IUT Admission Test 2010-2011

Physics

01. The maximum value of the resultant of two vectors is 7 units and minimum value of those is 1 unit. When two vectors are acting on a point at right angle, the resultant will be-
(a) 2 units (b) 3 units (c) 4 units (d) 5 units

Solution: (d); $P + Q = 7 \Rightarrow P - Q = 1 \therefore (P, Q) = (4,3) \therefore R = \sqrt{P^2 + Q^2} = 5$

02. A lift is going down with an acceleration of 4.8 m/s^2. A ball is released 2m height from the floor of the lift. How much time it will take to hit the floor by the ball?
(a) 2 sec (b) 1.5 sec (c) 0.984 sec (d) 0.965 sec

Solution: (No answer); $f = g - a = 9.8 - 4.8 = 5\ ms^{-2} \therefore t = \sqrt{\frac{2h}{f}} = \sqrt{\frac{2\times2}{5}} = 0.894$ sec

03. A 1000 kg truck moving at 20 m/s collides with 1500 kg truck which was at rest and both the trucks move together coupling each other. The resultant velocity will be.
(a) 12.5 m/s (b) 8 m/s (c) 10 m/s (d) 7.5 m/s

Solution: (b); $m_1u_1 + m_2u_2 = (m_1 + m_2)V \Rightarrow V = \frac{1000\times20}{2500} = 8$ m/s

04. If the length of the minute arm of a wrist watch is 2 cm, what will be linear speed at the mid-point of the arm?
(a) 1.745×10^{-5} m/s (b) 1.775×10^{-4} m/s (c) $1.745 \times 5 \times 10^{-3}$ m/s (d) 1.74×10^{-1} m/s

Solution: (a); $V = \omega r = \frac{2\pi}{3600} \times \frac{0.02}{2} = 1.745 \times 10^{-5}$ m/s

05. The radius of curvature of a rail-line is 450 m and the distance between two rails is 1 m. How much should be the height of outside rail compared to inner rail for necessary raking of a running a train at the speed of 7.5 km/hr.
(a) 0.012 m (b) 0.1 m (c) 1 m (d) 3 cm

Solution: (No answer); $\frac{V^2}{rg} = \frac{h}{x} \Rightarrow h = \frac{V^2x}{rg} = \frac{\left(\frac{7.5}{3.6}\right)^2\times1}{450\times9.8} = 0.984\text{mm} \approx 1\text{mm}$

06. If the kinetic energy of a body is increased by 300%, its momentum is increased by.
(a) 100% (b) 150% (c) 300% (d) 400%

Solution: (a); $E_k = \frac{P^2}{2m}$; $\ln E_k = 2\ln P - \ln(2m)$ ..... (i); $\ln E'_k = 2\ln P' - \ln(2m)$ ..... (ii)

(ii) $-$ (i) $\Rightarrow \ln E'_k - \ln E_k = 2\ln P' - 2\ln P \Rightarrow \ln\frac{E'_k}{E_k} = 2\ln\frac{P'}{P} \Rightarrow \ln\frac{400}{100} = 2\ln\frac{P'}{P}$

$\Rightarrow \ln 4 = \ln\left(\frac{P'}{P}\right)^2 = 4 = \left(\frac{P'}{P}\right)^2 \Rightarrow P' = 2P = 200 \therefore \Delta P = 200 - 100 = 100\%$

07. A ball of iron of weight 0.05 kg is revolving by fastening it at the end of a thread of length of 2 m. The moment of inertia.
(a) 2 kg-m^2 (b) 0.2 kg-m^2 (c) 0.4 kg-m^2 (d) 1.4 kg-m^2

Solution: (b); $I = mr^2 = 0.05 \times 2^2 = 0.2\ kgm^2$

08. A second-pendulum reads correct time on the earth surface. What will be the time period of it if it is placed on the moon's surface? The radius and mass of the earth is 4 times and 81 times that of the moon respectively.
(a) 5.4 sec (b) 4.5 sec (c) 2.5 sec (d) 3.5 sec

Solution: (b); $g_m = \frac{GM_m}{R_m^2} = \frac{GM_e}{R_e^2} \times \frac{4^2}{81} = \frac{16}{81} \times 9.8 = 1.9358\ ms^{-2} \Rightarrow T = 2\pi\sqrt{\frac{L}{g}}$

$\therefore T_m = T_e\sqrt{\frac{g_e}{g_m}} = 2\sqrt{\frac{81}{16}} = 2 \times \frac{9}{4} = 4.5$ s

09. A weight of 15 kg is hung with a wire of cross-sectional area 2 mm^2. The length of the wire is 4 m at the time of hanging the weight. Taking Young's modulus of the wire as $1.3 \times 10^{10}\ Nm^{-2}$, find the reduction of length of the wire when the weight is withdrawn.

(a) 0 m (b) Increase in length by 5cm

(c) 0.025 m (d) 0.0225 m

Solution: (d); $Y = \frac{\frac{F}{A}}{\frac{\Delta l}{L}} = \frac{\frac{mg}{A}}{\frac{\Delta l}{L}} \Rightarrow \frac{\Delta l}{L} = \frac{mg}{AY} \Rightarrow \frac{\Delta l}{4-\Delta l} = \frac{15\times9.8}{2\times10^{-6}\times1.3\times10^{10}} \Rightarrow \Delta l = 0.022488 \approx 0.0225\ m$

10. 25 tiny drops of water of radius 0.17×10^{-2} m merge to a large drop. Calculate the amount of energy released in this process. (Surface tension of water: 7.2×10^{-3} N/m).

(a) 5.97×10^{-4}J (b) 5.37×10^{-3}J (c) 6.37×10^{-4}J (d) 6.5×10^{-4}J

Solution: (No answer); $25 \times \frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3 \Rightarrow R = \left(\sqrt[3]{25}\right) \times r \ \therefore \Delta E = (4\pi r^2 \times 25 - 4\pi R^2) \times T$

$= \left\{4\pi \times (0.17 \times 10^{-2})^2 \times 25 - 4\pi \times \left(\sqrt[3]{25} \times r\right)^2\right\} \times 7.2 \times 10^{-3} = 4.3 \times 10^{-6}\ J$

11. There are some clouds in the sky 1.5 km from the earth surface. The cloud is converted to rain and deposited as water on the surface on earth of area $1 \times 10^6\ m^2$ with a depth of 1 cm. Calculate the amount of work required to convert the rain from the cloud.

(a) 15.7×10^5 J (b) 14.7×10^{19} J (c) 14.7×10^{10} J (d) 50 J

Solution: (c); $w = mgh = \rho Vgh = \rho Adgh = 1000 \times (10^6 \times 0.01) \times 9.8 \times 1.5 \times 10^3 = 14.7 \times 10^{10}\ J$

12. A metal rod of length 20 cm and diameter 1 cm is covered with non-conducting substance. One of its end is maintained at 100°C, while the other end is put in ice at 0°C. It is found that 25 gm of ice melts in 5 minutes. Calculate the co-efficient of thermal conductivity of the metal in $cm^{-1}°C^{-1}S^{-1}$. [Specific latent heat of ice: 80cal/ g/ °C]

(a) 0.424 (b) 0.564 (c) 0.634 (d) 0.765

Solution: (No answer); $Q = ml_f = 25 \times 80 = 2000$ cal

Now, $Q = \frac{kA\Delta\theta t}{d} \Rightarrow k = \frac{Qd}{A\Delta\theta t} = \frac{2000\times20}{\pi\times(0.5)^2\times100\times5\times60} = 1.697\ calcm^{-1}°C^{-1}S^{-1}$

13. It takes 5 minutes to decrease the temperature of a material from 80°C to 64°C and it takes 10 minutes to decrease from 80°C to 52°C. What is the ambient temperature?

(a) 10°C (b) 14°C (c) 16°C (d) 12°C

Solution: (c); From newton's low of cooling,

$\frac{dT}{dt} = -k(T - T_a) \int_{T_0}^{T} \frac{dT}{-k(T-T_a)} = \int_0^t dt \Rightarrow T(t) = T_a + (T_0 - T_a)e^{-kt}$

Now, $64 = T_a + (80 - T_a)e^{-k\times5\times60}$ ..... (i)

$52 = T_a + (80 - T_a)e^{-k\times10\times60}$ ..... (ii) ; Solving (i) & (ii) we get,

$T_a = 16°C$ & $k = 9.5894024 \times 10^{-4}s^{-1}$

14. The resistances of the first and the second arms of a Wheatstone bridge are 10Ω and 12Ω respectively. The third arm contains an unknown resistance. When two parallel resistances each of 20Ω are connected to the fourth arm of the bridge, it attains null condition. Find out the value of the unknown resistance.

(a) 3.33 Ω (b) 5.33 Ω (c) 8.33 Ω (d) 10.33 Ω

Solution: (c); $\frac{10}{12} = \frac{x}{10} \Rightarrow x = \frac{100}{12} = 8.33\ \Omega$

15. A Carnot engine takes heat at 227°C and releases at 77°C. The efficiency of the engine is–

(a) 70% (b) 35% (c) 30% (d) 66%

Solution: (c); $\eta = \left(1 - \frac{T_2}{T_1}\right) \times 100\% = \left(1 - \frac{77+273}{227+273}\right) \times 100\% = 30\%$

16. A progressive wave is described by the following equation: $y = 10\sin(140\pi t - 0.08\pi x)$, where units of x and y are cm and unit of t is in second. Find the frequency in Hz.

(a) 50 (b) 60 (c) 70 (d) 80

Solution: (c); $n = \frac{\omega}{2\pi} = \frac{140\pi}{2\pi} = 70$ Hz

17. A loud speaker used in an open field produces 250 W of power. Find the reduction in sound in dB at the points of 20 m and 30 m straight apart from the loud speaker.

(a) 3.2 (b) -3.52 (c) 4 (d) -4

Solution: (b); $I \propto \frac{1}{r^2}$ $\therefore \frac{I_{20}}{I_{30}} = \frac{30^2}{20^2} = \frac{9}{4}$; $\Delta\beta = 10\log\frac{I_{30}}{I_0} - 10\log\frac{I_{20}}{I_0} = 10\log\frac{I_{30}}{I_{20}} = 10\log\left(\frac{4}{9}\right) = -3.52$ dB

18. The velocity of sound in air is 330 m/s. Determine its velocity in hydrogen gas. (The mass of 1 litre of hydrogen is 0.0896 gm and 1 litre of air is 1.293 gm.)

(a) 1253.6 m/s (b) 12.93 m/s (c) 1.2536 m/s (d) 12536 m/s

Solution: (a); $V \propto \sqrt{\frac{1}{\rho}} \Rightarrow V_{H_2} = V_{air} \cdot \sqrt{\frac{\rho_{air}}{\rho_{H_2}}} = 330 \times \sqrt{\frac{1.293}{0.0896}} = 1253.6\ ms^{-1}$

19. The electric potential at the surface of an atomic nucleus ($z = 50$) of radius 9.0×10^{-13} cm is–

(a) 9 V (b) 60 V (c) 9×10^5 V (d) 8×10^6 V

Solution: (d); $V = 9 \times 10^9 \cdot \frac{q}{r} = 9 \times 10^9 \cdot \frac{50\times1.6\times10^{-19}}{(9\times10^{-13}\times10^{-2})} = 8 \times 10^6$ V

20. A current of 4.8 amperes flows through an automobile headlight. How many coulombs of charge flow through it in two hours?

(a) 7×10^4C (b) 3.5×10^4C (c) 1.7×10^4C (d) 0.35×10^4C

Solution: (b); $Q = It = 4.8 \times 2 \times 3600 = 3.456 \times 10^4$ C

21. A heater is connected with a line of 120 volt and the power absorbed is 1000 watt. How much resistance should be added to reduce the 10% of power?

(a) 2 Ohm (b) 0.5 Ohm (c) 1.0 Ohm (d) 1.6 Ohm

Solution: (d); $R = \frac{V^2}{P} = \frac{120^2}{1000} = 14.4\ \Omega$; $R' = \frac{V^2}{P'} = \frac{120^2}{1000-0.1\times1000} = 16\ \Omega$

$\therefore r = R' - R = 16 - 14.4 = 1.6\ \Omega$

22. In a house an electric meter is rated as 10 A-220 V. How many 60 Watt lamp can be connected in the house maintaining proper safety?

(a) 36 (b) 37 (c) 38 (d) 40

Solution: (a); $n = \frac{10\times220}{60} = 367 \approx 36$

23. A coil of 300 turns has self-inductance of 10 mH. If the current flow in the coil is 3 amperes, what will be the magnetic flux?

(a) 10^{-3} Wb (b) 10^{-4} Wb (c) 10^{-5} Wb (d) 10^{-2} Wb

Solution: (b); $N\varphi = LI \Rightarrow \varphi = \frac{LI}{N} = \frac{10\times10^{-3}\times3}{300} = 1 \times 10^{-4}$ Wb

24. The dip circle is placed in such a way that the pick remains vertical. The dip circle is moved 30° vertically and the apparent angle of the dip becomes 45°. Find the actual value of the dip.

(a) 10.323° (b) 27.92° (c) 26.565° (d) 28.656°

Solution: (c); $\tan\delta = \frac{V}{H}$, Now, $\tan 45° = \frac{V}{H\cos60°} \Rightarrow \delta = \tan^{-1}(\tan45° \times \cos60°) = 26.565°$

25. A transformer has primary to secondary turn ratio 20:1. A 20 ohm load is connected across the secondary. If the applied voltage across the primary is 220 V, then the current through the primary is–

(a) 0.55 mA (b) 2.75 mA (c) 27.5 mA (d) 5.5 mA

Solution: (c); $\frac{E_P}{E_S} = \frac{N_P}{N_s} \therefore E_S = E_P \times \frac{N_S}{N_P} = 220 \times \frac{1}{20} = 11\,V$

$\therefore I_S = \frac{11}{20}A \therefore I_P = I_S \times \frac{N_S}{N_P} = \frac{11}{20} \times \frac{1}{20} = 27.5\,mA$ **[Ans: b]**

26. Which of the following is not electromagnetic wave?

(a) Radio wave (b) Ultrasonic wave (c) Ultraviolet wave (d) Microwave

27. An object is placed at a distance of 3f in front of a concave mirror of focal length f. What is the size of the mage with respect to size of the object?

(a) 0.5 times size of the object (b) 2 times of the object

(c) 0.25 times of the object (d) 2 times size of the object

Solution: (a); $\frac{1}{3f} + \frac{1}{V} = \frac{1}{f} \Rightarrow \frac{1}{V} = \frac{1}{f}\left(1 - \frac{1}{3}\right) \Rightarrow V = \frac{3}{2}f \therefore |m| = \frac{V}{U} = \frac{\frac{3}{2}f}{3f} = \frac{1}{2}$

28. The angle of minimum deviation of a prism is 30°. If the refractive angle of the prism is 60°, what is refractive index?

(a) 1.414 (b) 2.414 (c) 1.214 (d) 2.141

Solution: (a); $\mu = \frac{\sin\left(\frac{A+\delta m}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\left(\frac{60°+30°}{2}\right)}{\sin\left(\frac{60°}{2}\right)} = \sqrt{2}$

29. A slit is illuminated by a light of wavelength of 650 nm. The first minimum is obtained at $\theta = 30°$. The width of the slit is- **[Ans: b]**

(a) 320 nm (b) 1.3 micron (c) 6.5×10^{-4} mm (d) 2.6×10^{-4} cm

Solution: (b); $a\sin\theta = n\lambda \Rightarrow a = \frac{650\times10^{-9}}{\sin30°} = 1.3 \times 10^{-6}\,m$

30. A boy cannot see any object at distance beyond 60 cm due his eye defect. What is the power of the lens required to see distant objects beyond that distance? **[Ans: b]**

(a) −25 (b) −1.67 (c) 2.5 (d) 1.6

Solution: (b); $\frac{1}{f} = \frac{1}{\infty} - \frac{1}{60} \Rightarrow f = -60\,cm \therefore P = \frac{1}{f} = \frac{1}{-0.6} = -1.67\,D$

Mathematics

31. The value of $\sqrt[4]{-81}$ is- **[Ans: a, d]**

(a) $\pm\frac{3}{\sqrt{2}}(1 \pm i)$ (b) $\pm\frac{3}{\sqrt{2}}(1 \pm 2i)$ (c) $\pm\frac{3}{\sqrt{2}}(2 \pm i)$ (d) $\pm\frac{3}{\sqrt{2}}(1 \pm i)$

Solution: (a, d); $x^4 = -81 \Rightarrow x^2 = \pm 9i \therefore x = \pm\frac{3}{\sqrt{2}}(1 \pm i)$

32. All 120 students in a class play either cricket or football or both the games. Out of 120 students, 75 students play cricket only and 60 students play football only. How many students play both games? **[Ans: b]**

(a) 13 (b) 15 (c) 25 (d) 23

Solution: (b); $n(C) = 75\,;n(F) = 60\,;\, n(C) + n(F) - n(C \cap F) = 120 \Rightarrow n(C \cap F) = 135 - 120 = 15$

33. The sum of the roots of the equation $(x+\alpha)(x-\beta) + (x-\beta)(x+\gamma) + (x+\gamma)(x+\alpha) = 0$ becomes zero if– **[Ans: c]**

(a) $\alpha + \beta + \gamma$ (b) $\alpha = \beta + \gamma$ (c) $\beta = \alpha + \gamma$ (d) $\gamma = \alpha + \beta$

Solution: (c); $\sum\alpha = -\alpha + \beta + \beta - \gamma - \gamma - \alpha = 0 \Rightarrow 2\alpha + 2\gamma = 2\beta \Rightarrow \alpha + \gamma = \beta$

34. If ω is a complex cube root of unity, then the value of the following determinant will be $\begin{vmatrix} 1 & \omega & \omega^2 \\ \omega & \omega^2 & 1 \\ \omega^2 & 1 & \omega \end{vmatrix}$

(a) 0 (b) 1 (c) ω (d) ω^2 **[Ans: a]**

35. A committee of 4 members is to be formed from 5 engineering and 3 arts students. In how many ways can this be done so that the committee contains at least one engineering and at least one arts students.

(a) 60 (b) 65 (c) 70 (d) 75

Solution: (b); $^5C_3 \times {}^3C_1 + {}^5C_2 \times {}^3C_2 + {}^5C_1 \times {}^3C_3 = 65$

36. If two consecutive coefficients in the expansion of $(1+x)^{24}$ are in the ratio of 4:1, the terms are.

(a) 5, 6 (b) 4, 5 (c) 20, 21 (d) a & c

Solution: (c); $\frac{T_r}{T_{r+1}} = \frac{4}{1} \Rightarrow \frac{n_{C_{r-1}}}{n_{C_r}} = \frac{4}{1} \Rightarrow \frac{n!}{(r-1)!\,(n-r+1)!} \times \frac{r!(n-r)!}{n!} = \frac{4}{1} \Rightarrow \frac{r}{n-r+1} = \frac{4}{1} \Rightarrow 4n - 4r + 4 = r$

$\Rightarrow 4 \times 24 + 4 = 5r \Rightarrow r = 20 \;\therefore$ 20 th and 21 st term.

37. The sum of the series $\frac{1}{1!} + \frac{5}{2!} + \frac{9}{3!} + \frac{13}{4!} + \cdots + \infty$ is–

(a) 2e + 1 (b) e + 5 (c) e + 3 (d) e + 2

Solution: (c); $e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots + \infty$; $T_r = \frac{4r-3}{r!} = \frac{4}{(r-1)!} - \frac{3}{r!}$ $[1 \le r < \infty]$

$S_\infty = \sum \frac{4}{(r-1)!} - 3\sum \frac{1}{r!} = 4e - 3(e-1) = 4e - 3e + 3 = e + 3$

38. If $\cos A = 4/5$, then the value of $\frac{1+\tan^2 A}{1-\tan^2 A}$ is–

(a) $-25/7$ (b) 7/5 (c) 25/7 (d) $-4/5$

Solution: (c); $\frac{1+\tan^2 A}{1-\tan^2 A} = \frac{1}{\cos 2A} = \frac{1}{\cos\left[2\cos^{-1}\left(\frac{4}{5}\right)\right]} = \frac{25}{7}$

39. How many solutions are there for $\sec 4\theta - \sec 2\theta = 2$; $[0° < \theta < 180°]$

(a) 3 (b) 5 (c) 6 (d) 9

Solution: (b); $\frac{1}{\cos 4\theta} - \frac{1}{\cos 2\theta} = 2 \Rightarrow \cos 2\theta - \cos 4\theta = 2\cos 4\theta \cos 2\theta$

$\Rightarrow \cos 2\theta - \cos 4\theta = \cos 6\theta + \cos 2\theta \Rightarrow \cos 6\theta + \cos 4\theta = 0 \Rightarrow 2\cos 5\theta \cos\theta = 0$

$\Rightarrow \cos 5\theta = 0 \Rightarrow 5\theta = (2n+1)\frac{\pi}{2} \Rightarrow \theta = (2n+1)\frac{\pi}{10} = \frac{\pi}{2}, \frac{3\pi}{2}, \frac{7\pi}{10}, \frac{9\pi}{10}$ or , $\cos\theta = 0 \therefore \theta = \frac{\pi}{2}$

40. For the ABC triangle, if $\cos A = \sin B - \cos C$, the angle C is–

(a) 90° (b) 45° (c) 30° (d) 120°

Solution: (a); $\cos A + \cos C = \sin B$

$\Rightarrow 2\cos\frac{A+C}{2}\cos\frac{A-C}{2} = 2\sin\frac{B}{2}\cos\frac{B}{2} \Rightarrow 2\sin\frac{B}{2}\cos\frac{A-C}{2} = 2\sin\frac{B}{2}\cos\frac{B}{2}$

$\Rightarrow A - C = -B \Rightarrow A + B = C$; $A + B + C = 180° \Rightarrow C + C = 180°C \Rightarrow C = 90°$

41. Evaluate: $\tan^{-1}\frac{m}{n} - \tan^{-1}\frac{m-n}{m+n}$.

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{2}$ (c) $\frac{\pi}{9}$ (d) $\frac{\pi}{4}$

Solution: (d); $\tan^{-1}\frac{m}{n} - \tan^{-1}\frac{m-n}{m+n} = \tan^{-1}\left[\frac{\frac{m}{n} - \frac{m-n}{m+n}}{1+\frac{m}{n}\cdot\left(\frac{m-n}{m+n}\right)}\right]$

$= \tan^{-1}\left[\frac{m^2+mn-mn+n^2}{n(m+n)+m(m-n)}\right] = \tan^{-1}\left(\frac{m^2+n^2}{m^2+n^2}\right) = \tan^{-1} 1 = \frac{\pi}{4}$

42. If a moving point $P \equiv (a\sin\theta, b\cos\theta)$, then the locus of P will be a– [**Ans:** c]

(a) parabola (b) circle (c) ellipse (d) straight line

Solution: (c); $x = a\sin\theta, y = b\cos\theta$

$\therefore \left(\frac{x}{a}\right)^2 + \left(\frac{y}{b}\right)^2 = \sin^2\theta + \cos^2\theta \Rightarrow \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ (equation of an ellipse)

43. If the points $(2, 2-2x)$, $(1, 2)$ and $(2, b-2x)$ are collinear, the value of b is–

(a) -1 (b) 1 (c) 2 (d) -2

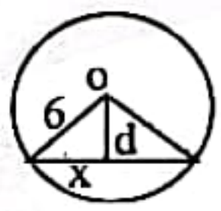
Solution: (c); $\begin{vmatrix} 2 & 2-2x & 1 \\ 1 & 2 & 1 \\ 2 & b-2x & 1 \end{vmatrix} = 0 \Rightarrow \begin{vmatrix} 1 & 1 & 1 \\ 2-2x & 2 & b-2x \\ 2 & 1 & 2 \end{vmatrix} = 0$

$\Rightarrow 4 - b + 2x + 2b - 4x - 4 + 4x + 2 - 2x - 4 = 0 \Rightarrow b = 2$

44. If the equation of a given circle is $x^2 + y^2 = 36$, then the length of the chord which lies along the line $3x + 4y - 15 = 0$ is-

(a) $3\sqrt{6}$ (b) $2\sqrt{3}$ (c) $6\sqrt{3}$ (d) None

Solution: (c); $r = 6 \Rightarrow d = \left|\frac{3.0+4.0-15}{\sqrt{3^2+4^2}}\right| = \frac{15}{5} = 3 \ \therefore 2x = 2\sqrt{6^2 - 3^2} = 6\sqrt{3}$



45. What is the distance between the lines $4x + 3y + 16 = 0$ and $4x + 3y + 26 = 0$?

(a) 10 (b) 2 (c) 5 (d) 4

Solution: (b); $d = \frac{|26-16|}{\sqrt{3^2+4^2}} = \frac{10}{5} = 2$

46. The component of the vector $\vec{B} = 5\hat{i} - 3\hat{j} + 2\hat{k}$ along the vector $\vec{A} = 2\hat{i} + \hat{j} - 2\hat{k}$ will be–

(a) 0 (b) $\frac{1}{\sqrt{2}}$ (c) $\sqrt{2}$ (d) 1

Solution: (d); $\left|\vec{B}\right|\cos\theta = \left|\vec{B}\right| \cdot \frac{\vec{A}\cdot\vec{B}}{\left|\vec{A}\right|\left|\vec{B}\right|} = \frac{\vec{A}\cdot\vec{B}}{\left|\vec{A}\right|} = \frac{5.2-3.1-2.2}{\sqrt{2^2+1^2+2^2}} = \frac{3}{3} = 1$

47. Which of the following function is even function-

(a) $f(x) = \frac{a^x+1}{a^x-1}$ (b) $f(x) = x\frac{a^x-1}{a^x+1}$ (c) $f(x) = \frac{a^x-a^{-x}}{a^x+a^{-x}}$ (d) $f(x) = \sin x$

Solution: (b); For an even function, $F(x) = F(-x)$

48. Evaluate $\lim\limits_{x\to\frac{\pi}{2}} \frac{(1-\sin x)}{\left(\frac{\pi}{2}-x\right)^2}$

(a) 0 (b) 1 (c) $\frac{1}{2}$ (d) 2

Solution: (c); $\lim\limits_{x\to\frac{\pi}{2}} \frac{1-\sin x}{\left(\frac{\pi}{2}-x\right)^2} = \lim\limits_{h\to0} \frac{1-\sin\left(\frac{\pi}{2}+h\right)}{(-h)^2}$ $\left[\text{let}, x = \frac{\pi}{2} + h\ ; \text{as } x \to \frac{\pi}{2}, h \to 0\right]$

$= \lim\limits_{h\to0} \frac{1-\cos h}{h^2} = \lim\limits_{h\to0} \frac{2\sin^2\frac{h}{2}}{h^2} = \lim\limits_{h\to0} \left(\frac{\sin\frac{h}{2}}{\frac{h}{2}}\right)^2 \cdot \frac{1}{4} \cdot 2 = \frac{1}{2}$

49. If $f(x) = e^x, g(x) = \sin^{-1}x, h(x) = f(g(x))$, then $\frac{h'(x)}{h(x)} = ?$

(a) $e^{\sin^{-1}x}$ (b) $\frac{1}{\sqrt{1-x^2}}$ (c) $\sin^{-1}x$ (d) $\frac{i}{1-x^2}$

Solution: (b); $h(x) = f(g(x)) = f(\sin^{-1}x) = e^{\sin^{-1}x}$; $h'(x) = \frac{e^{\sin^{-1}x}}{\sqrt{1-x^2}}$ $\therefore \frac{h'(x)}{h(x)} = \frac{1}{\sqrt{1-x^2}}$

50. If $\tan y = \frac{2t}{1-t^2}$, $\sin x = \frac{2t}{1+t^2}$ then $\frac{dy}{dx} = ?$

(a) $\frac{1}{\sqrt{2}}$ (b) 1 (c) ∞ (d) 0

Solution: (b); $\tan y = \frac{2t}{1-t^2} \Rightarrow y = \tan^{-1}\frac{2t}{1-t^2} = 2\tan^{-1}t \therefore \frac{dy}{dt} = \frac{2}{1+t^2}$

Again, $x = \sin^{-1}\frac{2t}{1+t^2} = 2\tan^{-1}t \therefore \frac{dx}{dt} = \frac{2}{1+t^2} \therefore \frac{dy}{dx} = 1$

51. The radius of a circular plate increases at the rate of 0.25 cm/sec when heat is applied. If the radius of the plate is 7 cm, the area increase rate is-

(a) 10 cm^2/sec (b) 11 cm^2/sec (c) 0.5 cm^2/sec (d) 12 cm^2/sec

Solution: (b); $A = \pi r^2 \Rightarrow \frac{dA}{dt} = 2\pi r\frac{dr}{dt} = 2\pi \times 7 \times 0.25 = \frac{7}{2}\pi \approx 11 cm^2/sec$

52. If $y = \frac{1}{2}(\sin^{-1}x)^2$, then $(1-x^2)y_2 - xy_1 = ?$

(a) 2 (b) $\sqrt{2}$ (c) 1 (d) -1

Solution: (c); $y = \frac{1}{2}(\sin^{-1}x)^2$

$y_1 = \frac{\sin^{-1}x}{\sqrt{1-x^2}} \Rightarrow \sqrt{1-x^2}\,y_1 = \sin^{-1}x \Rightarrow \sqrt{1-x^2}\,y_2 - \frac{x}{\sqrt{1-x^2}}y_1 = \frac{1}{\sqrt{1-x^2}} \Rightarrow (1-x^2)y_2 - xy_1 = 1$

53. Evaluate the integral $\int e^x \sec x(1+\tan x)dx$-

(a) $e^{-x}\cos x + c$ (b) $e^x \sec 2x + c$ (c) $e^x \sec x + c$ (d) $e^x \sin x + c$

Solution: (c); $\int e^x \sec x(1+\tan x)dx = e^x \sec x + C$ $[\therefore \int e^x[f(x)+f'(x)]\,dx = e^x f(x) + c]$

54. Evaluate: $\int_0^{\frac{\pi}{2}} \cos^3 x\sqrt{\sin x}\,dx$

(a) $\frac{5}{21}$ (b) $-\frac{8}{21}$ (c) $\frac{9}{21}$ (d) $\frac{8}{21}$

Solution: (d); [let, $z = \sin x$; $dz = \cos x\,dx$]

x	0	$\frac{\pi}{2}$
z	0	1

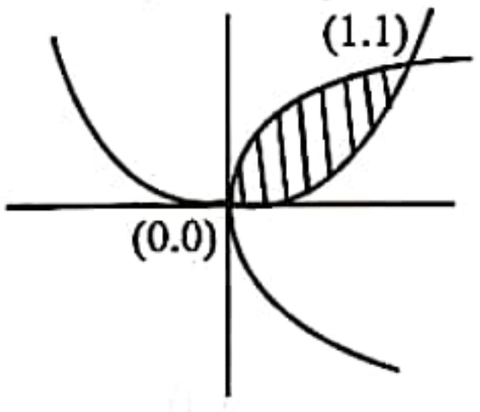
$\int_0^{\frac{\pi}{2}} \cos^3 x\sqrt{\sin x}\,dx = \int_0^{\frac{\pi}{2}}(1-\sin^2 x)\sqrt{\sin x}\cos x\,dx = \int_0^1 (1-z^2)\sqrt{z}\,dz$

$= \left[\frac{z^{\frac{1}{2}+1}}{\frac{1}{2}+1} - \frac{z^{\frac{5}{2}+1}}{\frac{5}{2}+1}\right]_0^1 = \left[\frac{2}{3}z^{\frac{3}{2}} - \frac{2}{7}z^{\frac{7}{2}}\right]_0^1 = \frac{8}{21}$

55. The area of the region enclosed by the curves $y^2 = x$ and $y = x^2$ is-

(a) $\frac{1}{12}$sq. unit (b) $\frac{1}{3}$ sq. unit (c) $\frac{1}{2}$ sq. unit (d) $\frac{1}{6}$ sq.unit

Solution: (b);



$\Delta = \int_0^1 (y_1 - y)dx = \int_0^1 (\sqrt{x} - x^2)\,dx = \left|\left[\frac{x^{\frac{1}{2}+1}}{\frac{1}{2}+1} - \frac{x^3}{3}\right]_0^1\right| = \left|\frac{2}{3} - \frac{1}{3}\right| = \frac{1}{3}$ sq. unit

56. The resultant of two forces 3P and 2P is R. If the first force is doubled, then the resultant is also doubled. The angle between the force is-

(a) 60° (b) 30° (c) 180° (d) 120°

Solution: (d); $R^2 = 9P^2 + 4P^2 + 2.3P.2P.\cos\theta$ ..... (i); $4R^2 = 36P^2 + 4P^2 + 2.6P.2P\cos\theta$ ..... (ii)

(ii) $-$ (i) $\times 4 \Rightarrow -12P^2 - 24P^2\cos\theta = 0 \Rightarrow \cos\theta = -\frac{12}{24} = -\frac{1}{2} \therefore \theta = 120°$

57. The sides of a triangles are 13, 14 and 15 units. The area of the triangle is:

(a) 84 Sq. units (b) 88 Sq. units (c) 80 Sq. units (d) 64 Sq. units

Solution: (a); $\Delta = \sqrt{s(s-a)(s-b)(s-c)}$

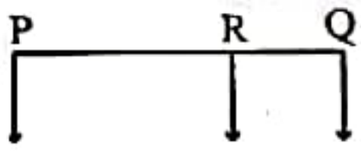
$= \sqrt{21(21-13)(21-14)(21-15)} = \sqrt{21.8.7.6} = 84$ sq. unit

[given, $s = \frac{13+14+15}{2} = 21, a = 13, b = 14, c = 15$]

58. The extremities of an 8m long straight bamboo pole rest on two smooth pegs P and Q in the same horizontal line. A heavy load hangs from a point R of the pole. If PR=3RQ and the pressure at Q be 325 gm-wt more than that of P, the weight of the load is-

(a) 500 gm-wt (b) 600 gm-wt (c) 650 gm-wt (d) 700 gm-wt

Solution: (c);



P. PR = Q. RQ $\Rightarrow$ 3P = Q ..... (i); Now, Q $-$ P = 325 $\Rightarrow$ 3P $-$ P = 325 $\Rightarrow$ P = $\frac{325}{2} = 162.5$

$\therefore$ (i) $\Rightarrow$ Q = 3P = 487.5 $\therefore$ R = P + Q = 650

59. If $y = x^2 \log x$ then d^3y/dx^3 is-

(a) $-x/2$ (b) $2/x$ (c) $-2/x$ (d) $x/2$

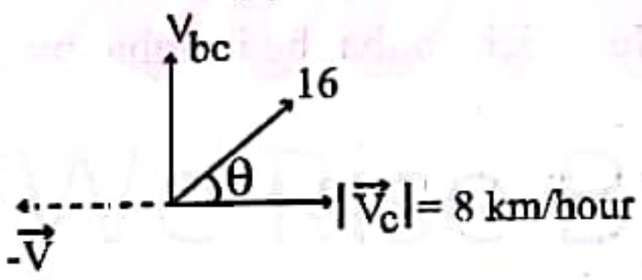
Solution: (b); $y = x^2\log x \Rightarrow \frac{dy}{dx} = \frac{x^2}{x} + 2x\log x = x + 2x\log x$

$\Rightarrow \frac{d^2y}{dx^2} = 1 + \frac{2x}{x} + 2\log x = 3 + 2\log x \therefore \frac{d^3y}{dx^3} = \frac{2}{x}$

60. A car is moving at a velocity of 8 km/hour. A body is thrown outside the car at a velocity of 16 km/hour. If the body moves perpendicular to the car, what is the angle at which the body was thrown?

(a) 60° (b) 90° (c) 120° (d) 145°

Solution: (a);



$V_{bc} = \sqrt{16^2 - 8^2} = 8\sqrt{3}, \theta = \tan^{-1}\left(\frac{8\sqrt{3}}{8}\right) = 60°$

English

61. Which of the following phrases is most suitable that completes the sentence: "I am afraid that my success as an engineer was just a ....." [**Ans:** b]

(a) bolt from the blue (b) flash in the pan (c) cock and blue sky (d) broad day light

62. The passive form of the sentence: "It is time to close the door" is [**Ans:** c]

(a) It is to be time for closing the door (b) It is time for the door be closed.

(c) It is time for the door to be closed. (d) It is timed to be closed the door.

63. The simple form of the following complex sentence: "Wait here till I arrive" [Ans: d]
(a) Wait here till mine arrive (b) Wait here till I am arrived
(c) You wait up to my arrival (d) Wait here till my arrival.

64. The negative form of the sentence: "Everybody is liable to error" [Ans: b]
(a) Everyman is not correct (b) Nobody is free from error
(c) Everyone is subjected to error (d) None of the above

65. Which one is the correct form of English [Ans: b]
(a) A man can be relieved of his anxiety from revealing his secret to his friends
(b) A man can be relieved of his anxiety by revealing his secret to his friends
(c) A man can relieve of his anxiety to his reveal his secret through his friends
(d) All of the above

66. Where lays the mistake in sentence "They saw me write" [Ans: c]
(a) Subject (b) principal verb (c) participle (d) preposition

67. "Study hard if you want to pass in the examination". In this sentence, the word hard is used as [Ans: b]
(a) Adjective (b) adverb (c) conjunction (d) redundancy

68. The antonym of the word "Trival" is [Ans: c]
(a) unexpected (b) uncertain (c) important (d) unusual

69. "In 2025, the population of Bangladesh is projected to be 200 million". Choose a word which would best keep the meaning of the given sentence if it were substituted for the word **"projected"** [Ans: c]
(a) updated (b) admonished (c) estimated (d) recorded

70. "We squander health in search of wealth". The word squander can best be replaced by- [Ans: d]
(a) frugalise (b) economize (c) use (d) waste

71. The best word for the gap in the sentence: "The audience …… to his lecture" [Ans: c]
(a) Turned a deaf eye to (b) turned deaf to (c) turned a deaf ear to (d) turned an eye to

72. "Down to heel" means [Ans: b]
(a) Discouraged (b) worn out (c) remorseful (d) apologize

73. The appropriate preposition in the gap of the sentence: "I never thought …… playing cards. [Ans: b]
(a) in (b) of (c) about (d) from

74. "Though he is rich, he is unhappy". The correct compound form of the sentence is [Ans: d]
(a) He is rich so he is unhappy (b) He is rich so that he is unhappy
(c) He is rich that is why he is unhappy (d) He is rich but unhappy

75. "Her forehead was as white as a lily". The comparative form of the sentence. [Ans: a]
(a) A lily was not whiter than her forehead (b) a lily was as white as her forehead
(c) A lily was whiter than her forehead (d) A lily was not more whiter as her forehead

Read the following passage and answer question 76 to 80.

The great Pyramid was built thousands of years ago for a king called Khufu. It is located on the waste bank of the Nile river not far from Cairo. In fact all pyramids along the Nile are on the west bank. The ancient Egyptians compared the rising of the sun to the beginning of the life and setting of sun to the end of life. This is why they buried the dead on the West bank of the Nile.

In light of the above passage, choose the right answers.

76. Ancient Egyptians compared death with ____. [Ans: c]
(a) rising sun (b) end of life (c) setting sun (d) beginning of life

77. All pyramids are on the bank of the Nile and are ____ Cairo. [Ans: a]
(a) close to (b) far from (c) on the left of (d) behind

78. The word "great" in beginning of the passage refers to the ____ [Ans: b]

(a) greatness of the king Khufu (b) vastness of the Pyramid

(c) greatness of the Egyptians (d) vastness of the city of Cairo.

79. Pyramids were built ____ years ago. [Ans: c]

(a) a million (b) many thousand (c) a few thousand (d) one thousand

80. The dead were buried on the west bank of the Nile river because the ancient Egyptians believed that ____.

(a) they could see the setting sun [Ans: c]

(b) they could see the rising sun.

(c) the sun sets in the west resembles the end of life

(d) one can escape death

Chemistry

81. What is the temperature in Celsius scale at which the root mean square velocity of Cl_2 is equal to that SO_2 gas at NTP?

(a) 39.86° (b) 29.86° (c) 40.86° (d) 50.86°

Solution: (b); $\bar{C} \propto \sqrt{\frac{T}{M}} \Rightarrow \bar{C}_{Cl_2} = \bar{C}_{SO_2} \Rightarrow \sqrt{\frac{T+273}{35.5\times2}} = \sqrt{\frac{273}{64}} \Rightarrow T = 29.86°C$

82. Which of the following d-block elements contain one 4s electron? [Ans: d]

(a) Mn (25) (b) Fe (26) (c) Ni (28) (d) Cu (29)

83. The most active metal is- [Ans: d]

(a) Na (b) Fe (c) Hg (d) Cs

84. If 0.3 mol Zn is added to HCl containing 0.52 mol HCl, how many moles of H_2 are produced?

(a) 0.3 mole (b) 0.52 mole (c) 0.26 mole (d) 0.6 mole

Solution: (c); $Zn + 2HCl \rightarrow ZnCl_2 + H_2$; limiting reagent = HCl $\therefore n_{H_2} = \frac{0.52}{2} = 0.26$ mol

85. When $KMnO_4$ reacts with acidified $FeSO_4$, then [Ans: c]

(a) Only $FeSO_4$ is oxidized (b) Only $KMnO_4$ is oxidized

(c) $FeSO_4$ is oxidized and $KMnO_4$ is reduced (d) None of the above.

86. Which property is generally considered as the characteristic of an organic compound? [Ans: a]

(a) Low melting point (b) High melting point

(c) Solubility in polar solvent (d) Insolubility in non-polar solvent

87. At 17° temperature and fixed volume, heat of reaction of the following reaction: $C(s) + \frac{1}{2}O_2(g) = CO(g)$ is found as -122.55 KJ. What is the heat of reaction at fixed pressure?

(a) -122.55KJ (b) -1221.978 KJ (c) -121.344 KJ (d) 0 KJ

Solution: (c); $Q_p = Q_v + \Delta nRT = -122.55 + \frac{1}{2} \times 8.31 \times 10^{-3} \times 290 = -121.344$ KJ

88. Which of the following three metals form stainless steel? [Ans: b]

(a) Cu, Zn, Sn (b) Fe, Cr, Ni (c) Fe, Cr, Cu (d) Cu, Pb, Sn

89. 1 mole of each C_2H_5OH and CH_3CO_2H are allowed to react in 1 litre of solvent (dioxane), equilibrium is established when one-third of a mole of each of the reactants remains. What is the equilibrium constant K of the reaction at this state?

(a) 0.25 (b) 2 (c) 1 (d) 4

Solution: (d); $K = \frac{[CH_3COOC_2H_5][H_2O]}{[C_2H_5OH][CH_3COOH]} = \frac{\frac{2}{3}.\frac{2}{3}}{\frac{1}{3}.\frac{1}{3}} = 4$

90. If the hydrogen ion concentration of a fruit juice is 3.3×10^{-2}M, what is the pH?

(a) 2.48 (b) 3.48 (c) 2.18 (d) 1.48

Solution: (d); $pH = -\log[H^+] = -\log[3.3 \times 10^{-2}] = 1.48$

91. How much copper will be deposited when 10 ampere of current is passed for 30 minutes through an aqueous solution of copper sulphate?

(a) 12 gm (b) 5.92 gm (c) 8 gm (d) 9 gm

Solution: (b); $W = \frac{63.5}{2\times96500} \times 10 \times 30 \times 60 = 5.92$ gm

92. What is the emf of the following half-cell at 47°C? [E° for Fe = 0.036 V]: $Fel FeCl_3(0.25M)$

(a) 0.0478 V (b) 0.0487 V (c) 0.0742 V (d) 0.4781 V

Solution: (b); $E_{cell} = E°_{cell} - \frac{RT}{nF}\ln[Fe^{3+}] = 0.036 - \frac{8.314\times(47+273)}{3\times96500}\ln[Fe^{3+}] = 0.0487$ V

93. The rate of the reaction A + B → Product is k [A] [B]. What is the unit of the rate constant?

(a) $mol^2\ dm^{-6}\ s^{-1}$ (b) $mol^{-2}\ dm^{-6}\ s^{-1}$ (c) $mol^{-1}\ dm^3\ s^{-1}$ (d) $mol^2\ dm^{-6}\ s^1$

Solution: (c); $-\frac{dc}{dt} = k[A][B] \Rightarrow k = mol^{-1}Ls^{-1} = mol^{-1}dm^3s^{-1}$

94. From which of the following species, removal of an electron requires maximum energy? **[Ans:** a]

(a) Ar (b) PF_3 (c) $AlCl_3$ (d) Cl^-

95. A person inhales 200 mg of air once. If the air contains 20% (weight) of oxygen then how many oxygen atoms he takes in?

(a) 18.234×10^{12} (b) 7.528×10^{12} (c) 18.234×10^{20} (d) 7.528×10^{20}

Solution: (No answer); $n_{O_2} = \frac{200\times10^{-3}\times0.2}{32} = \frac{1}{800}$

$\therefore$ number of atoms $= 2 \times N_A \times \frac{1}{800} = 15.055 \times 10^{20}$ atoms

Number of O_2 molecules $= N_A \times \frac{1}{800} = 7.528 \times 10^{20}$ molecules

96. Glauber salt is- **[Ans: c]**

(a) $ZnSO_4.7H_2O$ (b) $CuSO_4.5H_2O$ (c) $Na_2SO_4.10H_2O$ (d) $[Cu(NH_3)_4]SO_4$

97. Which region of atmosphere does contain Ozone layer? **[Ans: d]**

(a) Troposphere (b) Thermosphere (c) Mesosphere (d) Stratosphere

98. Which of the following metals make an alloy called German Silver?

(a) Zn, Cu, Sn (b) Cu, Zn, Fe (c) Cu, Sn (d) Cu, Sn, Ni

Solution: (No answer); German Silver → Cu → 50 − 61.6% , Zn → 19 − 17.2% , Ni → 30 − 21.1%

99. Which of the following is the functional group of ketone? **[Ans: b]**

(a) −OH (b) > C = 0 (c) −CHO (d) −COOH

100. Which of the following mixture is petrol? **[Ans: b]**

(a) Aromatic hydrocarbons (b) Alkanes

(c) Alkynes (d) Alkenes