IUT Admission Test 2011-2012

Mathematics

01. If $f(x) = 2x^4 - 4$ and $g(x) = \sqrt{\frac{x-2}{\sqrt{2}}}$, then what is the value of $(fog)(5)$?

(a) $\sqrt[2]{2}$ (b) 5 (c) 2 (d) $\sqrt[2]{5}$

Solution: (b); $(fog)(5) = f(g(5)) = f\left(\sqrt{\frac{5-2}{\sqrt{2}}}\right) = 2\left(\sqrt{\frac{3}{\sqrt{2}}}\right)^4 - 4 = 9 - 4 = 5$

02. The value of $\sqrt{-\frac{1}{2} + \sqrt{-\frac{1}{2} + \sqrt{-\frac{1}{2} + \cdots \infty}}}$ is-

(a) $\frac{1\pm i}{2}$ (b) $\pm(1+i)$ (c) $\pm(1-i)$ (d) $\pm(\frac{1}{2}+i)$

Solution: (a); $x = \sqrt{-\frac{1}{2} + \sqrt{-\frac{1}{2} + \sqrt{-\frac{1}{2} + \cdots}}} \Rightarrow x^2 = -\frac{1}{2} + x \Rightarrow x^2 - x + \frac{1}{2} = 0 \Rightarrow x = \frac{1\pm i}{2}$

[Ans: c]

03. The value of $\sqrt{i}$

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

04. Which quadratic equation has a root $(-1+\sqrt{-5})$?

(a) $x^2 + 2x + 6 = 0$ (b) $x^2 - 2x + 6 = 0$ (c) $x^2 + 2x - 6 = 0$ (d) $x^2 - 2x - 6 = 0$

Solution: (a); The other root is $-1 - \sqrt{-5}$

$\therefore$ The equation is $x^2 - (-1+\sqrt{-5} - 1 - \sqrt{-5})x + (-1)^2 + 5 = 0 \;\therefore x^2 + 2x + 6 = 0$

05. Given $A = \begin{bmatrix}1\\2\\3\end{bmatrix}$ and $AB = \begin{bmatrix}-1 & 2 & 1\\-2 & 4 & 2\\-3 & 6 & 3\end{bmatrix}$, which one of the following is matrix B?

(a) $\begin{bmatrix}-1\\2\\1\end{bmatrix}$ (b) $\begin{bmatrix}-1 & 2 & 1\\-1 & 2 & 1\\-1 & 2 & 1\end{bmatrix}$ (c) $\begin{bmatrix}-1 & -1 & -1\\2 & 2 & 2\\1 & 1 & 1\end{bmatrix}$ (d) [-1 2 1]

Solution: (d); Only (d) has its number of rows equal to the number of columns of matrix A. As a genera solution,

Let, $B = [x \quad y \quad z] \;\therefore \begin{bmatrix}1\\2\\3\end{bmatrix}[x \quad y \quad z] = \begin{bmatrix}x & y & z\\2x & 2y & 2z\\3x & 3y & 3z\end{bmatrix}$

Now, comparing this with AB we get, $B = [-1 \quad 2 \quad 1]$

06. How many ways can you arrange the letters ABCDEFGH so that the word will contain the string ABC?

(a) 40320 (b) 720 (c) 120 (d) None of them

Solution: (b); Considering ABC as one element the number of ways, the letters can be arranged is $6! = 720$

07. Let **n** be a positive integer. Then the value of $\sum_{k=0}^{n}(-1)^k\binom{n}{k}$ is-

(a) -1 (b) 0 (c) 1 (d) None of them

Solution: (b); $\sum_{k=0}^{n}(-1)^k\binom{n}{k} = (1-1)^n = 0$

08. The sum of the series $1+\frac{1+2}{2!}+\frac{1+2+2^2}{3!}+\frac{1+2+2^2+2^3}{4!}+\cdots\infty$ is-

(a) e (b) $e-1$ (c) e^2-e (d) $1-e$

Solution: (c); The n^{th} term, $u_n=\frac{1+2+2^2+\cdots+2^{n-1}}{n!}=\frac{2^n-1}{n!}$

$\therefore S=\sum_{n=1}^{\infty}\frac{2^n-1}{n!}=\sum_{n=1}^{\infty}\frac{2^n}{n!}-\sum_{n=1}^{\infty}\frac{1}{n!}=\sum_{n=0}^{\infty}\frac{2^n}{n!}-\sum_{n=0}^{\infty}\frac{1}{n!}-1+1=e^2-e$

09. The value of $2\cos\frac{\pi}{13}\cos\frac{9\pi}{13}+\cos\frac{3\pi}{13}+\cos\frac{5\pi}{13}$ is- [Ans: d]

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

10. Solve: $\sin x+\cos x=\sqrt{2}$ when $-\pi<x<\pi$

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

Solution: (c); $\sin x+\cos x=\sqrt{2}\Rightarrow\frac{1}{\sqrt{2}}\sin x+\frac{1}{\sqrt{2}}\cos x=1$

$\Rightarrow\cos x\cos\frac{\pi}{4}+\sin x\sin\frac{\pi}{4}=1\Rightarrow\cos\left(x-\frac{\pi}{4}\right)=1\Rightarrow x-\frac{\pi}{4}=2n\pi\Rightarrow x=2n\pi+\frac{\pi}{4}$

Putting $n=0, x=\frac{\pi}{4}$

11. For any triangle ABC, if $c^4-2(a^2+b^2)c^2+a^4+a^2b^2+b^4=0$ then how many solutions are there for C?

(a) 0 (b) 1 (c) 2 (d) 3

Solution: (c); $c^4+a^4+b^4-2a^2c^2-2b^2c^2+2a^2b^2=a^2b^2\Rightarrow(a^2+b^2-c^2)^2=a^2b^2$

$\Rightarrow\left(\frac{a^2+b^2-c^2}{2ab}\right)^2=\frac{1}{4}\Rightarrow\cos^2C=\frac{1}{4}\Rightarrow\cos C=\pm\frac{1}{2}$

12. For what value of **k** will the three lines $x-y+5=0, x+y-1=0,$ and $kx-y+13=0$ be concurrent?

(a) 1 (b) 3 (c) 5 (d) 7

Solution: (c); $\begin{vmatrix}1 & -1 & 5\\ 1 & 1 & -1\\ k & -1 & 13\end{vmatrix}=0\Rightarrow k=5$

13. If point (a, 5) has equal distances from both the y-axis and a point (7, 2), then the of value of a is?

(a) 49 (b) 29 (c) 49/29 (d) 29/7

Solution: (d); $\sqrt{(a-7)^2+(5-2)^2}=\pm a\Rightarrow a^2-14a+58=a^2\Rightarrow a=\frac{58}{14}=\frac{29}{7}$

14. For which value of **k** the line $3x+4y=k$ will touch the circle $x^2+y^2=10x$?

(a) 40 (b) -10 (c) Both a & b (d) None of them

Solution: (c); Centre (5,0) and radius = 5 unit. $\frac{3.5+4.0-k}{\sqrt{3^2+4^2}}=\pm5\Rightarrow(15-k)^2=25^2\Rightarrow k=40,-10$

15. The standard equation of the Hyperbola is- [**Ans:** a]

(a) $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ (b) $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ (c) $y^2=4ax$ (d) $x^2=4by$

16. Against which axis does the vector $2\hat{i}-\hat{j}+2\hat{k}$ produce an angle of $\cos^{-1}\left(-\frac{1}{3}\right)$?

(a) x-axis (b) y-axis (c) z-axis (d) None of them

Solution: (b); From the concept of direction cosine, $\theta_y=\cos^{-1}\frac{R_y}{|R|}$

17. Evaluate $\lim_{x\to0}\frac{a^x-1}{x}$

(a) 0 (b) e^a (c) ln (a) (d) a

Solution: (c); $\lim_{x\to0}\frac{a^x-1}{x}=\lim_{x\to0}\frac{a^x\ln a}{1}=\ln(a)$ [L' Hospital rule $\frac{0}{0}$ form]

18. If $x = a\cos^3\theta$ and $y = b\sin^3\theta$ then $\frac{dy}{dx} = ?$

(a) $-\frac{b}{a}\cot\theta$ (b) $\frac{a}{b}\tan\theta$ (c) $\frac{a}{b}\cot\theta$ (d) $-\frac{b}{a}\tan\theta$

Solution: (d); $\frac{dx}{d\theta} = 3a\cos^2\theta(-\sin\theta) \Rightarrow \frac{dy}{d\theta} = 3b\sin^2\theta\cos\theta \ \therefore \frac{dy}{dx} = \frac{\frac{dy}{d\theta}}{\frac{dx}{d\theta}} = -\frac{b}{a}\tan\theta$

19. If $y = \cot^{-1}\frac{x^2}{e^x} + \cot^{-1}\frac{e^x}{x^2}$ then $\frac{dy}{dx} = ?$

(a) 1 (b) 0 (c) e (d) -1

Solution: (b); We know, $\cot^{-1}x + \cot^{-1}\frac{1}{x} = \frac{\pi}{2}$; Now $y = \cot^{-1}\frac{x^2}{e^x} + \cot^{-1}\frac{e^x}{x^2} = \frac{\pi}{2} \therefore \frac{dy}{dx} = 0$

20. If the slope of a curve at a point (x, y) is $x^2 - 2$ and that curve passes through a point (3, 8), then the equation for that curve is

(a) $y = x^3 - 2x$ (b) $y = x^3 - 2x + 5$ (c) $y = \frac{1}{3}x^3 - 2x + 5$ (d) $y = \frac{1}{3}x^3 - 2x$

Solution: (c); $y = \int(x^2 - 2)\,dx \ \therefore y = \frac{1}{3}x^3 - 2x + c$ .... (i); (i) passes through the point (3, 8)

$\therefore 8 = \frac{1}{3}\cdot 3^3 - 2\cdot 3 + c \Rightarrow c = 5$

21. Each side of a square box increases at the rate of 0.5 cm/sec. If the length of each side is 100cm then the rate of increase of its area is

(a) 50cm/sec (b) $20\text{cm}^2/\text{sec}$ (c) 100cm/sec (d) $100\text{cm}^2/\text{sec}$

Solution: (d); $A = a^2 \ \therefore \frac{dA}{dt} = 2a\frac{da}{dt} = 2 \times 100 \times 0.5 = 100\ \text{cm}^2/\text{sec}$

22. Evaluate $\int \frac{dx}{x\sqrt{x^2-1}}$

(a) sec x (b) $\sec^{-1}x + C$ (c) $\sec^{-1}x$ (d) secx + C

Solution: (b); $\int \frac{dx}{x\sqrt{x^2-1}} = \sec^{-1}x + C$ [direct formula]

23. Evaluate $\int_0^2 \frac{x}{\sqrt{9-2x^2}}dx$

(a) 9 (b) 2 (c) 1 (d) 0

Solution: (c);

x	0	2
z	9	1

$\int_0^2 \frac{x}{\sqrt{9-2x^2}}\,dx = -\int_9^1 \frac{dz}{4\sqrt{z}} = \frac{1}{2}\int_1^9 \frac{dz}{2\sqrt{z}} = \frac{1}{2}\left[\sqrt{z}\right]_1^9 = \frac{1}{2}(3-1) = 1.$

Let, $9 - 2x^2 = z \ \therefore -4xdx = dx$

24. The area of the region enclosed by the curve $y = \sin x$ and the x-axis is

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

Solution: (b); $\int_0^\pi \sin x\,dx = [-\cos x]_0^\pi = [\cos x]_\pi^0 = 1 - (-1) = 2$

25. A man carries, on his shoulder, a load at the end of a stick. The distance of the load and his hand from his shoulder is 1 meter and 0.25 meter, respectively. If thrust on his shoulder is R, then what is the weight of the load?

(a) 5R (b) $\frac{R}{5}$ (c) 4R (d) $\frac{R}{4}$

Solution: (b); $x \times 1 = y \times 0.25 \Rightarrow x - \frac{y}{4} = 0$ ..... (i); Again, $x + y = R$ ..... (ii)

Solving (i) & (ii) We get, $(x, y) = \left(\frac{R}{5}, \frac{4R}{5}\right)$

26. Two cars start their journey from the same point at a velocity of 1 km/hour and 2 km/hour, respectively. If the angle between their travel paths is 60° then what is their distance after 2 hour?

(a) $2\sqrt{2}$ km (b) $\sqrt{10}$ km (c) $2\sqrt{3}$ km (d) 4 km

Solution: (c); $c^2 = a^2 + b^2 - 2abcos\,C = 2^2 + 4^2 - 2 \cdot 2 \cdot 4 \cdot \cos 60°$

$= 4 + 16 - 16 \cdot \frac{1}{2} = 12 \;\therefore c = \sqrt{12} = 2\sqrt{3}$

27. A player throws a ball from a height of 3.5 meters. The ball flies at a speed of 9.8 m/sec creating an angle of 30° parallel to the surface. Another player catches the ball 2.1 meters from the surface. What is the distance between those two players? Note: $g = 9.8\ m/sec^2$.

(a) 10.44 m (b) 15.55 m (c) 20.22 m (d) 30 m

Solution: (a); $3.5 - 2.1 = -9.8\sin 30° \times t + \frac{1}{2} \times 9.8 \times t^2 \Rightarrow t = \frac{7+\sqrt{105}}{14} \therefore x = 9.8\cos 30° t = 10.46$

28. A thin glass sheet can just carry a mass of 5.5 kg. The sheet was raised with an increasing acceleration with an object on it and was found to breakdown when the acceleration equals 1.2 m/sec. What is the mass of the object? Note: $g = 9.8\ m/sec^2$.

(a) 5.45 kg (b) 4.15 kb (c) 4.5 kg (d) 4.9 kg

Solution: (d); $5.5 \times 9.8 = m(9.8 + 1.2) \Rightarrow m = \frac{5.5 \times 9.8}{9.8+1.2} = 4.9kg$

29. From a deck of cards if you pick four cards, what is the probability of getting four Aces?

(a) $\frac{24}{52\times51\times50\times49}$ (b) $\frac{256}{52\times51\times50\times49}$ (c) $\frac{24}{52\times52\times52\times52}$ (d) $\frac{256}{52\times52\times52\times52}$

Solution: (a); $P(A) = \frac{^4C_4}{^{52}C_4} = \frac{1\times4!}{52\times51\times50\times49} = \frac{24}{52\times51\times50\times49}$

30. 200 students have taken both math and physics exam. Among them 40 students fail in math and 20 students fail in physics exam. In both exams, 10 students have failed. If you randomly pick a student, what is the probability that he has failed in math exam and has passed in physics exam?

(a) $\frac{3}{20}$ (b) $\frac{4}{20}$ (c) $\frac{2}{20}$ (d) $\frac{1}{20}$

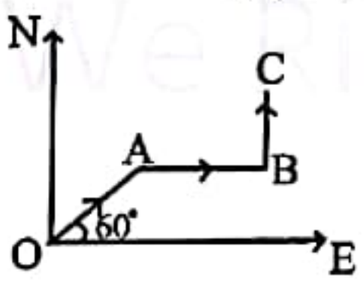
Solution: (a); The required probability $= \frac{40-10}{200} = \frac{3}{20}$

Physics

31. The pilot of a private plane flies 20.0 km in a direction 60° north of east, then 30.0 km straight east, then 10.0 km straight north. How far the plane is from the starting point.

(a) 58.44 km (b) 38.44 km (c) 48.44 km (d) 46.44 km

Solution: (c);



$, D_E = OA\cos 60° + AB = 20\cos 60° + 30 = 40$

$D_N = 20\sin 60° + BC = 20\sin 60° + 10 = 10 + 10\sqrt{3} \;\therefore D = \sqrt{D_E^2 + D_N^2} = 48.44\ km$

32. A car and a truck start from rest at the same instant, with the car initially at some distance behind the truck. The truck has a constant acceleration of 2 ms^{-2} and the car an acceleration of $3ms^{-2}$. The car overtakes the truck after the truck has moved 75 m. How far was the car behind the truck?

(a) 37.9 m (b) 48.5 m (c) 33.8 m (d) 37.5 m

Solution: (d); $\frac{1}{2}.3.t^2 = \frac{1}{2}.2.t^2 + x \ldots\ldots$ (i) and $\frac{1}{2}.2.t^2 = 75 \Rightarrow t^2 = 75$

(i) $\Rightarrow \frac{1}{2}.3.75 = \frac{1}{2}.2.75 + x \Rightarrow x = \frac{1}{2}.75 = 37.5m$

33. In a carnival ride the passengers travel in a circle of radius 5.0 m making one complete circle in 4 s. What is the acceleration of the ride?
(a) $22.34\ m-s^{-2}$ (b) $14.34\ m-s^{-2}$ (c) $12.34\ m-s^{-2}$ (d) $46.20\ m-s^{-2}$
Solution: (c); $a=\omega^2 r=\left(\frac{2\pi}{4}\right)^2\times 5=12.34\ ms^{-2}$

34. A marksman fires a 0.22 caliber rifle horizontally at a target. The bullet has a muzzle velocity of $300\ ms^{-1}$. How much does the bullet drop in flight if the target is 150 m away.
(a) 13.85 m (b) 1.050 m (c) 1.226 m (d) 1.630 m
Solution: (c); $x=ut\Rightarrow t=\frac{x}{u}=\frac{150}{300}$; $h=\frac{1}{2}gt^2\Rightarrow h=\frac{1}{2}g\left(\frac{150}{300}\right)^2=1.225\ m$

35. A marathon runner of mass 70 kg runs up the stairs to the top of the Sears tower that is 443 m high in 15 minutes. What is the average power output of the runner in horse power (hp).
(a) 0.453 hp (b) 1.5 hp (c) 0.50 hp (d) 0.7 hp
Solution: (a); $P=\frac{mgh}{t\times 746}\text{ (in hp)}=\frac{70\times 9.8\times 443}{15\times 60\times 746}=0.453\ hp$

36. Light rays incident obliquely on the interface of air and water. The angle of incidence is 60°. What is the angle of refraction? The refractive indices of air and water are respectively, 1.34 and 2.4, respectively.
(a) 18.92° (b) 48.92° (c) 28.92° (d) 38.92°
Solution: (c); $_a\mu_w=\frac{2.4}{1.34}=\frac{\sin i}{\sin r}=\frac{\sin 60^\circ}{\sin r}\Rightarrow r=\sin^{-1}\left(\frac{\sqrt{3}}{2}\times\frac{1.34}{2.4}\right)=28.92^\circ$

37. In a common base configuration of a transistor, the base current is 0.05mA and the emitter current is 0.85 ma. What is the α of the transistor?
(a) 0.841 (b) 0.941 (c) 0.782 (d) 0.991
Solution: (b); $I_C=I_E-I_B=0.85-0.05=0.8\ mA\ \therefore \alpha=\frac{I_C}{I_E}=\frac{0.8}{0.85}=0.941$

38. An ammeter with $1\ m-\Omega$ internal resistance can measure 10 A. What would be the value of the shunt in order to measure 100 A using this ammeter.
(a) $112\times 10^{-4}\Omega$ (b) $0.0152\times 10^{-4}\Omega$ (c) $1.11\times 10^{-4}\Omega$ (d) $0.021\times 10^{-4}\Omega$
Solution: (c); $n=\frac{100}{10}=10\ \therefore S=\frac{R}{n-1}=\frac{1\times 10^{-3}}{9}=1.11\times 10^{-4}\Omega$

39. At what distance an object must be placed in front of a concave mirror with focal length of 12 cm that the image would be 3 times the object.
(a) 12.5 cm (b) 16.75 cm (c) 16.0 cm (d) 18.0 cm
Solution: (c); $m=-\frac{v}{u}=\pm 3\Rightarrow v=\pm 3u\ \therefore \pm\frac{1}{3u}+\frac{1}{u}=\frac{1}{12}\Rightarrow u=\frac{2\times 12}{3}, 16=8, 16$

40. Two 10 C charge is placed on the surface of a sphere with radius 10 cm. Find the potential at the Centre.
(a) $1.8\times 10^{12}V$ (b) $2.8\times 10^{12}V$ (c) $1.3\times 10^{12}V$ (d) $3.8\times 10^{12}V$
Solution: (a); $V=9\times 10^9\times\frac{10\times 2}{10\times 10^{-2}}=1.8\times 10^{12}\ V$

41. There capacitors 3μF, 3μF and 1μF are connected in series and supplied with a 12 V source. What is the total charge stored?
(a) 11.5μC (b) 6.55μC (c) 5.5μC (d) 12μC
Solution: (b); $\frac{1}{C_{eq}}=\frac{1}{3}+\frac{1}{3}+\frac{1}{1}\Rightarrow C_{eq}=\frac{3}{5}\mu F\ \therefore Q=C_{eq}\times 12=\frac{3}{5}\times 12=7.2\ \mu C$

42. A glass flask of volume 200 cm^3 is just filled with mercury at 20°C. How much mercury will overflow when the temperature of system is raised to 100°C? The coefficient of volume expansion of glass and mercury are $1.2\times 10^{-5}(°C^{-1})$ and $18\times 10^{-5}(°C^{-1})$, respectively.
(a) $1.82\ cm^{+3}$ (b) $2.688\ cm^{+3}$ (c) $2.32cm^{+3}$ (d) $3.688\ cm^{+3}$
Solution: (b); $V_M=V_{20}(1+18\times 10^{-5}\times 80)=200(1+18\times 10^{-5}\times 80)=202.88\ cm^3$
$V_g=200(1+1.2\times 10^{-5}\times 80)=200.192\ cm^3\ \therefore \Delta V=V_M-V_g=2.688\ cm^3$

43. An overhead electrical conductor is carrying current of 500 A. What is the magnitude of the magnetic field 1.5 m below the conductor?

(a) 78.7μT (b) 56.7μT (c) 66.7μT (d) 60.7μT

Solution: (c); $B = \frac{\mu_0 I}{2\pi a} = \frac{4\pi\times10^{-7}\times500}{2\pi\times1.5} = 66.7\times10^{-6}\ T$

44. Assume that an ideal transformer produces 9 V in the secondary if 180 V is applied to the primary. If a 20 ohm resistance is connected across the secondary, what will be the primary current?

(a) 0.0225 A (b) 0.225 A (c) 0.035 A (d) 0.054 A

Solution: (a); $I_S = \frac{9}{20}A\ ; I_P = \frac{N_S}{N_P}\times I_S = \frac{9}{180}\times\frac{9}{20} = 0.0225\ A$

45. When 5 liter water is heated by a 500 W immersion electric water for 7 minutes the temperature of water is raised from 30° C to 40°C. What is mechanical equivalent of heat?

(a) $4.2JC^{-1}$ (b) $3.2JC^{-1}$ (c) $6.2JC^{-1}$ (d) $5.2JC^{-1}$

Solution: (a); $Pt = ms\Delta\theta \Rightarrow 500\times7\times60 = S\times5\times10 \Rightarrow S = 4200$

$\therefore$ Mechanical equivalent = 4.2 J/cal

46. If 0.5A current is passed through silver nitrate solution for 3 mins and 20 s, 0.1183 g of silver is deposited. What is the chemical equivalent of silver?

(a) $2.183\times10^{-6}kg\text{-}C^{-1}$ (b) $0.183\times10^{-6}kg\text{-}C^{-1}$ (c) $1.56\times10^{-6}kg\text{-}C^{-1}$ (d) $1.183\times10^{-6}kg\text{-}C^{-1}$

Solution: (d); $W = Zit \Rightarrow Z = \frac{W}{it} = \frac{0.1183\times10^{-3}}{0.5\times(3\times60+20)} = 1.183\times10^{-6}\ kgc^{-1}$

47. The refractive index of an equilateral prism is 1.414. What is its minimum angle of deviation?

(a) 30° (b) 26° (c) 33° (d) 45°

Solution: (a); $\mu = \frac{\sin\left(\frac{A+\delta m}{2}\right)}{\sin\frac{A}{2}} \Rightarrow 1.414 = \frac{\sin\left(\frac{60+\delta m}{2}\right)}{\sin 30°} \Rightarrow \delta m = 30°$

48. The RMS value of an AC voltage is 220V and frequency is 50 Hz. What is the equation (sine form) of the voltage?

(a) 220.0 Sin(314t) (b) 311.2 Sin(314t) (c) 390.0 Sin(314t) (d) 210.0 Sin(314t)

Solution: (b); $220\sqrt{2}\ \sin(100\pi t) = 311.2\ \sin(314t)$

49. Steel wire has a length of 2m and cross-sectional area of $1mm^2$. When 20 N force is applied to the wire its length is increased by 2×10^{-4}m. What is the Young's modulus for steel?

(a) $2.5\times10^{11}N\text{-}m^{-2}$ (b) $2.25\times10^{11}N\text{-}m^{-2}$ (c) $3.5\times10^{11}N\text{-}m^{-2}$ (d) $2\times10^{11}N\text{-}m^{-2}$

Solution: (d); $Y = \frac{\frac{F}{A}}{\frac{\Delta l}{L}} = \frac{\frac{20}{1\times10^{-6}}}{\frac{2\times10^{-4}}{2}} = 2\times10^{11}\ Nm^{-2}$

50. The sound produced by a vacuum cleaner and a TV set are respectively, 75dB and 88dB. What the intensity of sound produced by both the sources?

(a) 88.21 dB (b) 78 dB (c) 98.21 dB (d) 89.2 dB

Solution: (a); $75 = 10\log\left(\frac{I_1}{I_0}\right) \Rightarrow I_1 = 10^{7.5}I_0\ ;\ I_2 = 10^{8.8}\ I_0\ \therefore I = I_1 + I_2 = 6.63\times10^8\ I_0$

$\therefore \Delta\beta = 10\log\left(\frac{I}{I_0}\right) = 88.21\ dB$

51. An electron is accelerated by 10KV potential. What is the velocity of the electron?

(a) $6.93\times10^{7}m\text{-}s^{-1}$ (b) $2.93\times10^{7}m\text{-}s^{-1}$ (c) $5.93\times10^{7}m\text{-}s^{-1}$ (d) $3.93\times10^{7}m\text{-}s^{-1}$

Solution: (c); $\frac{1}{2}mv^2 = e\times10\times10^3 \Rightarrow v = \sqrt{\frac{2e\times10\times10^3}{m}} = 5.93\times10^7\ ms^{-1}$

52. A student can read a book when placed 8 cm in front his eyes. If he wants to read the book at distance equal to the least distance of distinct vision what would be the power of the lens?

(a) -9.5D (b) -8.5D (c) -5.5D (d) -7.5D

Solution: (b); $u = .25\text{cm} = 0.25\text{m}, v = -8\text{cm} = -0.08\text{m}$

$\frac{1}{u}+\frac{1}{v}=\frac{1}{f}=P \Rightarrow P=-\frac{1}{8\times10^{-2}}+\frac{1}{25\times10^{-2}}=-8.5\text{D}$

53. How much phase difference is created when an electromagnetic wave of frequency 1000 MHz travels a distance of 10 cm?

(a) $125°$ (b) $120°$ (c) $130°$ (d) $100°$

Solution: (b); $\lambda=\frac{c}{f}=\frac{3\times10^8}{1000\times10^6}=0.3\text{m} \therefore \Delta\varphi=\frac{2\pi}{\lambda}\times\Delta x=\frac{2\pi}{0.3}\times0.1=\frac{2\pi^c}{3}=120°$

54. One gram of radium is reduced to 997.9 mg in 5 years by alpha decay. What is the half-life of radium?

(a) 1248.27 y (b) 1000.27 y (c) 1648.27 y (d) 1723.27 y

Solution: (c); $k=\frac{1}{5}\ln\left(\frac{1}{0.9979}\right)=4.2\times10^{-4}\,\text{y}^{-1}$; $t_{\frac{1}{2}}=\frac{\ln2}{k}=1648.62\,\text{y}$

55. In a Carnot's engine the temperature of the source and sink are respectively 500 K and 375 K. If the engine consumes 252×10^4 J per cycle. What is the work done per cycle?

(a) 63×10^4J (b) 79×10^4J (c) 53×10^4J (d) 89×10^4J

Solution: (a); $W=\eta\times252\times10^4=\left(1-\frac{375}{500}\right)\times252\times10^4\,\text{J}=63\times10^4\,\text{J}$

56. A proton gains its mass twice of its rest mass while moving in an energy field. What is the velocity of the proton? The rest mass of the proton is 1.67×10^{-27} kg.

(a) 6.3×10^4 m/s (b) 5.3×10^4 m/s (c) 1.73×10^4 m/s (d) 2.598×10^7 m/s

Solution: (No correct answer); $m=\frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}} \Rightarrow 1-\frac{v^2}{c^2}=\frac{1}{4}\Rightarrow v=\frac{\sqrt{3}}{2}c=2.598\times^8\ \text{ms}^{-1}$

57. An electron with velocity 4.8×10^7m/s enters in a magnetic field with flux density of 0.32 T. What is the radius of the path of the electron?

(a) 7.5×10^{-4} m (b) 10.5×10^{-4} m (c) 9.5×10^{-4} m (d) 8.5×10^{-4} m

Solution: (d); $\frac{mv^2}{r}=qvB \Rightarrow r=\frac{mv}{qB}=\frac{9.1\times10^{-31}\times4.8\times10^7}{1.6\times10^{-19}\times0.32}=8.5\times10^{-4}$ m

58. Two steel wires of length 1.0 m and 2.0 m have diameters 1.0 mm and 2.0 mm, respectively. If they are stretched by forces of 40 N and 8 N respectively, what is the ratio of their elongation?

(a) 3:7 (b) 10:1 (c) 5:12 (d) 2:5

Solution: (b); $Y_1=Y_2 \Rightarrow \frac{\frac{40}{(1\times10^{-3})^2}}{\frac{\Delta l_1}{1}}=\frac{\frac{8}{(2\times10^{-3})^2}}{\frac{\Delta l_2}{2}}\Rightarrow\frac{\Delta l_1}{\Delta l_2}=\frac{10}{1}$

59. A coil of 300 turns has self-inductance of 10 mH. If the current flowing through the coil is 3 A, what will be magnetic flux?

(a) 10^{-3} wb (b) 10^{-4} wb (c) 120^{-7} wb (d) 10^{-5} wb

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

60. One gram of water becomes 1671 cm^3 of steam when boiled at a pressure of 1 atm. The heat of vaporization at this pressure is 2256Jg^{-1}. What is the external work?

(a) 169J (b) 128J (c) 445J (d) 137J

Solution: (a); $dW=PdV=101325\times(1671-1)\times10^{-6}=169.21\,\text{J}$

Chemistry

61. A flask of volume 0.3 m^3 contains a gas 'X' at a pressure of 60 k. Pa. Another flask of volume 0.6 m^3 contains a gas 'Y' at a pressure of 84 k. Pa. Flasks are connected by a stop cock. If the temperature remains constant and the stop cock is opened, percentage volume of gas 'X' in the mixture is-

(a) 26.31% (b) 73.69% (c) 40.65% (d) 100%

Solution: (a); $P = \frac{P_1V_1+P_2V_2}{V_1+V_2} = \frac{0.3\times60+0.6\times84}{0.3+0.6} = 76\ \text{kPa}$; $V_1' = \frac{P_1V_1}{P} = \frac{0.3\times60}{76} = 0.2368\ m^3$

$\therefore \%V = \frac{V_1'}{V_1+V_2}\times100\% = \frac{0.2368}{0.9}\times100\% = 26.31\%$

62. If the mass defect of radium is 0.95 amu, the binding energy of radium is

(a) 4.5×10^{-11} cal (b) 2.5×10^{-11} cal (c) 5.5×10^{-11} cal (d) 3.4×10^{-11} cal

Solution: (d); $E = \Delta mc^2 = 0.95\times1.66\times10^{-27}\times(3\times10^8)^2\times1.42\times10^{-10}J$

$= \frac{1.42\times10^{-10}}{4.2}\text{cal} = 3.4\times10^{-11}\text{cal}$

63. The electronic configuration of an element is given as: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5 4s^1$. The position of the element in the periodic table is

(a) IA; 4^{th} (b) IB; 4^{th} (c) VIB; 4^{th} (d) VIB; 3^{rd}

Solution: (c); Cr(24) is in 4^{th} period and in Gr. VIB

64. 38.50gm of dry salt is produced after evaporation of 1silver of sea water. If the specific gravity of sea water is 1.03, then the percentage of dry substance in the sea water will be-

(a) 3.53% (b) 4.01% (c) 3.74% (d) 3.85%

Solution: (c); mass of 1 liter of sea water $= 1.03\times1000 = 1030$ gm

$\therefore$ % dry substance $= \frac{38.5}{1030}\times100\% = 3.74\%$

65. The relation between K_p and K_c for the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3$ is-

(a) $K_p = K_c(RT)^2$ (b) $K_p = K_c(RT)^{-2}$ (c) $K_p = K_c(RT)^{-1}$ (d) $K_p = K_c(RT)$

Solution: (b); $K_p = K_c(RT)^{\Delta n} = K_c(RT)^{-2}$

66. Fill in the gap: Duralumin $\Longrightarrow$ Al + ··· + Mg + Cu **[Ans: a]**

(a) Mn (b) Zn (c) Ni (d) Pb

67. How many times will the concentration of H^+ ion in a solution decrease if its P^H is changed from 2 to 5.

(a) 10000 times (b) 100 times (c) 1000 times (d) 10 times **[Ans: c]**

68. How much current is required to release 10gm of iodine from a KI solution in 1 hour?

(a) 3 A (b) 4.22 A (c) 2.11 A (d) 1.22 A

Solution: (c); $10 = \frac{127\times2}{2\times96500}\times60\times60\times I \Rightarrow I = 2.11\ A$

69. A half cell has following data: E^0 for Zn=0.758: $Zn/ZnCl_2 = (0.09M)$. The emf of the half cell at 55°C is-

(a) 1.0792 V (b) 0.792 V (c) 17.92 V (d) 20 V

Solution: (b); $E_{cell} = E°_{cell} - \frac{RT}{nF}\ln\ [Zn^{2+}] = 0.758 - \frac{8.314\times(55+273)}{2\times96500}\times\ln(0.09) = 0.792\ V$

70. The half life of a first order reaction is 28 sec. In how many seconds will the concentration of the reactant be reduced to one eight of the initial value?

(a) 28 sec (b) 56 sec (c) 84 sec (d) 223 sec

Solution: (c); $t = \frac{28}{\ln2}\times\ln 8 = 84$ sec

71. What is the hybridization state of Xe in XeF_2? [Ans: a]
(a) sp^3d (b) sp^3 (c) d^2sp^3 (d) fsp^2

72. What is the mostly used reagent in the analysis of inorganic salt? [Ans: c]
(a) CuS (b) $BaSO_4$ (c) H_2S (d) $AgNO_3$

73. The reaction: $3\ Cl^-(aq) \rightarrow 2Cl^-(aq) + ClO_3^{-1}(aq)$ is knows as- [Ans: b]
(a) Dissociation (b) Disproportion (c) Displacement (d) Oxidation-Reduction

74. Which one of the following produces urea after reacting with ammonia [Ans: a]
(a) CO_2 (b) H_2O (c) CH_4 (d) C_6H_6

75. Following of which is produced after reacting CH_3I with metallic sodium?
(a) C_3H_8 (b) C_2H_6 (c) C_2H_4 (d) C_3H_6
Solution: (b); $CH_3I + 2Na \xrightarrow[ether]{dry} CH_3 - CH_3 + 2NaI$

76. Which of the following regent will not respond to iodoform test? [Ans: d]
(a) CH_3CH_2OH (b) $CH_3CHOHCH_3$ (c) $CH_3COCH_2CH_3$ (d) $CH_3CH_2CH_2OH$

77. Which of the following product is formed when ethanol is oxidized by a strong oxidizing agent? [Ans: b]
(a) CH_3CHO (b) CH_3COOH (c) $CH_3CH_2OOCCH_3$ (d) CH_3CH_3

78. Which of the following compound forms red precipitate when treated with Fehling's solution? [Ans: c]
(a) RCH_2X (b) CH_3CH_2OH (c) RCH_2CHO (d) RCOOH

79. Which functional group is meta directing? [Ans: d]
(a) $-NH_2$ (b) $-OH$ (c) $-Cl$ (d) $-NO_2$

80. Natural rubber is a polymer, its monomer is? [Ans: c]
(a) Propylene (b) Ethylene (c) Isoprene (d) Styrene

English

Question 81-86: Choose the correct word(s) for each blank that best fits the meaning of the sentences as a whole.

81. A child should not be ___ as being either very shy or over aggressive. [Ans: a]
(a) categorized (b) instructed (c) intoned (d) distracted

82. Despite assorted effusion to the contrary, there is no necessary link between scientific skill and humanism, and quite possibly, there may be something of a ------- between them. [Ans: a]
(a) dichotomy (b) congruity (c) reciprocity (d) generosity

83. Ecology, like economics, concerns itself with the movement of valuable --------- through a complex network of producers and consumers. [Ans: a]
(a) nutrients (b) dividends (c) communications (d) artifacts

84. It would be difficult for one so------ to be led to believe that all men are equal and that we must disregard race, color and creed. [Ans: d]
(a) tolerant (b) democratic (c) broadminded (d) intolerant.

85. If the books ---------- last week, why haven't they been placed on the shelf? [Ans: d]
(a) have been cataloged (b) would have been cataloged
(c) was cataloged (d) were cataloged

86. The helium-filled balloon---------- [Ans: a]
(a) rose in the air. (b) was rising in the air. (c) was in the air. (d) rose into the air.

87. ANGLE : DEGREE [Ans: a]
(a) area : square inch (b) milk : quart (c) society : classes (d) letter : alphabet

88. CONFIRMED : INVETERATE [Ans: c]
(a) knowledge : supposed (b) financial : bankrupt (c) immature : callow (d) credible : incredible

89. SAW : CARPENTER [Ans: a]
(a) Scissors : tailor (b) Wagon : farmer (c) Brush : painter (d) Typewriter : author

90. LURK : WAIT [Ans: c]
(a) boost : elevate (b) deplete : drain (c) abscond : depart (d) bilk : cheat

91. NEEDLE : KNIT [Ans: c]
(a) bait : fish (b) match : fire (c) loom : weave (d) soap : wash

Questions: 92-96

Marie Curie was one of the most accomplished scientists in history. Together with her husband, Pierre, she discovered radium, an element widely used for treating cancer, and studied uranium and other radioactive substances. Pierre and Marie's amicable collaboration later helped to unlock the secrets of the atom.

Marie was born in 1867 in Warsaw, Poland, where her father was a professor of physics. At the early age, she displayed a brilliant mind and a blithe personality. Her great exuberance for learning prompted her to continue with her studies after high school. She became disgruntled, however, when she learned that the university in Warsaw was closed to women. Determined to receive a higher education, she defiantly left Poland and in 1891 entered the Sorbonne, a French university, where she earned her master's degree and doctorate in physics.

Marie was fortunate to have studied at the Sorbonne with some of the greatest scientists of her day, one of whom was Pierre Curie. Marie and Pierre were married in 1895 and spent many productive years working together in the physics laboratory. A short time after they discovered radium, Pierre was killed by a horse-drawn wagon in 1906. Marie was stunned by this horrible misfortune and endured heartbreaking anguish. Despondently she recalled their close relationship and the joy that they had shared in scientific research. The fact that she had two young daughters to raise by herself greatly increased her distress.

Curie's feeling of desolation finally began to fade when she was asked to succeed her husband as a physics professor at the Sorbonne. She was the first woman to be given a professorship at the world-famous university. In 1911 she received the Nobel Prize in chemistry for isolating radium. Although Marie Curie eventually suffered a fatal illness from her long exposure to radium, she never became disillusioned about her work. Regardless of the consequences, she had dedicated herself to science and to revealing the mysteries of the physical world.

92. The Curies ___ collaboration helped to unlock the secrets of the atom. [Ans: a]
(a) friendly (b) competitive (c) courteous (d) industrious

93. Marie had a bright mind and a ____ personality. [Ans: b]
(a) strong (b) lighthearted (c) humorous (d) strange

94. Marie ____ by leaving Poland and traveling to France to enter the Sorbonne. [Ans: a]
(a) challenged authority (b) showed intelligence (c) behaved (d) was distressed

95. ____ she remembered their joy together. [Ans: a]
(a) Dejectedly (b) Worried (c) Tearfully (d) Happily

96. Even though she became fatally ill from working with radium, Marie Curie was never ____. [Ans: c]
(a) troubled (b) worried (c) disappointed (d) sorrowful

Question 97-100: Choose the word or phrase which is most nearly opposite in meaning to the given word.

97. TOUT [Ans: a]
(a) cast aspersions on (b) deny the relevance of (c) withhold consent (d) misrepresent

98. QUOTA: [Ans: d]
(a) Anonymous remark (b) decisive action (c) debatable issue (d) unlimited number

99. TURBULENCE: [Ans: b]
(a) immunity (b) tranquility (c) meditation (d) coordination

100. OPPORTUNIST [Ans: a]
(a) Man of principle (b) fatalist (c) fledgling (d) colleague