Sri Chaitanya IIT Academy., A.P.

AIEEE - 2012

B.Tech_Key & Solutions

Admin Off : Plot No : 304, Kasetty Heights.

Ayyappa Society - Madhapur , Pin : 500081

PART A – MATHEMATICS

1. The equation $e^{\sin x} - e^{-\sin x} - 4 = 0$ has :

   1) infinite number of real roots. 2) no real roots

   3) exactly one real root 4) exactly four real roots

Ans: 2

sol $e^{\sin x} - e^{-\sin x} - 4 = 0$

Let $e^{\sin x} = t$

$t - \frac{1}{t} = 4 \quad \Rightarrow \quad t^2 - 4t - 1 = 0$

$t = \frac{4 \pm \sqrt{20}}{2} = 2 \pm \sqrt{5}$

$e^{\sin x} = 2 \pm \sqrt{5}$

which can not possible.

2. Let $\hat{a}$ and $\hat{b}$ be two unit vectors. If the vectros $\vec{c} = \hat{a} + 2\hat{b}$ and $\vec{d} = 5\hat{a} - 4\hat{b}$ are perpendicular to each other, then the angle between $\hat{a}$ and $\hat{b}$ is:

   1) $\frac{\pi}{6}$ 2) $\frac{\pi}{2}$ 3) $\frac{\pi}{3}$ 4) $\frac{\pi}{4}$

Ans. 3

sol. $\vec{c} = \hat{a} + 2\hat{b}$ & $\vec{d} = 5\hat{a} - 4\hat{b}$

$\vec{c}.\vec{d} = 0$

$(a + 2b) \cdot (5a - 4b) = 0$

$5a^2 + 6a.b - 8b^2 = 0$

as $|a| = |b| = 1$

6 a. b = 3

$\cos\theta = \frac{1}{2}$

3. A spherical balloon is filled with $4500\ \pi$ cubic meters of helium gas. If a leak in the balloon causes the gas to escape at the rate of $72\ \pi$ cubic meters per minute, then the rate (in meters per minute) at which the radius of the balloon decreases 49 minutes after the leakage began is:

1) 9/7 2) 7/9 c) 2/9 4)9/2

Ans. 3

sol. Total volume = 4500π

volume Dcr in 49 min= $72\pi \times 49 = 3528\pi$

volume Left after 49 min= $4500\pi - 3528\pi = 972\pi$

radius after 49 min $\Rightarrow \frac{4}{3}\pi r^3 = 972\pi$

$r = 9$

$$V = \frac{4}{3}\pi r^3$$

$$\frac{dV}{dt} = 4\pi r^2 \frac{dr}{dt}$$

$$72\pi = 4\pi \times 9^2 \frac{dr}{dt}$$

$$\frac{dr}{dt} = \frac{18}{9\times 9} = 2/9$$

4. **Statement 1:** The sum of the series

$1+(1+2+4)+(4+6+9)+(9+12+16)+...+(361+380+400)$ is 8000.

Statement 2: $\sum_{k=1}^{n}\left(k^3-(k-1)^3\right)=n^3$ **,** for any natural number n.

1) Statement 1 is false, Statement 2 is true.

2) Statement 1 is true, Statement 2 is true; Statement 2 is a correct explanation for Statement 1.

3) Statement 1 is true, Statement 2 is true; Statement **2 is not** a correct explanation for Statement 1.

4) Statement 1 is true , Statement 2 is false.

Ans. 2

sol. $1+(1+2+4)+(4+6+9)+(9+12+16)+...+(361+380+400)$

$$=\sum\frac{\left[r^2+r(r+1)+(r+1)^2\right](r+1-r)}{(r+1)-r}$$

$$=1+\sum_{r=1}^{19}\frac{(r+1)^3-r^3}{1}$$

$$=\left(1+2^3+3^3+4^3+...+20^3\right)-\left(1^3+2^3+3^3+...+19^3\right)$$

$$=\frac{20^2(21)^2}{4}-\frac{19^2(20)^2}{4}$$

$$=\frac{(20)^2}{4}[441-361]$$

$$= 8000$$

5. The negation of the statement

"If I become a teacher, then I will open a school", is:

1) I will become a teacher and I will not open a school.

2) Either I will not become a teacher or I will not open a school.

3) Neither I will become a teacher nor I will open a school.

4) I will not become a teacher or I will open a school.

Ans. 1

sol. we know that

$$\sim(p-q)\equiv p\wedge\sim q$$

6. If the integral $\int\frac{5\tan x}{\tan x-2}dx=x+a\ln\left|\sin x-2\cos x\right|+k$ then a is equal to:

1) –1 2) –2 3) 1 4) 2

Ans. 4

sol. $\int\frac{5\tan x}{\tan x-2}dx=\int\frac{5\sin x}{\sin x-2\cos x}dx$

put $\sin x=A(\sin x-2\cos x)+B.\frac{d}{dx}(\sin x-2\cos x)$

$= \sin x \cdot (A+2B) + \cos x \cdot (-2A+B)$

$A+2B=1, \quad B=2A$

$A=\frac{1}{5} \quad \& \quad B=\frac{2}{5}$

$$\int \frac{5\tan x}{\tan x-2}dx = \frac{5}{5}\int \frac{\sin x-2\cos x}{\sin x-2\cos x}dx + 5.\frac{2}{5}\int \frac{\cos x+2\sin x}{\sin x-2\cos x}dx$$

$= x + 2\ln|\sin x - 2\cos x|$

$\therefore$ 2

7. **Statement 1:** An equation of a common tangent to the parabola $y^2 = 16\sqrt{3}x$ and the ellipse $2x^2 + y^2 = 4$ is $y = 2x + 2\sqrt{3}$.

Statement 2: If the line $y = mx + \frac{4\sqrt{3}}{m}, (m \neq 0)$ is a common tangent to the parabola $y^2 = 16\sqrt{3}x$ and the ellipse $2x^2 + y^2 = 4$, then m satisfies $m^4 + 2m^2 = 24$

1) Statement 1 is false, Statement 2 is true.

2) Statement 1 is true, Statement 2 is true, Statement 2 is a correct expalnation for Statement 1

3) Statement 1 is true, Statement 2 is true, Statement 2 is **not** a correct explanation for Statement 1.

4) Statement 1 is true , Statement 2 is false.

Ans. 2

Sol. $y^2 = 16\sqrt{3}x$

equation of tangent $y = mx = \frac{4\sqrt{3}}{m}$

$2x^2 + y^2 = 4 \Rightarrow \frac{x^2}{2} + \frac{y^2}{4} = 1$

equation of tangent $y = mx \pm \sqrt{4m^2+2}$

$\therefore \frac{4\sqrt{3}}{m} = \pm\sqrt{4m^2+2} \Rightarrow \frac{48}{m^2} = 2(2m^2+1)$

$m^4 + 2m^2 + 24$

$m^2 = -6 \& 4 \Rightarrow m = 2$

$\therefore$ Equation of tangent $y = 2x + 2\sqrt{3}$

8. Let $A = \begin{pmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{pmatrix}$. If u_1 and u_2 are column matrices such that $Au_1 = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$ and $Au_2 = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$ then $u_1 + u_2$ is equal to:

1) $\begin{pmatrix} -1 \\ 1 \\ 0 \end{pmatrix}$ 2) $\begin{pmatrix} -1 \\ 1 \\ -1 \end{pmatrix}$ 3) $\begin{pmatrix} -1 \\ -1 \\ 0 \end{pmatrix}$ 4) $\begin{pmatrix} 1 \\ -1 \\ -1 \end{pmatrix}$

Ans. 4

sol. $A\begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix} \quad u_1 = \begin{bmatrix} a \\ b \\ c \end{bmatrix} \quad u_2 = \begin{bmatrix} d \\ e \\ c \end{bmatrix}$

$$Au_1 = \begin{bmatrix} a \\ 2a+b \\ 3a+2b+c \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} \Rightarrow a = 1, b = -2, c = 1$$

$$Au_2 = \begin{bmatrix} d \\ 2d+e \\ 3d+2e+f \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} \Rightarrow d = 0, e = 1, f = -2$$

$$\therefore u_1 + u_2 = \begin{bmatrix} 1 \\ -1 \\ -1 \end{bmatrix}$$

9. If n is a positive integer, then $\left(\sqrt{3}+1\right)^{2n} - \left(\sqrt{3}-1\right)^{2n}$ is:

1) an irrational number 2) an odd positive integer

3) an even positive integer

4) a rational number other than positive integers

Ans. 1

sol. $\left(\sqrt{3}+1\right)^{2n} = \left(\sqrt{3}-1\right)^{2n}$

$\Rightarrow 2\left[{}^{2n}C_1\left(\sqrt{3}\right)^{2n-1}.1+{}^{2n}C_3\left(\sqrt{3}\right)^{2n-3}.1^3+.....\right]$

$\Rightarrow$ irrational number

10. If 100 times the 100th term of an AP with non zero common difference equals the 50 times its 50th term, then the 15th term of this AP is:

1) –150 2) 150 times its 50th term

3) 150 4) zero

Ans. 4

sol. $100\left[a+99d\right]=50\left[a+49d\right]$

$a+149d=0$

$T_{150}=a+149d=0$

11. In a ΔPQR, if $3\sin P+4\cos Q=6$ and $4\sin Q+3\cos P=1$, then the angle R is equal to:

1) $\frac{5\pi}{6}$ 2) $\frac{\pi}{6}$ 3) $\frac{\pi}{4}$ 4) $\frac{3\pi}{4}$

Ans. 1 or 2

sol. $3\sin P+4\cos Q=6 \quad \rightarrow(1)$

$3\cos P+4\sin Q=1 \quad \rightarrow(2)$

$(1)^2+(2)^2=9(1)+16(1)+24\left(\sin P\cos Q+\cos p\sin Q\right)=36+1$

$\Rightarrow 25+24\sin\left(P+Q\right)=37$

$\Rightarrow 24\sin\left(P+Q\right)=12$

$\sin\left(P+Q\right)=\frac{1}{2} \qquad P+Q=\frac{\pi}{6};R=\frac{5\pi}{6}$

12. An equation of a plane parallel to the plane $x-2y+2z-5=0$ and at a unit distance from the origin is:

1) $x-2y+2z-3=0$ 2) $x-2y+2z+1=0$ 3) $x-2y+2z-1=0$ 4) $x-2y+2z+5=0$

Ans. 1

sol. Equation of plane parallel to $x-2y+2z-5=0$ is

$x-2y+2z+\lambda=0$

Distance from origin $\Rightarrow \frac{|\lambda|}{3}=1$

$\lambda=\pm 3$

$\therefore \quad x-2y+2z\pm 3=0$

13. If the line $2x+y=k$ passes through the point which divides the line segment joining the points (1, 1) and (2, 4) in the ratio 3 : 2 ,then k equals:

1) 29/5 2) 5 3) 6 4) 11/5

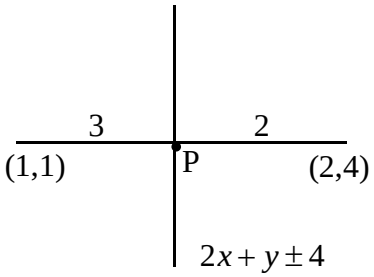
Ans. 3

sol. $P=\left(\frac{3\times 2+2\times 1}{3+2},\frac{3\times 4+2\times 1}{3+2}\right)$

$P\left(\frac{8}{5},\frac{14}{5}\right)$

satisfy line

$\frac{16}{5}+\frac{14}{5}=K \quad \Rightarrow \quad k=6$



14. Let $x_1, x_2, \ldots x_n$ be n observations, and let $\bar{x}$ be thier arithmetic mean and σ^2 be their vaariance.

Statement 1: Variance of $2x_1, 2x_2, \ldots, 2x_n$ is $4\sigma^2$.

Statement 2: Arithmetic mean of $2x_1, 2x_2, \ldots, 2x_n$ is $4\bar{x}$.

1) Statement 1 is false, Statement 2 is true,

2) Statement 1 is true, Statement 2 is true, Statament 2 is a correct explanation for Statement 1

3) Statement 1 is true, Statement 2 is true, Statement 2 is not a correct explanation for Statement 1.

4) Statement 1 is true, Statement 2 is false.

Ans. 4

sol. we know that

$Var\left(aX+b\right)=a^2 \text{ var}\left(X\right)$

15. The population p(t) at time t of a certain mouse species satisfies the differential equation $\frac{dp(t)}{dt} = 0.5p(t) - 450$. If p(0) = 850, then the come at which the population become zero as:

1) 2 ln 18 2) ln 9 3) $\frac{1}{2}\ln 18$ 4) ln 18

Ans. 1

sol. $\frac{dp(t)}{dt} = .5p(t) - 450$

$$\frac{dp(t)}{.5p(t) - 450} = dt$$

$$2\ln\left|.5p(t) - 450\right| = t + k$$

at t=0, p(t) =850

k= 2 ln 25

$$\therefore 2\ln\left|\frac{p(t)}{2} - 450\right| = t + 2\ln 25$$

$$t = 2\ln\left|\frac{p(t)}{2} - 450\right| - 2\ln 25$$

p(t)=0

$$t = 2\ln\left(\frac{450}{25}\right) = 2\ln 18$$

16. Let $a, b \in R$ be such that the function f given by $f(x) = \ln|x| + bx^2 + ax, x \neq 0$ has extreme values at x = –1 and x = 2.

Statement 1: f has

1) Statement 1

2) Statement 1 is true, Statement 2 is true; Statement 2 is correct explanation for Statement 1

3) Statement 1 is true, Statement 2 is true; Statement 2 **is not** a correct expalnation for Statement 1.

4) Statement 1 is true, Statement 2 is false.

Ans. 2

sol. $f(x)=\ln|x|+bx^2+ax$

$f(x)=\frac{1}{x}+2bx+a$

at x = –1 & 2, $f'(x)=0$

–1–2b+a=0, $\frac{1}{2}+4b+a=0$

on solving a=1/2 & b=-1/4

17. The area bounded between the parabolas $x^2=\frac{y}{4}$ and $x^2=9y$, and the straight line y = 2 is:

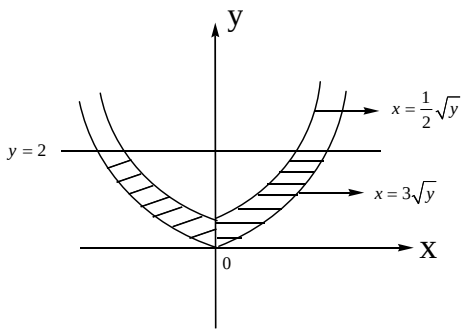
1) $20\sqrt{2}$ 2) $\frac{10\sqrt{2}}{3}$ 3) $\frac{20\sqrt{2}}{3}$ 4) $10\sqrt{2}$

Ans. 3

sol: Required area

$$=2\cdot\left|\int_{y=0}^{2}\left(3\sqrt{y}-\frac{1}{2}\sqrt{y}\right)dy\right|$$

$$=2\cdot\left(\frac{10\sqrt{2}}{3}\right)=\frac{20\sqrt{2}}{3}$$



18. Assuming the balls to be identical except for difference in colours, the number of ways in which one or more balls can be selected from 10 white, 9 green and 7 black balls is:

1) 880 2) 629 3) 630 4) 879

Ans. 4

sol. p = 10, q = 9, r = 7

Total ways of selection

$(p+1)(q+1)(r+1)-1$

$11\times10\times8-1$

879

19. If $f:R\to R$ is a function defined by $f(x)=[x]\cos\left(\frac{2x-1}{2}\right)\pi$, where [x] denotes the greatest integer function , then f is:

1) contunuous for every real x

2) discontinuous only at x = 0

3) discontinuous only at non-zero integral values of x

4) continuous only at x = 0

Ans. 1

sol. $f(x)=[x]\cos\left(\frac{2x-1}{2}\right)\pi$

at x = 0:

$$LHL=\lim_{h\to 0}[-h]\cos\left(\frac{-2h-1}{2}\right)\pi=0$$

$$RHL=\lim_{h\to 0}[h]\cos\left(\frac{2h-1}{2}\right)\pi=0$$

f (0) = 0

at x = 1:

$$LHL\Rightarrow\lim_{h\to 0}[1-h]\cos\left(\frac{2-1}{2}\right)\pi=0$$

$$RHL\Rightarrow\lim_{h\to 0}[1+h]\cos\left(\frac{2+1}{2}\right)\pi=0$$

f (1) = 0

$\therefore$ continuous at all integers.

20. If the lines $\frac{x-1}{2}=\frac{y+1}{3}=\frac{z-1}{4}$ and $\frac{x-3}{1}=\frac{y-k}{2}=\frac{z}{1}$ intesect, then k is equal to:

1) –1 2) $\frac{2}{9}$ 3) $\frac{9}{2}$ 4) 0

Ans. 3

sol. $\frac{x-1}{2}=\frac{y+1}{3}=\frac{z-1}{4}=\lambda \quad P(1+2\lambda,-1+3\lambda,1+4\lambda)$

$\frac{x-3}{1}=\frac{y-k}{2}=\frac{z}{1}=\mu \Rightarrow Q(3+\mu,k+2\mu,\mu)$

as lines are intersecting so

$1+2\lambda=3+\mu,-1+3\lambda=K+2\mu,1+4\lambda=\mu$

From (1) & (3) $\lambda=\frac{-3}{2}$ & $\mu=-5$

$\therefore K=-1+3\times\frac{-3}{2}+10$

$K=\frac{9}{2}$

21. Three numbers are chosen at random without replacement from {1, 2, 3, ..., 8}. The probability that their minimum is 3, given that their maximum is 6, is:

1) $\frac{3}{8}$ 2) $\frac{1}{5}$ 3) $\frac{1}{4}$ 4) $\frac{2}{5}$

Ans. 2

sol. required Probability is $\frac{{}^{2}C_{1}}{{}^{5}C_{2}}$

22. If $z\neq1$ and $\frac{z^2}{z-1}$ is real , then the point represented by the complex number z lies:

1) either on the real axis or on a circle passing through the origin.

2) on a circle with centre at the origin.

3) either on the real axis or on a circle not passing through the origin.

4) on the imaginary axis

Ans. 1

sol. $\frac{z^2}{z-1}=\frac{\bar{z}^2}{\bar{z}-1}$

$z^2\bar{z}-z^2=\bar{z}z^2-\bar{z}^2$

$z\bar{z}(z-\bar{z})=z^2-\bar{z}^2=(z-\bar{z})(z+\bar{z})$

$z-\bar{z}=0$ *or* $z\bar{z}=z+\bar{z}$

$x+iy=x-iy$ *or* $x^2+y^2=2x$

y=0, or $x^2+y^2-2x=0$

$z\bar{z}=z+\bar{z}$ or $x^2+y^2=2x$

23. Let P and Q be 3×3 matrices with $P\neq Q$. If $P^3=Q^3$ and $P^2Q=Q^2P$, then determinant of $\left(P^2+Q^2\right)$ is equal to:

1) –2 2) 1 3) 0 4) –1

Ans. 3

sol. $\left(P^2+Q^2\right)(P-Q)=P^3-P^2Q+PQ^2-Q^3=0$

If det $\left(P^2+Q^2\right)\neq0$, then P^2+Q^2 is inverible and we shall

get $P-Q=0\Rightarrow P=Q$

$\therefore$ det $\left(P^2+Q^2\right)\neq0$, then P^2+Q^2 is invertibel and we shall get $P-Q=0\Rightarrow P=Q$.

$\therefore$ det $\left(P^2+Q^2\right)=0$

24. If $g(x)=\int_0^x\cos 4t\ dt$, then $g(x+\pi)$ equals:

1) $\frac{g(x)}{g(\pi)}$ 2) $g(x)+g(\pi)$ 3) $g(x)-g(\pi)$ 4) $g(x).g(\pi)$

Ans. 2 or 3

sol. $g(x)=\int_0^x\cos 4t\,dt=\left(\frac{\sin 4t}{4}\right)_0^x=\frac{\sin 4x}{4}$

$g(x+\pi)=\int_0^{x+\pi}\cos 4t\,dt$ $g(\pi)=\int_0^{\pi}\cos 4t\ dx$

$=\left[\frac{\sin(4t)}{4}\right]_0^{(x+\pi)}$ $=\left(\frac{\sin 4t}{4}\right)_0^{\pi}=0$

$=\frac{1}{4}\sin 4(\pi+x)$

$= \frac{1}{4}\sin(4x)$

$g(x+\pi) = g(x) + g(\pi)$

$g(x+\pi) = g(x) - g(\pi)$

25. The length of the diameter of the circle which touches the x-axis at the point (1, 0) and passes through the point (2, 3) is:

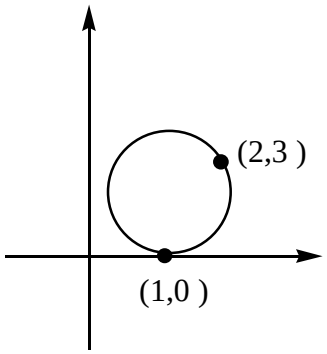
1) 10 / 3 2) 3 / 5 3) 6 / 5 4) 5 / 3

Ans. 1

sol. As circuit touches (1,0)

So, x -axis is tangent of circle

If C(h,k) then r = k



$(x-h)^2 + (y-k)^2 = k^2$

$(1-h)^2 + k^2 = k^2 \Rightarrow$ h = 1

$(2-h)^2 + (3-k)^2 = k^2$

$1+9+k^2-6k = k^2 \Rightarrow$ 6k = 10

k = 5/3

r = 5/3

26. Let $X = \{1,2,3,4,5\}$. The number of different ordered pairs. (Y, Z) that can be formed such that $Y \subseteq X, Z \subseteq X$ and $Y \cap Z$ is empty, is:

1) 5^2 2) 3^5 3) 2^5 4) 5^3

Ans. 2

sol. $x_i \in y,\ x_i \in z$

$x_i \notin y, x_i \in z$

$x_i \in y, x_i \notin z$ $y \cap z = \phi$

$x_i \notin y, x_i \notin z$ each $x_i \in X$ having 3 chances

$n(y \cap z) = 3^5$

27. An ellipse is drawn by taking a diameter of the circle $(x-1)^2 + y^2 = 1$ as its semiminor axis and a diameter of the circle $x^2 + (y-2) = 4$ as its semi-major axis. If the centre of the ellipse is at the origin and its axes are the ellispe is:

1) $4x^2 + y^2 = 4$ 2) $x^2 + 4y^2 = 8$ 3) $4x^2 + y^2 = 8$ 4) $x^2 + 4y^2 = 16$

Ans. 4

sol. $(x-1)^2 + y^2 = 1 \Rightarrow$ dia = 2 = b

$x^2 + (y-2)^2 = 4 \Rightarrow$ dia = 4 = a

$\therefore$ ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

$\frac{x^2}{16} + \frac{y^2}{4} = 1$

$x^2 + 4y^2 = 16$

28. Consider the functions, $f(x) = |x-2| + |x-5|, x \in R$

Statement 1: $f'(4) = 0$

Statement 2: f is continuous in [2, 5] , differentiable in (2, 5) and f (2) = f(5)

1) Statement 1 is false, Statement 2 is true

2) Statement 1 is true, Statement 2 is true; Statement 2 is a correct explanation for Statement 1

3) Statement 1 is true, Statement 2 is true; Statement 2 is not a correct explanation for Stateement 1.

4) Statement 1 is true, Statement 2 is false.

Ans. 2

sol. $f(x) = |x-2| + |x-5|$

$$f(x)=\begin{cases}-2x+7 & ; \quad x\geq 2\\ 3 & ; \quad x\in(2,5)\\ 2x-7 & ; \quad x\geq 5\end{cases}$$

$f'(x)=0$

f(x) is continous in [2,5] & Differntiable in (2,5) & f(2)=f(5)

29. A line is drawn through the point (1,2) to meet the coordinate axes at P and Q such that it forms a triangle OPQ,where O is the origin .If the area of the triangle OPQ is least ,the the slope of the line PQ is

1) -1/4 2) -4 3) -2 4) -1/2

Ans. 3

sol. $\frac{x}{a}+\frac{y}{b}\Rightarrow\frac{1}{a}+\frac{2}{b}=1$

$S=\frac{1}{2}ab\Rightarrow b=\frac{2S}{a}$

$\Rightarrow a^2-aS+S=0$

$a\in R,\ \Delta\geq 0$

$S\geq 4$

if s = 4, a = 2, b = 4

$\therefore$ slope $=\frac{-b}{a}=-2$

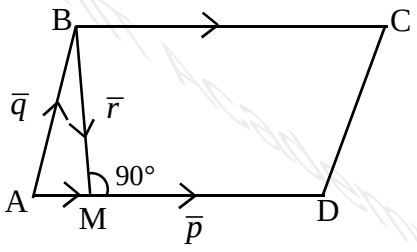
30. Let ABCD be a prallelogram such that $\overrightarrow{AB}=\vec{q},\overrightarrow{AD}=\vec{p}$ and $\angle BAD$ be an acute angle.If $\vec{r}$ is the vectro that coincides with the altitude directed from the vertex B to the side AD ,then $\vec{r}$ is given by

1) $\vec{r}=3\vec{q}-\frac{3(\vec{p}.\vec{q})}{(\vec{p}.\vec{p})}\vec{p}$ 2) $\vec{r}=-\vec{q}+\frac{(\vec{p}.\vec{q})}{(\vec{p}.\vec{p})}\vec{p}$ 3) $\vec{r}=\vec{q}-\frac{(\vec{p}.\vec{q})}{(\vec{p}.\vec{p})}\vec{p}$ 4) $\vec{r}=-3\vec{q}+\frac{3(\vec{p}.\vec{q})}{(\vec{p}.\vec{p})}\vec{p}$

Ans. 2

sol. $\overline{AM}=\lambda\overline{P}$,where λ is scalar

$\overline{q}+\overline{r}=\lambda\overline{p}\rightarrow(1)\quad\left[\because\overline{AB}+\overline{BM}=\overline{AM}\right]$

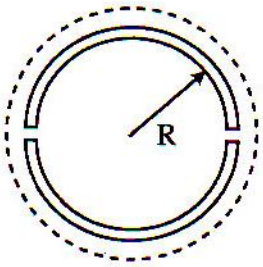


$\therefore\lambda=\frac{\overline{p}\cdot\overline{q}}{\overline{p}\cdot\overline{p}}$

$\therefore\overline{r}=-\overline{q}+\left(\frac{\overline{p}\cdot\overline{q}}{\overline{p}\cdot\overline{p}}\right)\overline{p}$

PART A – PHYSICS

31. The wooden wheel of radius R is made of two semicircular parts (see figure). The two parts are held together by a ring made of metal strip of cross sectional are S and length L. L is slightly less than $2\pi R$. To fit the ring on the wheel it is heated so that its temperature rised by ΔT and it just steps over the wheel. As it cools down to surrounding temperature it presses the semicircular part together. If the coefficient of linear expansion of the metal is α, and its Young's modulus is Y, the force that one part of the wheel applies on the other part is

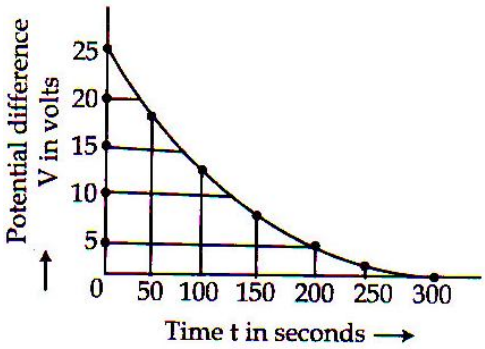


1) $2\pi SY\alpha\Delta T$ 2) $SY\alpha\Delta T$ 3) $\pi SY\alpha\Delta T$ 4) $2SY\alpha\Delta T$

Ans: 4

Sol : $\left[\frac{L\times\Delta T}{\perp}\right]SY = F$: force of compression in wood

So wheels applies 2F force on each other

32. 

The figure shows an experimental plot for discharging of a capacitor in an R–C circuit. The time constant τ of this circuit lies between :

1) 150 sec and 200 sec 2) 0 and 50 sec

3) 50 sec and 100 sec 4) 100 sec and 150 sec

Ans: 3

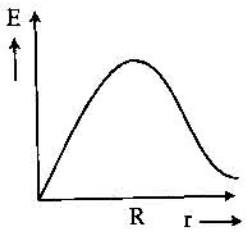
Sol : $V = V_0 e^{-t/\tau}$

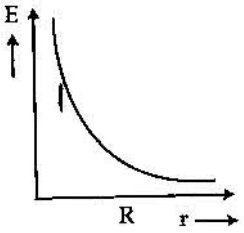
$$V = \frac{V_0}{e}$$

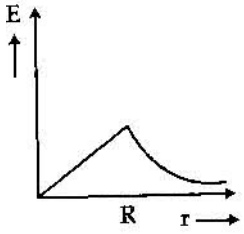
$V < 0.4V_0$

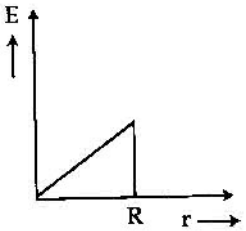
V should be more than 10

33. In a uniformly charged sphere of total charge Q and radius R the electric fieled E is plotted as a function of distance from the centre. The graph which would correspond to the above will be:

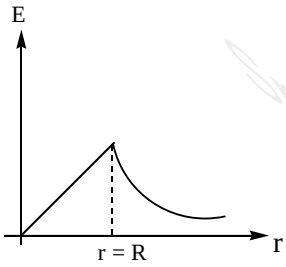
1) 

2) 

3) 

4) 

Ans: 3

Sol : 

34. An electromagnetic wave in vacuum has the electric and magnetic field $\vec{E}$ and $\vec{B}$, which are always perpendicular to each other. The direction of polarization is given by $\vec{X}$ and that of wave propagation by $\vec{k}$. Then

1) $\vec{X} \parallel \vec{B}$ and $\vec{k} \parallel \vec{B} \times \vec{E}$

2) $\vec{X} \parallel \vec{E}$ and $\vec{k} \parallel \vec{E} \times \vec{B}$

3) $\vec{X} \parallel \vec{B}$ and $\vec{k} \parallel \vec{E} \times \vec{B}$

4) $\vec{X} \parallel \vec{E}$ and $\vec{k} \parallel \vec{B} \times \vec{E}$

Ans: 2

Sol : Direction of propagation is $\hat{k} \parallel \vec{E} \times \vec{B}$

Plane of propagation is $\vec{X} \parallel \vec{E}$

35. If a simple pendulum has significant amplitude (up to a factor of 1/e of original) only in the period between t = 0s to $t = \tau s$, then τ may be called the average life of the pendulum. When the spherical bob of the pendulum suffers a retardation (due to viscous drag) propotional to its velocity, with 'b' as the constant of proportionality, the average life time of the pendulum is (assuming damping is small) in seconds

1) $\frac{0.693}{b}$ 2) b 3) $\frac{1}{b}$ 4) $\frac{2}{b}$

Ans: 1

Sol : $A = A_0 e^{-t/\tau}$

$b = \frac{1}{\tau}$

Average life = $\frac{\ell n 2}{b}$

36. Hydrogen atom is excited from ground state to another state with principal quantum number equal to 4. Then the number of spectral lines in the emission spectra will be :

1) 2 2) 3 3) 5 4) 6

Ans: 4 (Ambiguity)

Sol: Considering "Hydrogen gas sample " [in Question it is given as "Hydrogen atom". Number of spectral lines will be 4

37. A coil is suspended in a uniform magnetic field, with the plane of the coil parallel to the magnetic lines of force. When a current is passed through the coil it starts oscillating, it is very difficult to stop. But if an aluminium plate is placed near to the coil, it stops. This is due to :

1) development of air current when the plate is placed

2) induction of electrical charge on the plate

3) shielding of magnetic lines of force as aluminium is a paramagnetic material

4) electromagnetic induction in the aluminium plate giving rise to electromagnetic damping

Ans: 4

Sol: Eddy current developed in aluminium plate gives heating in plate, it will oppose the motion of coil

38. The mass of a spaceship is 1000 kg. It is to be launced from the earth's surface out into free space. The value of 'g' and 'R' (radius of earth) are 10 m/s² and 6400 km respectively. The required energy for this work will be :

1) 6.4×10^{11} **Joules** 2) 6.4×10^{8} **Joules** 3) 6.4×10^{9} **Joules** 4) 6.4×10^{10} **Joules**

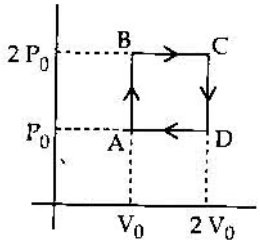
Ans: 4

Sol: $-\frac{GMm}{R}+E=0$

$$E=\left(\frac{GM}{R^2}\right)Rm=0$$

$$E=6.4\times10^{11}$$

39. Helium gas goes through a cycle ABCD (consisting of two isochoric and isobaric lines) as shown in figure. Efficiency of this cycle is nearly : (Assume the gas to be close to ideal gas)



1) 15.4 % 2) 9.1 % 3) 10.5 % 4) 12.5 %

Ans: 1

Sol : efficiency $=\frac{\text{work done in cycle}}{\text{heat absorbed}}\times100$

$$=\frac{P_0V_0}{P_0V_0\left[\frac{3}{2}+2\frac{5}{2}\right]}\times100\%$$

$$\simeq15\%$$

40. In Young's double slit experiment, one of the slit is wider than other, so that amplitude of the light from one slit double of that from other slit. If I_m be the maximum intensity, the resultant intensity I. When they interfere at phase difference Φ is given by

1) $\frac{I_m}{9}(4+5\cos\Phi)$ 2) $\frac{I_m}{3}\left(1+2\cos^2\frac{\Phi}{2}\right)$ 3) $\frac{I_m}{5}\left(1+4\cos^2\frac{\Phi}{2}\right)$ 4) $\frac{I_m}{9}\left(1+8\cos^2\frac{\Phi}{2}\right)$

Ans: 4

Sol: If I_0 and $4I_0$ are the intensity due to individual slits $I_{max}; I_m = 9I_0$

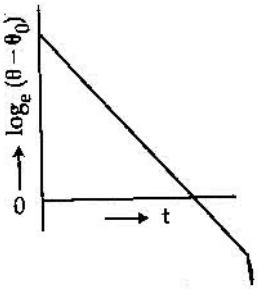
In this case $I_R = I_0 + 4I_0 + 4I_0\cos\Phi$

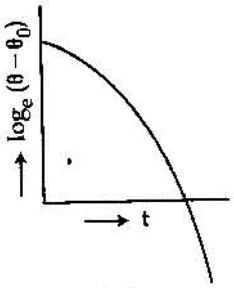
$I_R = I_0[5+4\cos\Phi]$

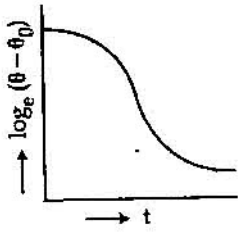
$I_R = I_0\left[1+8\cos^2\left(\frac{\Phi}{2}\right)\right]$

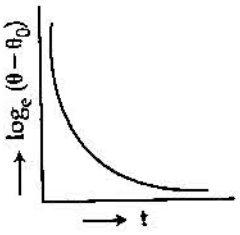
$I_R = \frac{I_m}{9} = \left[1+8\cos^2\left(\frac{\Phi}{2}\right)\right]$

41. A liquid in a beaker has temperature $\theta(t)$ at time t and θ_0 is tempeature of surroundings, then according to Newton's law of cooling the correct graph between $\log_e(\theta-\theta_0)$ and t is :

1) 

2) 

3) 

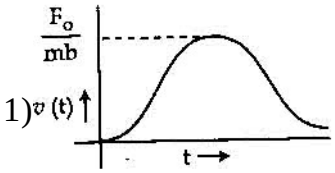
4) 

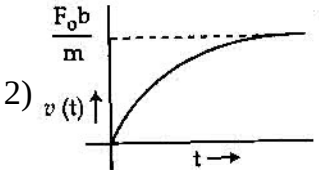
Ans: 1

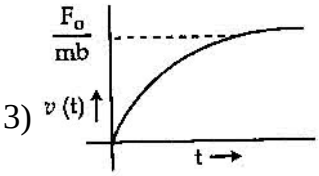
Sol: $\frac{d\theta}{dt} = -c(\theta - \theta_0)$

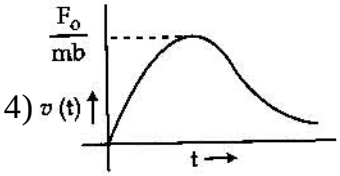
$\ell n(\theta - \theta_0) \propto t$

42. A particle of mass m is at rest at the origin at time t = 0. It is subjected to a force $F(t) = F_0 e^{-bt}$ in the x direction. Its speed $v(t)$ is depicted by which of the following curves ?

1) 

2) 

3) 

4) 

Ans: 2

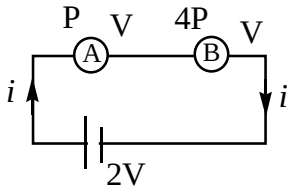
Sol ; $V = \frac{\int F_0 e^{-bt}}{m} dt$

$V = \frac{-F_0 b}{m} e^{-bt} + \frac{F_0 b}{m}$

43. Two electric bulbs marked 25W-220V and 100W-220W are connected in series to a 440V supply. Which of the bulbs will fuse ?

1) both 2) 100W 3) 25W 4) neither

Ans: 3

Sol: 

$$R_A = 4R_B = \frac{V^2}{P}$$

$$i = \frac{2V\,4P}{5V^2} = \frac{8P}{5V}$$

$P_A = i \times$ (potential difference across it)

$$P_A = \left(\frac{8P}{5V}\right)\left(\frac{2V \cdot 4}{5}\right)$$; more than maximum

$$P_A = \frac{64}{25}P$$

$$P_B = \left(\frac{8P}{5V}\right)\left(\frac{2V}{5}\right) = \frac{16}{25}P$$

$$P_B = \frac{4}{25}\left[P_{B\max}\right]$$; less than maximum

So bulb with 25W-220V will get fused

44. Resistance of a given wire is obtained by measuring the current flowing in it and the voltage difference applied across it. If the percentage errors in the measurement of the current and the voltage difference are 3% each, then error in the value of resistance of the wire is

1) 6% 2) zero 3) 1% 4) 3%

Ans: 1

Sol: $\frac{\Delta R}{R} = \frac{\Delta i}{i} + \frac{\Delta V}{V}; 6\%$

45. A boy can throw a stone up to a maximum height of 10 m. The maximum horizontal distance that the boy can throw the same stone up to will be :

1) $20\sqrt{2}\,m$ 2) 10 m 3) $10\sqrt{2}\,m$ 4) 20 m

Ans: 4

Sol : $\frac{v^2}{2g} = 10m$

$$\frac{v^2 \sin(90)}{g} = R_{max}$$

$$\Rightarrow R_{max} = 20\,m$$

46. This question has statement 1 and statement 2. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement-1 : Davisson- Germer experiment established the wave nature of electrons.

Statement-2 : If electrons have wave nature, they can interfere and show diffraction.

1) statement-1 is false, statement 2 is true

2) statement-1 is true, statement-2 is false

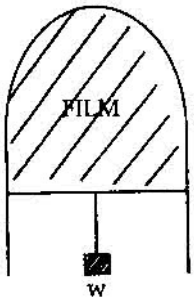
3) statement-1 is true, statement-2 is true, statement-2 is correct explanation for statement-1

4) Statement-1 is true, statement-2 is true, statement-2 is not the correct explanation of statement-1

Ans: 3

Sol: Both the statements are correct

47. A thin liquid film formed between a U-shaped wire and light slider supports a weight of $1.5\times10^{-2}\,N$ (see figure). The length of the slider 30 cm and its weight negligible. The surface tension of the liquid film is :



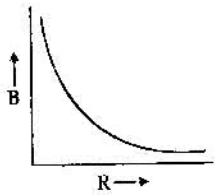
1) $0.0125\,Nm^{-1}$ 2) $0.1\,Nm^{-1}$ 3) $0.05\,Nm^{-1}$ 4) $0.025\,Nm^{-1}$

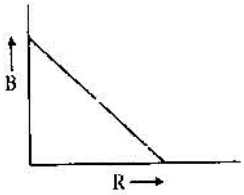
Ans: 4

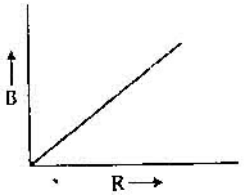
Sol: $2TL = W$

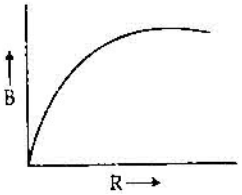
$$T = \frac{W}{2L} = \frac{1.5\times10^{-2}}{2\times0.3} = 2.5\times10^{-2}\,Nm^{-1}$$

48. A charge Q is uniformly distributed over the surface of non-conducting disc of the radius R. The disc rorates about an axis perpendicular to its plane and passing through its centre with an angular velocity ω. As a result of this rotation a magnetic field of induction B is obtained at the centre of the disc if we keep both the amount of charge placed on the disk and its angular velocity to be constant and vary the radius of the disc then the variation of the magnetic induction at the centre of the disc will be represented by the figure.

1) 

2) 

3) 

4) 

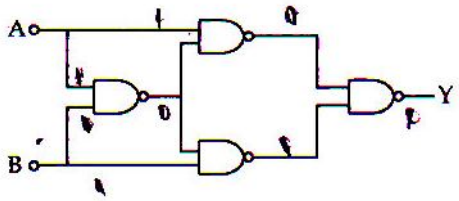
Ans: 1

Sol : $$B = \int \frac{\mu_0 di}{2r} = \int \mu_0 \left[\frac{\sigma\frac{(2\pi r dr)\omega}{2\pi}}{2r}\right] = \frac{\mu_0\sigma\omega R}{2}$$

$$= \frac{\mu_0\theta\omega}{2\pi R}$$

$$\therefore B \propto \frac{1}{R}$$

49. Truth table for system of four NAND gates as shown in figure is :



1)

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

2)

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

3)

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

4)

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

Ans: 1

Sol: $Y = \overline{\left[A\cdot\left(\overline{AB}\right)\right]\cdot\left[B\cdot\overline{AB}\right]} = A\bar{B} + \bar{A}B$

50. A radar has a power of 1 kW and is operating at a frequency of 10 GHz. It is located on a mountain top of height 500 m. The maximum distance upto which it can detect object located on the surface of the earth (Radius of earth = $6.4\times10^{6}m$) is:

1) 80 km 2) 16 km 3) 40 km 4) 64 km

Ans: 1

Sol: Maximum distance to detect $= \sqrt{(h+R)^2 - R^2}$

$$= \sqrt{h^2 + 2Rh}$$

$$\approx \sqrt{2Rh}$$

$$= \sqrt{2\times6.4\times10^{3}\times\frac{1}{2}km^2}$$

$$= 80\,km$$

51. Assume that a neutron breaks into a proton and an electron. The energy released during this process is :

(Mass of neutron = $1.6725\times10^{-27}kg$

Mass of proton = $1.6725\times10^{-27}kg$

Mass of electron = $9\times10^{-31}kg$)

1) 0.73 MeV 2) 7.10 MeV 3) 6.30 MeV 4) 5.4 MeV

Ans: Add

52. A carnot engine, whose efficiency is 40% takes in heat from a source maintained at a temperature of 500 K. It is desired to have an engine of efficiency 60 %. Then, the intake temperature for the same exhaust (sink) temperature must be :

1) efficiency of carnot engine cannot be made larger than 50%

2) 1200 K 3) 750 K 4) 600 K

Ans: 3

Sol: Let the sink temperature be T_S, then

$$1-\frac{T_s}{500} = 0.4$$

$$\therefore T_S = 300\,K$$

Let required temperature be R, then

$$1-\frac{300}{T}=0.6$$

$$T=\frac{300}{0.4}=750\ \text{K}$$

53. This question has statement 1 and statement 2. Of the four choices given after the statements, choose the one that best describes the two statements.

If two springs S_1 and S_2 of the force constants k_1 and k_2, respectively, are stretched by the same force, it is found that more work is done on spring S_1 than on spring S_2.

Statement-1 : If stretched by the same amount, workd done on S_1, will be more than that of S_2

Statement-2 : $k_1 < k_2$

1) Statement-1 is false, statement-2 is true

2) statement-1 is true, statement-2 is false

3) statement-1 is true, statement-2 is true, statement 2 is the correct explanation of statement-1

4) statement-1 is true, statement-2 is true, statement-2 is not the correct explanation of statement-1

Ans: 1

Sol: According to given data

$$w_1 > w_2$$

$$\frac{(k_1x_1)^2}{2k_1} > \frac{(k_2x_2)^2}{2k_2} \qquad (\because k_1x_1 = k_2x_2)$$

$$\therefore k_1 < k_2$$

When elongation is same $w_1 < w_2$

So, statement(1) is wrong

statement (2) is correct

54. Two cars of masses m_1 and m_2 are moving in circles of radii r_1 and r_2 respectively. Their speeds are such that they make complete circles in the same time t. The ratio of their centripetal acceleration is :

1) $m_1 r_1 : m_2 r_2$ 2) $m_1 : m_2$ 3) $r_1 : r_2$ 4) 1 : 1

Ans: 3

Sol: Cars complete circles in same time t, so they have same angular velocity

centripetal acceleration $a_c = rw^2$

$$\therefore \frac{a_{c1}}{a_{c2}} = \frac{r_1 w_1^2}{r_2 w_2^2} = \frac{r_1}{r_2}$$

55. A cylindrical tube, open at both ends, has a fundamental frequency, f, in air. The tube is dipped vertically in water so that half of it is in water. The fundamental frequency of the air-column is now.

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

Ans: 1

Sol: For opentube $\frac{\lambda}{2} = L, \lambda = 2L$

$$\therefore f = \frac{c}{2L}$$

For closed tube $\frac{\lambda}{4} = \frac{L}{2}, \lambda = 2L$

$$\therefore f^1 = \frac{c}{2L} = f$$

56. An object 2.4 m in front of a lens forms a sharp image on a film 12 cm behind the lens. A glass plate 1 cm thick, of refractive index 1.50 is interposed between lens and film with its plane faces parallel to film. At what distance (from lens) should object be shifted to be in sharp focus on film?

1) 7.2 m 2) 2.4 m 3) 3.2 m 4) 5.6 m

Ans: 4

Sol: The glass plate produces a shift of $1\left[1-\frac{2}{3}\right] = \frac{1}{3}cm$. So when plate is placed required image distance $= 12 - \frac{1}{3}cm$

$$\therefore \frac{1}{240}+\frac{1}{12}=\frac{1}{7}=\frac{1}{f}+\frac{1}{12-\frac{1}{3}}$$

$$\frac{1}{u}=\frac{1}{240}+\frac{1}{12}-\frac{3}{35}=\frac{1}{240}-\frac{1}{12\times 35}$$

$$\therefore u=560\,cm$$

57. A diatomic molecule is made of two masses m_1 and m_2 whch are seperated by a distance r. If we calculate its rotational energy by applying Bohr's rule of angular momentum quantization, its energy will be given by :

(n is an integer)

1) $\frac{(m_1+m_2)^2 n^2h^2}{2m_1^2m_2^2r^2}$ 2) $\frac{n^2h^2}{2(m_1+m_2)r^2}$ 3) $\frac{2n^2h^2}{(m_1+m_2)r^2}$ 4) $\frac{(m_1+m_2)n^2h^2}{2m_1m_2r^2}$

Ans: 4

Sol: Moment of inertia of the atoms about C.M

$$=m_1r_1^{\,2}+m_2r_2^{\,2}$$

$$=m_1\left(\frac{m_2}{m_1+m_2}r\right)^2+m_2\left(\frac{m_1}{m_1+m_2}r\right)^2$$

$$=\frac{m_1m_2}{m_1+m_2}r^2$$

$\therefore$ Required energy = $\frac{L^2}{2I}$

$$=\frac{\left(\frac{nh}{2\pi}\right)^2}{2\frac{m_1m_2}{(m_1+m_2)^2}\cdot r^2}$$

$$=\frac{1}{4\pi^2}\times\frac{n^2h^2(m_1+m_2)}{2m_1m_2r^2}$$

58. A spectrometer gives the following reading when used to measure the angle of a prism.

Main scale reaading: 58.5 degree

Vernier scale reading : 09 divisions

Given that 1 division on main scale corresponds to 0.5 degree. Total divisions on the vernier scale is 30 and match with 29 divisions of the main scale. The angle of the prism from the above data:

1) 58.59 degree 2) 58.77 degree 3) 58.65 degree 4) 59 degree

Ans: 3

Sol: Reading = M S R + V S R $\times$ L C

$$= 58.5 + 9 \times \frac{0.5}{30}$$

$$= 58.65 \text{ degree}$$

59. This question has statement 1 and statement-2. Of the four choices given after the statements, choose the one that best describes the two statements.

An insulating solid sphere of radius R has a uniformly positive charge density ρ. As a result of this uniform charge distribution there is a finite value of electric potential at the centre of the sphere, at the surface of the sphere and also at a point out side the sphere. The electric potential at infinity is zero

Statement-1 : When a charge 'q' is taken from the centre to the surface of the sphere, its potential energy changes by $\frac{q\rho}{3\varepsilon_0}$

Statement-2 : The electric field at a distance r(r<R) from the centre of the sphere is $\frac{\rho r}{3\varepsilon_0}$

1) statement-1 is true, statement 2 is true, statement-2 is not the correct explanation of statement-1

2) statement-1 is true statement-2 is false.

3) statement-1 is false, statement-2 is true

4) statement-1 is true, statement-2 is true, statement-2 is the correct explanation of statement-1

Ans: 3

Sol: When charge is taken from centre to the surface work done = $\frac{q\rho}{6\varepsilon_0}R^2$

So, statement (1) is wrong

The electric field inside uniform sphere = $\frac{\rho}{3\varepsilon_0}\vec{r}$

Statement-2 is correct

60. Proton, Deuteron and alpha particle of the same kinetic energy and moving in circular trajectories in a constant magnetic field. The radii of proton, deuteron and alpha particle are respectively r_p, r_d and r_α .. Which one of the following relations is correct ?

1) $r_\alpha = r_p = r_d$ 2) $r_\alpha = r_p < r_d$ 3) $r_\alpha > r_d > r_p$ 4) $r_\alpha = r_d > r_p$

Ans: 2

Sol: Radius of circular path = $r = \frac{mv}{Bq}$

$$= \frac{\sqrt{2mKE}}{Bq}$$

$\therefore r \propto \frac{\sqrt{m}}{q}$ ($\because K.E$ is same)

$\therefore r_\alpha = r_p < r_d$

PART C- CHEMISTRY

61. Which among the following will be named as dibromidobis (ethylene diamine) chromium (III) bromide?

1) $\left[Cr(en)_3\right]Br_3$ 2) $\left[Cr(en)_2 Br_2\right]Br$ 3) $\left[Cr(en)Br_4\right]^-$ 4) $\left[Cr(en)Br_2\right]Br$

Ans:2

62. Which method of purification is represented by the following equation:

$$Ti(s)+2I_2(g)\xrightarrow{523K}TiI_4(g)\xrightarrow{1700K}Ti(s)+2I_2(g)$$

1) Zone refining 2) Cupellation 3) Poling 4) Van Arkel

Ans:4

63. Lithium forms body centred cubic strcture.The length of the side of its unit cell is 351 pm. Atomic radius of the lithium will be

1) 75 pm 2) 300 pm 3) 240 pm 4) 152 pm

Ans:4

Sol: Formula : $\frac{\sqrt{3}a}{4}=r$

$$r=\frac{\sqrt{3}\times 351}{4}=152$$

64. The molecule having smallest bond angle is

1) NCl_3 2) $AsCl_3$ 3) $SbCl_3$ 4) PCl_3

Ans:3

65. Which of the following compounds can be detected by Molish's test?

1) Nitro compounds 2) Sugars 3) Amines 4) Primary alcohols

Ans:2

66. The incorrect expression among the following is

1) $\frac{\Delta G_{system}}{\Delta S_{total}}=-T$ 2) In isothermal process, $w_{reversible}=-nRT\ln\frac{V_f}{V_i}$

3) $lnK=\frac{\Delta H^0-T\Delta S^0}{RT}$ 4) $K=e^{-\Delta G^0/RT}$

Ans:3

67. The density of a solution prepared by dissolving 120g of urea (mol. mass=60u) in 1000 g of water is 1.15 g/mL. The molarity of this solution is

1) 0.50 M 2) 1.78 M 3) 1.02 M 4) 2.05 M

Ans:4

Sol: $M = \frac{wt}{GMM} \times \frac{1000}{wt\ of\ solution} \times d$

$= \frac{120}{60} \times \frac{1000}{1000+120} \times 1.15$

$= \frac{230}{112} = 2.05M$

68. The species which can best serve as an initiator for the cationic polymerization is

1) $LiAlH_4$ 2) HNO_3 3) $AlCl_3$ 4) BuLi

Ans:3

69. Which of the following on thermal decomposition yields a basic as well as an acidic oxide?

1) $NaNO_3$ 2) $KClO_3$ 3) $CaCO_3$ 4) NH_4NO_3

Ans:3

70. The standard reduction potentials for Zn^{2+}/Zn, Ni^{2+}/Ni and Fe^{2+}/Fe are -0.76 , -0.23 and -0.44 V respectively.The reaction $X + Y^{2+} \rightarrow X^{2+} + Y$ will be spontaneous when

1) X=Ni, Y=Fe 2)X=Ni, Y=Zn 3) X=Fe, Y=Zn 4) X=Zn, Y=Ni

Ans:4

71. According to Freundlich adsorption isotherm,which of the following is correct?

1) $\frac{x}{m} \propto p^0$ 2) $\frac{x}{m} \propto p^1$ 3) $\frac{x}{m} \propto p^{1/n}$

4) All the above are correct for different ranges of pressure

Ans:4

72. The equilibrium constant (K_c) for the reaction $N_2(g) + O_2(g) \rightarrow 2NO(g)$ at temperature T is 4×10^{-4} .The value of K_c for the reaction, $NO(g) \rightarrow \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$ at the same temperature is:

1) 0.02 2) 2.5×10^2 3) 4×10^{-4} 4) 50.0

Ans:4

Sol: $N_2 + O_2 \rightleftharpoons 2NO$ ..... K_1

$NO \rightleftharpoons \frac{1}{2}N_2 + \frac{1}{2}O_2$ ..... K_2

$K_2 = \frac{1}{\sqrt{K_1}} = \frac{1}{\sqrt{4\times10^{-4}}} = \frac{100}{2} = 50$

73. The compressibility factor for a real gas at high pressure is

1) 1+RT/pb 2) 1 3) 1+pb/RT 4) 1-pb/RT

Ans:3

Sol: $\left(p + \frac{a}{n^2}\right)(V - b) = RT$

at high pressures, pressure correction is neglected

74. Which one of the following statements is correct?

1) All amino acids except lysine are optically active.

2) All amino acids are optically active.

3) All amino acids except glycine are optically active.

4) All amino acids except glutamic acids are optically active.

Ans:3

75. Aspirin is known as :

1) Acetyl salicylic acid 2) Phenyl salicylate

3) Acetyl salicylate 4) Methyl salicylic acid

Ans:1

76. Ortho-Nitrophenol is less soluble in water than p-and m-Nitrophenols because

1) o- Nitrophenol is more voltaile is steam than those of m- and p- isomers

2) o- Nitrophenol shows Intramolecular H-bonding

3) o-Nitrophenol shows Intermolecular H-bonding

4) Melting point of o- Nitrophenol lower than those of m-and p-isomers

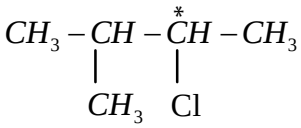
Ans:2

77. How many chiral compounds are possible on monochlorination of 2- methyl butane?

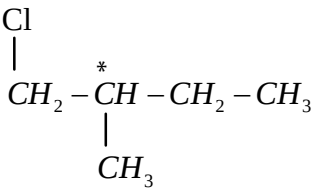
1) 8 2) 2 3) 4 4) 6

Ans:3

Sol:



2 isomers



2 isomers

78. Very pure hydrogen (99.9%) can be made by which of the following processes?

1) Reaction of methane with steam

2) Mixing natural hydrocarbons of high molecular weight

3) Elecrolysis of water

4) Reaction of salt like hydrides with water

Ans:3

79. The electrons identified by quantum numbers n and1

a) n=4, l=1 b) n=4, l=0 c) n=3, l=2 d) n=3,l=1

can be placed in order of increasing energy as:

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

Ans:2

80. For a first order reaction ,(A) $\rightarrow$ products ,the concentration of A chnages from 0.1 M to 0.025 M in 40 minutes . The rate of reaction when the concentration of A is 0.01 M, is:

1) $1.73\times10^{-5}M$ / min 2) $3.47\times10^{-4}M$ / min 3) $3.47\times10^{-5}M$ / min 4) $1.73\times10^{-4}M$ / min

Ans:2

Sol: Change of concentration from 0.1 M to 0.025 M corresponds to 75% completion of reaction

$t_{75\%} = 2t_{1/2}$

$\therefore t_{1/2} = 20\,\text{minutes}$

Rate =K[A]

Rate= $\frac{0.693}{20}\times0.1$

$=3.47\times10^{-4}\,M$ / min

81. Iron exhibits +2 and +3 oxidation states. Which of the following statements about iron is incorrect ?

1) Ferrous oxide is more basic in nature than the ferric oxide.

2) Ferous compounds are relatively more ionic than the corresponding ferric compounds.

3) Ferrous compounds are less volatile than the corresponding ferric compounds.

4) Ferrous compounds are more easily hydrolysed than the corresponding ferric compounds

Ans:4

82. The pH of a 0.1 molar solution of the acid HQ is 3.The value of the ionization constant Ka of this acid is

1) 3×10^{-1} 2) 1×10^{-3} 3) 1×10^{-5} 4) 1×10^{-7}

Ans:3

Sol: pH of weak acid is given by

$$pH = \frac{pK_a - \log c}{2}$$

$$3 = \frac{pK_a + 1}{2}$$

$$pK_a = 5$$

$$\therefore K_a = 10^{-5}$$

83. Which branched chain isomer of the hydrocarbon with molecular mas 72u gives only one isomer of mono substituted alkyl halide ?

1) Tertiary butyl chloride 2) Neopentane

3) Isohexane 4) Neohexane

Ans:2

84. K_f for water is $1.86\,K\,kg\,mol^{-1}$. If your automobile radiator holds 1.0 kg of water, how many grams of ethylene glycol $(C_2H_6O_2)$ must you add to get the freezing point of the solution lowered to -2.8^0C ?

1) 72 g 2) 93 g 3) 39 g 4) 27 g

Ans:2

Sol: $\Delta T_f = k_f m$

$$2.8 = 1.86 \times \frac{w}{62} \times \frac{1000}{1000}$$

w=93 gm

85. What is DDT among the following :

1) Greenhouse gas 2) A fertilizer

3) Biodegradable pollutant 4) Non-biodegradable pollutant

Ans:4

86. The increasing order of the ionic radii of the given isoelectronic species is

1) $Cl^-, Ca^{2+}, K^+, S^{2-}$ 2) $S^{2-}, Cl^-, Ca^{2+}, K^+$ 3) $Ca^{2+}, K^+, Cl^-, S^{2-}$ 4) $K^+, S^{2-}, Ca^{2+}, Cl^-$

Ans:3

87. 2-Hexyne gives trans -2-hexene on treatment with

1) Pt / H_2 2) Li / NH_3 3) $Pd / BaSO_4$ 4) $LiAlH_4$

Ans:2

88. Iodofrom can be prepared from all except

1) Ethyl methyl ketone 2) Isopropyl alcohol

3) 3-Methyl-2-butanone 4) Isobutyl alcohol

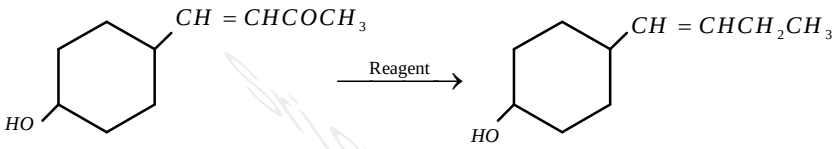
Ans:4

89. In which of the following pairs the two species are not isostructural ?

1) CO_3^{2-} and NO_3^- 2) PCl_3^- and $SiCl_4$ 3) PF_5 and BrF_5 4) AlF_6^{3-} and SF_6

Ans:3

90. In the given transformation ,which of the following is the most appropriate reagent ?



1) $NH_2NH_2, \overset{\ominus}{O}H$ 2) $Zn - Hg / HCl$ 3) $Na, Liq.NH_3$ 4) $NaBH_4$

Ans:1