IUT Admission Test 2014-2015

English

01. Peripheral is most nearly opposite in meaning to- [Ans: b]
(a) Redial (b) Central (c) Concrete (d) Axial

02. Disingenuous is most nearly opposite in meaning to- [Ans: a]
(a) Transparent (b) Parched (c) Blank (d) Ingratiating

03. Untoward is most nearly opposite in meaning to- [Ans: c]
(a) Proactive (b) Abstemious (c) Expected (d) Egregious

04. Unequivocal is most nearly opposite in meaning to- [Ans: b]
(a) Multifaceted (b) Ambiguous (c) Unanimous (d) Miniscule

05. Turbid is most similar in meaning to- [Ans: b]
(a) Shiny (b) Murky (c) Pellucid (d) Agitated

06. Potable is most similar in meaning to- [Ans: c]
(a) Bland (b) Unsavory (c) Drinkable (d) Distilled

07. Undermine is most similar in meaning to- [Ans: d]
(a) Impose (b) Apprehend (c) Glorify (d) Weaken

08. Destitute is most similar in meaning to- [Ans: a]
(a) Impoverished (b) Desolate (c) Affluent (d) Meticulous

Read the following sentences and try to choose the best definition for the underlined and italicized word by searching for context clues in the sentence.

09. You cannot become a certified teacher without completing the prerequisite student teaching assignment. [Ans: a]
(a) Required (b) Optional (c) Preferred (d) Advisable

10. Excited about winning the award, Marium walked up to the podium and delivered an animated acceptance speech. [Ans: d]
(a) Abbreviated (b) Courteous (c) Reserved (d) Lively

11. The intermittent rain soaked the garden many different times during the day. [Ans: b]
(a) Protracted (b) Periodic (c) Incredulous (d) Light

12. The air in the rainforest was humid, making the heat seem even more somthering than before. [Ans: b]
(a) Hot (b) Damp (c) Hazy (d) Volatile

Questions 13, 14 and 15 are based on the following paragraph.

The Sami are an indigenous people living in the northern part of Norway, Sweden, Finland and Russia's Kola peninsula. Originally, the Sami religion was animistic; that is, for them, nature and natural objects had a conscious life, a spirit. Therefore, one was expected to move quietly in the wilderness and avoid making a disturbance. Out of courtesy to these spirits. Ghengis Khan is said to have declared that the Sami were one people he would never try to fight again. Because the Sami were not warriors and did not believe in war, they simply disappeared in ties of conflict. They were known as "peaceful retreaters."

13. Based on the tone of the passage, which of the following words best describes the author's attitude toward the Sami people? [Ans: c]
(a) Admiring (b) Pitying (c) Contemptuous (d) Patronizing

14. The closest meaning of the underlined word animistic, as it is used in the passage, is- [Ans: b]
(a) The irrational belief in supernatural beings.
(b) The belief that animals and plants have souls.
(c) The belief that animals are gods.
(d) The primitive belief that people can be reincarnated as animals.

15. What is the meaning of the underlined word courtesy as it is used in the passage? [Ans: c]
(a) Timidity (b) Caution (c) Respect (d) Fear

16. If $i^2 = -1$, then the value of $\frac{2-3i}{2i}$ =?

(a) $-\frac{3}{2}+i$ (b) $\frac{3}{2}+i$ (c) $-\frac{3}{2}-i$ (d) None of these

Solution: (c); $\frac{2-3i}{2i} = -\frac{3}{2}+\frac{1}{i} = -\frac{3}{2}-i$

17. If A and B are two sets, and the complements of A and B are A' and B', respectively, then $A' - B'$ is-

(a) $A - B$ (b) $B - A$ (c) $A \cap B$ (d) $A \cap B'$

Solution: (b); $A' - B' = A' \cap (B')' = A' \cap B = B - A$

18. The height, in feet, to which a golf ball rises when it is short upward from ground level is described by $h(t) = -16t^2 + 48t$. Where, t is the time elapsed in seconds. Use the discriminant to determine whether the golf ball can reach a height of 32 feet or not, and if it can then how many times it reaches that height.

(a) Not possible (b) Possible to reach the height 2 times

(c) Possible only once (d) None of these

Solution: (b); $32 = -16t^2 + 48t \Rightarrow t^2 - 3t + 2 = 0$

Discriminant $= \sqrt{(-3)^2 - 4.2.1} = 1 > 0$ ∴ The golf ball can reach a height of 32 feet. The equation has 2 solutions. Therefore, it is possible to reach the height 2 times.

19. If $\begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix} = -6$ then $\begin{vmatrix} 3a & 3b & 3c \\ -d & -e & -f \\ 4g & 4h & 4i \end{vmatrix}$ =?

(a) 72 (b) -72 (c) 6 (d) 24

Solution: (a); $\begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix} = -6 \Rightarrow \begin{vmatrix} 3a & 3b & 3c \\ -d & -e & -f \\ 4g & 4h & 4i \end{vmatrix}$

$= (-6) \times 3 \times (-1) \times 4 = 72\ [r_1' = 3r_1, r_2' = -r_2, r_3' = 4r_3]$

20. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $AB = \begin{bmatrix} 6 & 7 \\ 16 & 17 \end{bmatrix}$, then B =?

(a) $\begin{bmatrix} 4 & 2 \\ 1 & 3 \end{bmatrix}$ (b) $\begin{bmatrix} 4 & 3 \\ 1 & 2 \end{bmatrix}$ (c) $\begin{bmatrix} 4 & 1 \\ 3 & 2 \end{bmatrix}$ (d) $\begin{bmatrix} 4 & 3 \\ 2 & 1 \end{bmatrix}$

Solution: (b); $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \Rightarrow A^{-1} = -\frac{1}{2}\begin{bmatrix} 4 & -2 \\ -3 & 1 \end{bmatrix} = \begin{bmatrix} -2 & 1 \\ \frac{3}{2} & -\frac{1}{2} \end{bmatrix}$

$B = A^{-1} \cdot AB = \begin{bmatrix} -2 & 1 \\ \frac{3}{2} & -\frac{1}{2} \end{bmatrix}\begin{bmatrix} 6 & 7 \\ 16 & 17 \end{bmatrix} = \begin{bmatrix} 4 & 3 \\ 1 & 2 \end{bmatrix}$

21. Determine whether one or more of the following situations is/are permutations(s): [Ans: d]

(i) Creating a password for a computer using any 8 alphabet letters.

(ii) Determining how many different ways you can elect a Chairman and Co-Chairman of a committee from a group of 10 people.

(iii) Voting to allow 10 new members to join a club when there are 25 persons who are interested to join the club.

(iv) Finding different ways to arranges a line-up for batsmen on a cricket team.

(v) Choosing 3 toppings for a pizza if there are 9 choices.

(a) i (b) iii (c) i, iv (d) i, ii, iv

22. Suppose 7 students are staying in a room of a hostel and they are allotted 7 beds placed one after another. Among them, X does not want a bed next to Y, because he snores. Then, in how many ways, can you allot the beds?

(a) 600 (b) 1200 (c) 2400 (d) 3600

Solution: (d); Considering X and Y to be allotted beds next to each other, the number of ways is $6! \times 2!$.
$\therefore$ Number of ways to allot the beds where X and Y are not next to each other $= 7! - 6! \times 2! = 3600$

23. The coefficient of x^n in the expansion of $\frac{x}{(1-4x)(1-5x)}$ is-

(a) $4^{n+1} - 1$ (b) $4^n + 5^n$ (c) $5^n - 4^n$ (d) $5^{n+1} - 1$

Solution: (c); $\frac{x}{(1-4x)(1-5x)} = -\frac{1}{1-4x} + \frac{1}{1-5x} = (1-5x)^{-1} - (1-4x)^{-1}$ $\therefore$ Coefficient of $x^n = 5^n - 4^n$

24. Find the sum of the first n terms of the series: $1 + \frac{5}{2.3}2 + \frac{10}{3.4}2^2 + \frac{17}{4.5}2^3 + \cdots$

(a) $\frac{2^{n+1}}{n+1}$ (b) $\frac{n2^n}{n+1}$ (c) $\frac{2^{n+1}}{3}$ (d) $\frac{n2^{n+1}}{3(n-1)}$

Solution: (b); $u_n = \frac{n^2+1}{n(n+1)} \cdot 2^{n-1} = \left\{1 - \frac{n-1}{n(n+1)}\right\}2^{n-1} = 2^{n-1} - \left(\frac{2}{n+1} - \frac{1}{n}\right)2^{n-1}$

$= 2^{n-1} - \frac{2^n}{n+1} - \frac{2^{n-1}}{n} = 2^{n-1} - (v_n - v_{n-1})$

Therefore, $s_n = \sum_{n=1}^{n} 2^{n-1} - (v_n - v_0) = 2^n - 1 - \frac{2^n}{n+1} + 1 = \frac{n2^n}{n+1}$

25. If $2\cos^2\theta - \sin\theta = 1$ then the value of θ is-

(a) $\frac{\pi}{6}$ and $\frac{5\pi}{6}$ (b) $\frac{3\pi}{2}$ (c) Both a and b (d) None of these

Solution: (c); $2\cos^2\theta - \sin\theta = 1 \Rightarrow 2\sin^2\theta + \sin\theta - 1 = 0 \Rightarrow \sin\theta = \frac{1}{2}, -1 = \sin\frac{\pi}{6}, \sin\left(-\frac{\pi}{2}\right)$

$\therefore \theta = n\pi + (-1)^n\frac{\pi}{6}, n\pi + (-1)^n\left(-\frac{\pi}{2}\right)$ putting $n = 0, 1$ we get, $\theta = \frac{\pi}{6}, -\frac{\pi}{2}, \frac{5\pi}{6}, \frac{3\pi}{2}$

26. $\tan^{-1}x + \tan^{-1}\frac{1-x}{1+x} = ?$

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

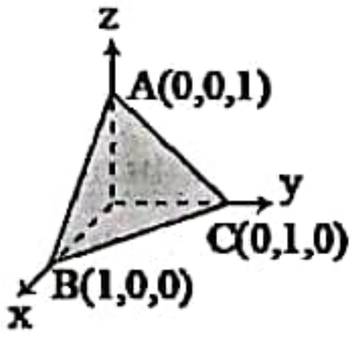
Solution: (c); $\tan^{-1}x + \tan^{-1}\frac{1-x}{1+x} = \tan^{-1}x + \tan^{-1}1 - \tan^{-1}x = \frac{\pi}{4}$

27. For triangle ABC, $a = 2x + 3, b = x^2 + 3x + 3$ and $c = x^2 + 2x$. The largest angle of the triangle is-

(a) 110° (b) 120° (c) 135° (d) 160°

Solution: (b); Let, $x = 1$ $\therefore a = 5, b = 7, c = 3$ $\therefore$ Largest angle $= \cos^{-1}\frac{3^2+5^2-7^2}{2.3.5} = 120^\circ$

28. Find a unit vector normal to the plane ABC as shown in the figure given below. Note that a vector normal to the plane will be perpendicular to any two of AB, AC and BC vectors.



(a) $\frac{1}{\sqrt{6}}(\hat{i} + 2\hat{j} + \hat{k})$ (b) $\frac{1}{\sqrt{3}}(\hat{i} + \hat{j} + \hat{k})$ (c) $\frac{1}{\sqrt{2}}(\hat{i} + \hat{k})$ (d) $\frac{1}{\sqrt{2}}(\hat{i} + \hat{j})$

Solution: (b); Let, a normal vector on the plane be $x\hat{i} + y\hat{j} + z\hat{k}$. This is perpendicular to $\overrightarrow{AB}$ and $\overrightarrow{BC}$.
$\therefore \overrightarrow{AB} \cdot (x\hat{i} + y\hat{j} + z\hat{k}) = 0 \Rightarrow (\hat{i} - \hat{k})(x\hat{i} + y\hat{j} + z\hat{k}) = 0 \Rightarrow x = z$
$\overrightarrow{BC} \cdot (x\hat{i} + 2\hat{j} + 2\hat{k}) = 0 \Rightarrow (-\hat{i} + \hat{j}) \cdot (x\hat{i} + y\hat{j} + z\hat{k}) = 0 \Rightarrow x = y$ $\therefore x = y = z$
So the unit vector normal to the surface is $= \frac{x\hat{i}+y\hat{i}+z\hat{k}}{\sqrt{x^2+y^2+z^2}} = \frac{x(\hat{i}+\hat{j}+\hat{k})}{\sqrt{3x^2}} = \frac{1}{\sqrt{3}}(\hat{i} + \hat{j} + \hat{k})$

29. Assume that the point A(5,6) is a reflection of the point B(−1,8) in a line, when a mirror is placed along the line. The equation of the line is-

(a) $3x - y - 23 = 0$ (b) $x + 3y - 23 = 0$ (c) $3x - y + 1 = 0$ (d) $x + 3y - 1 = 0$

Solution: (c); Straight line passing through A(5,6) & B(−1,8) is,

$\frac{x-5}{5+1} = \frac{y-6}{6-8} \Rightarrow 2x + 6y - 46 = 0 \Rightarrow x + 3y - 23 = 0$

Perpendicular to this line, the equation of any straight line would be: $3x - y + k = 0$

For the mirror, the line passes through $\left(\frac{5-1}{2}, \frac{6+8}{2}\right)$ or (2, 7)

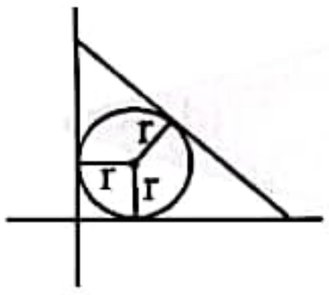
$\therefore 6 - 7 + k = 0 \Rightarrow k = 1 \ \therefore 3x - y + 1 = 0$

30. A circle whose center is in the first quadrant and touches the x and y axes, and the line $3x - 4y = 12$, the equation of the circle is-

(a) $x^2 + y^2 + 4x + 4y - 1 = 0$ (b) $x^2 + y^2 - 6x - 6y + 9 = 0$

(c) $x^2 + y^2 + 4x - 6y + 4 = 0$ (d) $x^2 + y^2 - 6x + 4y + 4 = 0$

Solution: (b);



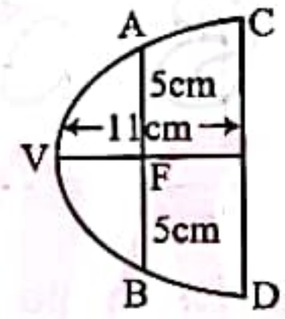
The equation of the circle is, $x^2 + y^2 + 2(-r)x + 2(-r)y + r^2 = 0$

The point (r,r) has a distance of r from the straight line $3x - 4y = 12$

$\therefore \frac{|3r-4r-12|}{5} = r \Rightarrow r + 12 = \pm 5r \Rightarrow r = 3, -2$ (not possible)

$\therefore$ The equation of the circle is, $x^2 + y^2 - 6x - 6y + 9 = 0$

31. A cross-section of a parabolic reflector is shown in the figure below. The light source is located at the focus of the parabola and the opening of the focus is 10cm. The equation of the parabola is-



(a) $y^2 = 22x$ (b) $y^2 = 5x$ (c) $y^2 = 10x$ (d) $y^2 = 17x$

Solution: (c); Length of latus rectum = 10cm $\therefore$ The equation of the parabola is, $y^2 = 10x$

32. A man made satellite orbits the earth in an elliptical path whose center is at the center of the earth. If the altitude of the satellite ranges from 1000 to 2000 miles, find the equation of its path. The radius of the earth is approximately 4000 miles.

(a) $\frac{x^2}{(2000)^2} + \frac{y^2}{(1000)^2} = 1$ (b) $\frac{x^2}{(4000)^2} + \frac{y^2}{(3000)^2}$ (c) $\frac{x^2}{0.9\times10^7} + \frac{y^2}{0.4\times10^7} = 1$ (d) $\frac{x^2}{3.6\times10^7} + \frac{y^2}{2.5\times10^7} = 1$

Solution: (d); $a = 4000 + 2000 = 6000, b = 4000 + 1000 = 5000$

$\therefore \frac{x^2}{(6000)^2} + \frac{y^2}{(5000)^2} = 1 \Rightarrow \frac{x^2}{3.6\times10^7} + \frac{y^2}{2.5\times10^7} = 1$

33. An architect's design for a building includes some pillars in the shape of hyperbolas. The curve can be modeled by the equation- $\frac{x^2}{0.0625} - \frac{y^2}{0.1875} = 1$

Where units are in meters. If the heights of the pillars are same as height of the latus rectum of the hyperbola, find the diameter of the top of the pillars.

(a) 1 meter (b) 0.5 meter (c) 0.25 meter (d) 2 meters

Solution: (a); The equation of the hyperbola given is, $\frac{x^2}{0.25^2}-\frac{y^2}{\left(\frac{\sqrt{3}}{4}\right)^2}=1$, $a=\frac{1}{4}$, $b=\frac{\sqrt{3}}{4}$

$\therefore$ length of the latus rectum $=\frac{2b^2}{a}=\frac{3}{2}m$

Now, $\frac{x^2}{0.25^2}-\frac{0.75^2}{\left(\frac{\sqrt{3}}{4}\right)^2}=1\Rightarrow x=0.5m$ $\therefore$ diameter $=2x=1m$

34. Which of the following statements is / are correct? [Ans: d]

(i) The number L is the limit of f(x) as $x\to a$ if, given any $\in>0$, there exists a value of x for which $|f(x)-L|<\in$.

(ii) The number L is the limit of f(x) as $x\to a$, if for every number $\epsilon>0$, there exists a corresponding number $\delta>0$ such that for all x, if $0<|x-a|<\delta$, then $|f(x)-L|<\epsilon$.

(iii) The number L is the limit of f(x) as $x\to a$, if f(x) gets closer to L as x approaches a.

(iv) The number L is the limit of f(x) as $x\to a$, if the values of f(x) can be made as close as we like to L by making x sufficiently close to a (but not equal to a).

(a) ii (b) iii (c) ii, iv (d) All are correct

35. The value of $\lim_{x\to\infty}(\sqrt{x^2+1}-x)$ is-

(a) 0 (b) ∞ (c) $-\infty$ (d) 1

Solution: (a); $\lim_{x\to\infty}(\sqrt{x^2+1}-x)=\lim_{x\to\infty}\frac{(\sqrt{x^2+1}+x)(\sqrt{x^2+1}-x)}{\sqrt{x^2+1}+x}=\lim_{x\to\infty}\frac{x^2+1-x^2}{\sqrt{x^2+1}+x}=\lim_{x\to\infty}\frac{1}{\sqrt{x^2+1}+x}=0$

36. $\frac{d}{dx}\sin\left(2\tan^{-1}\sqrt{\frac{1-x}{1+x}}\right)=?$

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

Solution: (b); $\frac{d}{dx}\sin\left(2\tan^{-1}\sqrt{\frac{1-x}{1+x}}\right)=\frac{d}{dx}\sin\left[\tan^{-1}\left(\frac{2\sqrt{\frac{1-x}{1+x}}}{1-\frac{1-x}{1+x}}\right)\right]=\frac{d}{dx}\sin\left[\tan^{-1}\left(\frac{2\sqrt{1-x^2}}{2x}\right)\right]$

$=\frac{d}{dx}\sin[\sin^{-1}(\sqrt{1-x^2})]=\frac{d}{dx}(\sqrt{1-x^2})=\frac{-2x}{2\sqrt{1-x^2}}=-\frac{x}{\sqrt{1-x^2}}$

37. In a dc circuit consisting of two resistors in series, the power P delivered to resistor R_2 is $=\frac{V^2R_2}{(R_1+R_2)^2}$.

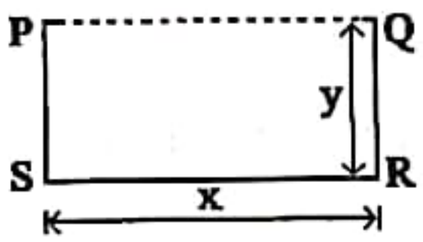
If V and R_1 are constants, what is the value of R_2 that produces a maximum power in this resistor?

(a) $R_2=R_1$ (b) $R_2=-R_1$ (c) $R_2=2R_1$ (d) $R_2=2R_1$

Solution: (a); $\frac{dP}{dR_2}=\frac{(R_1+R_2)^2\cdot V^2-V^2R_2\cdot 2(R_1+R_2)}{(R_1+R_2)^4}=0\Rightarrow(R_1+R_2)^2-2R_2(R_1+R_2)=0$

$\Rightarrow R_1^2+2R_1R_2+R_2^2-2R_1R_2-2R_2^2=0\Rightarrow R_1^2=R_2^2\Rightarrow R_2=R_1$

38. A farmer has an adjustable electric fence that is 100m long. He uses this fence to enclose a rectangular area on three sides as show in the figure given below. The fourth side is kept open. The maximum area that he can enclose is-



(a) $1050m^2$ (b) $1200m^2$ (c) $1250m^2$ (d) None of these

Solution: (c); $l=100=x+2y$ $\therefore A=xy=(100-2y)y=100y-2y^2$

Now, $\frac{dA}{dy}=100-4y=0\Rightarrow y=25$ $\therefore A_{max}=100\times25-2\times(25)^2=1250m^2$

39. $\int e^{-2x}\tan(e^{-2x})d =?$

(a) $\frac{1}{2}\ln\tan(e^{-2x})+C$ (b) $\frac{1}{2}\ln\sec(2^{-2x})+C$ (c) $-\frac{1}{2}\ln\cos(e^{-2x})+C$ (d) Both a and c

Solution: (No answer); $\int e^{-2x}\tan(e^{-2x})\,dx = \frac{1}{2}\int 2e^{-2x}\frac{\sec(e^{-2x})\tan(e^{-2x})}{\sec(e^{-2x})}dx = -\frac{1}{2}\ln[\sec(e^{-2x})]+C$

40. $\int_0^{\ln\sqrt{2}}\frac{1+\cos(e^{-2x})}{e^{2x}}dx =?$

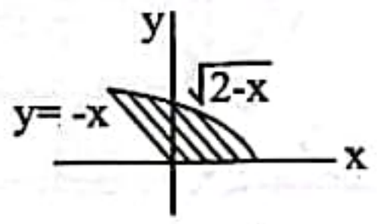
(a) $\frac{1}{8}+\frac{1}{2}\left(\sin 1-\sin\frac{1}{4}\right)$ (b) $\frac{1}{4}+\frac{1}{2}\left(\sin 1-\sin\frac{1}{2}\right)$ (c) $\frac{3}{8}+\frac{1}{2}\left(\sin 1-\sin\frac{1}{4}\right)$ (d) $\frac{3}{4}+\frac{1}{2}\left(\sin 1-\sin\frac{1}{2}\right)$

Solution: (b); $\int_0^{\ln\sqrt{2}}\frac{1+\cos(e^{-2x})}{e^{2x}}dx = \int_0^{\ln\sqrt{2}}e^{-2x}\,dx+\int_0^{\ln\sqrt{2}}e^{-2x}\cos(e^{-2x})dx$

$= \left[\frac{e^{-2x}}{-2}\right]_0^{\ln\sqrt{2}} - \frac{1}{2}[\sin(e^{-2x})]_0^{\ln\sqrt{2}} = \left[\frac{e^{-2x}}{2}\right]_{\ln\sqrt{2}}^{0} + \frac{1}{2}[\sin(e^{-2x})]_{\ln\sqrt{2}}^{0}$

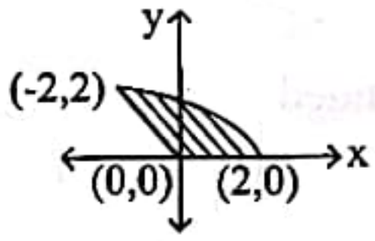
$= \left[\frac{1}{2}-\frac{1}{4}\right]+\frac{1}{2}\left[\sin 1-\sin\frac{1}{2}\right] = \frac{1}{4}+\frac{1}{2}\left[\sin 1-\sin\frac{1}{2}\right]$

41. Find the area of the region enclosed by $y=\sqrt{2-x}$ and $y=-x$ as shown in the figure given below?



(a) $\frac{22}{3}$ (b) $\frac{10}{3}$ (c) $\frac{9}{2}$ (d) None of these

Solution: (b); $y=\sqrt{2-x}, y=-x$

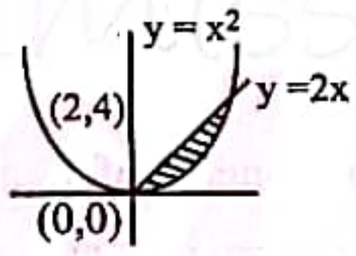


$A=\int_{-2}^{2}\left(\sqrt{2-x}\right)dx - \frac{1}{2}\times 2\times 2 = \frac{16}{3}-2 = \frac{10}{3}$

42. Find the area bounded by the curves $y=x^2$ and $y=2x$.

(a) $\frac{4}{3}$ (b) $\frac{5}{3}$ (c) $\frac{3}{5}$ (d) None of these

Solution: (a); $A = \left|\int_0^2(x^2-2x)\,dx\right| = \left|\left[\frac{x^3}{3}-x^2\right]_0^2\right| = \left|\frac{8}{3}-4\right| = \frac{4}{3}$



43. $\int x^2\,\text{cosec}\,x^3dx =?$

(a) $\frac{1}{3}\ln\left(\cot\frac{x^3}{2}\right)+C$ (b) $\frac{1}{3}\ln\left(\tan\frac{x^3}{2}\right)+C$ (c) $\ln\left(\tan\frac{x^3}{2}\right)+C$ (d) $\ln\left(\cot\frac{x^3}{2}\right)+C$

Solution: (b); $\int x^2\,\text{cosec}\,x^3\,dx = \frac{1}{3}\int 3x^2\,\text{cosec}\,x^3\,dx = \frac{1}{3}\ln\left(\tan\frac{x^3}{2}\right)+C$

44. In a flood hit area relief supplies are dropped in a 20kg bag from a helicopter. The helicopter is flying parallel to the ground at 200km/h and is 80m above the ground when the package is dropped. How much horizontal distance does the bag travel before it hits the ground? [Assume $g=10ms^{-2}$]

(a) $\frac{2}{9}$km (b) $\frac{32}{9}$km (c) $\frac{2}{5}$km (d) $\frac{32}{5}$km

Solution: (a); $T=\sqrt{\frac{2h}{g}}=\sqrt{\frac{2\times 80}{10}}=4s \;\therefore s=V_0T=200\times\frac{4}{3600}\text{km}=\frac{2}{9}\text{km}$

45. An Olympic long jumper leaves the ground at an angle of 23^o and travels through the air for a horizontal distance of 8.7m before landing. The takeoff speed of the jumper is- [Assume $g=9.8ms^{-2}$]

(a) $19.8ms^{-1}$ (b) $14.7ms^{-1}$ (c) $17.3ms^{-1}$ (d) $10.9ms^{-1}$

Solution: (d); $R=\frac{u^2\sin 2\alpha}{g}\Rightarrow 8.7=\frac{u^2\sin 46^o}{9.8}\Rightarrow u=10.9ms^{-1}$

46. A ball is thrown vertically upwards with speed $7.7ms^{-1}$ from the top of a sheer cliff of height 21m. The time taken by the ball to reach the foot of the cliff is- [Assume $g = 9.8ms^{-2}$]

(a) $\frac{10}{7}s$ (b) $\frac{11}{7}s$ (c) 5s (d) 3s

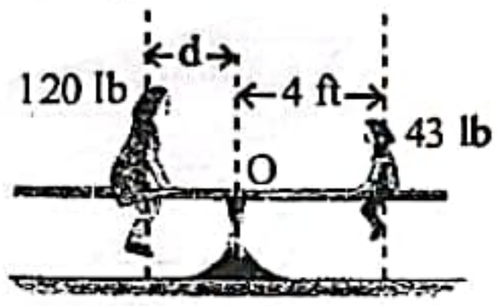
Solution: (d); $h = -7.7t + \frac{1}{2} \times 9.8 \times t^2 \Rightarrow 4.9t^2 - 7.7t - 21 = 0 \Rightarrow t = 3s, -\frac{10}{7}s \therefore t = 3s$

[$\because t = -\frac{10}{7}s$ is not acceptable]

47. From the set of all families with two children, a child is selected at random and is found to be a girl. The probability that the second child of this family is also a girl is- [Ans: c]

(a) $\frac{1}{4}$ (b) $\frac{1}{3}$ (c) $\frac{1}{2}$ (d) None of these

48. A mother would like to balance her son on the teetor totter as shown in the figure give below. Calculate the distance d so that the system is in equilibrium.



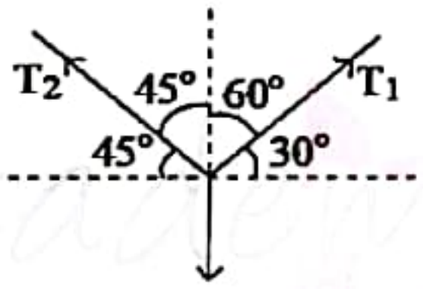
(a) 0.7 ft (b) 1.2 ft (c) 0.9 ft (d) 1.4 ft

Solution: (d); $120d = 4 \times 43 \Rightarrow d = \frac{4 \times 43}{120} = 1.4$ ft

49. A mass of 8 kgs hangs in equilibrium, suspended by two light, inelastic strings making angles of 30° and 45° with the horizontal. Calculate the tensions in the two strings.

(a) 59.6N and 72.4N (b) 57.4N and 70.3N (c) 53.2N and 68.3N (d) None of these

Solution: (b);

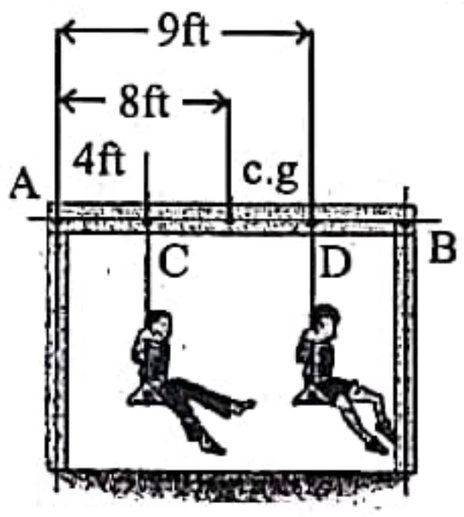


$W = 8 \times 9.8N$

Resolving the components of W along T_1 and T_2,

$T_1 = \frac{W \sin 45^\circ}{\sin(60^\circ + 45^\circ)} = 57.4N$; $T_2 = \frac{W \sin 60^\circ}{\sin(60^\circ + 45^\circ)} = 70.3N$

50. Two children are swinging from a 12 ft long jungle gym that weights 50 lbs as shown in the figure given below. The child at C weights 70 lbs and the child at D weights 60 lbs. Calculate the reactions for the pin at A and the roller at B. [In the figure, c.g. refers to center of gravity.]



(a) 78 lbs 120 lbs (b) 78 lbs and 112 (c) 68 lbs and 112 lbs (d) 68 lbs and 102 lbs

Solution: (a); Taking the moments of all forces about A

We get, $B \times 12 - 70 \times 4 - 8 \times 50 - 60 \times 9 = 0 \Rightarrow B = 101.67 \approx 102$ lbs

$\therefore A = 70 + 50 + 60 - B = 78.3 \approx 78$ lbs

Physics

51. A tennis ball is thrown straight up with an initial speed of $22.5ms^{-1}$. It is caught at the same distance above the ground. How high does the ball rise?
(a) 38.5m (b) 25.8m (c) 20.8m (d) 16.5m
Solution: (b); $h = \frac{v^2}{2g} = \frac{22.5^2}{2\times9.8} = 25.8m$

52. You and your friend each drive 50.0km. You travel at $90.0kmh^{-1}$; your friend travels at $95.0kmh^{-1}$; How long will your friend wait for you at the end of the trip?
(a) 1.75 min (b) 3.75 min (c) 2.25 min (d) 1.35 min
Solution: (a); $t = \left(\frac{50}{90} - \frac{50}{95}\right) \times 60 = 1.75$ min

53. On a planet with an unknown value of 'g' the period of a 0.65m long pendulum is 2.8s. What is the value of 'g' for this planet?
(a) $1.27ms^{-2}$ (b) $2.45ms^{-2}$ (c) $3.27ms^{-2}$ (d) $4.27ms^{-2}$
Solution: (c); $T^2 = 4\pi^2\frac{L}{g} \Rightarrow 2.8^2 = 4\pi^2\frac{0.65}{g} \Rightarrow g = 3.27ms^{-2}$

54. A 75kg boy and a 60kg girl use an elastic rope while engaged in a tug of war on a frictionless surface. If the acceleration of the girl toward the boy is $3.0ms^{-2}$, what is the magnitude of acceleration of the boy toward the girl?
(a) $2.75ms^{-2}$ (b) $5.6ms^{-2}$ (c) $3.25ms^{-2}$ (d) $2.40ms^{-2}$
Solution: (d); $m_1a_1 = m_2a_2 \Rightarrow 60 \times 3 = 75\,a_2 \Rightarrow a_2 = 2.4ms^{-2}$

55. A 615kg racing car completes one lap in 14.3s around a circular track with a radius of 50.0m. The car moves at constant speed. What is the centripetal acceleration of the car?
(a) $9.65ms^{-2}$ (b) $9.80ms^{-2}$ (c) $10.25ms^{-2}$ (d) $9.25ms^{-2}$
Solution: (a); $a = \omega^2 r = \left(\frac{2\pi}{14.3}\right)^2 \times 50 = 9.65ms^{-2}$

56. The moon has a period of 27.3 days and has a mean distance of 3.90×10^5km from the centre of Earth. What is the period of an artificial satellite that is in an orbit 6.70×10^3km from the centre of Earth?
(a) 90.52 min (b) 78.52 min (c) 88.52 min (d) 82.52 min
Solution: (c); $T^2 \alpha R^3 \;\therefore T_2^2 = T_1^2 \times \left(\frac{R_2}{R_1}\right)^3 = 27.3^2 \times \left(\frac{6.7\times10^3}{3.9\times10^5}\right)^3 = 0.0037788 \;\therefore T_2 = 88.52$ min

57. The sun is considered to be a satellite of our galaxy, the Milky-way. The sun revolves around the center of the galaxy with a radius of 2.2×10^{20}m. The period of one revolution 2.5×10^8 years. What is the mass of the galaxy? [Gravitational constant $G = 6.67 \times 10^{-11} N.m^2/kg$]
(a) 1.01×10^{41}kg (b) 2.22×10^{41}kg (c) 2.00×10^{40}kg (d) 3.25×10^{41}kg
Solution: (a); $M = 4\pi^2\frac{(R+h)^3}{GT^2} = 4\pi^2\frac{(2.2\times10^{20})^3}{6.67\times10^{-11}\times(2.5\times10^8\times365\times24\times3600)^2} = 1.01 \times 10^{41}$kg

58. A 1325kg car moving north at $27.0ms^{-1}$ collides with a 2165kg car moving east at $17.0ms^{-1}$. They stick together. With what speed do they move after collision?
(a) $12.7ms^{-1}$ (b) $13.7ms^{-1}$ (c) $10.2ms^{-1}$ (d) $14.7ms^{-1}$
Solution: (d); $m_1\vec{v}_1 + m_2\vec{u}_2 = (m_1 + m_2)\vec{v}$ | Here, $\vec{u}_1 = 27\hat{i}, \vec{u}_2 = 17\hat{j}, m_1 = 1325kg, m_2 = 2165$ kg
$\Rightarrow \vec{v} = \frac{m_1\vec{u}_1 + m_2\vec{u}_2}{m_1+m_2} = 10.25\hat{i} + 10.546\hat{j} \;\therefore |\vec{v}| = 14.7ms^{-1}$

59. The third floor of a house is 8.0m above the street level. How much work is needed to move a 150kg refrigerator to this third floor?
(a) 9.5 kJ (b) 10.8 kJ (c) 11.8 kJ (d) 12.8 kJ
Solution: (c); $w = mgh = 150 \times 9.8 \times 8 = 11.76$ kJ

60. A 6×10^2g sample of water at 90°C is mixed with 4.00×10^2g of water at 22°C. Assume no heat loss at the surroundings. What is the final temperature of this mixture?
(a) 66.8°C (b) 62.8°C (c) 42.5°C (d) 52.8°C
Solution: (b); $6 \times 10^2 \times 4200 \times (90 - \theta) = 4 \times 10^2 \times 4200 \times (\theta - 22) \Rightarrow \theta = 62.8°C$

61. A 4.2g lead bullet moving at $275ms^{-1}$ strikes a steel plate and stops. If all its kinetic energy is converted to thermal energy and none leaves the bullet, what is its temperature change? [Specific heat of lead is 130 J/kg°C]
(a) 255°C (b) 291°C (c) 300°C (d) 272°C
Solution: (b); $\frac{1}{2}mv^2 = ms\Delta\theta \Rightarrow v^2 = 2s\,\Delta\theta \Rightarrow \Delta\theta = \frac{v^2}{2s} = \frac{275^2}{2\times130} = 291°C$

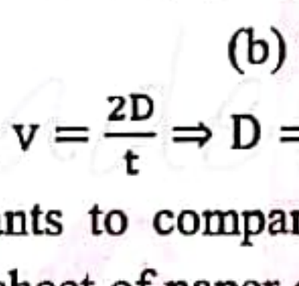
62. A boy is floating in a freshwater lake with his head just above the water. If he weights 600N, what is the volume of the submerged part of his body?
(a) $0.061m^3$ (b) $0.085m^3$ (c) $0.091\ m^3$ (d) $0.075\ m^3$
Solution: (a); $w = mg \Rightarrow m = \frac{w}{g} = \frac{600}{9.8} = 61.22$ kg
Now, $m = \rho v = 1000v \Rightarrow v = \frac{m}{1000} = 0.061m^3$

63. A test tube standing vertically in a test tube rack contains 2.5cm of oil (density = 0.81 g.cm^3) and 6.5 cm of water. What is the pressure on the bottom of the test tube?
(a) 845 Pa (b) 827 Pa (c) 836 Pa (d) 817 Pa
Solution: (c); $p = h_1\rho_1 g + h_2\rho_2 g$
$= 2.5 \times 10^{-2} \times 0.81 \times 10^3 \times 9.8 + 6.5 \times 10^{-2} \times 1000 \times 9.8 = 835.45Pa$

64. If you clap your hands and hear the echo from a distant wall 0.20s later, how far away is the wall? [Velocity of sound in air = $343ms^{-1}$]
(a) 34.3m (b) 33.0m (c) 43.5m (d) 37.3m
Solution: (a); $v = \frac{2D}{t} \Rightarrow D = \frac{vt}{2} = \frac{343\times0.2}{2} = 34.3m$

65. A student wants to compare the luminous flux from a bulb with that of a 1750Lm lamp. The bulb illuminates a sheet of paper equally. The 1750 Lm lamp is 1.25m away; the unknown bulb is 1.08m away. What is the luminous flux of the bulb?
(a) 1506 Lm (b) 1306 Lm (c) 1200 Lm (d) 1356 Lm
Solution: (b); $\frac{1750}{1.25^2} = \frac{x}{1.08^2} \Rightarrow x = 1306Lm$

66. A light source is located 2.0m below the surface of a swimming pool and 1.5m from one edge of the pool. The pool is filled to the top with water. At what angle does the light reaching the edge of the pool leave the water?
(a) 63° (b) 45° (c) 53° (d) 65°
Solution: (c);



$\mu = \frac{4}{3} = \frac{\sin r}{\sin i} \Rightarrow \sin r = \frac{4}{3} \times \frac{1.5}{\sqrt{1.5^2+2^2}} \Rightarrow r = \sin^{-1}\left(\frac{4}{5}\right) = 53°$

67. A jeweler inspects a watch with a diameter of 3.0cm by placing it 8.0m in front of a concave mirror of 12.0cm focal length. Where will the image of the watch appear?
(a) −24cm (b) −18cm (c) −19cm (d) −22cm
Solution: (No answer); $\frac{1}{u} + \frac{1}{v} = \frac{1}{f} \Rightarrow \frac{1}{8} + \frac{1}{v} = \frac{1}{0.12} \Rightarrow v = \left(\frac{1}{0.12} - \frac{1}{8}\right)^{-1} = 0.12183\ m = 12.183cm$

68. What work is done when 5.0C charge is moved through an electric potential difference of 1.5V?
(a) 8.3J (b) 8.5J (c) 7.5J (d) 7.8J
Solution: (c); $W = VQ = 1.5 \times 5 = 7.5J$

69. A 2.2μF capacitor is first charged so that the electric potential difference is 6.0V. How much additional charge is needed to increase the electric potential difference to 15.0V?
(a) 18.7 μC (b) 19.4 μC (c) 18.8 μC (d) 19.8 μC
Solution: (d); $Q = CV = 2.2\mu \times 6 = 13.2 \times 10^{-6}C$; $Q' = CV' = 2.2\mu \times 15 = 33 \times 10^{-6}C$
$\therefore \Delta Q = Q' - Q = 19.8 \times 10^{-6}C = 19.8\mu C$

70. How many more minutes would it take light from the Sun to reach Earth if the space between them were filled with water rather than vacuum? [The sun is 1.5×10^8km from Earth.]
(a) 2.25 min (b) 2.75 min (c) 3.75 min (d) 2.60 min
Solution: (b); $\mu = \frac{C_o}{C_w} \Rightarrow \frac{4}{3} = \frac{3\times10^8}{C_w} \Rightarrow C_w = \frac{3}{4} \times 3 \times 10^8 = 2.25 \times 10^8 ms^{-1}$
$\therefore t_1 = \frac{d}{C_w} = \frac{1.5\times10^8\times10^3}{2.25\times10^8\times60} = 11.11$ minutes $= \frac{100}{9}$ minutes
$\therefore t_2 = \frac{d}{C_o} = \frac{25}{3}$ minutes $\therefore \Delta t = t_1 - t_2 = 2.78$ minutes

71. A heating coil of resistance 4.0 ohm and operates at 220V AC. If the coil is immersed in an insulated container holding 20.0kg of water for 5.30 minutes, what will be the increase of temperature of water? Assume that 100% heat is absorbed by water.
(a) 43.42°C (b) 45.50°C (c) 46.25°C (d) 49.25°C
Solution: (a); $\frac{V_{rms}^2}{R} \times t = ms\Delta\theta \Rightarrow \frac{220^2}{4} \times 5 \times 60 = 20 \times 4200 \times \Delta\theta = \Delta\theta = 43.21°C$

72. Mohammad needs 5.0V for some integrated circuit experiments. He uses a 6.0V battery and two resistors to make a potential divider. One resistor is 330 ohm. He decides to make the other resistor smaller, what value should it have?
(a) 60 ohm (b) 58 ohm (c) 66 ohm (d) 76 ohm
Solution: (c); $\frac{6}{R_1+330} \times 330 = 5 \Rightarrow R_1 = 66\Omega$

73. The amplitude of an AC current is 5.0A and its frequency is 50Hz. How much time will it be required to reach the first peak?
(a) 5 ms (b) 6 ms (c) 4 ms (d) 4.5 ms
Solution: (a); $\frac{T}{4} = \frac{1}{4f} = \frac{1}{200} = 5ms$

74. A space-ship is 98 m long. How fast would it have to be moving to appear only 49m?
(a) $2.25 \times 10^8 ms^{-1}$ (b) $2.75 \times 10^8 ms^{-1}$ (c) $2.60 \times 10^8 ms^{-1}$ (d) $1.85 \times 10^8 ms^{-1}$
Solution: (c); $L = L_o\sqrt{1 - \frac{v^2}{c^2}} \Rightarrow 49 = 98\sqrt{1 - \frac{v^2}{c^2}} \Rightarrow v = \frac{\sqrt{3}}{2} \times 3 \times 10^8 = 2.598 \times 10^8 ms^{-1}$

75. A tank of helium gas used to inflate a toy balloon is at 15.5×10^6Pa pressure at 293K. Its volume is $0.20m^3$. How large a balloon would it fill at 1.00 atmosphere at 323K? [I atmosphere $= 101.3 \times 10^3$Pa]
(a) $3.70m^3$ (b) $3.40m^o$ (c) $4.70m^3$ (d) $4.30m^3$
Solution: (No answer); $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \Rightarrow V_2 = \frac{P_1V_1T_2}{P_2T_1} = \frac{15.5\times10^6\times0.2\times323}{101.3\times10^3\times293} = 33.7355\ m^3$
$\therefore$ The volume of the balloon will be- 33.7355

76. A 50gm mass vibrating up and down at the end of a spring has its position given by $y = 0.150 \sin 3t$ (m) for 't' is in second. What is the force acting on the mass to give this motion?
(a) $-0.0875 \sin 3t$ (N) (b) $-0.0575 \sin 3t$ (N) (c) $-0.0675 \sin 3t$ (N) (d) $-0.675 \sin 3t$ (N)
Solution: (c); $a = \frac{d^2y}{dt^2} = -0.15 \times 3^2 \sin 3t$ (N)
$\therefore F = ma = -0.05 \times 0.15 \times 9 \sin 3t$ (N) $= -0.0675 \sin 3t$ (N)

77. A 10kg mass is suspended by a metallic string with cross-sectional area of $1.0mm^2$. The length of the wire with the mass suspended is 4.02m. When the mass is removed, the length is reduced by 0.02m. What is the modulus of elasticity of the wire?

(a) $1.96 \times 10^{10}Nm^{-2}$ (b) $1.86 \times 10^{10}Nm^{-2}$ (c) $1.76 \times 10^{10}Nm^{-2}$ (d) $2.96 \times 10^{10}Nm^{-2}$

Solution: (a); $Y = \frac{\frac{F}{A}}{\frac{\Delta l}{L}} = \frac{mgL}{A\Delta l} = \frac{10\times9.8\times4}{1\times10^{-6}\times0.02} = 1.96 \times 10^{10}\ Nm^{-2}$

78. What is the wavelength of a 100MeV photon? [Plank's constant $h = 6.63 \times 10^{-34}Js$]

(a) $1.943 \times 10^{-14}m$ (b) $1.243 \times 10^{-14}m$ (c) $1.343 \times 10^{-14}m$ (d) $2.943 \times 10^{-14}m$

Solution: (b); $E = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{E} = \frac{6.63\times10^{-34}\times3\times10^{8}}{100\times10^{6}\times1.6\times10^{-19}} = 1.24 \times 10^{-14}m$

79. A diffraction grating has 6000 lines/cm. If light of wavelength 5896Å is incident on the grating, what is the diffraction angle for the second maximum?

(a) 48^o (b) 55^o (c) 43^o (d) 45^o

Solution: (d); $d\sin\theta = n\lambda \Rightarrow \theta = \sin^{-1}(n\lambda N) = \sin^{-1}(2 \times 5896 \times 10^{-10} \times 6000 \times 100) = 45^o$

80. The radioactive isotope ^{57}CO decays by electron capture with a half-life of 272 days. What is the decay constant?

(a) $2.23 \times 10^{-8}s^{-1}$ (b) $2.95 \times 10^{-8}s^{-1}$ (c) $1.95 \times 10^{-8}s^{-1}$ (d) $2.55 \times 10^{-8}s^{-1}$

Solution: (b); $k = \frac{\ln 2}{t_{\frac{1}{2}}} \Rightarrow k = \frac{\ln 2}{272\times24\times3600} = 2.95 \times 10^{-8}\ s^{-1}$

81. A surveyor uses a steel tape that is exactly 50.00m long at a temperature of 20^oC. What is its length on a hot summer day when the temperature is 35^oC? [Coefficient of linear expansion of steel is $1.2 \times 10^{-5}mK^{-1}$]

(a) 50.009m (b) 50.09m (c) 50.08m (d) 49.009m

Solution: (a); We know, $L = L_o(1 + \alpha t)$

Now, $L_{20} = L_o(1 + 1.2 \times 10^{-5} \times 20) \Rightarrow L_o = 49.98\ m$; $L_{35} = L_o(1 + 1.2 \times 10^{-5} \times 35) = 50.009m$

82. A plastic tube 25.0m long and 4.00 cm in diameter is dipped into a silver solution, depositing a layer of silver 0.100 mm thick uniformly over the outer surface of the tube. If the coated tube is then connected to a 12.0V battery, what will be the current? [Specific resistance of silver $= 1.47 \times 10^{-8}\Omega m$.]

(a) 425 A (b) 435 A (c) 410 A (d) 445 A

Solution: (c); $R = \frac{\rho L}{A} = \frac{1.47\times10^{-8}\times25}{\pi\times(2.01^2-2^2)\times10^{-4}} = 29.172 \times 10^{-3}\Omega\ \therefore I = \frac{V}{R} = \frac{12}{R} = 411.36A$

83. A particle with a charge of $-1.24 \times 10^{-8}C$ is moving with instantaneous velocity $\vec{v} = (4.19 \times 10^4)\vec{i} + (-3.85 \times 10^4)\vec{j}ms^{-1}$. What is the force exerted on this particle by a magnetic field $\vec{B} = (1.40)\vec{i}T$.

(a) $(-6.884 \times 10^{-4})\vec{k}(N)$ (b) $(-6.684 \times 10^{-4})\vec{k}(N)$

(c) $(-6.84 \times 10^{-4})\vec{k}(N)$ (d) $(-5.884 \times 10^{-4})\vec{k}(N)$

Solution: (b); $\vec{F} = q(\vec{V} \times \vec{B}) = -1.24 \times 10^{-8}\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 4.19 \times 10^4 & -3.85 \times 10^4 & 0 \\ 1.4 & 0 & 0 \end{vmatrix} = -6.6836 \times 10^{-4}\hat{k}(N)$

84. A wire 75cm long carrying a DC current of 6.0A is at right angle to a uniform magnetic field. The magnitude of the force acting on the wire is 0.6N. What is the strength of the magnetic field?

(a) 0.130T (b) 0.18T (c) 0.15T (d) 0.166T

Solution: (a); $F = ilB\sin 90^o = ilB \Rightarrow B = \frac{F}{iL} = \frac{0.6}{6\times0.75} = 0.13T$

85. What is the β of a transistor whose $\alpha = 0.98$?

(a) 50 (b) 39 (c) 49 (d) 45

Solution: (c); $\beta = \frac{\alpha}{1-\alpha} = \frac{0.98}{1-0.98} = 49$

Chemistry

86. Natural radio-active elements continuously emit radiation. The ultimate product of this radiation is-
(a) ^{13}C (b) ^{82}Pb (c) ^{84}Po (d) ^{92}U [Ans: b]

87. Radium (At. no. 88) is converted to Rn (At. no. 86) by the emission of radioactive rays. Which ray has been emitted from Radium? [Ans: a]
(a) $\alpha-$ ray (b) $\beta-$ ray (c) $\gamma-$ ray (d) Canal ray

88. The atomic mass of H-atom is 1.0 and that of Cl-atom is 35.5. The diffusion rate of H-atom through the same orifice will be x times higher than that of Cl-atom. The value of x is-
(a) 35.5 (b) 5.96 (c) 3.55 (d) 2

Solution: (b); $r\alpha\frac{1}{\sqrt{d}}\ \therefore \frac{r_H}{r_{Cl}} = \sqrt{\frac{M_{Cl}}{M_H}} = \sqrt{\frac{35.5}{1}} = 5.96$

89. At a constant pressure the volume of a definite mass of a gas at 100^oC is $200cm^3$. The volume of that gas at the same pressure and 0^oC will be-
(a) $146.384cm^3$ (b) $22.4\times10^3cm^3$ (c) $4.46\times10^{-3}L$ (d) $8.92\times10^{-3}L$

Solution: (a); $\frac{V_1}{T_1} = \frac{V_2}{T_2} \Rightarrow V_2 = \frac{V_1}{T_1}\times T_2 = \frac{200}{100+273}\times 273 = 146.38\ cm^3$

90. Which group of periodic table has the lowest number of s-block elements? [Ans: c]
(a) Gr-1(I-A) (b) Gr-2(II-A) (c) Gr-11(I-B) (d) Gr-18(VIII-A)

91. The density of a solution of NaOH is 1.10g/mL. The concentration of the solution is 0.1M. The percentage (in mass) of water present in the solution is-
(a) 90.9g (b) 95.5g (c) 99.63g (d) 99.9g

Solution: (c); $C = 0.1\ molL^{-1} = (0.1\times40)g/L = 4g/L = 0.004g/mL$

$\therefore$ % water $= \frac{1.1-0.004}{1.1}\times100\% = 99.63\%$

92. The concentration of F^- in a saturated aqueous solution of CaF is $6.55\times10^{-3}gL^{-1}$. The solubility product of CaF_2 in water is- [The atomic weight of Ca and F are 40 and 19 respectively]
(a) 2.05×10^{-11} (b) 6.55×10^{-3} (c) 7.8×10^{-4} (d) 7.6×10^{-5}

Solution: (a); $K_{sp} = [Ca^{2+}][F^-]^2 = \left(\frac{6.55\times10^{-3}}{19\times2}\right)\times\left[\frac{6.55\times10^{-3}}{19}\right]^2 = 2.05\times10^{-11}\ mol^3L^{-3}$

93. Which of the following salt of Calcium is not dissolved by H_2O, HCl or even aquaregia? [Ans: c]
(a) Ca-carbonate (b) Ca-oxalate (c) Ca-silicate (d) Ca-nitrate

94. Lime Stone reacts with HCl with the liberation of CO_2 gas. Which of the following factor does not have any effect on rate of this reaction? [Ans: c]
(a) Temperature (b) Pressure (c) Surface Area (d) Concentration

95. A colorless organic compound contains 59.2% C, 13.6% H and the rest is oxygen. The vapor density of the compound is 30. In the presence of H_2SO_4 the compound reacts with acetic acid and forms a compound which has sweet smell of ripe fruit. The compound is-
(a) Acetone (b) Propanaldehyde (c) Propanol (d) Ethyl Methyl Ether

Solution: (c); $C = \frac{59.2}{12} = 4.93 \equiv 2.9\ ;\ H = \frac{13.6}{1} = 13.6 \equiv 8\ ;\ O = \frac{27.2}{16} = 1.7 \equiv 1$

Molecular mass $= 2\times30 = 60\ \therefore (C_3H_8O)_x = 60 \Rightarrow x = \frac{60}{3\times12+8+16} = 1$

$\therefore$ The formula: $CH_3-CH_2-CH_2-OH$ [$\because$ forms ester with acid]

96. An ester on hydrolysis produces a monobasic acid and an alcohol. 0.185g of the product acid requires 25.0mL 0.1N NaOH to neutralize it. The molecular formula of the acid is-
(a) HCOOH (b) CH_3COOH (c) C_2H_5COOH (d) C_3H_7COOH

Solution: (c); $\frac{0.185}{M_A} = \frac{25\times0.1}{1000} \Rightarrow M_A = 74\ \therefore$ The formula of the acid is C_2H_5COOH [M = 74]

97. 0.535g of a mixture of acetaldehyde and ethanol reacts with Fehling's solution and form 1.2g red precipitate. The percentage of acetaldehyde present into the mixture is-

(a) 69% (b) 53.5% (c) 50% (d) 60.2%

Solution: (a); $n_{Cu_2O} = \frac{1.2}{2\times63.5+16} = 8.39 \times 10^{-3}$ mol

$\therefore W_{CH_3CHO} = n_{Cu_2O} \times M_{CH_3CHO} = 8.39 \times 10^{-3} \times 44 = 0.369gm$ [$\because n_{CH_3CHO} = n_{Cu_2O}$]

$\therefore \%CH_3CHO = \frac{0.369}{0.535} \times 100 = 69\%$

98. What is the oxidation number of sulfur in $Al_2(SO_4)_3$?

(a) 3 (b) 6 (c) 2 (d) None

Solution: (b); $2 \times 3 + (x - 4 \times 2) \times 3 = 0 \Rightarrow x = +6$

99. The atomic weight of oxygen is 16. How many grams of electron are there in 1.0 mole oxygen atom?

(a) 6.023×10^{-29}g (b) 9.1×10^{-28}g (c) 4.03×10^{-3}g (d) None

Solution: (c); $W_e = 1 \times 8 \times m_e \times N_A = 9.11 \times 10^{-31} \times 8 \times 6.02 \times 10^{23} \times 1000 = 4.3 \times 10^{-3}$g

100. Which of the following metals produces medically usable alkaline oxides when burns in oxygen?

(a) Na (b) K (c) Mg (d) Ca

Solution: (c); MgO is used as antacid.

IUT Admission Test 2013-2014

Mathematics

01. Find the root of 2i. **[Ans: d]**

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

02. If the sides of a triangle are 5, 12, 13 cm respectively. Then the triangle is-

(a) Obtuse angled (b) Acute angled (c) Right angled (d) None

Solution: (c); $5^2 + 12^2 = 13^2$

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

(a) 10 (b) 2 (c) 5 (d) 20

Solution: (b); $d = \frac{10}{5} = 2$

04. $\sin x \sin(x + 30°) + \cos x \sin(x + 30°) = ?$

(a) $\frac{1}{2}$ (b) 1 (c) $\frac{\sqrt{3}}{2}$ (d) 0

Solution: (c); $\sin x \sin(x + 30°) + \cos x \cos(x + 30°) = \cos 30° = \frac{\sqrt{3}}{2}$

05. The fundamental period of $\frac{1}{2}\cot\frac{2}{3}\theta$ is-

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

Solution: (c); $\frac{1}{2}\cot\frac{2}{3}\theta$ $\therefore$ period $= \frac{\pi}{\frac{2}{3}} = \frac{3\pi}{2}$

06. The value of $\begin{vmatrix} b+c & a & a \\ b & c+a & b \\ c & c & a+b \end{vmatrix}$

(a) 0 (b) abc (c) 4abc (d) a + b + c

Solution: (c); $\begin{vmatrix} b+c & a & a \\ b & c+a & b \\ c & c & a+b \end{vmatrix} = \begin{vmatrix} 0 & -2c & -2b \\ b & c+a & b \\ c & c & a+b \end{vmatrix} = 4abc$