Resonance®
Educating for better tomorrow

JEE (Main)

PAPER-1 (B.E./B. TECH.)

2021

COMPUTER BASED TEST (CBT)
Memory Based Questions & Solutions

Date: 25 July, 2021 (SHIFT-2) | TIME : (3.00 p.m. to 6.00 p.m)

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

SUBJECT: PHYSICS

Resonance Eduventures Ltd.
Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005
Ph. No.: +91-744-2777777, 2777700 | **FAX No. :** +91-022-39167222
To Know more : sms RESO at 56677 | **Website :** www.resonance.ac.in | **E-mail :** contact@resonance.ac.in | **CIN :** U80302RJ2007PLC024029
Toll Free : 1800 258 5555 7340010333 facebook.com/ResonanceEdu twitter.com/ResonanceEdu www.youtube.com/resowatch blog.resonance.ac.in

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

PART : PHYSICS

1 Value of force F = Asin(Bt) + Ccos(Dx) find dimension of $\frac{AB}{D}$

(1) ML^3T^{-1} (2) ML^2T^{-3} (3) ML^1T^{-3} (4) ML^2T^3

Ans. (2)

Sol. Dimension of A= MLT^{-2} , B = T^{-1}, D = L^{-1}

$$\text{Dim} = \frac{AB}{D} = \frac{MLT^{-2}T^{-1}}{L^{-1}} = ML^2T^{-3}$$

2 Force is given by $F = (5y + 20)\hat{j}$ Find work done for moving particle from y = 0 to y = 5 :

(1) 162.5 J (2) 165 J (3) 132.5 J (4) 140.5 J

Ans. (1)

Sol. $w = \int F.dy$

$w = \int_0^5 (5y + 20)dy$

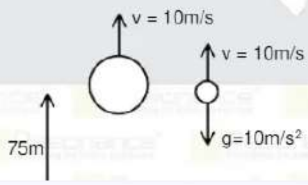
$= \left[\frac{5y^2}{2} + 20y\right]_0^5 \Rightarrow \frac{5 \times 25}{2} + 100 = 162.5 \text{ J}$

3 A hot air balloon is ascending with constant velocity of 10 m/s. when balloon reaches a height of 75 m, a stone is dropped from balloon. what will be the height of balloon, when stone reaches earth?

(1) 125 m. (2) 135 m. (3) 140 m. (4) 145 m.

Ans. (1)

Sol. For stone



$75 = -10t + \frac{1}{2}gt^2$

$75 = -10t + 5t^2$

$t^2 - 2t - 15 = 0$

t = 5 sec.

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

$H = vt + 75$

$H = 10 \times 5 + 75 = 125$ m.

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

4. Relation between position and time of a particle moving along straight line is given by $t = x + 3x^2$. Find acceleration of particle at t = 10s

(1) $\frac{-5}{1331}$ (2) $\frac{6}{1331}$ (3) $\frac{-6}{1331}$ (4) $\frac{5}{1331}$

Ans. (3)

Sol. $t = x + 3x^2$ ....(1)

$1 = \frac{dx}{dt} + 6x\frac{dx}{dt} \Rightarrow v = \frac{1}{(1+6x)}$

$0 = \frac{d^2x}{dt^2} + 6\left(x\frac{d^2x}{dt^2} + \left(\frac{dx}{dt}\right)^2\right)$

$0 = a + 6xa + 6v^2$

$a = \frac{-6v^2}{(1+6x)}$ ...(2)

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

From equation ....(1)

$10 = x + 3x^2$

$3x^2 + x - 10 = 0$

$3x^2 + 6x - 5x - 10 = 0$

$3x(x + 2) - 5(x + 2)$

$(3x - 5)(x + 2) \Rightarrow x = \frac{5}{3}$

From equation (2)

$$a = \frac{-6}{\left(1+6\times\frac{5}{3}\right)^3} = \frac{-6}{1331}$$

5. Two particle of same mass & charges Q_1 and Q_2 are moving perpendicular to an uniform magnetic field where the ratio of charges is $\frac{Q_1}{Q_2} = \frac{1}{2}$ and ratio of velocities is $\frac{V_1}{V_2} = \frac{3}{2}$ then find the ratio of the radius $\frac{R_1}{R_2}$:

(1) 2 : 1 (2) 3 : 1 (3) 4 : 1 (4) 1 : 1

Sol. Given

$$\frac{Q_1}{Q_2} = \frac{1}{2} \ \& \ \frac{V_1}{V_2} = \frac{3}{2}$$

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

$$\frac{R_1}{R_2} = \frac{V_1}{V_2}\times\frac{Q_2}{Q_1} = \frac{3}{2}\times\frac{2}{1} = \frac{3}{1}$$

6. A particle performing SHM with amplitude A. Find the ratio of kinetic energy and total energy when particle is at A/2

(1) $\frac{3}{4}$ (2) $\frac{2}{3}$ (3) $\frac{4}{3}$ (4) $\frac{1}{2}$

Ans. (1)

Sol. $V_{A/2} = \omega\sqrt{A^2 - x^2}$

$$= \omega\sqrt{A^2 - \left(\frac{A}{2}\right)^2} = \omega\left(\frac{\sqrt{3}}{2}A\right)$$

$$= \frac{\sqrt{3}}{2}V_{max}$$

$$KE = \frac{1}{2}m\left(\frac{\sqrt{3}}{2}V_{max}\right)^2$$

$$\frac{KE}{TE} = \frac{3}{4}$$ Ans.

7. In photoelectric effect stopping potential is $3V_0$ for incident wave length λ_0 and stopping potential V_0 for incident wavelength $2\lambda_0$. Find threshold wavelength.

(1) $3\lambda_0$ (2) $2\lambda_0$ (3) $4\lambda_0$ (4) $8\lambda_0$

Ans. (3)

Sol. $KE = h\nu - W$

$$eV = \frac{hc}{\lambda} - W$$

For first case

$$e(3V_0) = \frac{hc}{\lambda_0} - W \quad ...(i)$$

For second case

$$eV_0 = \frac{hc}{2\lambda_0} - W \quad ...(ii)$$

From equation (i) and (ii)

For λ_{th}

$$W = \frac{hc}{\lambda_{th}}$$

$$\Rightarrow \frac{hc}{\ } = \frac{hc}{\ } \Rightarrow \lambda_{th} = 4\lambda_0$$

$\Rightarrow \quad 4\lambda_0 \quad \lambda_{th}$

8. Efficiency of heat engine is $\eta = 1/6$. If temperature of sink is decreased by 62K, then efficiency becomes 1/3. Find temperature of source :

(1) 372K (2) 272K (3) 350K (4) 450K

Ans. (1)

Sol. $\eta = \left(1 - \frac{T_2}{T_1}\right)$

$\frac{T_2}{T_1} = 1 - \eta = 1 - \frac{1}{6}$ .....(1)

$\frac{T_2 - 62}{T_1} = 1 - \frac{1}{3}$ .....(2)

Equation $\frac{(1)}{(2)}$:

$\Rightarrow \quad \frac{T_2}{T_2 - 62} = \frac{5}{6} \times \frac{3}{2} = \frac{5}{4}$

$\Rightarrow \quad T_2 = 5 \times 62$

From eq. (1)

$T_1 = \frac{T_2}{1-\eta} = \frac{5 \times 62}{1 - \frac{1}{6}} = 5 \times 62 \times \frac{6}{5} = 372K$

9. Activity of an element x becomes 1/8 of initial in 30 years. Find half-life :

(1) 10 Year. (2) 12 Year (3) 15 Year (4) 17 Year

Ans. (1)

Sol. $A = A_0 e^{-\lambda t}$

For half life

$\frac{1}{2} = e^{-\lambda t_{1/2}}$ .....(1)

Given $1/8 = e^{-\lambda 30}$ .....(2)

Solving (1) and (2)

$e^{-3\lambda t_{1/2}} = e^{-\lambda 30}$

$T_{1/2} = 10$ Yrs.

10. If De-Broglie wavelengths of photon and electron are equal, what will be the ratio of kinetic energy of electron and energy of photon? Given that velocity of electron is v and velocity of light is c :

(1) $\frac{2v}{c}$ (2) $\frac{v}{2c}$ (3) $\frac{3v}{c}$ (4) $\frac{c}{3v}$

Ans. (2)

Sol. De-Broglie wavelength is given by $\lambda = \frac{h}{p}$

$KE_{pn} = mc^2 = pc \quad ...(1)$

$KE_e = \frac{1}{2}mv^2 = \frac{pv}{2} \quad ...(2)$

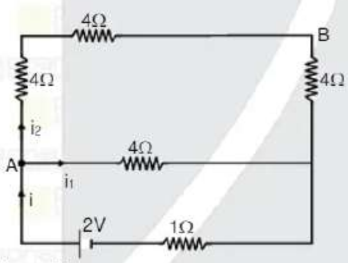
$KE_{pn} \quad pc \quad 2c$

11. A square loop of total resistance 16Ω. If a battery of 2V and 1Ω internal resistance is connected across one of its side then find potential difference across its diagonal :

(1) 1V (2) 2V (3) 3V (4) 4V

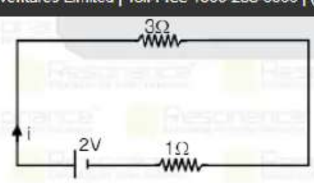
Ans. (1)

Sol.



$V_{AB} = ??$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029



$i = \frac{2}{3+1} = \frac{1}{2}$ A

$i_2 = \frac{r_2}{r_2 + r_1} i = \frac{1}{3+1} \times \frac{1}{2} = \frac{1}{8}$

$V_{AB} = \frac{1}{8} \times 8 = 1V$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Resonance® Educating for better tomorrow | JEE MAIN-2021 | DATE : 25-07-2021 (SHIFT-2) | PAPER-1 | MEMORY BASED | PHYSICS

12. $\vec{A}$ and $\vec{B}$ are two vectors such that $|\vec{A}| = 2$ and $|\vec{B}| = 5$. If $|\vec{A} \times \vec{B}| = 8$, then $|\vec{A}\vec{B}| = ?$

(1) 2 (2) 6 (3) 7 (4) 9

Ans. (2)

Sol. $|\vec{A} \times \vec{B}| = |\vec{A}||\vec{B}| \sin\theta$

$\Rightarrow 10\sin\theta = 8$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Now $|\vec{A}.\vec{B}| = |\vec{A}||\vec{B}|\cos\theta = 10 \times \frac{3}{5} = 6$

13. Find significant figure for the value 0.00346.

(1) 5 (2) 4 (3) 3 (4) 2

Ans. (3)

Sol. There are 3 non zero digit after the decimal point so significant number is 3.

0.00346

14. For a prism, if angle of minimum deviation is equal to angle of prism. If refractive index of prism material is μ. Then angle of prism should be?

(1) $2\sin^{-1}\left(\frac{\mu}{2}\right)$ (2) $2\cos^{-1}\left(\frac{\mu}{2}\right)$ (3) $3\cos^{-1}\left(\frac{\mu}{2}\right)$ (4) $3\sin^{-1}\left(\frac{\mu}{2}\right)$

Ans. (2)

Sol. $\mu = \frac{\quad}{\sin\left(\frac{A}{2}\right)}$

$\mu = \frac{\sin A}{\sin A/2}$

$\mu = 2\cos\frac{A}{2}$

$A = 2\cos^{-1}\left(\frac{\mu}{2}\right)$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

15. A photon of wavelength 500 nm falls on a metal surface of work function 1.3eV. An electron releases from metal moved in a perpendicular magnetic field. In a circular path of radius 30 cm. Then the magnitude of magnetic field will be ?

(1) 12.2 μT (2) 10.2 μT (3) 8.2 μT (4) 6.2 μT

Ans. (1)

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

$\frac{1240}{500} = 1.3 + KE_{max}$

$KE_{max} = 1.18$ eV

Now $R = \frac{mv}{qB} = \frac{\sqrt{2mKE}}{qB}$

$B = \frac{\sqrt{2mKE}}{qR}$

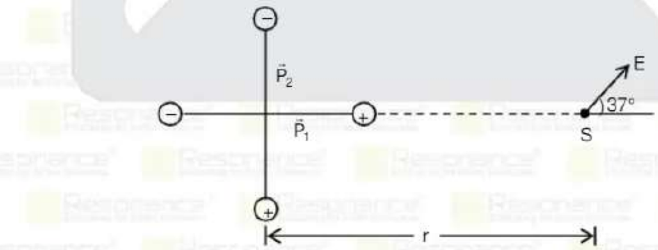
$B = \frac{\sqrt{2\times 9.1\times 10^{-31}\times 1.18\times 1.6\times 10^{-19}}}{1.6\times 10^{-19}\times 30\times 10^{-2}}$

$B = 0.122 \times 10^{-4}$

$B = 12.2 \times 10^{-6}$

i.e., $B = 12.2\ \mu T$

16. Two electric dipole $\vec{P}_1$ and $\vec{P}_2$ are kept as shown in figure. Net electric field at point S is E makes an angle



(1) $\frac{3}{2}$ (2) $\frac{1}{2}$ (3) $\frac{2}{3}$ (4) $\frac{3}{4}$

Ans. (3)

Resonance Eduventures Ltd.

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Sol.

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Electric field due to $\vec{P}_1$ at axis point S

$$E_{axis} = \frac{2KP_1}{r^3}$$

$$\Rightarrow \quad E\cos 37° = \frac{2KP_1}{r^3} \qquad ...(1)$$

Electric field due to $\vec{P}_2$ at perpendicular bisector at point S.

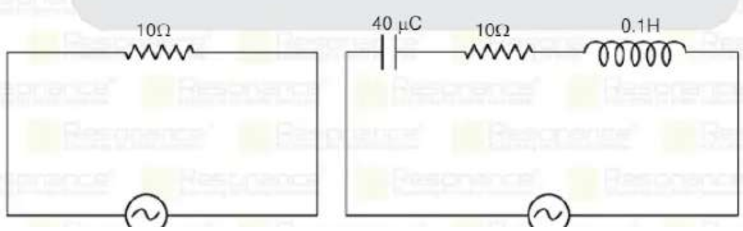
$$E_{\perp} = \frac{KP_2}{r^3}$$

$$\Rightarrow \quad E\sin 37° = \frac{KP_2}{r^3} \qquad ....(2)$$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

$$\Rightarrow \frac{2P_1}{P_2} = \frac{4}{3} \Rightarrow \frac{P_1}{P_2} = \frac{2}{3}$$

17. Power in both the given circuit are same then find angular frequency of AC source.



(1) 200 (2) 300 (3) 400 (4) 500

Sol. $P_1 = P_2$

$$\left(\frac{V^2}{R}\right)_1 = \left(\frac{V^2}{Z}\right)_2 \Rightarrow R = Z$$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

$$10 = \sqrt{\left(\omega L - \frac{1}{\omega C}\right)^2 + R^2}$$

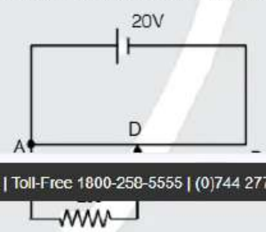
$$100 = \left[\omega(0.1) - \frac{1}{\omega(40\times10^{-6})}\right]^2 + 100$$

$$\omega^2(0.1) = \frac{1}{40\times10^{-6}}$$

$$\omega^2 = \frac{1}{4}\times10^6$$

$$\omega = 500$$

18. For the given circuit, find the potential drop across 2Ω resistance ?



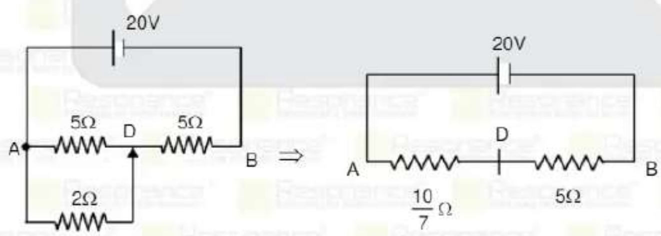
© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

The wire AB is of length 10 cm, and its resistance is 1Ω/cm. Point D is mid-point of wire AB.

(1) 2.44 V (2) 4.44 V (3) 3.44 V (4) 10.44V

Ans. (2)

Sol.



$$V_{2\Omega} = \frac{20}{\frac{10}{7}+5}\times\frac{10}{7}$$

$V_{2\Omega} = 4.44$ V

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Resonance Eduventures Ltd.
Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005
Ph. No.: +91-744-2777777, 2777700 | FAX No. : +91-022-39167222
To Know more : sms RESO at 56677 | Website : www.resonance.ac.in | E-mail : contact@resonance.ac.in | CIN : U80302RJ2007PLC024029
Toll Free : 1800 258 5555 | 7340010333 | facebook.com/ResonanceEdu | twitter.com/ResonanceEdu | www.youtube.com/resowatch | blog.resonance.ac.in

19. Mass of a planet is double the mass of earth. Both the planet have same mass density. A body has weight W on surface of earth, then weight of the same body on surface of planet ?

Ans. (2)

Sol. $2M_E = M_P$

$2\rho \times \frac{4}{3} R_E^3 = \rho \times \frac{4}{3} \pi R_P^3$ (same density)

$R_P = 2^{1/3} R_E$

$g_P = \frac{GM_P}{R_P^2}$ (acceleration due to gravity)

$g_P = \frac{G2M_E}{(2^{1/3}R_E)^2} = \frac{G2M_E}{2^{2/3}R_E^2}$

$g_P = 2^{1/3} g_e$

weight on planet = $2^{1/3}$ weight on earth

$W_P = 2^{1/3} W$

20. A force $\vec{F} = 40\hat{i} + 10\hat{j}$ is applied on a stationary object of mass 5kg. What will be the position of object after 10s, if initially object was at origin ?

Ans. (3)

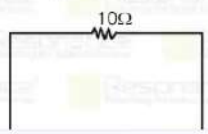
Sol. $\vec{a} = 8\hat{i} + 2\hat{j}$

$\vec{s} = \vec{u}t + \frac{1}{2}\vec{a}t^2$

$\vec{s} = \frac{1}{2}(8\hat{i} + 2\hat{j}) \times 100$

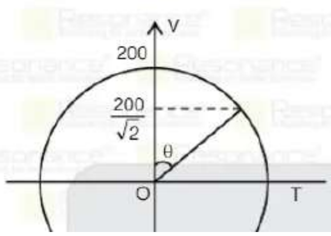
$\vec{s} = 400\hat{i} + 100\hat{j}$

21. An AC Source with V_{max} = 200 V and f =50 Hz connected across 10Ω resistance. Find the time in which source voltage changes from maximum to rms value.



(1) $\frac{1}{200}$ s (2) $\frac{1}{400}$ s (3) $\frac{1}{300}$ s (4) $\frac{1}{500}$ s

Ans. (2)



$\omega = 2\pi f$

$= 100\ \pi$ rad/s.

$V = V_0 \sin(\omega t + \frac{\pi}{2})$

$\sqrt{2}$

$\omega t = \frac{\pi}{4}$

thus $t = \frac{\pi/4}{100\pi} = \frac{1}{400}$ s

22. A Disc of mass 2 kg and radius 2m is rotating with angular velocity $\omega = 600$ rpm. If this disc stops under the action of a constant Torque in 10 sec then if Torque is $n\pi$ then 'n' is.

(1) 7 (2) 6 (3) 8 (4) 4

Ans. (3)

Sol. $\omega = \frac{600 \times 2\pi}{60} = 20\pi$ rad/s

$\omega_f = \omega_i + \alpha t$

$0 = 20\ \pi - \alpha(10)$

$\alpha = 2\pi$ rad/s^2

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

$= \frac{mR^2}{2} \times 2\pi = \frac{2 \times 4}{2} \times 2\pi = 8\ \pi$

$\eta = 8$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

23. For two vector $\vec{X}$ and $\vec{Y}$, $|\vec{X}| = |\vec{Y}|$ and $|\vec{X} - \vec{Y}| = n\,|\vec{X} + \vec{Y}|$. Then find angle between $\vec{X}$ and $\vec{Y}$?

(1) $\cos^{-1}\frac{1-n^2}{1+n^2}$ (2) $\cos^{-1}\frac{1+n^2}{1-n^2}$ (3) $\cos^{-1}\frac{2-n^2}{2+n^2}$ (4) $\cos^{-1}\frac{2+n^2}{2-n^2}$

Ans. (1)

Sol. $|\vec{X} - \vec{Y}| = n|\vec{X} + \vec{Y}|$

$|\vec{X}|^2 + |\vec{Y}|^2 - 2|\vec{X}||\vec{Y}|\cos\theta = n^2\left[|\vec{X}|^2 + |\vec{Y}|^2 + 2|\vec{X}||\vec{Y}|\cos\theta\right]$

As $|\vec{X}| = |\vec{Y}|$

$2|\vec{X}|^2 - 2|\vec{X}|^2\cos\theta = 2n^2|\vec{X}|^2 + 2n^2|\vec{X}|^2\cos\theta$

$1 - \cos\theta = n^2 + n^2\cos\theta$

$\cos\theta = \frac{1-n^2}{1+n^2}$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

$1+n^2$

24 Find energy required to break an Aluminium nucleus into its constituent nucleons.

($m_n = 1.00867$ u, $m_p = 1.00783$ u, $m_{Al} = 26.98154$ u)

(1) 225 MeV (2) 230 MeV (3) 235 MeV (4) 245 MeV

Ans. (1)

Sol. Binding Energy = ΔmC^2

$\Delta m = [13 \times 1.00783 + 14 \times 1.00867 - 26.98154]$

$= [13.10179 + 14.12138 - 26.98154] = 0.24163$

$\therefore$ B.E = $0.24163\ C^2 \times 931\ MeV/C^2$

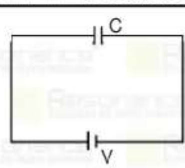
$= 224.95\ MeV \approx 225\ MeV.$

25. A Cell of Voltage 'V_0' is connected across a capacitor of capacitance 'C'. Now the space between the plates is filled with a material of dielectric constant K. Find the ratio of charge appear on the plates of capacitor before and after filling.

Ans. (1)

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Sol.



$Q_1 = CV$

$Q_2 = KCV$

$\frac{Q_1}{Q_2} = \frac{1}{K}$

26. Pure S_i at room temperature has equal electron (n_e) and hole (n_h) concentration of $1.5 \times 10^{16}\ m^{-3}$. Doping by indium increases n_h to $3 \times 10^{22}\ m^{-3}$. Calculate n_e in the doped S_i.

(1) $7.5 \times 10^9\ m^{-3}$ (2) $6.5 \times 10^9\ m^{-3}$ (3) $7.5 \times 10^8\ m^{-3}$ (4) $7.5 \times 10^7\ m^{-3}$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

$n_e n_h = n_i^2$

$\Rightarrow n_e = \frac{n_i^2}{n_h} = \frac{(1.5 \times 10^{16})^2}{3 \times 10^{22}} = 7.5 \times 10^9\ m^{-3}$

27. A particle starts from rest and moves with a variable acceleration $a = \alpha t + \beta t^2$, where α and β are positive constants. Find the distance covered by particle in t = 1sec to t = 2sec ?

(1) $\frac{11}{6}\alpha + \frac{15}{12}\beta$ (2) $\frac{7}{6}\alpha + \frac{17}{12}\beta$ (3) $\frac{7}{6}\alpha + \frac{15}{12}\beta$ (4) $\frac{1}{3}\alpha + \frac{15}{12}\beta$

Ans. (3)

Sol. $\int_0^v dv = \int_0^t a dt$

$v = \frac{\alpha t^2}{2} + \frac{\beta t^3}{3}$

Now

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

$\int_0^s ds = \int_1^2 v dt$

$s = \left[\frac{\alpha t^3}{6} + \frac{\beta t^4}{12}\right]_1^2 \Rightarrow s = \frac{7}{6}\alpha + \frac{15}{12}\beta$

28. A carrier frequency of 1 MHz and peak value of 10 v is amplitude modulated with a signal frequency of 10 KHz with peak value of 0.5 v. Find modulation index.

(1) 0.02 (2) 0.03 (3) 0.04 (4) 0.05

Ans. (4)

Sol. $A_{max.} = 10 + 0.5 = 10.5$

$A_{min} = 10 - 0.5 = 9.5$

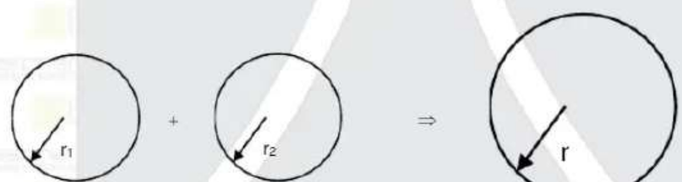
$m_a = \frac{A_{max.} - A_{min.}}{A_{max.} + A_{min.}} = \frac{10.5 - 9.5}{10.5 + 9.5} = 0.05$

29. Two soap bubbles of radius r_1 and r_2 in vacuum are combined isothermally to form a new bubble. Find the radius of this new bubble ?

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Ans. (1)

Sol.



By surface energy conservation

$\sigma A_1 + \sigma A_2 = \sigma A$

$\sigma[2 \times 4\pi r_1^2] + \sigma[2 \times 4\pi r_2^2] = \sigma[2 \times 4\pi r^2]$

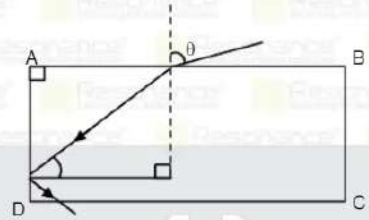
$r_1^2 + r_2^2 = r^2$

$r = \sqrt{r_1^2 + r_2^2}$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

30. A ray is incident on a slab of refractive index $\frac{5}{4}$ at an angle θ as shown in figure. Find maximum angle θ. So that TIR occur at surface AD.



Ans. (3)

Sol. $1 \times \sin\theta = \frac{5}{4}\sin(90 - C)$

$\sin\theta = \frac{5}{4}\cos C$

but $\sin C = \frac{1}{\mu} = \frac{4}{5}$

$\cos C = \frac{3}{5}$

$\sin\theta = \frac{5}{4} \times \frac{3}{5} = \frac{3}{4}$

For T.I.R. $\sin\theta < \frac{3}{4}$

$\theta = \sin^{-1}\frac{3}{4}$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

JEE (Main) 2021

COMPUTER BASED TEST (CBT)

Date: 25 July, 2021 (SHIFT-2) | TIME : (3.00 p.m. to 6.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: CHEMISTRY

Resonance Eduventures Ltd.
Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005
Ph. No.: +91-744-2777777, 2777700 | FAX No. : +91-022-39167222
To Know more : sms RESO at 56677 | Website : www.resonance.ac.in | E-mail : contact@resonance.ac.in | CIN : U80302RJ2007PLC024029
Toll Free : 1800 258 5555 | 7340010333 | facebook.com/ResonanceEdu | twitter.com/ResonanceEdu | www.youtube.com/resowatch | blog.resonance.ac.in

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

1. 3 gm of 'X' dissolve in 100 gm of CCl_4 which increases the boiling point by 0.6. Find molar mass of 'X'.

Given K_b of CCl_4 = 5 K kg/mol.

Ans. 250

Sol. $\Delta T_b = K_b\, m$

$$= 5 \times \left(\frac{Wt. \times 1000}{M.M \times \text{Mass of solvent (g)}}\right)$$

$$= 5 \times \frac{3 \times 1000}{M.M \times 100}$$

$$0.6 = \frac{150}{M.M}$$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

2. In the following ions, The spin only magnetic moment of Ti^{3+} ; Sc^{3+} ; V^{2+} respectively are

(1) 1.73, 0, 3.87 (2) 1.73, 3.87, 0 (3) 3.87, 0, 1.73 (4) 0, 1.73, 3.87

Ans. (1)

Sol. Ti^{3+} {Unpaired electron = 1}

Sc^{3+} {Unpaired electron = 0}

V^{+2} {Unpaired electron = 3}

$\mu = \sqrt{n(n+2)}$ B.M.

3. Heat given to a system is 150 joules and work done by the system is 200 joules. The magnitude of the change in the internal energy is :

Ans. (50)

$\Delta E = q + w$ (First law of thermodynamics

$\Delta E = 150 + (-200)$

$\Delta E = -50$ Joule

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

4. The covalent radii of F^- = 1.33 Å, O^{2-} = 1.40 Å and for N = 0.74 Å. Then which of the following in correct:

(1) Ionic radius of N^{3-} is in between F^- and O^{2-} but greater than 'N'.

(2) Ionic radius of N^{3-} is greater than both F^- and O^{2-} and greater than 'N'.

(3) Ionic radius of N^{3-} is less than both F^- and O^{2-} and less than 'N'.

(4) Ionic radius of N^{3-} is less than both F^- and O^{2-} but less than 'N'.

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Sol. F^- = 1.33 Å N = 0.74 Å

O^{2-} = 1.40 Å N^{3-} = 1.46 Å

Ionic radius of N^{3-} is greater than F^- and O^{2-}

size of Anion ∝ Magnitude of –ve change

5. For the following ions correct order of their Bond order is :

O_2^-, O_2, O_2^{2-}, O_2^+

(1) $O_2^- > O_2^- > O_2^+ > O_2^{2-}$ (2) $O_2^+ > O_2 > O_2^- > O_2^{2-}$

(3) $O_2^+ > O_2 > O_2^- > O_2^-$ (4) $O_2^+ > O_2^{2-} > O_2 > O_2^-$

Ans. (2)

Sol. According to Molecular orbital theory

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

$O_2^+ = 2.5$

$O_2^- = 1.5$

$O_2^{2-} = 1.0$

6.

Colloid	Dispersion Medium
a) Pumice Stone	(i) Liquid in Liquid
b) Cloud	(ii) Gas in Solid
c) Cheese	(iii) Liquid in Gas
d) Hair Cream	(iv) Liquid in solid

The Correct option is

(1) a-(iii) b-(ii) c-(i) d-(iv) (2) a-(i) b-(iv) c-(ii) d-(iii)

Ans. (3)

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Sol.

Dispersed phase	Dispersion medium	Type of colloid	Examples
Solid	Solid	Solid sol	Some coloured glasses and gem stones
Solid	Liquid	Sol	Paints, cell fluids
Solid	Gas	Aerosol	Smoke, dust
Liquid	Solid	Gel	Cheese, butter, jellies
Liquid	Liquid	Emulsion	Milk, hair cream
Liquid	Gas	Aerosol	Fog, mist, cloud, insecticide sprays
Gas	Solid	Solid sol	Pumice stone, foam rubber
Gas	Liquid	Foam	Froth, whipped cream, soap lather

7. In Ho^{3+} [Atomic No. = 67), number of 4f electron are :

Ans. 10

Sol. Holmium (Z = 67) : $4f^{11}$, $6s^2$

Ho^{+3} : $4f^{10}$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Column - I	Column - II
a) Li	(i) I^- is least soluble
b) Na	(ii) Bicarbonate is used in fire extinguisher
c) K	(iii) Carbonate easily decomposed on heating
d) Cs	(iv) Has vital role in biological system

The Correct option is :

(1) a-(iv) b-(iii) c-(ii) d-(i) (2) a-(iii) b-(ii) c-(iv) d-(i)

(3) a-(i) b-(iv) c-(ii) d-(iii) (4) a-(iv) b-(ii) c-(iii) d- (i)

Ans. (2)

Sol. (i) $Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2$

(ii) $NaHCO_3$ is used in dry fire extinguishers.

(iii) Potassium has vital role in biological systems

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

9. The concentration of H_3O^+ ions in 0.005 M solution of $Ba(OH)_2$ at 298 K is [x] × 10^{-12}. Assume that $Ba(OH)_2$ is completely ionized under given conditions.

Ans. 1

Sol.
$$\begin{array}{cccc} Ba(OH)_2 & \rightleftharpoons & Ba^{+2} & + \; 2OH^- \\ 0.005\ M & & — & — \\ — & & 0.005\ M & 0.010\ M \end{array}$$

Resonance Eduventures Ltd.

Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005

Ph. No.: +91-744-2777777, 2777700 | FAX No. : +91-022-39167222

To Know more : sms RESO at 56677 | Website : www.resonance.ac.in | E-mail : contact@resonance.ac.in | CIN : U80302RJ2007PLC024029

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

$[OH^-] = 0.01 = 10^{-2}$ M

Now $[H^+][OH^-] = K_w$

$[H_3O^+] = \dfrac{K_w}{[OH^-]}$

10. Which form interstitial hydride easily ?

(1) Fe (2) Cr (3) Ni (4) Co

Ans. (2)

Sol. These are formed by many d-block and f-block elements. However, the metals of group 7, 8 and 9 do not form hydride. Even from group 6, only chromium forms CrH.

11. Match List-I with List-II

Column-I	**Column-II**
(a) Froth Floatation	(i) Sulphide ore
(b) Bessemer convertor	(ii) Pig iron
(c) Blast furnance	(iii) Ag

(3) a-(iv) b-(ii) c-(iii) d-(i) (4) a-(iii) b-(iv) c-(ii) d-(i)

Ans. (2)

12. In which of the following reaction oxidation state changes by 5.

(1) $Cr_2O_7^{2-} \rightarrow Cr^{+3}$ (2) $MnO_4^- \rightarrow Mn^{2+}$

(3) $C_2O_4^{2} \rightarrow CO_2$ (4) $CrO_4^{2-} \rightarrow Cr^{+3}$

Ans. (2)

Sol. $\overset{+7}{MnO_4^-} \xrightarrow{\quad} Mn^{2+}$

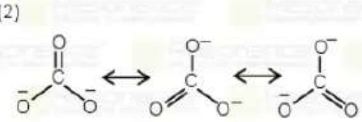
+5

13. In which of the following compounds one π bond is present and maximum canonical structures possible.

(1) SO_3 (2) CO_3^{2-} (3) O_2 (4) SO_2

Ans. (2)

Sol.



3 canonical structures

14. An e⁻ moving with a velocity of 2×10^6 m/s. If the speed can be measured with an accuracy of 0.02% calculate the uncertainty in its position is 1.45×10^{-x}. The value of x :

Ans. (7)

$\Delta x . m\Delta V = \frac{h}{4\pi}$

$\Delta v = 2 \times 10^6 \times \frac{0.02}{100}$

$\Delta v \rightarrow 400$ m/s

$\Delta x = \frac{h}{4\pi \times m.\Delta V} = \frac{6.63 \times 10^{-34}}{4 \times 3.14 \times 9.1 \times 10^{-31} \times 400\,m/s} = 1.45 \times 10^{-7}$s

15. $A \longrightarrow B$

In this reaction, concentration of B changes by 0.2 in 30 minutes. The average rate of the reaction is x × 10^{-1} moles per litre hour. The value of x is :

Ans. 4

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

⇒ 0.4 mole/L hr.

16. Which among the following compounds is most stable :

(1) $[Cr(en)_2(NH_3)_2]Cl_3$ (2) $[Cr(en)_3]Cl_3$ (3) $[Cr(en)(NH_3)_4]Cl_3$ (4) $[Cr(NH_3)_6]Cl_3$

Ans. (2)

Sol. Chelation due to bidentateligand. Greater the chelation greater is the stability.

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

17. In Kjeldahl's method, 0.8g of organic compound is used. The percentage of Nitrogen came out to be 42%. The _____ ml of 1M H_2SO_4 used to neutralize ammonia.

(1) 17 (2) 20 (3) 30 (4) 12

Ans. (4)

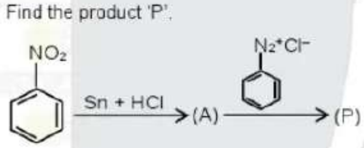
Sol. $\% N = \frac{1.4\,N.V}{}$

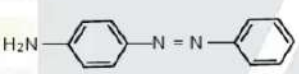
© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

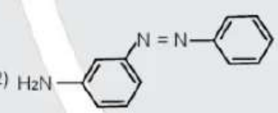
$42 = \frac{1.4 \times (1 \times 2) \times V}{0.8}$

V = 12 ml

18. Find the product 'P'.



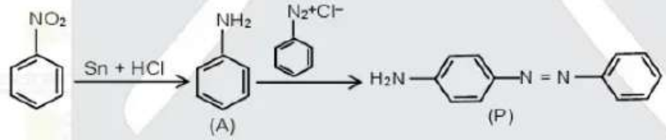
(1) 

(2) 

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

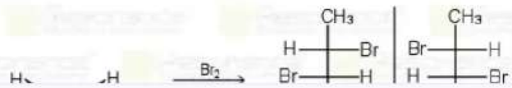
Ans. (1)

Sol.



19.  $\xrightarrow[CCl_4]{Br_2}$ Total no. of stereo isomeric products :

Ans. (2)



(Racemic mixture)

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

20. Biodegradable polyamide is formed by-

(1) Glycine + isoprene (2) Glycine + Aminocaproic acid

(3) Alanine + chloroprene (4) Acrylonitrile + Aminocaproic acid

Ans. (2)

Sol. Nylon 2-Nylon 6 (Polyamide copolymer) is biodegradable polymer.

Its monomer units are : Glycine + Aminocaproic acid

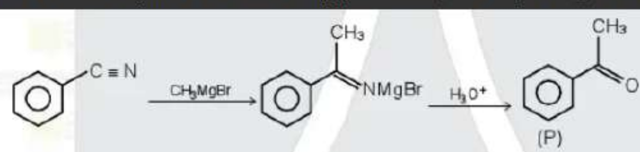
$[\underset{\text{Glycine}}{H_2N-CH_2-COOH}+\underset{\text{Aminocaproic acid}}{NH_2(CH_2)_5-COOH}]$

21. Benzenenitrile with grignard reagent form product (P), which of the following chemical test given by product (P)

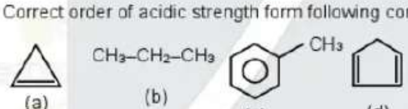
(1) Schiff's reagent (2) Iodoform (3) Ninhydrin (4) Tollen's test

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Sol.



22. Correct order of acidic strength form following compounds :



(a) (b) (c) (d)

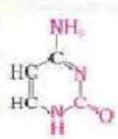
(1) a > b > c > d (2) d > c > b > a (3) b > c > d > a (4) c > b > a > d

Ans. (2)

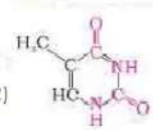
Sol. Acidic strength ∝ stability of conjugate base

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

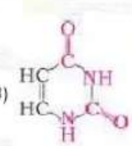
23. Structure of cytosine is :

(1) 

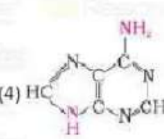
Cytosine (C)

(2) 

Thymine (T)

(3) 

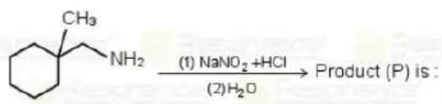
Uracil (U)

(4) 

Adenine (A)

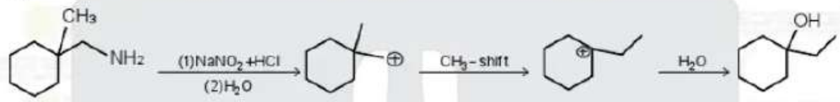
Ans. (1)

Sol. NCERT

24. 

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Ans. (3)

Sol. 

25. **S_1 :** CFCs are dissociated with to Cl radical by radiation of visible region.

S_2 : O_3 reacts with nitric oxide to form N_2 & O_2

(1) False, True (2) False, False (3) True, False (4) True, True

Ans. (2)

Sol. CFCs + UV $\longrightarrow Cl^{\bullet}$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

26. Increasing order of density :

(I) Benzene (II) 1,3-Dichlorobenzene

(III) Chloro benzene (IV) 1-Bromo-3-chlorobenzene

(1) IV > II > III > I (2) IV > III > II > I (3) III > II > IV > I (4) I > II > III > IV

Ans. (1)

Sol. Higher the molecular weight higher will be density.

27. Maleic anhydride can be prepared by.

(1) Treating cis but-2-ene-1,4-dioic acid with alcohol.

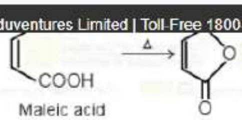
(2) Heating cis but-2-ene-1,4-dioic acid

(3) Treating trans but-2-ene-1,4-dioic acid with alcohol and acid

(4) Heating trans but-2-ene-idiric acid

Ans. (2)

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Sol. 

Resonance®
Educating for better tomorrow

JEE (Main) 2021

COMPUTER BASED TEST (CBT)

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Date: 25 July, 2021 (SHIFT-2) | TIME : (3.00 p.m. to 6.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: MATHEMATICS

Resonance Eduventures Ltd.

Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005

Ph. No.: +91-744-2777777, 2777700 | FAX No. : +91-022-39167222

To Know more : sms RESO at 56677 | Website : www.resonance.ac.in | E-mail : contact@resonance.ac.in | CIN : U80302RJ2007PLC024029

Toll Free : 1800 258 5555 | 7340010333 | facebook.com/ResonanceEdu | twitter.com/ResonanceEdu | www.youtube.com/resowatch | blog.resonance.ac.in

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

1. If matrix $P = \begin{bmatrix} 1 & 0 \\ \frac{1}{2} & 1 \end{bmatrix}$, then the matrix P^{50} is equal to

(1) $\begin{bmatrix} 1 & 0 \\ 50 & 1 \end{bmatrix}$ (2) $\begin{bmatrix} 1 & 0 \\ 25 & 1 \end{bmatrix}$ (3) $\begin{bmatrix} 1 & 0 \\ 75 & 1 \end{bmatrix}$ (4) $\begin{bmatrix} 1 & 1 \\ 25 & 0 \end{bmatrix}$

Ans. (2)

Sol. $P^2 = \begin{bmatrix} 1 & 0 \\ \frac{1}{2} & 1 \end{bmatrix}\begin{bmatrix} 1 & 0 \\ \frac{1}{2} & 1 \end{bmatrix}$

$P^3 = \begin{bmatrix} 1 & 0 \\ \frac{2}{2} & 1 \end{bmatrix}\begin{bmatrix} 1 & 0 \\ \frac{1}{2} & 1 \end{bmatrix}$

$P^3 = \begin{bmatrix} 1 & 0 \\ \frac{3}{2} & 1 \end{bmatrix}$

Similarly

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

$P^{50} = \begin{bmatrix} 1 & 0 \\ 25 & 1 \end{bmatrix}$

2. If the first sample A of 100 items has the mean 15 and standard deviation 3 and second sample B has 150 items. If the combined mean and standard deviation of items of both the sample is 15.6 and $\sqrt{13.44}$. Then the standard deviation of items of sample B is :

Ans. (4)

Sol. Combined mean = 15.6

$\therefore\ 15.6 = \frac{100 \times 15 + 150 \times \bar{x}_B}{250}$

$\Rightarrow \bar{x}_B = 16$ (mean of sample B)

Combined standard deviation = $\sqrt{13.44}$

$\Rightarrow$ combined variance (σ^2) = 13.44

$13.44 = \frac{\sum x_i^2}{250} - 243.36$

$\Rightarrow \sum x_i^2 = 64200$ ....(1)

for sample A

$9 = \frac{\sum x_A^2}{100} - 225$

$\Rightarrow \sum x_A^2 = 23400$

$\Rightarrow \sum x_B^2 = 64200 - 23400 = 40800$

standard deviation of sample B will be

$\sqrt{\frac{\sum x_B^2}{n_B} - (\bar{x}_B)^2} = \sqrt{\frac{40800}{150} - 256} = 4$ Ans.

3. The value of $x \in \left[\frac{\pi}{4}, \frac{\pi}{4}\right]$ for which

$$\begin{vmatrix} \sin x & \cos x & \cos x \\ \cos x & \sin x & \cos x \\ \cos x & \cos x & \sin x \end{vmatrix} = 0$$

(1) $-\frac{\pi}{4}$ (2) $-\frac{\pi}{8}$ (3) $\frac{\pi}{4}$ (4) $\frac{\pi}{8}$

Ans. (3)

Sol. $$\begin{vmatrix} \sin x & \cos x & \cos x \\ \cos x & \sin x & \cos x \\ \cos x & \cos x & \sin x \end{vmatrix} = 0$$

$R_1 \rightarrow R_1 + R_2 + R_3$

$\cos x \quad \cos x \quad \sin x$

$$(\sin x + 2\cos x)\begin{vmatrix} 1 & 1 & 1 \\ \cos x & \sin x & \cos x \\ \cos x & \cos x & \sin x \end{vmatrix} = 0$$

$C_2 \rightarrow C_2 - C_1$, $C_3 \rightarrow C_3 - C_1$

$$(\sin x + 2\cos x)\begin{vmatrix} 1 & 0 & 0 \\ \cos x & \sin x - \cos x & 0 \\ \cos x & 0 & \sin x - \cos x \end{vmatrix} = 0$$

$(\sin x + 2\cos x)(\sin x - \cos x)^2 = 0$

$\sin x = \cos x$ or $\sin x = -2\cos x$

$\tan x = 1$ or $\tan x = -2$

$\because x \in \left[-\frac{\pi}{4}, \frac{\pi}{4}\right]$

$x = \frac{\pi}{}$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

4. If $\vec{a}$ and $\vec{b}$ are two vectors such that $|\vec{a}\times\vec{b}| = 8$, $|\vec{a}| = 2$, $|\vec{b}| = 5$, then the value of $|\vec{a}.\vec{b}|$ is :

(1) 6 (2) 3 (3) 12 (4) 9

Ans. (1)

Sol. $|\vec{a}\times\vec{b}| = |\vec{a}||\vec{b}|\sin\theta$

$8 = 2 \times 5 \times \sin\theta$

$\sin\theta = \frac{4}{5} \Rightarrow \cos\theta = \pm\frac{3}{5} \Rightarrow |\cos\theta| = \frac{3}{5}$

$|\vec{a}.\vec{b}| = |\vec{a}||\vec{b}||\cos\theta| = 2\times5\times\frac{3}{5} = 6$

5. If function $f(x) : A \to B$, and $g(x) : B \to C$ are defined such that $(g(f(x)))^{-1}$ exist then $f(x)$ and $g(x)$ are :

(1) one-one and onto (2) many-one and onto
(3) one-one and into (4) many-one and into

Ans. (1)

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

6. If $a + b + c = 1$, $ab + bc + ca = 2$ and $abc = 3$, then the value of $a^4 + b^4 + c^4$ is:

Ans. 13

Sol. $(a + b + c)^2 = 1$

$\Rightarrow a^2 + b^2 + c^2 + 2(ab + bc + ca) = 1$

$\Rightarrow a^2 + b^2 + c^2 = -3$ ....(i)

$\Rightarrow ab + bc + ca = 2$ ....(ii)

Squaring of equation (ii),

$\Rightarrow a^2b^2 + b^2c^2 + c^2a^2 + 2(ab^2c + bc^2a + ca^2b) = 4$

$\Rightarrow a^2b^2 + b^2c^2 + c^2a^2 + 2abc(a + b + c) = 4$

$\Rightarrow a^2b^2 + b^2c^2 + c^2a^2 + 6 = 4$

$\Rightarrow a^2b^2 + b^2c^2 + c^2a^2 = -2$ ....(iii)

Squaring of equation (i),

$\Rightarrow a^4 + b^4 + c^4 + 2(a^2b^2 + b^2c^2 + c^2a^2) = 9$

$\Rightarrow a^4 + b^4 + c^4 - 4 = 9$

$\Rightarrow a^4 + b^4 + c^4 = 13$

7. Which of the following value is just greater than $\left(1+\frac{1}{10^{100}}\right)^{10^{100}}$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Ans. (2)

Sol. Let $10^{100} = n$

So, $\left(1+\frac{1}{n}\right)^n = {}^nC_0 + {}^nC_1\left(\frac{1}{n}\right) + {}^nC_2\left(\frac{1}{n}\right)^2 + {}^nC_3\left(\frac{1}{n}\right)^3 + ...$

$= 1 + 1 + \frac{n(n-1)}{2n^2} + \frac{n(n-1)(n-2)}{6n^3} + ...$

$\Rightarrow \left(1+\frac{1}{n}\right)^n > 2$

Also $\lim\limits_{n\to\infty}\left(1+\frac{1}{n}\right)^n = e < 3.$

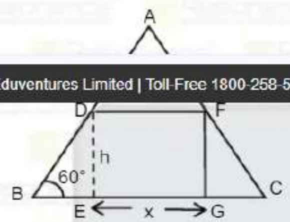
Resonance Eduventures Ltd.
Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005
Ph. No.: +91-744-2777777, 2777700 | **FAX No. :** +91-022-39167222
To Know more : sms RESO at 56677 | **Website :** www.resonance.ac.in | **E-mail :** contact@resonance.ac.in | **CIN :** U80302RJ2007PLC024029

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

8. If a rectangle is inscribed in an equilateral triangle of side $2\sqrt{2}$, then the square of maximum area of rectangle is :

Ans. (3)

Sol.



Area of rectangle = x. h ......(i)

from ΔBDE

h = BE tan 60

$h = \frac{(2\sqrt{2}-x)}{2}\sqrt{3}$ ......(ii)

So area, $A = \frac{\sqrt{3}}{2}(2\sqrt{2}x - x^2)$

For maxima $\frac{dA}{dx} = \frac{\sqrt{3}}{2}(2\sqrt{2}-2x) = 0$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

From (ii) $h = \sqrt{\frac{3}{2}}$

Area = x. h = $\sqrt{3}$

$(\text{Area})^2 = 3$

9. If the coefficients of x^7 and x^8 in the expansion of $\left(2+\frac{x}{3}\right)^n$ are equal then the value of n is :

(1) 53 (2) 54 (3) 55 (4) 56

Ans. (3)

Sol. $\left(2+\frac{x}{3}\right)^n = \sum_{r=0}^{n} {}^nC_r\, 2^{n-r}\left(\frac{x}{3}\right)^r$

Coefficient of $x^7 = {}^nC_7\, 2^{n-7}\left(\frac{1}{3}\right)^7$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Coefficient of $x^8 = {}^nC_8\, 2^{n-8}.\left(\frac{1}{3}\right)^8$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

$\therefore {}^nC_7\, \frac{2^{n-7}}{3^7} = {}^nC_8\, \frac{2^{n-8}}{3^8}$

$\Rightarrow {}^nC_7 \,.\, 6 = {}^nC_8$

$\Rightarrow \frac{6\,n!}{7!.(n-7)!} = \frac{n!}{8!.(n-8)!}$

$\Rightarrow 48 = n - 7 \Rightarrow n = 55$

10. If $f(x) = \begin{cases} \frac{P(x)}{x-2} & ; x \neq 2 \end{cases}$ and P(x) is a polynomial such that P"(x) is constant and P(3) = 9. If f(x) is continuous

$\left(7 \quad ; x = 2 \right.$

at x = 2 then find the value of P(5)

Ans. (39)

$\lim_{x \to 2} f(x) = \lim_{x \to 2} \quad (x-2)$

$\Rightarrow K(2-\beta) = 7$ ....(1)

and $P(3) = K(3-2)(3-\beta) = 9$

$K(3-\beta) = 9$ ......(2)

Divide equation (1) by (2)

$\frac{2-\beta}{3-\beta} = \frac{7}{9} \Rightarrow \beta = \frac{-3}{2}$

So, K = 2

Then $P(x) = 2(x-2)\left(x+\frac{3}{2}\right)$

$P(5) = 2 \times (5-2) \times \left(5+\frac{3}{2}\right) = 39$

11. The number of real solutions of the equation $x^2 - |x| - 12 = 0$ is :

(1) 0 (2) 1 (3) 3 (4) 2

Ans. (4)

Sol. $|x|^2 - |x| - 12 = 0$

$|x| = 4, -3$ (not possible)

$\Rightarrow |x| = 4 \Rightarrow x = \pm 4$

$\therefore$ Number of real solutions = 2

12. A coin is tossed n times. If the probability of getting at least one head is greater than 0.9, then the minimum value of n is :

(1) 3 (2) 5 (3) 4 (4) 2

Ans. (3)

Sol. $1 - \left(\frac{1}{2}\right)^n > 0.9$

$\Rightarrow 0.1 > \left(\frac{1}{2}\right)^n \Rightarrow n = 4$

13. Negation of the statement :

"We will play football only if ground is not wet and there is no sunlight" is:

(1) We will play football if ground is wet and there is no sunlight.

(2) We will play football if ground is wet and there is sunlight.

(3) There is no sunlight and ground is not wet and we will not play football.

(4) There is sunlight or ground is wet and we will play football.

Ans. (4)

Sol. p: We will play football.

q: Ground is not wet.

r: There is no sunlight.

$\therefore$ Given statement is $p \rightarrow (q \wedge r)$

$\therefore$ Negation is $p \wedge \sim(q \wedge r)$

$p \wedge (\sim q \vee \sim r)$

14. If $^nC_0 + 3\,^nC_1 + 5\,^nC_2 + 7\,^nC_3 + \ldots\ldots\ldots$ till (n + 1) terms, is equal to $2^{\ldots}$ .101, then the value of $2\left[\frac{\ldots}{2}\right]$

(where [.] represents G.I.F.)

(1) 98 (2) 97 (3) 96 (4) 100

Ans. (4)

Sol. $^nC_0 + 3\,^nC_1 + 5\,^nC_2 + 7\,^nC_3 + \ldots\ldots$ (n + 1) terms = $\sum_{r=0}^{n}(2r+1)\cdot{}^nC_r$

$= 2\sum_{r=0}^{n} r\,^nC_r + \sum_{r=0}^{n} {}^nC_r$

$= 2n \cdot 2^{n-1} + 2^n = (n + 1).2^n$

15. Evaluate $\int^{1}\log\left(x+\sqrt{x^2+1}\right)dx$

Ans. (1)

Sol. $I = \int_{-1}^{1}\log\left(x+\sqrt{x^2+1}\right)dx$

$f(x) = \log\left(\sqrt{x^2+1}+x\right)$

$f(-x) = \log\left(\sqrt{x^2+1}-x\right)$

$= -f(x)$

So f(x) is a odd function.

$\Rightarrow I = 0$

16. If $^nP_r = {}^nP_{r+1}$ and $^nC_r = {}^nC_{r-1}$, then the value of n is :

Sol. $^nC_r = {}^nC_{r-1} \Rightarrow \frac{n-r+1}{r} = 1 \Rightarrow n + 1 = 2r$ …… (1)

and $^nP_r = {}^nP_{r+1} \Rightarrow \frac{n!}{(n-r)!} = \frac{n!}{(n-r-1)!}$

$\Rightarrow n - r = 1$ …… (2)

Solving (1) & (2) $n + 1 = 2(n - 1) \Rightarrow n = 3$

17. Value of $\sum_{n=8}^{100}\left[(-1)^n\frac{n}{2}\right]$ is : (Where [.] represent greatest integer function)

Ans. (4)

Sol. $\sum_{n=8}^{100}\left[(-1)^n\frac{n}{2}\right]$

$\Rightarrow -1 \times 46 + 50 = 4$

18. Evaluate $\cot\left(\frac{\pi}{24}\right)$

(1) $\sqrt{6}-\sqrt{3}+\sqrt{2}-2$ (2) $\sqrt{6}+\sqrt{3}-\sqrt{2}+2$ (3) $\sqrt{6}+\sqrt{3}+\sqrt{2}-2$ (4) $\sqrt{6}+\sqrt{3}+\sqrt{2}+2$

Ans. (4)

Sol. $\cot\theta = \dfrac{\cos\theta}{\sin\theta} = \dfrac{2\cos^2\theta}{2\sin\theta\cos\theta}$

$= \dfrac{1+\cos2\theta}{\sin2\theta}$

$\sin\frac{\pi}{12}$

$\Rightarrow \dfrac{1+\frac{\sqrt{3}+1}{2\sqrt{2}}}{\frac{\sqrt{3}-1}{2\sqrt{2}}} = \dfrac{2\sqrt{2}+\sqrt{3}+1}{\sqrt{3}-1}$

$\Rightarrow \dfrac{(2\sqrt{2}+\sqrt{3}+1)(\sqrt{3}+1)}{2}$

$\Rightarrow \dfrac{2\sqrt{6}+2\sqrt{2}+3+\sqrt{3}+\sqrt{3}+1}{2} = \sqrt{6}+\sqrt{2}+\sqrt{3}+2$

19. If two lines $L_1 = \dfrac{x-k}{1} = \dfrac{y-2}{2} = \dfrac{z-3}{3}$ and $L_2 = \dfrac{x+1}{3} = \dfrac{y+2}{2} = \dfrac{z+3}{1}$ are coplanar. Then the value of k is:

(1) -1 (2) 1 (3) 2 (4) -2

Ans. (2)

$\begin{vmatrix} k+1 & 2+2 & 3+3 \end{vmatrix}$

$\Rightarrow (k+1)(-4) - 4(-8) + 6(2-6) = 0$

$\Rightarrow (k+1)(-4) = -8$

$k = 1.$

20. If $y = f(x)$ is the solution of differential equation $xdy = (y + x^3\cos x)dx$ and $f(\pi) = 0$ then $f\left(\dfrac{\pi}{2}\right)$ is:

(1) $\dfrac{\pi^2}{4}+\dfrac{\pi}{6}$ (2) $\dfrac{\pi^2}{4}+\dfrac{\pi}{2}$ (3) $\dfrac{\pi^2}{6}+\dfrac{\pi}{4}$ (4) $\dfrac{\pi^2}{6}+\dfrac{\pi}{6}$

Ans. (2)

Sol. $\dfrac{xdy-ydx}{x^2} = x\cos x\,dx$

$\Rightarrow \int d\left(\dfrac{y}{x}\right) = \int x\cos x\,dx$

$\Rightarrow \dfrac{y}{x} = x\sin x + \cos x + c$

$\Rightarrow y = x^2\sin x + x\cos x + x$

$\Rightarrow f\left(\dfrac{\pi}{2}\right) = \dfrac{\pi^2}{4} + 0 + \dfrac{\pi}{2} = \dfrac{\pi^2}{4} + \dfrac{\pi}{2}$

21. If three vector $\hat{i}+\hat{k}, b\hat{i}+b\hat{j}+c\hat{k}$ and $a\hat{i}+a\hat{j}+b\hat{k}$ are coplanar then

(1) $a^2 = bc$ (2) $b^2 = ac$ (3) $c^2 = ab$ (4) $ab = c$

Ans. (2)

Sol. $\begin{vmatrix} 1 & 0 & 1 \\ b & b & c \\ a & a & b \end{vmatrix} = 0$

$1(b^2 - ac) + 1\,(ab - ab) = 0 \Rightarrow b^2 = ac$

22. If $\vec{x}$ & $\vec{y}$ are two vectors such that $|\vec{x}| = |\vec{y}|$ & $|\vec{x}-\vec{y}| = n|\vec{x}+\vec{y}|$, then the angle between $\vec{x}$ & $\vec{y}$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Ans. (4)

Sol. $|\vec{x}-\vec{y}| = n|\vec{x}+\vec{y}|$

$x^2 + y^2 - 2xy\cos\theta = n^2(x^2 + y^2 + 2xy\cos\theta)$

$x^2(1+1-2\cos\theta) = n^2x^2(1+1+2\cos\theta)$

$2(1-n^2) = 2\cos\theta\,(n^2+1)$

$\cos\theta = \dfrac{1-n^2}{n^2+1}$

$\theta = \cos^{-1}\left(\dfrac{1-n^2}{n^2+1}\right)$

23. If combined equation of line $y = p(x)$ and $y = q(x)$ can be written as $(y - p(x))\,(y - q(x)) = 0$ then angle bisector of $x^2 - 4xy - 5y^2 = 0$ is :

(1) $x^2 + 3xy + y^2 = 0$ (2) $x^2 + 3xy - y^2 = 0$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Ans. (2)

Sol. Equation of angle bisector of homogeneous equation of pair of straight line $ax^2 + 2hxy + by^2$ is

$\dfrac{x^2-y^2}{a-b} = \dfrac{xy}{h}$

for $x^2 - 4xy - 5y^2 = 0$

$a = 1,\ h = -2,\ b = -5$

so, equation of angle bisector is

$\dfrac{x^2-y^2}{1-(-5)} = \dfrac{xy}{-2}$

$x^2 - y^2 + 3xy = 0$

so, combined equation of angle bisector is $x^2 + 3xy - y^2 = 0$

Resonance Eduventures Ltd.

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

Resonance | JEE MAIN-2021 | DATE : 25-07-2021 (SHIFT-2) | PAPER-1 | MEMORY BASED | MATHEMATICS

24. Equation of a circle is $Re(z^2) + 2(Im(z))^2 + 2Re(z) = 0$ where $z = x + iy$ and a line passes through the vertex of parabola $x^2 - 6x + y + 13 = 0$ and the centre of circle, then y intercept of the line is :

(1) –2 (2) –1 (3) 2 (4) 1

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

So, $z^2 = x^2 - y^2 + i2xy$

Now $x^2 - y^2 + 2y^2 + 2x = 0$

$x^2 + y^2 + 2x = 0 \Rightarrow$ centre $= (-1, 0)$ and $x^2 - 6x + y + 13 = 0$

$(x-3)^2 = -(y+4)$

Vertex (3, –4)

$\therefore$ Equation of line is $(y-0) = \frac{-4-0}{3+1}(x+1) \Rightarrow 4y = -4(x+1)$

$x + y + 1 = 0 \Rightarrow \frac{x}{-1} + \frac{y}{-1} = 1$

25. If $f(x) = \begin{cases} 5x+1 & ; \ x < 2 \\ \int_0^x (5+|1-t|)dt & ; \ x \ge 2 \end{cases}$

(1) f(x) is differentiable $\forall x \in R$

(3) f(x) is continuous at x = 2 but not differentiable at x = 1.

(4) f(x) is neither continuous nor differentiable at x = 2.

Ans. (2)

Sol. $\text{LHL} = \lim_{x \to 2^-} (5x+1) = 11$

$\text{RHL} = \lim_{x \to 2^+} \int_0^x (5+|1-t|)dt = \int_0^1 (5+(1-t))dt + \int_1^2 (5-(1-t))dt = 11$

f(2) = 11

So, f(x) is continuous at x = 2

LHD at x = 2 is $\frac{d}{dx}(5x+1)\Big|_{x=2} = 5$

RHD at x = 2 is $\frac{d}{dx}\int_0^x (5+|1-t|)dt\Big|_{x=2} = 6$

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029

© Resonance Eduventures Limited | Toll-Free 1800-258-5555 | (0)744 2777777, 2777700 | contact@resonance.ac.in | CIN - U80302RJ2007PLC024029