{\tau} = -6\hat{i}$ Nm

3. A cylinder contains hydrogen gas at pressure of 249 kPa and temperature 27°C.

Its density is : ($R = 8.3$ J mol^{-1} K^{-1})

(1) 0.02 kg/m^3 (2) 0.5 kg/m^3

(3) 0.2 kg/m^3 (4) 0.1 kg/m^3

Ans. (3)

Sol. For an ideal gas sample

$$\frac{P}{\rho} = \frac{RT}{Mw}$$

$$\rho = \frac{PMw}{RT} = \frac{249 \times 10^3 \times 2 \times 10^{-3}}{8.314 \times 300} = 0.199$$

$\rho = 0.2$ kg/m^3

4. Two cylinders A and B of equal capacity are connected to each other via a stop cock. A contains an ideal gas at standard temperature and pressure. B is completely evacuated. The entire system is thermally insulated. The stop cock is suddenly opened. The process is :

(1) isobaric (2) isothermal

(3) adiabatic (4) isochoric

Ans. (3)

Sol. Free expansion i.e. expansion against vacuum is adiabatic in nature for all type of gases. It should be noted that temperature final temperature is equal to initial temperature for ideal gases.

5. Two particles of mass 5 kg and 10 kg respectively are attached to the two ends of a rigid rod of length 1 m with negligible mass.

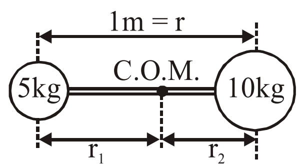
The centre of mass of the system from the 5 kg particle is nearly at a distance of :

(1) 80 cm (2) 33 cm

(3) 50 cm (4) 67 cm

Ans. (4)

Sol.



$$mr = \text{constant} \Rightarrow r \propto \frac{1}{m}$$

$$\frac{r_1}{r_2} = \frac{m_2}{m_1} = \frac{10}{5} = \frac{2}{1}$$

$$r_1 = \frac{2}{3}r = \frac{2}{3} \times 1 \text{ m} = 67 \text{ cm}$$

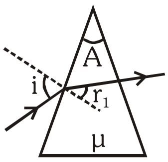
6. A ray is incident at an angle of incidence i on one surface of a small angle prism (with angle of prism A) and emerges normally from the opposite surface. If the refractive index of the material of the prism is μ, then the angle of incidence is nearly equal to:

(1) $\frac{\mu A}{2}$ (2) $\frac{A}{2\mu}$

(3) $\frac{2A}{\mu}$ (4) μA

Ans. (4)

Sol.



$r_2 = 0$
$r_1 = A$
Apply Snell's law
$\sin i = \mu \sin r_1$
for small angle ($r_1 = A$)

$i \quad \mu A$

7. A body weighs 72 N on the surface of the earth. What is the gravitational force on it, at a height equal to half the radius of the earth?

(1) 24 N (2) 48 N
(3) 32 N (4) 30 N

Ans. (3)

Sol. $W_s = mg_s = 72$ N

$$W_h = mg_h = \frac{mg_s}{\left(1 \quad \frac{h}{R}\right)^2} = \frac{72N}{\left(1 \quad \frac{R/2}{R}\right)^2} = \frac{72}{9/4}$$

$W_h = 32$ N

8. An iron rod of susceptibility 599 is subjected to a magnetising field of 1200 A m^{-1}. The permeability of the material of the rod is :
($\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1})
(1) $2.4\pi \times 10^{-7}$ T m A^{-1}
(2) $2.4\pi \times 10^{-4}$ T m A^{-1}
(3) 8.0×10^{-5} T m A^{-1}
(4) $2.4\pi \times 10^{-5}$ T m A^{-1}

Ans. (2)

Sol. $\mu_r = x_m + 1 = 599 + 1 = 600$
$\mu = \mu_0\mu_r = 4\pi \times 10^{-7} \times 600$

$$= 2.4\pi \times 10^{-4} \frac{Tm}{A}$$

9. For transistor action, which of the following statements is **correct**?

(1) The base region must be very thin and lightly doped.

(2) Base, emitter and collector regions should have same doping concentrations.

(3) Base, emitter and collector regions should have same size.

(4) Both emitter junction as well as the collector junction are forward biased.

Ans. (1)

Sol. Base region is very thin and lightly doped.

10. Light with an average flux of 20 W/cm^2 falls on a non-reflecting surface at normal incidence having surface area 20 cm^2. The energy received by the surface during time span of 1 minute is :

(1) 48×10^3 J (2) 10×10^3 J

(3) 12×10^3 J (4) 24×10^3 J

Ans. (4)

Sol. $I = \frac{E}{At}$

$E = IAt$

$$= \frac{20}{10^{-4}} \times 20 \times 10^{-4} \times 60$$

$= 24 \times 10^3$ J

11. A short electric dipole has a dipole moment of 16×10^{-9} C m. The electric potential due to the dipole at a point at a distance of 0.6 m from the centre of the dipole, situated on a line making an angle of 60° with the dipole axis is :

$$\left(\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 Nm^2/C^2\right)$$

(1) zero (2) 50 V

(3) 200 V (4) 400 V

Ans. (3)

Sol. $V = \frac{kP\cos\theta}{r^2} = \frac{9 \times 10^9 \times 16 \times 10^{-9}}{(0.6)^2} \times \frac{1}{2}$

V = 200 V

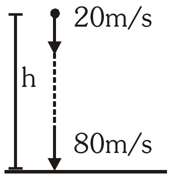
12. A ball is thrown vertically downward with a velocity of 20 m/s from the top of a tower. It hits the ground after some time with a velocity of 80 m/s. The height of the tower is : (g = 10 m/s^2)

(1) 300 m (2) 360 m

(3) 340 m (4) 320 m

Ans. (1)

Sol.



$v^2 = u^2 + 2gh$

$80^2 = 20^2 + 2 \times 10h$

$h = 300m$

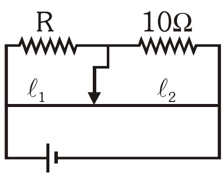
13. A resistance wire connected in the left gap of a metre bridge balances a 10 Ω resistance in the right gap at a point which divides the bridge wire in the ratio 3 : 2. If the length of the resistance wire is 1.5 m, then the length of 1 Ω of the resistance wire is :

(1) 1.5×10^{-2} m (2) 1.0×10^{-2} m

(3) 1.0×10^{-1} m (4) 1.5×10^{-1} m

Ans. (3)

Sol.



$$\frac{R}{10} = \frac{\ell_1}{\ell_2}$$

$$\frac{R}{10} = \frac{3}{2}$$

R = 15Ω

Length of 15Ω resistance wire is 1.5 m

$\therefore$ length of 1Ω resistance wire = $\frac{.5}{15}$ = 0.1

$= 1.0 \times 10^{-1}$ m

14. When a uranium isotope $^{235}_{92}U$ is bombarded with a neutron, it generates $^{89}_{36}Kr$, three neutrons and:

(1) $^{103}_{36}Kr$ (2) $^{144}_{56}Ba$

(3) $^{91}_{40}Zr$ (4) $^{101}_{36}Kr$

Ans. (2)

Sol. $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{89}_{36}Kr \;\; ^{144}_{56}Ba \;\; 3^{1}_{0}n \;\; Q$

15. A long solenoid of 50 cm length having 100 turns carries a current of 2.5 A. The magnetic field at the centre of the solenoid is :

($\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1})

(1) 3.14×10^{-5} T (2) 6.28×10^{-4} T

(3) 3.14×10^{-4} T (4) 6.28×10^{-5} T

Ans. (2)

Sol. $B = \mu_0 \frac{N}{\ell} I$

$$= 4\pi \times 10^{-7} \times \frac{100}{(0.5)} \times 2.5$$

$= 6.28 \times 10^{-4}$ T

16. The average thermal energy for a mono-atomic gas is : (k_B is Boltzmann constant and T, absolute temperature)

(1) $\frac{7}{2}k_BT$ (2) $\frac{1}{2}k_BT$

(3) $\frac{3}{2}k_BT$ (4) $\frac{5}{2}k_BT$

Ans. (3)

Sol. Average thermal energy = $\frac{3}{2}K_B T$

where 3 is translational degree of freedom

For monoatomic gas total degree of freedom f = 3 (translational degree of freedom)

17. A capillary tube of radius r is immersed in water and water rises in it to a height h. The mass of the water in the capillary is 5g. Another capillary tube of radius 2r is immersed in water. The mass of water that will rise in this tube is :

(1) 20.0 g (2) 2.5 g

(3) 5.0 g (4) 10.0 g

Ans. (4)

Sol. $m \propto r$

$$\frac{m_2}{m_1} = \frac{r_2}{r_1}$$

$$\frac{m_2}{5} = \frac{2r}{r}$$

$m_2 = 10g$

18. The ratio of contributions made by the electric field and magnetic field components to the intensity of an electromagnetic wave is :

(c = speed of electromagnetic waves)

(1) $1 : c^2$ (2) $c : 1$

(3) $1 : 1$ (4) $1 : c$

Ans. (3)

Sol. In EMW, electric field and magnetic field have same energy density and same intensities.

19. Assume that light of wavelength 600 nm is coming from a star. The limit of resolution of telescope whose objective has a diameter of 2 m is :

(1) 6.00×10^{-7} rad (2) 3.66×10^{-7} rad

(3) 1.83×10^{-7} rad (4) 7.32×10^{-7} rad

Ans. (2)

Sol. Limit of resolution $= \dfrac{1.22\lambda}{a}$

$$= \frac{1.22 \times 6 \times 10^{-7}}{2}$$

$= 3.66 \times 10^{-7}$ rad

20. A wire of length L, area of cross section A is hanging from a fixed support. The length of the wire changes to L_1 when mass M is suspended from its free end. The expression for Young's modulus is :

(1) $\dfrac{MgL}{A(L_1 - L)}$ (2) $\dfrac{MgL_1}{AL}$

(3) $\dfrac{Mg(L_1 - L)}{AL}$ (4) $\dfrac{MgL}{AL_1}$

Ans. (1)

Sol. $Y = \dfrac{FL}{A\Delta L} = \dfrac{MgL}{A(L_1 - L)}$

21. The energy required to break one bond in DNA is 10^{-20} J. This value in eV is nearly :

(1) 0.006 (2) 6

(3) 0.6 (4) 0.06

Ans. (4)

Sol. $E = \dfrac{10^{-20}}{1.6 \times 10^{-19}}$ eV

$= 0.625 \times 10^{-1}$

$= 0.0625$ eV

22. In a certain region of space with volume 0.2 m^3 the electric potential is found to be 5 V throughout. The magnitude of electric field in this region is :

(1) 5 N/C (2) Zero

(3) 0.5 N/C (4) 1 N/C

Ans. (2)

Sol. Potential is constant throughout the volume

$\therefore$ Electric field is zero.

23. The mean free path for a gas, with molecular diameter d and number density n can be expressed as :

(1) $\dfrac{1}{\sqrt{2}\, n^2 \pi^2 d^2}$ (2) $\dfrac{1}{\sqrt{2}\, n\pi d}$

(3) $\dfrac{1}{\sqrt{2}\, n\pi d^2}$ (4) $\dfrac{1}{\sqrt{2}\, n^2 \pi d^2}$

Ans. (3)

Sol. Mean free path for a gas sample

$$\lambda_m = \frac{1}{\sqrt{2}\,\pi d^2 n}$$

where d is diameter of a gas molecule and n is molecular density

24. An electron is accelerated from rest through a potential difference of V volt. If the de Broglie wavelength of the electron is 1.227×10^{-2} nm, the potential difference is :

(1) 10^4 V (2) 10 V

(3) 10^2 V (4) 10^3 V

Ans. (1)

Sol. $\lambda = 1.227 \times 10^{-2}$ nm

$= 0.1227$ Å

$$\lambda = \frac{12.27}{\sqrt{v}} \text{Å}$$

$$0.1227 = \frac{12.27}{\sqrt{v}} \text{Å}$$

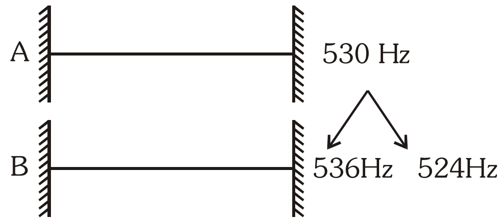
$\sqrt{v} = 10^2 \Rightarrow v = 10^4$ volt

25. In a guitar, two strings A and B made of same material are slightly out of tune and produce beats of frequency 6 Hz. When tension in B is slightly decreased, the beat frequency increases to 7 Hz. If the frequency of A is 530 Hz, the original frequency of B will be:

(1) 537 Hz (2) 523 Hz
(3) 524 Hz (4) 536 Hz

Ans. (3)

Sol. Guitar string i.e. string is fixed from both ends



Frequency $\propto \sqrt{\text{Tension}}$

If tension in B slightly decrease then frequency of B decrease.

If B is 536 Hz, as the frequency decreases, beats with A also decreases.

If B is 524 Hz, as the frequency decreases, beats with A increases.

$\therefore$ Original frequency of B will be 524 Hz.

26. A 40 μF capacitor is connected to a 200 V, 50 Hz ac supply. The rms value of the current in the circuit is, nearly :

(1) 25.1 A (2) 1.7 A
(3) 2.05 A (4) 2.5 A

Ans. (4)

Sol. $I \quad \frac{V}{X_C} \quad \frac{V}{1/C\omega} \quad VC\omega$

$= 200 \times 40 \times 10^{-6} \times 2\pi \times 50$

$= 2.5$ A

27. The increase in the width of depletion region in a p-n junction diode is due to :

(1) increase in forward current
(2) forward bias only
(3) reverse bias only
(4) both forward bias and reverse bias

Ans. (3)

Sol. In reverse bias external battery attract majority charge carriers.

so width of the depletion region increase

28. The Brewsters angle i_b for an interface should be:

(1) $i_b = 90°$ (2) $0° < i_b < 30°$
(3) $30° < i_b < 45°$ (4) $45° < i_b < 90°$

Ans. (4)

Sol. $\tan i_b = \frac{\mu_2}{\mu_1} \quad \frac{\mu_2}{1}$

$\mu_2 > 1$

$\therefore \tan i_b > 1$

$\therefore 90° > i_b > 45°$

29. The phase difference between displacement and acceleration of a particle in a simple harmonic motion is :

(1) Zero (2) π rad
(3) $\frac{3\pi}{2}$ rad (4) $\frac{\pi}{2}$ rad

Ans. (2)

Sol. Displacement (x) equation of SHM

$x = A \sin(\omega t + \phi)$ ...(1)

$\frac{dx}{dt} = A\omega \cos(\omega t + \phi)$

acceleration (a) $= \frac{d^2x}{dt^2}$

$a = -\omega^2 A \sin \omega t + \phi$

$a = \omega^2 A \sin(\omega t + \phi + \pi)$ ...(2)

from (1) & (2), phase difference between displacement and acceleration is π.

30. A spherical conductor of radius 10 cm has a charge of 3.2×10^{-7} C distributed uniformly. What is the magnitude of electric field at a point 15 cm from the centre of the sphere ?

$\left(\frac{1}{4\pi \epsilon_0} = 9 \times 10^9 \, Nm^2/C^2\right)$

(1) 1.28×10^7 N/C
(2) 1.28×10^4 N/C
(3) 1.28×10^5 N/C
(4) 1.28×10^6 N/C

Ans. (3)

Sol. $E = \frac{kQ}{r^2} = \frac{9 \times 10^9 \times 3.2 \times 10^{-7}}{(15 \times 10^{-2})^2}$

$E = 1.28 \times 10^5$ N/C

31. The capacitance of a parallel plate capacitor with air as medium is 6 μF. With the introduction of a dielectric medium, the capacitance becomes 30 μF. The permittivity of the medium is :
($\varepsilon_0 = 8.85 \times 10^{-12} C^2 N^{-1} m^{-2}$)
(1) $5.00\ C^2 N^{-1} m^{-2}$
(2) $0.44 \times 10^{-13} C^2 N^{-1} m^{-2}$
(3) $1.77 \times 10^{-12} C^2 N^{-1} m^{-2}$
(4) $0.44 \times 10^{-10} C^2 N^{-1} m^{-2}$

Ans. (4)

Sol. $C_m = \epsilon_r C_o$

$$\epsilon_r = \frac{30}{6} = 5$$

$\epsilon = \epsilon_o \cdot \epsilon_r = 8.85 \times 10^{-12} \times 5$
$\epsilon = 0.44 \times 10^{-10}$

32. Taking into account of the significant figures, what is the value of 9.99 m – 0.0099 m ?
(1) 9.9 m (2) 9.9801 m
(3) 9.98 m (4) 9.980 m

Ans. (3)

Sol. In subtraction the number of decimal places in the result should be equal to the number of decimal places of that term in the operation which contain lesser number of decimal places.

9.99
–0.0099
9.98 → 3 siginificant figures

33. A series LCR circuit is connected to an ac voltage source. When L is removed from the circuit, the phase difference between current and voltage is $\frac{\pi}{3}$. If instead C is removed from the circuit, the phase difference is again $\frac{\pi}{3}$ between current and voltage. The power factor of the circuit is :
(1) –1.0 (2) zero
(3) 0.5 (4) 1.0

Ans. (4)

Sol. When L removed $\tan\phi = \frac{X_C}{R}$

When L removed $\tan\phi = \frac{X_L}{R}$

$\frac{X_C}{R} = \frac{X_L}{R} \Rightarrow$ Resonance

Z = R

$$\cos\phi = \frac{R}{Z} = \frac{R}{R} = 1$$

34. Dimensions of stress are :
(1) $[M L^{-1} T^{-2}]$ (2) $[M L T^{-2}]$
(3) $[M L^2 T^{-2}]$ (4) $[M L^0 T^{-2}]$

Ans. (1)

Sol. $\text{stress} = \frac{\text{Force}}{\text{Area}}$

$$= \frac{M^1L^1T^{-2}}{L^2}$$

$\text{stress} = M^1L^{-1}T^{-2}$

35. Light of frequency 1.5 times the threshold frequency is incident on a photosensitive material. What will be the photoelectric current if the frequency is halved and intensity is doubled ?
(1) zero
(2) doubled
(3) four times
(4) one-fourth

Ans. (1)

Sol. $K_1 = 1.5\ h\nu_0 - \phi_0 = 0.5\ h\nu_0$

$$K_2 = \frac{1.5}{2} h\nu_0 - h\nu_0 = -\ 0.25\ h\nu_0$$

∵ Kinetic energy can never be negative
So, no emission and i = 0

OR

In second case the incident frequency is halved

Incident frequency $= \frac{1.5}{2}\nu_0 = 0.75\ \nu_0$

Now the incident frequency is less than threshold frequency so no emission of electron take place therefore no current. (i = 0)

36. The solids which have the negative temperature coefficient of resistance are :
(1) insulators and semiconductors
(2) metals
(3) insulators only
(4) semiconductors only

Ans. (1)

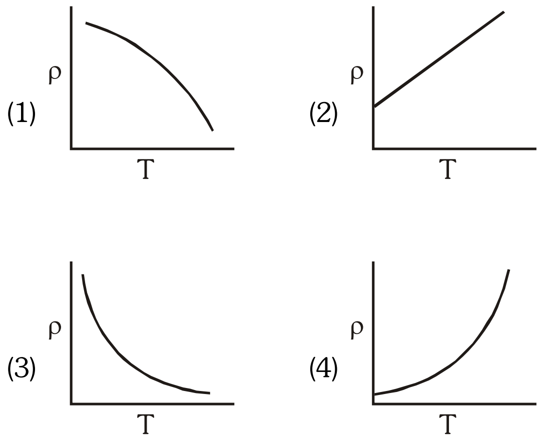
37. A charged particle having drift velocity of $7.5 \times 10^{-4}\ ms^{-1}$ is an electric field of $3 \times 10^{-10}\ Vm^{-1}$, has a mobility in $m^2 V^{-1} s^{-1}$ of :
(1) 2.25×10^{-15}
(2) 2.25×10^{15}
(3) 2.5×10^{6}
(4) 2.5×10^{-6}

Ans. (3)

Sol. $\mu = \frac{v_d}{E} = \frac{7.5 \times 10^{-4}}{3 \times 10^{-10}}$

$= 2.5 \times 10^6$

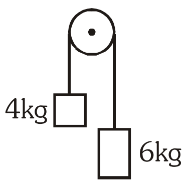
38. Which of the following graph represents the variation of resistivity (ρ) with temperature (T) for copper ?



Ans. **(4)**

Sol. For some metals like copper, resistivity is nearly proportional to temperature although a non linear region always exists at very low temperature.

39. Two bodies of mass 4kg and 6kg are tied to the ends of a massless string. The string passes over a pulley which is frictionless (see figure). The acceleration of the system in terms of acceleration due to gravity (g) is :



(1) g/10 (2) g

(3) g/2 (4) g/5

Ans. **(4)**

Sol. $a = \frac{(m_2 - m_1)g}{m_1 + m_2}$

$a \quad \frac{(6-4)g}{6 \quad 4} = \frac{2g}{10}$

$a = \frac{g}{5}$

40. A screw gauge has least count of 0.01 mm and there are 50 divisions in its circular scale.

The pitch of the screw gauge is :

(1) 1.0 mm (2) 0.01 mm

(3) 0.25 mm (4) 0.5 mm

Ans. **(4)**

Sol. $\text{L.C.} = \frac{\text{Pitch}}{\text{Number of division on circular scale}}$

$\Rightarrow 0.01 \text{ mm} = \frac{\text{Pitch}}{50}$

$\Rightarrow \text{Pitch} = 0.5 \text{ mm}$

41. In Young's double slit experiment, if the separation between coherent sources is halved and the distance of the screen from the coherent sources is doubled, then the fringe width becomes :

(1) one-fourth

(2) double

(3) half

(4) four times

Ans. **(4)**

Sol. $\beta = \frac{\lambda D}{d}$

$\beta' \quad \frac{\lambda D'}{d'}$

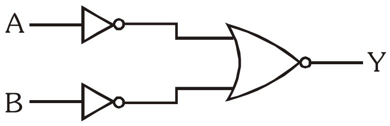
$D' = 2D, \quad d' = \frac{d}{2}$

$\beta' = \frac{\lambda \times 2D}{d/2} = \frac{4\lambda D}{d}$

$\beta' = 4\beta$

Fringe with becomes 4 times

42. For the logic circuit shown, the truth table is :



(1)

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

(2)

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

(3)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

(4)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

Ans. (2)

Sol. $Y = \overline{\overline{A} + \overline{B}} = \overline{\overline{A}}.\overline{\overline{B}} = A.B$ = AND gate

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

43. The energy equivalent of 0.5 g of a substance is:
(1) 0.5×10^{13} J
(2) 4.5×10^{16} J
(3) 4.5×10^{13} J
(4) 1.5×10^{13} J

Ans. (3)

Sol. $E = mc^2$
$= 0.5 \times 10^{-3} \times 9 \times 10^{16}$
$= 4.5 \times 10^{13}$ J

44. For which one of the following, Bohr model in **not** valid ?
(1) Singly ionised neon atom (Ne^+)
(2) Hydrogen atom
(3) Singly ionised helium atom (He^+)
(4) Deuteron atom

Ans. (1)

Sol. Bohr model is applicable for only single electron species.

45. The quantities of heat required to raise the temperature of two solid copper spheres of radii r_1 and r_2 ($r_1 = 1.5\, r_2$) through 1 K are in the ratio:

(1) $\frac{5}{3}$ (2) $\frac{27}{8}$

(3) $\frac{9}{4}$ (4) $\frac{3}{2}$

Ans. (2)

Sol. Heat supplied $\Delta Q = Ms\Delta T$
For same material 's' same.

$\Delta Q \propto M$ and $M = \frac{4}{3}\pi r^3 \rho$

$\Delta Q \propto r^3$

$$\frac{\Delta Q_1}{\Delta Q_2} = \left(\frac{r_1}{r_2}\right)^3 = \left(\frac{1.5}{1}\right)^3 = \frac{27}{8}$$