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Date : 01-11-2015 **Time: 3 Hours** **Max. Marks : 160**

STREAM - SB/SX

INSTRUCTIONS

1. Immediately fill the particulars on this page of the Test Booklet with Blue / Black Ball Point Pen. Use of pencil is strictly prohibited.

2. The Test Booklet consists of **120** questions.

3. There are Two parts in the question paper. The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART-I :

MATHEMATICS
Question No. **1 to 20** consist of **ONE (1)** mark for each correct response.
PHYSICS
Question No. **21 to 40** consist of **ONE (1)** mark for each correct response.
CHEMISTRY
Question No. **41 to 60** consist of **ONE (1)** mark for each correct response.
BIOLOGY
Question No. **61 to 80** consist of **ONE (1)** mark for each correct response.

PART-II :

MATHEMATICS
Question No. **81 to 90** consist of **TWO (2)** marks for each correct response.
PHYSICS
Question No. **91 to 100** consist of **TWO (2)** marks for each correct response.
CHEMISTRY
Question No. **101 to 110** consist of **TWO (2)** marks for each correct response.
BIOLOGY
Question No. **111 to 120** consist of **TWO (2)** marks for each correct response.

4. Candidates will be awarded marks as stated above in Instructions No. 3 for correct response of each question. for Part-I **0.25** marks will be deducted for indicating incorrect response of each question and for Part-II **0.50** marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the Answer sheet.

5. No candidate is allowed to carry any textual material, printed or written, bits of papers, paper, mobile phone, any electronic device, etc., except the Admit Card inside the examination hall/room.

6. Rough work is to be done on the space provided for this purpose in the Test Booklet only. This space is given at the bottom of each page.

7. On completion of the test, the candiate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. However, the candidates are allowed to take away this Test Booklet with them.

8. Do not fold or make any stray marks on the Answer Sheet.

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PART-I
One Mark Questions

MATHEMATICS

1. The number of ordered pairs (x,y) of real numbers that satisfy the simultaneous equations.

$x+y^2=x^2+y=12$

Is

[A] 0 [B] 1 [C] 2 [D] 4

Ans. **[D]**

Sol. $x + y^2 = x^2 + y = 12$

$x + y^2 = x^2 + y$

$x-y=x^2-y^2 \Rightarrow x=y$, $x + y = 1$

when x = y $x^2 + x = 12$

$x^2 + x - 12 = 0$

$x^2 + 4x - 3x - 12 = 0$

$(x + 4)(x - 3) = 0$

$x = -4, 3$

$(3,3)\ (-4,-4)$

When $y = 1 - x$

$x + (1 - x)^2 = 12$

$x^2 - x - 11 = 0$

$x=\frac{1\pm\sqrt{1+44}}{2}$ } for two value of x there are two value of y.

So four pair.

2. If z is a complex number satisfying $|z^3+z^{-3}|\le 2$, then the maximum possible value of $|z+z^{-1}|$ is

[A] 2 [B] $\sqrt[3]{2}$ [C] $2\sqrt{2}$ [D] 1

Ans. **[A]**

Sol. $\left|z^3+\frac{1}{z^3}\right|\le 2$

But we know that $\left|z^3+\frac{1}{z^3}\right|\le |z|^3+\frac{1}{|z|^3}$

So when $|z|=1$ by $AM\ge GM$

$|z|^3+\frac{1}{|z|^3}=2$

Now $\left|z+\frac{1}{z}\right|\le |z|+\frac{1}{|z|}=2$

Maximum value = 2

3. The largest perfect square that divides $2014^3-2013^3+2012^3-2011^3+....+2^3-1^3$ is

[A] 1^2 [B] 2^2 [C] 1007^2 [D] 2014^2

Ans. **[C]**

Sol. $S = 2014^3-2013^3+2012^3-2011^3+....+2^3-1^3$

$$\sum_{r=1}^{2014} r^2 + \sum_{r=1}^{1007}(2r-1)(2r)$$

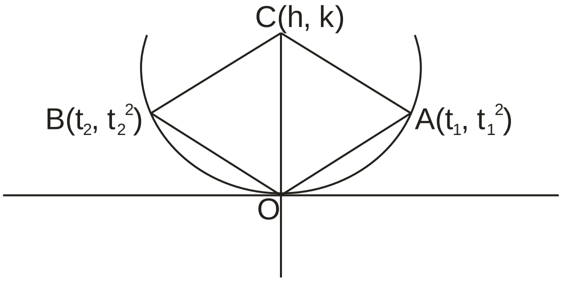
$$S = \sum_{r=1}^{2014} r^2 + \sum_{r=1}^{1007}(4r^2-2r)$$

$$S = \frac{(2014)(2015)(4029)}{6} + \frac{4\times1007\times1008\times2015}{6} - \frac{2\times1007\times1008}{2} = (1007)^2\times4031$$

4. Suppose OABC is a rectangle in the xy-plane where o is the origin and A,B lie on the parabola $y = x^2$. Then C must lie on the curve.

[A] $y = x^2+2$ [B] $y = 2x^2+1$ [C] $y = -x^2+2$ [D] $y = -2x^2+1$

Ans. [A]



Sol.

$m_{OA}\times m_{OB} = -1$

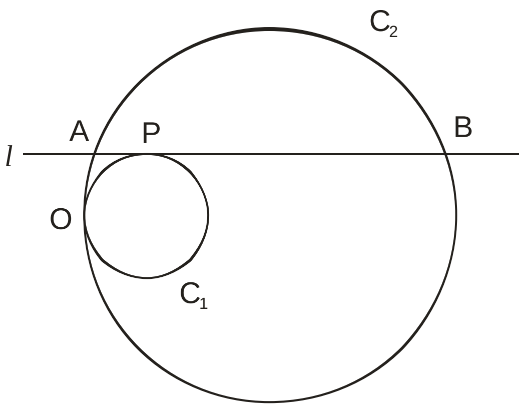
$t_1t_2 = -1$

$t_1+t_2 = h$

$K = (t_1+t_2)^2 - 2t_1t_2$

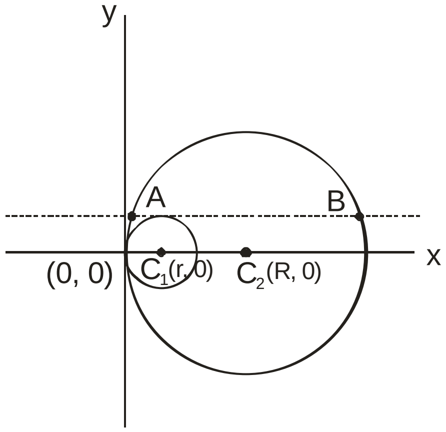
$K = h^2+2 \Rightarrow \boxed{y = x^2+2}$

5. Circles C_1 and C_2, of radii r and R respectively, touch each other as shown in figure. The line ℓ, which is parallel to the line joining the centres of C_1 and C_2, is tangent to C_1 at P and intersects C_2 at A,B. If $R^2 = 2r^2$, then $\angle AOB$



[A] $22\frac{1}{2}^0$ [B] 45º [C] 60º [D] $67\frac{1}{2}^0$

Ans. [B]



Sol.

$C_1(r, 0)$
$C_2(R, 0)$
Eq. of AB $\quad y = r$
Eq. of circle $\quad C_2 \quad (x - R)^2 + y^2 = R^2$
$A\left(R - \sqrt{R^2 - r^2}, r\right)$ using $R^2 = 2r^2$
$B\left(R + \sqrt{R^2 - r^2}, r\right) \quad A(R - r, r), B(R + r, r)$

Slope of OA = $\dfrac{r}{R - r} = m_1$

Slope of OB = $\dfrac{r}{R + r} = m_2$

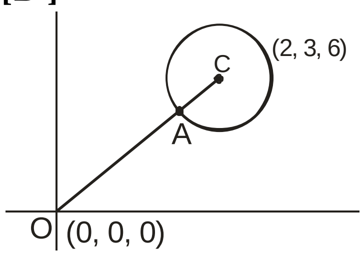
$\tan\theta = \dfrac{m_1 - m_2}{1 + m_1 m_2} = 1$

$\theta = 45^o$

6. The shortest distance from the origin to a variable point on the sphere $(x-2)^2 + (y-3)^2 + (z-6)^2 = 1$ is

[A] 5 [B] 6 [C] 7 [D] 8

Ans. [B]



Sol.

Required $= |\,OC - AC|$
$= \sqrt{4+9+36} - 1$
$= 6$

7. The number of real numbers λ for which the equality $\dfrac{\sin(\lambda\alpha)}{\sin\alpha} - \dfrac{\cos(\lambda\alpha)}{\cos\alpha} = \lambda - 1$, holds for all real α which are not integral multiples of $\pi/2$ is

[A] 1 [B] 2 [C] 3 [D] Infinite

Ans. [B]

Sol. $\dfrac{\sin(\lambda\alpha)}{\sin\alpha} - \dfrac{\cos(\lambda\alpha)}{\cos\alpha} = \lambda - 1$

$\sin\lambda\alpha\cos\alpha - \cos\lambda\alpha\sin\alpha = (\lambda-1)\sin\alpha\cos\alpha$

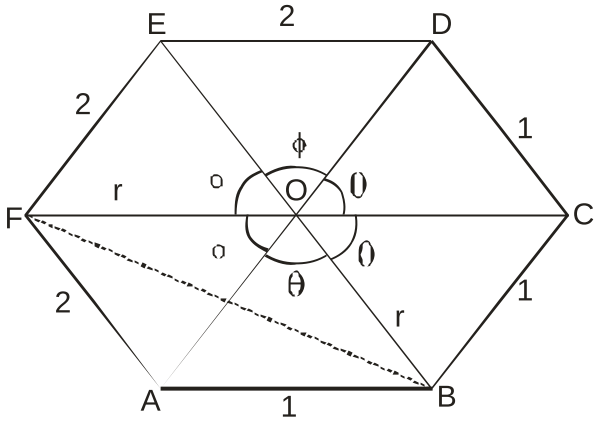
$\sin(\lambda\alpha-\alpha) = \frac{(\lambda-1)}{2}\sin 2\alpha$

so = $\lambda = 1$; 3

8. Suppose ABCDEF is a hexagon such that AB = BC = CD = 1 and DE = EF = FA = 2. If the vertices A,B,C,D,E,F are concyclic, the radius of the circle passing through them is.

[A] $\sqrt{\frac{5}{2}}$ [B] $\sqrt{\frac{7}{3}}$ [C] $\sqrt{\frac{11}{5}}$ [D] $\sqrt{2}$

Ans. [B]



Sol.

$\theta+\phi = 120^o$

So

$\angle A = 120^o$ $\because$ ABCDEF are concyclic

cos A = cos 120º = $\frac{1^2+2^2-FB^2}{2(1)(2)}$

$\frac{-1}{2} = \frac{5-FB^2}{2(2)} \Rightarrow FB^2 = 7$

$FB = \sqrt{7}$

Again by cosine rule

$\cos(\theta+\phi) = \frac{r^2+r^2-7}{2r^2}$

$-\frac{1}{2} = \frac{2r^2-7}{2r^2}$

$3r^2 = 7$

$r = \sqrt{\frac{7}{3}}$

9. Let p(x) be a polynomial such that $p(x)-p'(x) = x^n$, where n is a positive integer. Then $p(0)$ equals.

[A] $n!$ [B] $(n-1)!$ [C] $\frac{1}{n!}$ [D] $\frac{1}{(n-1)!}$

Ans. [A]

Sol. Let $P(x) = a_0x^n + a_1x^{n-1} + a_2x^{n-2}.......a_n = \sum_{r=0}^{n} a_r x^{n-r}$

$$P^1(x)=\sum_{r=0}^{n-1} a_r(n-r)x^{n-r-1}$$

$$P(x)-P^1(x)=a_0x^n+\sum_{r=1}^{n}\{a_r-a_{r+}(n-r+1)\}x^{n-r}=x^n$$

So, $a_0=1$ and $a_r=a_{r-1}(n-r+1)$

$$\frac{a_r}{a_{r-1}}=n-r+1$$

Now, $P(0)=a_n=\frac{a_n}{a_{n-1}}.\frac{a_{n-1}}{a_{n-2}}.......\frac{a_2}{a_1}\frac{a_1}{a_0}.a_0$

$=(1\times 2.......n)=n!$

10. The value of the limit

$$\lim_{x\to 0}\left(\frac{x}{\sin x}\right)^{6/x^2}$$

is

[A] e   [B] e^{-1} [C] $e^{-1/6}$ [D] e^6

Ans. **[A]**

Sol. $$\lim_{x\to 0}\left(\frac{x}{\sin x}\right)^{6/x^2}$$

$$e^{\lim_{x\to 0}\frac{6}{x^2}\left(\frac{x-\sin x}{\sin x}\right)}$$

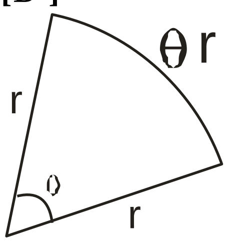
$$e^{\lim_{x\to 0}\frac{6}{x^2}\left(\frac{x-\left(x-\frac{x^3}{3!}\right)}{x}\right)}$$

$= e$

11. Among all sectors of a fixed perimeter, choose the one with maximum area. Then the angle at the center of this sector (i.e., the angle between the bounding radii) is

[A] $\frac{\pi}{3}$ [B] $\frac{3}{2}$ [C] $\sqrt{3}$ [D] 2

Ans. **[D]**



Sol.

Perimeter = $2r+r\theta=k$ (const.)

$$\text{Area}=\frac{\theta}{2}r^2=\frac{1}{2}(k-2r).r$$

$$A=\frac{1}{2}(kr-2r^2)$$

$$\frac{dA}{dr}=\frac{1}{2}(k-4r)=0\Rightarrow r=\frac{k}{4}$$

$$\frac{d^2A}{dr^2}<0$$

So, $2r+2\theta=k$

$$\frac{k}{2}+\frac{k\theta}{4}=k$$
$$\theta = 2$$

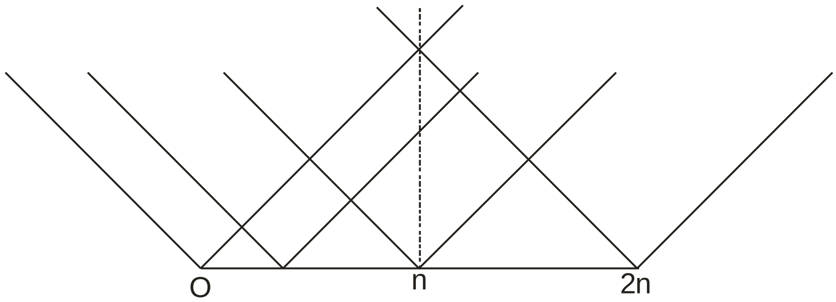
12. Define a function $f : R \to R$ by
$f(x) = \max\{|x|, |x-1|, ... |x-2n|\}$

Where n is a fixed natural number, Then $\int_0^{2n} f(x)dx$ is

[A] n [B] n^2 [C] 3n [D] $3n^2$

Ans. [D]

Sol.



$$\int_0^{2n} f(x)dx = \int_0^{n} |x-2n|\,dx + \int_n^{2n} |x|\,dx$$
$$\int_0^{n} (2n-x)dx + \int_n^{2n} xdx$$
$$= \left(2nx - \frac{x^2}{2}\right)_0^n + \left(\frac{x^2}{2}\right)_n^{2n} = 3n^2$$

13. If $p(x)$ is a cubic polynomial with p(1) = 3, p(0) = 2 and p (–1) = 4, then $\int_{-1}^{1} p(x)dx$ is

[A] 2 [B] 3 [C] 4 [D] 5

Ans. [D]

Sol. p (x) = $ax^3 + bx^2 + cx + d$
p(0) = 2
d = 2
p(1) = 3
a + b + c + 2 = 3
a + b + c = 1 …………… (1)
p(-1) = 4
$-a+b-c+2=4$
$-a+b-c=2$
from (1) and (2)
2b = 3 $\Rightarrow b = \frac{3}{2}$
$$P(x) = ax^3 + \frac{3}{2}x^2 + cx + 2$$
$$\int_{-1}^{1} p(x)dx = \int_{-1}^{1}\left(ax^2 + \frac{3}{2}x^2 + cx + 2\right) dx = 5$$

14. Let x > 0 be a fixed real number. Then the integral $\int_0^\infty e^{-t}|x-t|\,dt$ is equal to.

[A] $x+2e^{-x}-1$ [B] $x-2e^{-x}+1$

[C] $x+2e^{-x}+1$ [D] $-x-2e^{-x}+1$

Ans. [A]

Sol. $\int_0^\infty e^{-t}|(x-t)|\,dt$

$= \int_0^x \underset{II}{e^{-t}}\underset{I}{(x-t)}\,dt + \int_x^\infty \underset{II}{e^{-t}}\underset{I}{(t-x)}\,dt$

$\left\{-(x-t)e^{-t}-(-1)e^{-t}\right\}_0^x - \left\{-(x-t)e^{-t}+e^{-t}\right\}_x^\infty$

$= x+2e^{-x}-1$

15. An urn contains marbles of four colours: red, white, blue and green. When four marbles are drawn without replacement, the following events are equally likely:
(1) the selection of four red marbles;
(2) the selection of one white and three red marbles;
(3) the selection of one white, one blue and two red marbles;
(4) the selection of one marble of each colour.
The smallest total number of marbles satisfying the given condition is
[A] 19 [B] 21 [C] 46 [D] 69

Ans. [B]

Sol. Let number of red, white, blue, green balls be r, w, b, g respectively and r + w + b + g = n

Given $\frac{{}^rC_4}{{}^nC_4} = \frac{{}^wC_1.{}^rC_3}{{}^nC_4} = \frac{{}^wC_1.{}^bC_1.{}^rC_2}{{}^nC_4} = \frac{{}^rC_1.{}^wC_1.{}^bC_1.{}^gC_1}{{}^0C_4}$

$\Rightarrow \frac{r(r-1)(r-2)(r-3)}{24} = \frac{wr(r-1)(r-2)}{6} = \frac{wbr(r-1)}{2} = r.w.b.g$

$\Rightarrow$ r – 3 = 4w, r – 2 = 3b, r – 1 = 2g

$\Rightarrow$ r = 4w + 3, r = 3b + 2, r = 2g + 1

Now LCM of (4, 3, 2) = 12

$\therefore\ r_{min} = 11 \Rightarrow w_{min} = 2 \Rightarrow b_{min} = 3 \Rightarrow g_{min} = 5$

$\therefore\ (r + w + b + g)_{min.} = 21$

16. There are 6 boxes labeled B_1, B_2, …..B_6. In each trial, two fair dice D_1,D_2 are known. If D_1 shows j and D_2 shows k, then j balls are put into the box B_k. After n trials, what is the probability that B_1 contains at most one ball?

[A] $\left(\frac{5^{n-1}}{6^{n-1}}\right)+\left(\frac{5^n}{6^n}\right)\left(\frac{1}{6}\right)$ [B] $\left(\frac{5^n}{6^n}\right)+\left(\frac{5^{n-1}}{6^{n-1}}\right)\left(\frac{1}{6}\right)$

[C] $\left(\frac{5^n}{6^n}\right)+n\left(\frac{5^{n-1}}{6^{n-1}}\right)\left(\frac{1}{6}\right)$ [D] $\left(\frac{5^n}{6^n}\right)+n\left(\frac{5^{n-1}}{6^{n-1}}\right)\left(\frac{1}{6^2}\right)$

Ans. [D]

Sol. Let $P(B_1)$ be the probability that B_1 contains atmost one ball

$P(B_1)$ = $P(B_1$ contains 0 balls) + $P(B_1$ contains 1 balls)

= $P(D_2$ never show 1) + $P(D_2$ shows 1 once when D_1 show 1)

$$=\left(\frac{5}{6}\right)^n+\left\{{}^nC_1.\left(\frac{5}{6}\right)^{n-1}.\frac{1}{6}\right\}.\frac{1}{6}\Rightarrow D$$

17. Let $\vec{a}=6\vec{i}-3\vec{j}-6\vec{k}$ and $\vec{d}=\vec{i}+\vec{j}+\vec{k}$. Suppose that $\vec{a}=\vec{b}+\vec{c}$ where $\vec{b}$ is parallel to $\vec{d}$ and $\vec{c}$ is perpendicular to $\vec{d}$. Then $\vec{c}$ is

[A] $5\vec{i}-4\vec{j}-\vec{k}$ [B] $7\vec{i}-2\vec{j}-5\vec{k}$

[C] $4\vec{i}-5\vec{j}+\vec{k}$ [D] $3\vec{i}+6\vec{j}-9\vec{k}$

Ans. **[B]**

Sol. $\vec{a}=6\vec{i}-3\vec{j}-6\vec{k}$

$\vec{d}=\vec{i}+\vec{j}+\vec{k}$

$\vec{a}=\vec{b}+\vec{c}$ …………………….. (1)

$\vec{b}=\lambda\vec{d}$ & $\vec{c}.\vec{d}=0$

$\vec{b}=\lambda\hat{i}+\lambda\hat{j}+\lambda\hat{k}$

From (1)

$6\hat{i}-3\hat{j}-6\hat{k}=\lambda\hat{i}+\lambda\hat{j}+\lambda\hat{k}+\vec{c}$

$\vec{c}=(6-\lambda)\hat{i}-(3+\lambda)\hat{j}-(6+\lambda)\hat{k}$

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

$\Rightarrow\lambda=-1$

$\vec{c}=7\hat{i}-2\hat{j}-5\hat{k}$

18. If $\log_{(3x-1)}(x-2)=\log_{(9x^2-6x+1)}(2x^2-10x-2)$, then x equals.

[A] $9-\sqrt{15}$ [B] $3+\sqrt{15}$ [C] $2+\sqrt{15}$ [D] $6-\sqrt{5}$

Ans. **[B]**

Sol. $\log_{(3x-1)}(x-2)=\log_{(9x^2-6x+1)}(2x^2-10x-2)$

$\log_{(3x-1)}(x-2)=\log_{(3x-1)}\sqrt{2x^2-10x-2}$

$x-2=\sqrt{2x^2-10x-2}$ $\boxed{x>2}$

Square

$x^2-4-4x=2x^2-10x-2$

$x^2-6x-6=0$

$x=\dfrac{6\pm\sqrt{36-4(-6)}}{2}$

$x=\dfrac{6\pm2\sqrt{15}}{2}$

$x=3+\sqrt{15}$ possible

19. Suppose a,b,c are positive integers such that $2^a+4^b+8^c=328$. Then $\dfrac{\alpha+2b+3x}{abc}$ is equal to

[A] $\frac{1}{2}$ [B] $\frac{5}{8}$ [C] $\frac{17}{24}$ [D] $\frac{5}{6}$

Ans. **[C]**

Sol. $2^3 \times 41 = 2^a\left[1 + 2^{2b-a} + 2^{3c-a}\right]$

a = 3

$2^{3c-a} + 2^{2b-a} = 2^3 \times 5$

3c – a = 3

2b – 3c = 2

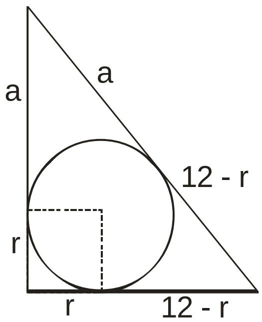
a = 3, c = 2, b = 4

$\frac{a+2b+3c}{abc} = \frac{17}{24}$

20. The sides of a right –angled triangle are integers. The length of one of the sides is 12. The largest possible radius of the in circle of such a triangle is

[A] 2 [B] 3 [C] 4 [D] 5

Ans. **[C]**



Sol.

$114 + (a + r)^2 = (12 + a - r)^2$

$\Rightarrow r = \frac{6a}{a+6}$

A = 6 r = 3

$a = 12 \Rightarrow r = 4$

PHYSICS

21. A small box resting on one edge of the table is struck in such a way that it slides off the other edge, 1 m away, after 2 seconds. The coefficient of kinetic friction between the box and the table.

[A] must be less than 0.05 [B] must be exactly zero

[C] must be more than 0.05 [D] must be exactly 0.05

Ans. **[A]**

Sol. $s = \frac{1}{2}at^2$

$1 > \frac{1}{2}\mu.g.2^2$

$\mu < \frac{1}{20}$

22. Carbon-11 decays to boron-11 according to the following formula.

${}^{11}_{6}C \rightarrow {}^{11}_{5}B + e^+ + v_e + 0.96MeV$

Assume that positrons (e^+) produced in the decay combine with free electrons in the atmosphere and annihilate each other almost immediately. Also assume that the neutrinos (v_e) are massless and do not intersect with the environment. At t = 0 we have 1 μg of ${}^{12}_{6}C$. If the half-life of the decay process is t_0, the net energy produced between time t = 0 and t = $2t_0$ will be nearly

[A] 8×10^{18} MeV [B] 8×10^{16} MeV [C] 4×10^{18} MeV [D] 4×10^{16} MeV

Ans. **[B]**

Sol. Amount decay = 0.75×10^{-6} gm

Number of atoms = 0.4×10^{17}

Energy(in nuclear reaction) = $0.96 \times$ number of atoms MeV

$\approx 4 \times 10^{16}$ MeV

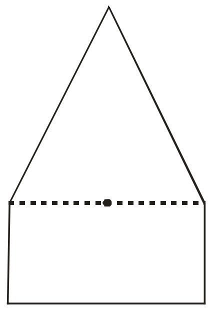
By $E = mc^2$

As 1 electron from reaction annihilate by another electrons from atmosphere so

Energy from annihilation = $2\ mc^2 \approx 4 \times 10^{16}$ MeV

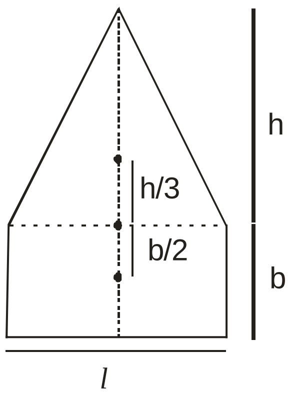
Total energy = 8×10^{16} MeV

23. Two uniform plates of the same thickness and area but of different materials, one shaped like an isosceles triangle and the other shaped like a rectangle are joined together to form a composite body as shown in the figure. If the centre of mass of the composite body is located at the midpoint of their common side, the ratio between masses of the triangle to that of the rectangle is



[A] 1 : 1 [B] 4 : 3 [C] 3 : 4 [D] 2 : 1

Ans. **[C]**



Sol.

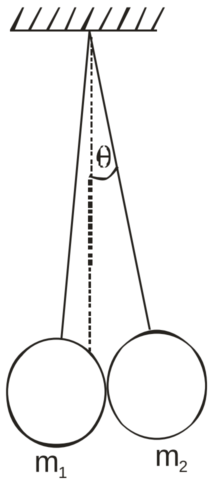
$$m_1 \times \frac{h}{3} = m_2 \times \frac{b}{2}$$ from center of mass (1)

$$\ell.b = \frac{1}{2} \times \ell.h$$ as area equal (2)

From (1) and (2)

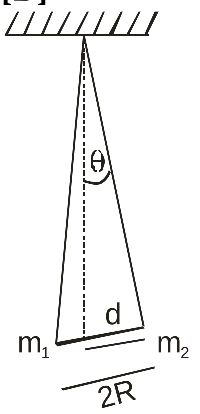
$$\frac{m_1}{m_2} = \frac{3}{4}$$

24. Two identical objects each of radii R and masses m_1 and m_2 are suspended using two strings of equal length L as shown in the figure (R<<L). The angle θ which mass m_2 makes with the vertical is approximately



[A] $\frac{m_1R}{(m_1+m_2)L}$ [B] $\frac{2m_1R}{(m_1+m_2)L}$ [C] $\frac{2m_2R}{(m_1+m_2)L}$ [D] $\frac{m_2R}{(m_1+m_2)L}$

Ans. **[B]**



Sol.

Distance of center of mass from m_2'

d = $\frac{m_1}{(m_1+m_2)} \times 2R$

$\theta = \frac{\text{distance(d)}}{\text{L}}$

$\theta = \frac{m_1}{(m_1+m_2)} \times \frac{2R}{\text{L}}$

25. A horizontal disk of moment of inertia 4.25 kg-m^2 with respect to its axis of symmetry is spinning counter clockwise at 15 revolutions per second about its axis, as viewed from above. A second disk of moment of inertia 1.80kg-m^2 with respect to its axis of symmetry is spinning clockwise at 25 revolutions per second as viewed from above about the same axis and is dropped on top of the first disk. The two disks stick together and rotate as one about their axis of symmetry. The new angular velocity of the system as viewed from above is close to.

[A] 18 revolutions/second and clockwise
[B] 18 revolutions/second and counter clockwise
[C] 3 revolutions/second and clockwise
[D] 3 revolutions/second and counter clockwise

Ans. **[C]**

Sol. Take anticlockwise positive

$I_1\omega_1 + I_2\omega_2 = I\omega$

$4.25 \times 15 - 1.80 \times 25 = 6.05 \times \omega$

ω = 3 revolutions/second and clockwise

26. A boy is standing on top of a tower of height 85m and throws a ball in the vertically upward direction with a certain speed. If 5.25 seconds later he hears the ball hitting the ground, then the speed with which the boy threw the ball is (take g = 10 m/s^2 , speed of sound in air = 340 m/s)

[A] 6 m/s [B] 8 m/s [C] 10 m/s [D] 12 m/s

Ans. **[B]**

Sol. Time taken by sound = $\frac{85}{340}$ = 0.25 sec

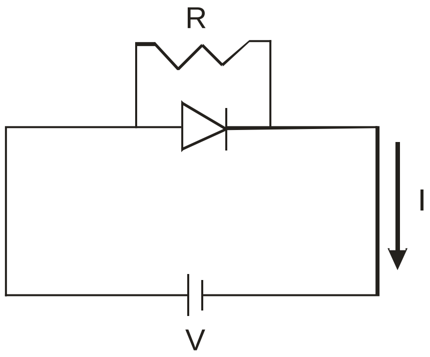
Time taken by the ball = 5.25 – 0.25 = 5 sec.

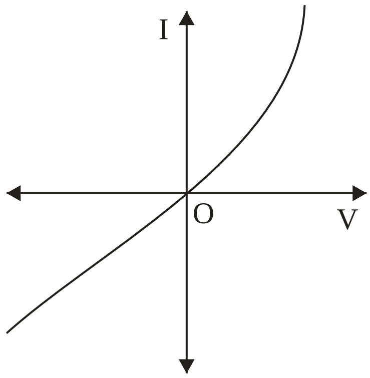
Now

$$-85 = u \times 5 - \frac{1}{2} \times 10 \times 25$$

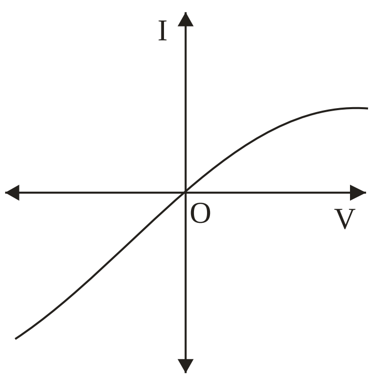
U = 8 m/sec

27. For a diode connected in parallel with a resistor, which is the most likely current(I)-voltage(V) characteristic?

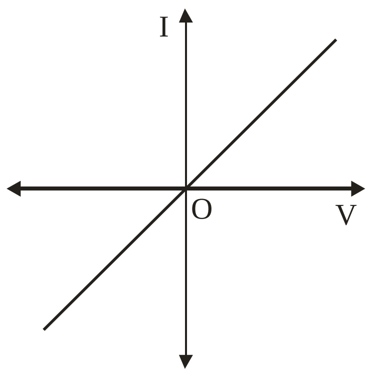




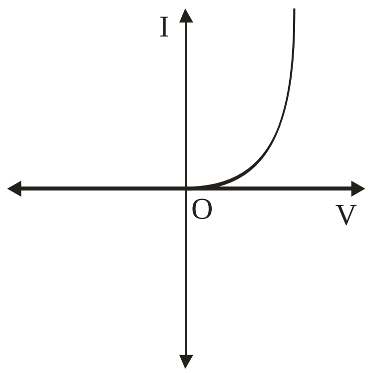
[A]



[B]



[C]



[D]

Ans. **[A]**

Sol. Initially major current flows through R & then from diode

Answer is A

28. A beam of monoenergetic electrons, which have been accelerated from rest by a potential U, is used to form an interference pattern in a Young's Double Slit experiment. The electrons are now accelerated by potential 4 U. Then the fringe width

[A] remains the same

[B] is half the original fringe width

[C] is twice the original fringe width

[D] is one-fourth the original fringe width

Ans. **[B]**

Sol. $eV = \frac{1}{2}mv^2$ so, eV = $\frac{p^2}{2m}$

and

$\lambda = \frac{h}{p}$, $\Rightarrow V \propto \frac{1}{\lambda^2}$ and $\beta = \frac{n\lambda D}{d}$

So as potential U becomes 4 U then β becomes half

29. A point charge Q = (= 3 × 10^{-12} C) rotates uniformly in a vertical circle of radius R = 1 mm. The axis of the circle is aligned along the magnetic axis of the earth. At what value of the angular speed ω, the effective magnetic field at the center of the circle will be reduced to zero? (Horizontal component of Earth's magnetic field is 30 micro Tesla)

[A] 10^{11} rad/s

[B] 10^{9} rad/s

[C] 10^{13} rad/s

[D] 10^{7} rad/s

Ans. **[A]**

Sol. $\frac{\mu_0}{2R}.\left(\frac{\omega.q}{2\pi}\right) = 30 \times 10^{-6}$

So ω = 10^{11} rad/s

30. A closed bottle containing water at 30°C is open on the surface of the moon. Then

[A] the water will boil

[B] the water will come out as a spherical ball

[C] the water will freeze

[D] the water decompose into hydrogen and oxygen

Ans. **[A]**

Sol. As boiling point depends upon atmospheric pressure which is zero at moon, so answer is (A)

31. A simple pendulum of length l is made to oscillate with amplitude of 45 degrees. The acceleration due to gravity is g. Let $T_0 = 2\pi\sqrt{l/g}$. The time period of oscillation of this pendulum will be

[A] T_0 irrespective of the amplitude

[B] slightly less than T_0

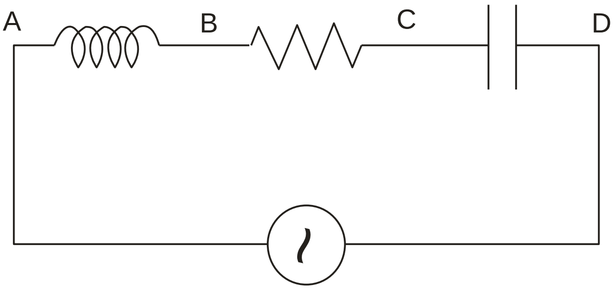
[C] Slightly more then T_0

[D] Dependent on whether it swings in a plane aligned with the north-south or east west directions.

Ans. **[C]**

Sol. $T = 2\pi\sqrt{\frac{\ell}{g}}\left(1+\frac{\theta_0^2}{16}\right)$

32. An ac voltmeter connected between points A and B in the circuit below reads 36V. If it is connected between A and C, the reading is 39 V. The reading when it is connected between B and D is 25V. What will the voltmeter read when it is connected between A and D?) Assume that the voltmeter reads true rms voltage values and that the source generated a pure ac.)



[A] $\sqrt{481}$ V [B] 31 V [C] 61 V [D] $\sqrt{3361}$ V

Ans. **[A]**

Sol. $v_L = 36$ ………………… (1)

$V_L^2 + V_R^2 = (39)^2$ …………………… (2)

$V_R^2 + V_C^2 = (25)^2$ …………………… (3)

by (1) and (2)

$V_R = 15$ …………….......... (4)

By (3) and (4)

$V_C = 20$ …………………… (5)

By (1), (4) and (5)

$V_{AD} = \sqrt{V_R^2 + (V_L - V_C)^2}$

$= \sqrt{481}$ V

33. A donor atom in a semiconductor has a loosely bound electron. The orbit of this electron is considerably affected by the semiconductor material but behaves in many ways like an electron orbiting a hydrogen nucleus. Given that the electrons has an effective mass of 0.07m (where m_e is mass of the free electron) and the space in which it moves has a permittivity $13\varepsilon_0$, then the radius of the electrons lowermost energy orbit will be close to (The Bohr radius of the hydrogen atom is 0.53Å)

[A] 0.53Å [B] 243Å [C] 10 Å [D] 100 Å

Ans. **[D]**

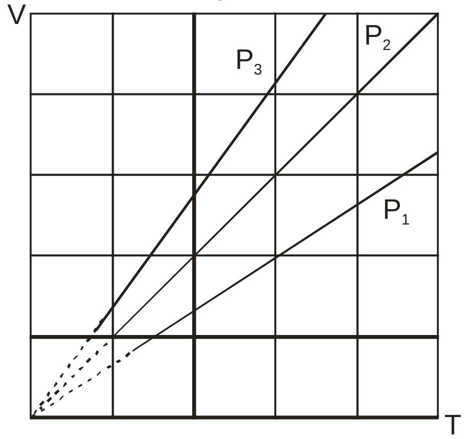
Sol. $\frac{MV^2}{r} = \frac{KQ^2}{r^2}$

&

$MVr = \frac{nh}{2\pi}$

Using data given in question r = 100 Å

34. The state of an ideal gas was changed isobarically. The graph depicts three such isobaric lines. Which of the following is true about the pressures of the gas?



[A] $P_1 = P_2 = P_3$ [B] $P_1 > P_2 > P_3$ [C] $P_1 < P_2 < P_3$ [D] $P_1/P_2 = P_3/P_1$

Ans. **[B]**

Sol. For constant temperature $P \propto \frac{1}{V}$

$V_3 > V_2 > V_1$

so $P_3 < P_2 < P_1$

35. A metallic ring of radius a and resistance R is held fixed with its axis along a spatially uniform magnetic field whose magnitude is $B_0 \sin(\omega t)$. Neglect gravity. Then;

[A] the current in the ring oscillates with a frequency of 2ω

[B] the joule heating loss in the ring is proportional to a^2

[C] the force per unit length on the ring will be proportional to B_0^2

[D] the net force on the ring is non-zero

Ans. **[C]**

Sol. $\frac{dF}{dL} = \frac{B}{R}\left(\frac{dB.A}{dt}\right)$

Where $B = B_0 \sin \omega t$

36. The dimensions of the area A of a black hole can be written in terms of the universal constant G, its mass M and the speed of light c as $A = G^{\alpha} M^{\beta} c^{\gamma}$. Here

[A] $\alpha = -2, \beta = -2,$ and $\gamma = 4$ [B] $\alpha = 2, \beta = 2,$ and $\gamma = -4$

[C] $\alpha = 3, \beta = 3,$ and $\gamma = -2$ [D] $\alpha = -3, \beta = -3,$ and $\gamma = 2$

Ans. **[B]**

Sol. $A = G^{\alpha} M^{\beta} c^{\gamma}$

$L^2 = (M^{-1}L^3T^{-2})^{\alpha}(M^1)^{\beta}(L^1T^{-1})^{\gamma}$

By comparing $-\alpha + \beta = 0$ …………….. (1)

$3\alpha + \gamma = 2$ …………….. (2)

$-2\alpha - \gamma = 0$ …………….. (3)

By solving (1),(2),(3)

$\alpha = 2, \beta = 2,$ and $\gamma = -4$

37. A 160 watt infrared source is radiating light of wavelength 50000Å uniformly in all directions. The photon flux at a distance of 1.8m is of the order of

[A] $10\ m^{-2}\ s^{-1}$ [B] $10^{10}\ m^{-2}\ s^{-1}$ [C] $10^{15}\ m^{-2}\ s^{-1}$ [D] $10^{20}\ m^{-2}\ s^{-1}$

Ans. **[D]**

Sol. $N = \frac{I\lambda}{hC} = \frac{P\lambda}{(4\pi R^2)hc}$

38. A wire bent in the shape of a regular n polygonal loop carries a steady current I. Let l be the perpendicular distance of a given segment and *R* be the distance of given segment and R be the distance of a vertex both from the centre of the loop. The magnitude of the magnetic field at the centre of the loop is given by.

[A] $\frac{n\mu_0 I}{2\pi l}\sin(\pi/n)$ [B] $\frac{n\mu_0 I}{2\pi R}\sin(\pi/n)$

[C] $\frac{n\mu_0 I}{2\pi l}\cos(\pi/n)$ [D] $\frac{n\mu_0 I}{2\pi R}\cos(\pi/n)$

Ans. **[A]**

Sol. $B = \frac{\mu_0 i}{4\pi\, l} \times 2\sin\theta$

Where $2\theta = \frac{2\pi}{n}$

39. The intensity of sound during the festival season increased by 100 times. This could imply a decibel level rise from

[A] 20 to 120 dB [B] 70 to 72 dB [C] 100 to 10000 dB [D] 80 to 100 dB

Ans. **[D]**

Sol. Sound intensity = 10 $\log_{10}\left(\frac{I}{I_0}\right)$,

$I = 100\ I_0$

so

$10 \times \log\ \frac{100 i_0}{i_0}$

= 20

So level rises by 20 dB

40. One end of a slack wire (Young's modulus Y, length L and cross-sectional area A) is clamped to a rigid wall and the other end to a block (mass m) which rests on a smooth horizontal plane. The block is set in motion with a speed v. What is the maximum distance the block will travel after the wire becomes taut?

[A] $v\sqrt{\frac{mL}{AY}}$ [B] $v\sqrt{\frac{2mL}{AY}}$ [C] $v\sqrt{\frac{mL}{2AY}}$ [D] $L\sqrt{\frac{mv}{AY}}$

Ans. **[A]**

Sol. $\frac{1}{2}mv^2 = \frac{1}{2}kx^2$

CHEMISTRY

41. The Lewis acid strength of BBr_3,BCl_3 and BF_3 is in the order

[A] $BBr_3 < BCl_3 < BF_3$ [B] $BCl_3 < BF_3 < BBr_3$

[C] $BF_3 < BCl_3 < BBr_3$ [D] $BBr_3 < BF_3 < BCl_3$

Ans. **[C]**

Sol. Order of back bonding

	BF_3	>	BCl_3	>	BBr_3
Back bonding	2p – 2p		2p – 3p		2p – 4p

Stronger is the back bonding weaker the tendency to act as a lewis acid

$BF_3 < BCl_3 < BBr_3$

42. O^{-2} is isoelectronic with

[A] Zn^{2+} [B] Mg^{2+} [C] K^{+} [D] Ni^{2+}

Ans. **[B]**

Sol. O^{2-} ; Total electron = 10

Mg^{2+} ; Total electron = 10

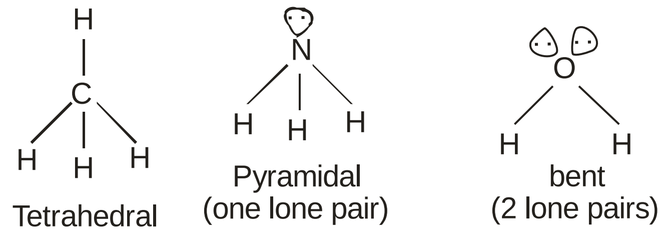
43. The H-C-H, H-N-H, and H-O-H bond angles (in degrees) in methane, ammonia and water are respectively, closest to

[A] 109.5, 104.5, 107.1 [B] 109.5,107.1,104.5

[C] 104.5,107.1,104.5 [D] 107.1,104.5,109.5

Ans. **[B]**

Sol.



Bond angle 109.5° 107.1° 104.5°

Order of repulsions: lp – bp > bp – bp, hence greater the no. of lone pairs smaller the bond angle (If hybridization of central atom is same)

44. In alkaline medium, the reaction of hydrogen peroxide with potassium permanganate produces a compound in which the oxidation state of Mn is

[A] 0 [B] +2 [C] +3 [D] +4

Ans. **[D]**

Sol. $2MnO_4^-(aq) + 3H_2O_2(aq) \rightarrow 2MnO_2(s) + 2H_2O(l) + 3O_2(g) + 2OH^-_{(aq)}$

Oxidation state of Mn in MnO_2 is +4.

45. The rate constant of a chemical reaction at a very high temperature will approach

[A] Arrhenius frequency factor divided by the ideal gas constant

[B] Activation energy

[C] Arrhenius frequency factor [D] activation energy divided by the ideal gas constant

Ans. **[C]**

Sol. $k = Ae^{-Ea/RT}$; At $T \rightarrow \infty$; $k = Ae^{-E_A[R\times\infty]} = Ae^{o}$

K = A

46. The standard reduction potentials (in V) of a few metal ion/metal electrodes are given below.

The reducing strength of the metals follows the order.

[A] Ag > Cu > Pb > Cr [B] Cr > Pb > Cu > Ag

[C] Pb > Cr > Ag > Cu [D] Cr > Ag > Cu > Pb

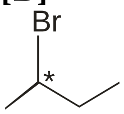
Ans. **[B]**

Sol. Which have low value of reduction potential is a good reducing agent.
Cr > Pb > Cu > Ag

47. Which of the following molecules can exhibit optical activity?

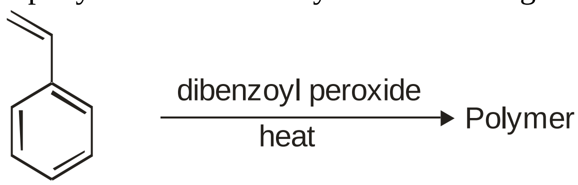
[A] 1-bromopropane [B] 2-bromobutane
[C] 3-bromopentane [D] bromocyclohexane

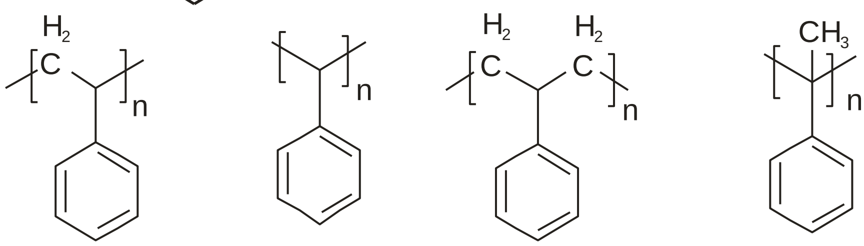
Ans. **[B]**

Sol. 

; 2-Bromobutane has asymmetric C-atom.

48. The structure of the polymer obtained by the following reaction is

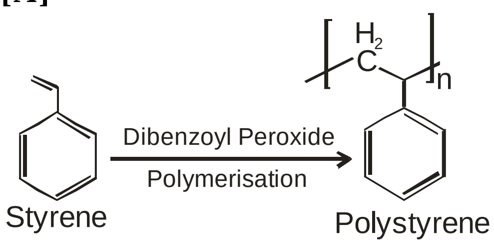




I II III IV

[A] I [B] II [C] III [D] IV

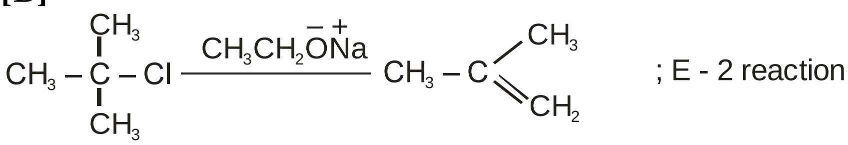
Ans. **[A]**

Sol. 

49. The major product of the reaction between CH_3CH_2ONa and $(CH_3)_3CCl$ in ethanol is

[A] $CH_3CH_2OC(CH_3)_3$ [B] $CH_2 = C(CH_3)_2$
[C] $CH_3CH_2C(CH_3)_3$ [D] $CH_3CH{=}CHCH_3$

Ans. **[B]**

Sol. 

; E - 2 reaction

50. When H_2S gas is passed through a hot acidic aqueous solution containing Al^{3+}, Cu^{2+}, Pb^{2+} and Ni^{2+}, a precipitate is formed which consists of

[A] CuS and Al_2S_3 [B] PbS and NiS [C] CuS and NiS [D] PbS and CuS

Ans. [D]

51. The electronic configuration of an element with the largest difference between the 1^{st} and 2^{nd} ionization energies is

[A] $1s^2 2s^2 2p^6$ [B] $1s^2 2s^2 2p^6 3s^1$ [C] $1s^2 2s^2 2p^6 3s^2$ [D] $1s^2 2s^2 2p^1$

Ans. [B]

Sol. Largest difference between 1^{st} and 2^{nd} IE

Abnormal jump in I.E. is normally observed when we break into an inner shell

Hence for

$m \leftarrow 1s^2 2s^2 2p^6 3s^1 \rightarrow IE$

$m^+ \rightarrow 1s^2 \underbrace{2s^2 2p^6}_{\text{fully filled inert configuration}} \rightarrow IE_2$ (Electron to be removed from 2p)

Hence $IE_2 >> IE_1$

52. The order of electro negativity of carbon in sp, sp^2 and sp^3 hybridized states follows

[A] $sp > sp^2 > sp^3$ [B] $sp^3 > sp^2 > sp$ [C] $sp > sp^3 > sp^2$

[D] $sp^2 > sp > sp^3$

Ans. [A]

Sol.

	SP	SP^2	SP^3
% S character	50%	33.33%	25%

More the % S character more the electronegativity [other factors being equal]

53. The most abundant transition metal in human body is

[A] copper [B] iron [C] zinc [D] manganese

Ans. [B]

Sol. Most abundant element (transition) in human body is Iron.

54. The molar conductivities of HCl,NaCl,CH_3COOH, and CH_3COONa at infinite dilution follow the order

[A] HCl > CH_3COOH > NaCl > CH_3COONa

[B] CH_3COONa > HCl > NaCl > CH_3COOH

[C] HCl > NaCl > CH_3COOH > CH_3COONa

[D] CH_3COOH > CH_3COONa > HCl > NaCl

Ans. [A]

Sol.

λ_∞	CH_3COO^-	=	40.9×10^{-4}	Sm^2	mol^{-1}
λ_∞	Na^+	=	50.10×10^{-4}	Sm^2	mol^{-1}
λ_∞	Cl^-	=	76.35×10^{-4}	Sm^2	mol^{-1}
λ_∞	H^+	=	349×10^{-4}	Sm^2	mol^{-1}

$\lambda_\infty HCl = \lambda_{H^+} + \lambda_{Cl^-} / \lambda_{CH_3COOH} = \lambda_{CH_3COO^-} + \lambda_{H^+}$

$\lambda_{NaCl} = \lambda_{Na} + \lambda_{Cl^-} / \lambda_{CH_3COONa} = \lambda_{CH_3COO^-} + \lambda_{Na^+}$

Hence $\lambda_{HCl} > \lambda_{CH_3COOH} > \lambda_{NaCl} > \lambda_{CH_3COONa}$

$\lambda_{HCl} = 425.35\ sm^2/mol$

$\lambda_{CH_3COOH} = 389.9\ sm^2/mol$

$\lambda_{NaCl} = 126.45\ sm^2/mol$

$\lambda_{CH_3COONa} = 91\ sm^2/mol$

55. The spin only magnetic moment of $[ZCl_4]^{2-}$ is 3.87 BM where Z is

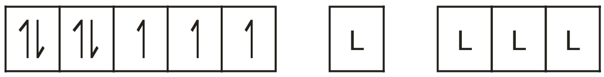
[A] Mn [B] Ni [C] Co [D] Cu

Ans. **[C]**

Sol. $[ZCl_4]^{2-}$; oxidation state of Z is +2

No. of unpaired electrons are 3

Hence $Z^{2+} = d^7$



56. If α-D-glucose is dissolved in water and kept for a few hours, the major constituent(s) present in the solution is (are)

[A] α-D-glucose

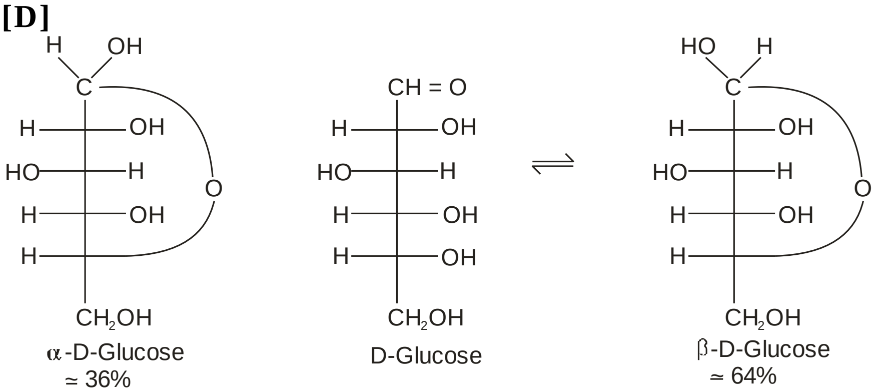
[B] mixture of β -D-glucose and open chain D-glucose open chain D-glucose

[C] open chain D-glucose

[D] mixture of α-D-glucose and β-D-glucose

Ans. **[D]**

Sol.



57. The pH of 1N aqueous solutions of HCl, CH_3COOh and HCOOH follows the order

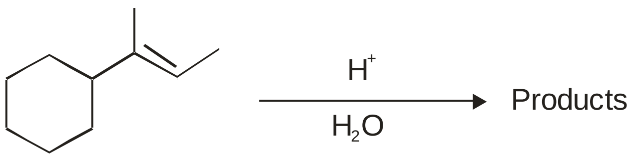
[A] HCl > HCOOH > CH_3COOH [B] CHl = HCOOH > CH_3COOH

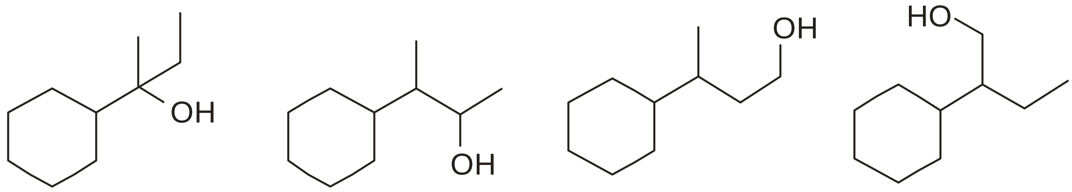
[C] CH_3COOH > HCOOH > HCl [D] CH_3COOH = HCOOH > HCl

Ans. **[C]**

Sol. HCl > HCOOH > CH_3COOH ; Order of Acidic strength

58. The major product of the reaction

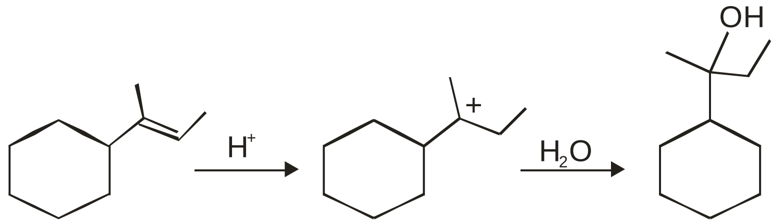




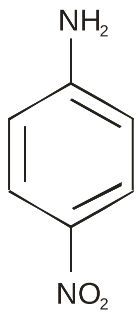
I II III IV

[A] I [B] II [C] III [D] IV

Ans. **[A]**

Sol. 

59. Reaction of aniline with $NaNO_2$ + dil. HCl at 0°C followed by reaction with CuCN yields.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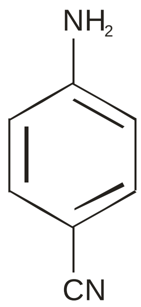
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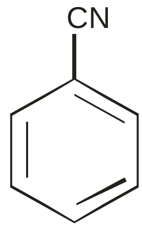
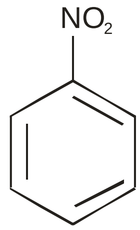
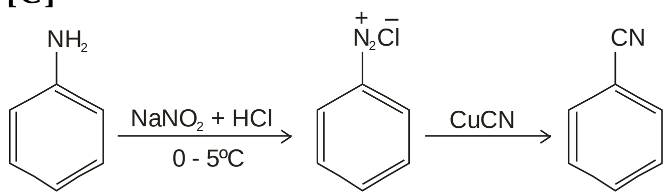

III


IV

[A] I [B] II [C] III [D] IV

Ans. **[C]**

Sol. 

60. Schottky defect in a crystal arises due to

[A] creation of equal number of cation and anion vacancies
[B] creation of unequal number of cation and anion vacancies
[C] migration of cations to interstitial voids
[D] migration of anions to interstitial voids

Ans. **[A]**

Sol. In SCHOTTKY by defect equal number of cations and anions leave the crystal LATTICE to form equal number of cationic and anionic vacancies.

BIOLOGY

61. Immunosuppressive drugs like cyclosporine delay the rejection of graft post organ transplantation by

[A] inhibiting T cell infiltration [B] Killing B cells
[C] Killing microphages [D] Killing dendritic cells

Ans. **[A]**

Sol. T-cells are responsible for rejection of transplanted organ.

62. Which one of these substances will repress the *lac* operon?

[A] Arabinose [B] Glucose [C] Lactose [D] Tryptopham

Ans. **[B]**

Sol. Excess of glucose prevent formation of allolactose thus repressure remaining active lac-operon turn off.

63. Assume a spherical mammalian cell has a diameter of 27 microns. If a polypeptide chain with alpha helical conformation has to stretch across the cell, how many amino acids should it be comprised of ?

[A] 18000 [B] 1800 [C] 27000 [D] 12000

Ans. **[B]**

Sol. $\frac{27\times10^{-6}}{5.4\times10^{-10}}$ = 500 helix

Each helix = 3.6 amino acid

so, 500 ×3.6 = 1800 amino acids

64. Which one of the following has phosphoric acid anhydride bonds ?

[A] Deoxy ribonucleic acid [B] Ribonucleic acid

[C] dNTPs [D] Phospholipids

Ans. **[C]**

Sol. Such bonding is present in ATP, dNTPs etc.

65. The two components of autonomous nervous system have antagonistic action. But in certain cases their effects are mutually helpful. Which of the following statement is correct?

[A] At rest, the control of heart beat is not by the vagus nerve

[B] During exercise the sympathetic control decreases

[C] During exercise the parasympathetic control decreases

[D] Stimulation of sympathetic system results in constriction of the pupil.

Ans. **[C]**

Sol. During exercise parasympathetic system slows heart beat

66. In a random DNA sequence, what is the lowest frequency of encountering a stop codon?

[A] 1 in 20 [B] 1 in 3 [C] 1 in 64 [D] 1 in 10

Ans. **[A]**

Sol. There are 64 codons for 20 amino acid, lowest frequency is 1 in 20.

67. The two alleles that determine the blood group AB of an individual are located on

[A] two different autosomes

[B] the same autosome

[C] two different sex chromosomes

[D] one on sex chromosome and the other on an autosome

Ans. **[B]**

Sol. Alleles of blood groups are located on 9^{th} autosome.

68. In biotechnology application, a selectable marker is incorporated in a plasmid

[A] to increase its copy number

[B] to increase the transformation efficiency

[C] to eliminate the non transformants

[D] to increase the expression of the gene of interest

Ans. **[C]**

Sol. Selectable markers helpful in selecting transformant cells.

69. Spermatids are formed after the second meiotic division from secondary spermatocytes. The ploidy of the secondary spermatocytes is

[A] n [B] 2n [C] 3n [D] 4n

Ans. [A]

Sol. Primary Spermatocyte is 2n while secondary spermatocyte and spermatids are haploid

70. Phospholipids are formed by the esterification of

[A] Three ethanol molecule with three acid molecules.

[B] One glycerol and two fatty acid molecules.

[C] One glycerol and three fatty acid molecules.

[D] One ethylene glycol and two fatty acids molecules.

Ans. [B]

Sol. Phospholipids contains one glycerol, 2-fatty acid chains, phosphate, choline.

71. Given the fact that histone binds DNA, it should be rich in

[A] arginine, lysine

[B] cysteine, methionine

[C] glutamate, aspartate [D] isoleucine, leucine

Ans. [A]

Sol. Histones are basic proteins rich in lysine and arginine.

72. If molecular weight of a polypeptide is 15.3 kDa, what would be the minimum number of nucleotides in the mRNA that codes for this polypeptide? Assume that molecule weight of each amino acid is 90 Da.

[A] 510 [B] 663 [C] 123 [D] 170

Ans. [A]

Sol. $\frac{15300}{90}$ = 170 amino acids

One aminoacid = 1 codon = 3 nucleotides, so, 170 × 3 = 510

73. Melting temperature for double stranded molecules are converted into single stranded molecules. Which one of the following DNA will have the highest melting temperature?

[A] DNA with 15% guanine

[B] DNA with 30% cytosine

[C] DNA with 40% Thymine [D] DNA with 50% adenine

Ans. [B]

Sol. DNA rich in cytosine and guanine is more stable, having highest melting point.

74. Following are the types of immunoglobulin and their functions. Which one of the Following is INCORRECTLY paired?

[A] IgD: viral pathogen [B] IgG: phagocytosis

[C] IgE: allergic reaction [D] IgM: complement fixation

Ans. [A]

Sol. IgD activates B-Cells for antigen recognization

75. Which one of the following can be used to detect amino acids ?

[A] Iodine vapour [B] Ninhydrin
[C] Ethidium Bromide [D] Bromophenol blue

Ans. **[B]**
Sol. Ninhydrin is used to detect protein and aminoacids.

76. Mutation in a single gene can lead to changes in multiple traits. This is an example of
[A] Heterotrophy [B] Co-dominance
[C] Penetrance [D] Pleiotropy

Ans. **[D]**
Sol. Multiple effects of a gene called as pleiotropy.

77. Which one of the following is used to treat cancers?
[A] Necrosis [B] Plasmolysis
[C] Apoptosis [D] Growth hoemone

Ans. **[C]**
Sol. Antibodies, interferons are useful in treatment of cancer.

78. Which of the following processes leads to DNA ladder formation?
[A] Necrosis [B] Plasmolysis [C] Apoptosis [D] Mitosis

Ans. **[D]**
Sol. Mitosis is useful in increasing amount of DNA.

79. Co-enzymes are components of an enzyme complex which are necessary for its function. Which of these is a known co enzyme?
[A] Zinc [B] Vitamin B_{12}
[C] Chlorophyll [D] Heme

Ans. **[B]**
Sol. Vitamin B_{12} is used as coenzyme cobamide.

80. The Peptidoglycans of bacteria consist of
[A] Sugar, D-amino acids and L-amino acids
[B] Sugars and only D-amino acids
[C] Sugars and only L-amino acids
[D] Sugars and glycine

Ans. **[A]**
Sol. Cell wall of bacteria contains sugars (NAG), D and L-aminoacids.

PART-II
Two Marks Questions

MATHEMATICS

81. Let $x = \left(\sqrt{50}+7\right)^{1/3} - \left(\sqrt{50}-7\right)^{1/3}$

[A] x = 2 [B] x = 3

[C] x is a rational number, but not an integer [D] x is an irrational number

Ans. **[A]**

Sol. $\left(\sqrt{50}+7\right)^{\frac{1}{3}} = t$

$x = t - \frac{1}{t}$

$x^3 = t^3 - \frac{1}{t^3} - 3\left(t - \frac{1}{t}\right)$

$x^3 + 3x = \sqrt{50} + 7 - (\sqrt{50} - 7)$

$x^3 + 3x = 14$

$x^3 + 3x - 14 = 0$

$(x-2)(x^2+2x+7) \Rightarrow x = 2$

82. Let

$(1+x+x^2)^{2014} = a_0 + a_1x + a_2x^2 + a_3x^3 + ... + a_{4028}x^{4028}$

and let

$A = a_0 - a_3 + a_6 - .... + a_{4026}$,

$B = a_1 - a_4 + a_7 - .... - a_{4027}$,

$C = a_2 - a_5 + a_8 - .... + a_{4028}$

Then

[A] $|A| = |B| > |C|$ [B] $|A| = |B| < |C|$

[C] $|A| = |C| > |B|$ [D] $|A| = |C| < |B|$

Ans. **[C]**

Sol. $(1+x+x^2)^{2014} = a_0 + a_1x + a_2x^2 + a_3x^3 + a_4x^4 + a_5x^5 + a_6x^6 + ...$

Substituting $-1, -\omega, -\omega^2$ where $\omega = e^{i2\pi/3}$

$1 = a_0 - a_1 + a_2 - a_3 + a_4 - a_5 + a_6$ ….. (i)

$(1-\omega+\omega^2)^{2014} = a_0 - a_1\omega + a_2\omega^2 - a_3 + a_4\omega - a_5\omega^2 + a_6.....$ ….. (ii)

$(1-\omega^2+\omega)^{2014} = a_0 - a_1\omega^2 + a_2\omega - a_3 + a_4\omega^2 - a_5\omega + a_6$ ….. (iii)

(i) + (ii) + (iii) $\Rightarrow a_0 - a_3 + a_6..... = \dfrac{1+2^{2014}(\omega+\omega^2)}{3}$

$= \dfrac{1-2^{2014}}{3}$

$(i) + \omega^2(ii) + \omega(iii) \Rightarrow a_1 - a_4 + a_7...... = -\left(\dfrac{1+2^{2015}}{3}\right)$

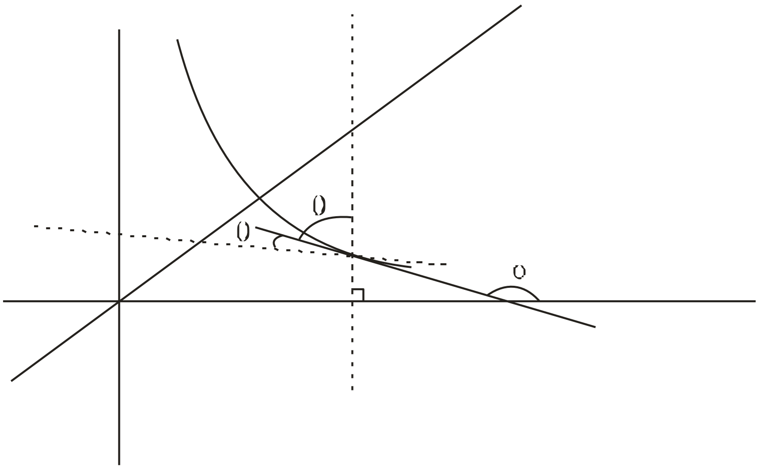
$(i) + \omega(ii) + \omega^2(iii) \Rightarrow a_2 - a_5 + a_8...... = \dfrac{1-2^{2014}}{3}$

$\Rightarrow$ |A| = |C| < |B|

83. A mirror in the first quadrant is in the shape of a hyperbola whose equation is xy = 1. A light source in the second quadrant emits a beam of light that hits the mirror at the point (2,1/2). If the reflected ray is parallel to the y-axis the slope of the incident beam is

[A] $\frac{13}{8}$ [B] $\frac{7}{4}$ [C] $\frac{15}{8}$ [D] 2

Ans. **[C]**



Sol.

Slope of tangent at $\left(2, \frac{1}{2}\right)$

$m = -\frac{1}{4}$

$\tan\theta = -\frac{1}{y}$

$\theta = \phi - 90^o$

$\tan\theta = 4$

Slope of incident ray = m

$$\left|\frac{m - \left(-\frac{1}{4}\right)}{1 + m\left(-\frac{1}{4}\right)}\right| = \tan\theta = 4$$

$$\left|\frac{4m+1}{4-m}\right| = 4$$

4m + 1 = 16 – 4m

$$m = \frac{15}{8}$$

84. Let

Which of the following statements is FALSE?

[A] $C(0).C(\pi) = 1$ [B] $C(0) + C(\pi) > 2$

[C] $C(\theta) > 0$ for all $\theta \in R$ [D] $C'(\theta) \neq 0$ for all $\theta \in R$

Ans. **[D]**

Sol. C(0) = e

$C(\pi) = \frac{1}{e}$

Option A, B correct

$$C'(\theta) = -\sum_{n=0}^{\infty} \frac{\sin n\theta}{(n-1)!}$$

$C'(\theta) = 0$

Option D false

85. Let a > 0 be a real number. Then the limit

$$\lim_{x\to 2}\frac{a^x + a^{3-x} - (a^2 + a)}{a^{3-x} - a^{x/2}}$$

is

[A] $2\log a$ [B] $-\frac{4}{3}a$ [C] $\frac{a^2+a}{2}$ [D] $\frac{2}{3}(1-a)$

Ans. [D]

Sol. $\lim_{x\to 2}\frac{a^x + a^{3-x} - (a^2 + a)}{a^{3-x} - a^{x/2}}$

$\lim_{x\to 2}\frac{(a^x - a)(a^{x/2} - a)(a^{x/2} + a)}{(a - a^{x/2})(a^2 + a^x + a^{x/2}.a)}$

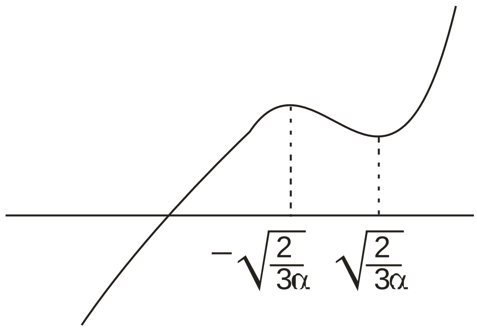
$\lim_{x\to 2} - \frac{(a^x - a)(a^{x/2} + a)}{a^2 + a^x + a^{x/2}.a}$

$= \frac{2}{3}(1-a)$

86. Let $f(x) = ax^2 - 2 + \frac{1}{x}$ where α is a real constant. The smallest α for which $f(x) \geq 0$ for all x > 0 is

[A] $\frac{2^2}{3^3}$ [B] $\frac{2^3}{3^3}$ [C] $\frac{2^4}{3^3}$ [D] $\frac{2^5}{3^3}$

Ans. [D]



Sol.

$f(x) = \frac{\alpha x^3 - 2x + 1}{x} \geq 0 \qquad \forall x \in (0, \infty)$

$\Rightarrow \alpha x^3 - 2x + 1 \geq 0 \qquad \forall x \in (0, \infty)$

Now Let $\phi(x) = \alpha x^3 - 2x + 1$

$\phi^1(x) = 3\alpha x^2 - 2 = 0 \qquad x = \pm\sqrt{\frac{2}{3\alpha}}$

So Graph of $\phi(x)$

$\phi\left(\sqrt{\frac{2}{3\alpha}}\right) \geq 0$

$\sqrt{\frac{2}{3\alpha}}\left[\alpha\frac{2}{3\alpha} - 2\right] + 1 \geq 0$

$$\sqrt{\frac{2}{3\alpha}}\left[-\frac{4}{3}\right]+1\geq 0$$

$$\sqrt{\frac{2}{3\alpha}}\leq\frac{3}{4}\Rightarrow\frac{2}{3\alpha}\leq\frac{9}{16}$$

$$=\frac{32}{27}\leq\alpha$$

87. Let $f:R\to R$ be a continuous function satisfying

$$f(x)+\int_0^x tf(t)dt+x^2=0$$

for all $x\in R$. Then

[A] $\lim_{x\to\infty} f(x)=2$ [B] $\lim_{x\to-\infty} f(x)=-2$

[C] $f(x)$ has more than one point in common with the x-axis

[D] $f(x)$ is an odd function

Ans. **[B]**

Sol. $f'(x)+xf(x)+2x=0$

$$\frac{dy}{dx}+xy=-2x$$

I.F. = $e^{x^2/2}$

$$\Rightarrow y.e^{x^2/2}=\int e^{x^2/2}(-2x)dx+C$$

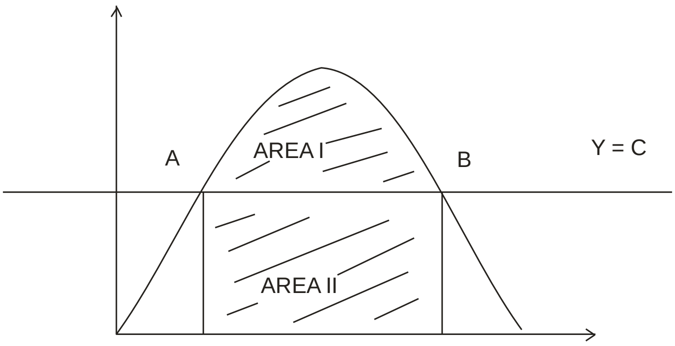
$$e^{x^2/2}.y=-2e^{x^2/2}+C$$

$$y=-2+Ce^{ix^2/2}$$

$$f(0)=0\Rightarrow C=2$$

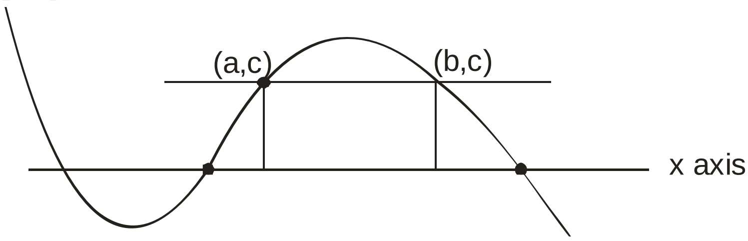
$$f(x)=2\left[e^{-x^2/2}-1\right]$$

88. The figure shows a portions of the graph $y=2x-4x^3$. The line y = c is such that the areas of the regions marked I and II are equal. If a,b are the x-coordinates of A,B respectively, then a + b equals



[A] $\frac{2}{\sqrt{7}}$ [B] $\frac{3}{\sqrt{7}}$ [C] $\frac{4}{\sqrt{7}}$ [D] $\frac{5}{\sqrt{7}}$

Ans. **[A]**



Sol.

$$\int_a^b (2x-4x^3)dx = 2(b-a)C$$
$$(x^2-x^4)_a^b = 2(b-a)C$$
$(b + a)[1 – (a^2 + b^2)] = 2C$

$(a+b)[1-(a+b)^2+2ab] = 2C$ ….. (i)

Again

$2x-4x^2 = C$

$4x^3-2x+C=0$

Roots, a, b, α

$4x^3+0.x^2-2x+C=0$

$a+b+\alpha=0$ ….. (ii)

$ab+(a+b)\alpha = -\dfrac{1}{2}$ ….. (iii)

$7\alpha^3 = 4\alpha \Rightarrow \alpha = \dfrac{2}{\sqrt{7}}$

89. Let X_n = {1,2,3,….n) and let a subset A of X_n be chosen so that every pair of elements of A differ by at least 3. (For example, if n = 5, A can be Ø, {2} or {1,5} among others). When n = 10, let the probability that $1 \in A$ be p and let the probability that $2 \in A$ be q. Then

[A] $p > q$ and $p-q=\dfrac{1}{6}$ [B] $p < q$ and $q-p=\dfrac{1}{6}$

[C] $p > q$ and $p-q=\dfrac{1}{10}$ [D] $p < q$ and $q-p=\dfrac{1}{10}$

Ans. **[C]**

Sol. When n = 10, Let A_r be no. of ways of selecting r numbers

No. of selection of A is

$= n(A_0) + n(A_1) + n(A_2) + n(A_3) + n(A_4)$

= 1 + 10 + (7 + 6 + 5 + ….+ 1) + {(4 + 3 + 2 + 1) + (3 + 2 + 1) + (2 + 1) + 1} + 1

$= 11+\dfrac{7.8}{2}+10+6+3+1+1=60$

N(p) = n (no. of ways 1 is selected) = 1 + 7 + 4 + 3 + 2 + 1 + 1 = 19

N(q) = n (no. of ways 2 is selected) = 1 + 6 + 3 + 2 + 1 = 13

So. $p=\dfrac{19}{60}$ and $q=\dfrac{13}{60}$ $\Rightarrow p-q=\dfrac{1}{10}$

90. The remainder when the determinant

$$\begin{vmatrix} 2014^{2014} & 2015^{2015} & 2016^{2016} \\ 2017^{2017} & 2018^{2018} & 2019^{2019} \\ 2020^{2020} & 2021^{2021} & 2022^{2022} \end{vmatrix}$$

is divided by 5 is.

[A] 1 [B] 2 [C] 4 [D] 4

Ans. **[D]**

Sol.
$$\begin{vmatrix} (2015-1)^{2014} & (2015)^{2015} & (2015+1)^{2016} \\ (2017)^{2017} & (2018)^{2018} & (2019)^{2019} \\ (2020)^{2020} & (2021)^{2021} & (2022)^{2022} \end{vmatrix}$$

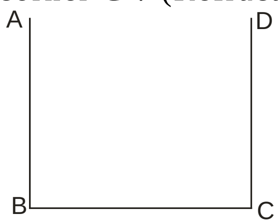
$$\text{Raminder} = \begin{vmatrix} 1 & 0 & 1 \\ 2^{2017} & 2^{2018} & -1 \\ 0 & 1 & 2^{2022} \end{vmatrix}$$

$$= \left(4^{4040}+1\right)+\left(2^{2017}\right)$$

$$1+(5-1)^{4040}+2(4)^{1008} = 1+1+2(1) = 4$$

PHYSICS

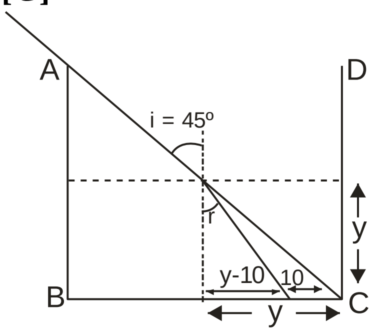
91. A cubical vessel has opaque walls. An observer (dark circle in figure below) is located such that she can see only the wall CD but not the bottom. Nearly to what height should water be poured so that she can see an object placed at the bottom at a distance of 10cm from the corner C ? (Refractive index of water is 1.33.



[A] 10 cm [B] 16 cm [C] 27 cm [D] 45 cm

Ans. **[C]**

Sol.



$$\mu \sin i = 1.\sin 45^{o}$$

$$\frac{4}{3}\sin i = \frac{1}{\sqrt{2}}$$

$$\frac{4}{3}\frac{y-10}{\sqrt{(y-10)^2+y^2}} = \frac{1}{\sqrt{2}}$$

y = 27 (approximate calculation)

92. The moments of inertia of a non-uniform circular disc (of mass M and radius R) about four mutually perpendicular tangents AB,BC CD, DA are I_1, I_2, I_3 and I_4 respectively (the square ABCD circumscribes the circle.) The distance of the center of mass of the disc from its geometrical center is given by.

[A] $\frac{1}{4MR}\sqrt{(I_3-I_3)^2+(I_2-I_4)^2}$ [B] $\frac{1}{12MR}\sqrt{(I_3-I_3)^2+(I_2-I_4)^2}$

[C] $\frac{1}{3MR}\sqrt{(I_1-I_2)^2+(I_3-I_4)^2}$ [D] $\frac{1}{2MR}\sqrt{(I_1+I_3)^2+(I_2+I_4)^2}$

Ans. **[A]**

Sol. $I_1 = I_{cm} + M(R-y)^2$

$I_3 = I_{cm} + M(R+y)^2$

So $I_3 - I_1 = M\left[(R+y)^2 - (R-y)^2\right]$ .... (1)
same as
$I_4 - I_2 = M\left[(R+x)^2 - (R-x)^2\right]$ .... (2)
By
Distance of CM from center of disc = $\sqrt{x^2+y^2} = \frac{1}{4MR}\sqrt{(I_3-I_3)^2+(I_2-I_4)^2}$

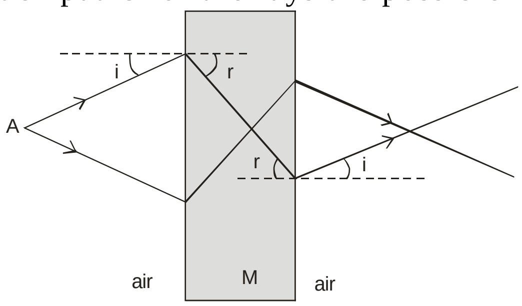
93. A horizontal steel railroad track has a length of 100 m when the temperature is 25°C. The track is constrained from expanding or bending. The stress on the track on a hot summer day, when the temperature is 40°C, is (Note: The linear coefficient of thermal expansion for steel is 1.1×10^{-5}/°C and the Young's modulus of steel is
2×10^{11} Pa)

[A] 6.6×10^7 Pa [B] 8.8×10^7 Pa [C] 3.3×10^7 Pa [D] 5.5×10^7 Pa

Ans. **[C]**

Sol. $\frac{F}{A} = Y\alpha.\Delta T = 2\times10^{11}\times1.1\times10^{-5}\times15$
3.3×10^7 Pa

94. Electromagnetic waves emanating from a point A (in air) are incident on a rectangular block of material M and emerge from the other side as shown. The angles I and r are angles of incidence and refraction when the wave travels from air to the medium. Such paths for the rays are possible



[A] if the material has a refractive index very nearly equal to zero
[B] only with gamma rays with a wavelength smaller than atomic nuclei of the material
[C] if the material has a refractive index less than zero
[D] only if the wave travels in M with a speed faster than the speed of light in vacuum.

Ans. **[C]**

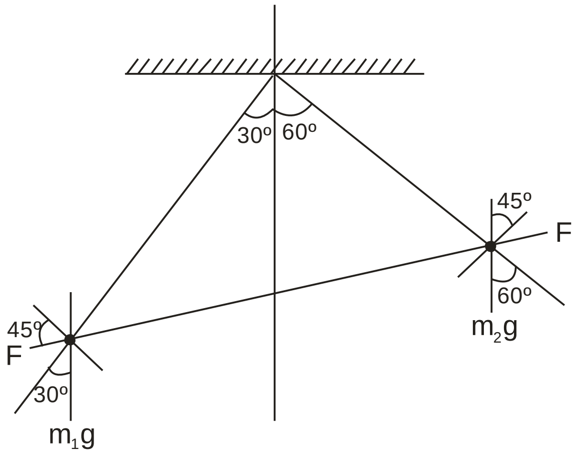
Sol. It is possible for negative μ only and materials are known as meta materials.

95. Two small metal balls of different mass m_1 and m_2 are connected by strings of equal length to a fixed point. When the balls are given charges, the angles that the two strings make with the vertical are 30° and 60°, respectively. The ratio m_1/m_2 is close to

[A] 1.7 [B] 3.0 [C] 0.58 [D] 2.0

Ans. **[A]**

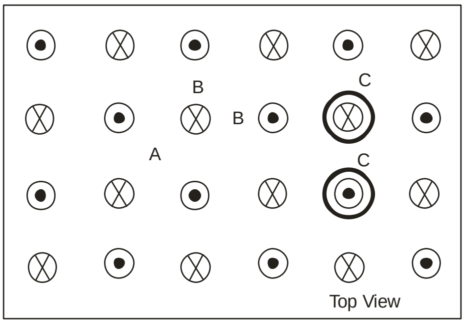
Sol.



$M_2 g\sin 60^\circ = F\cos 45^\circ$

$M_1 g\sin 30^\circ = F\cos 45^\circ$

96. Consider the regular array of vertical identical current carrying wires (with direction of current flow as indicated in the figure below) producing through a horizontal table. If we scatter some diamagnetic particles on the table, they are likely to accumulate.



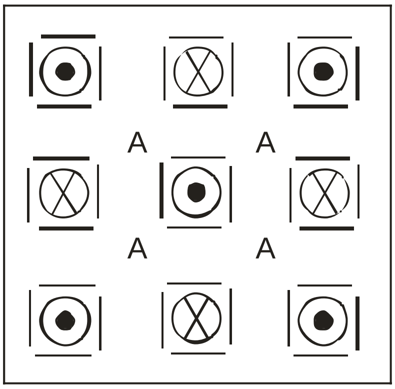
[A] around regions such as A [B] around regions such as B

[C] in circular regions around individual wires such as C

[D] uniformly everywhere.

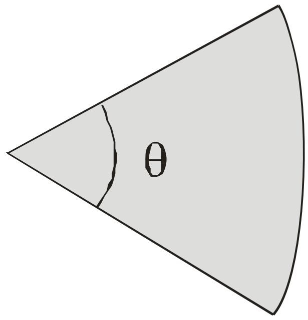
Ans. **[A]**

Sol.



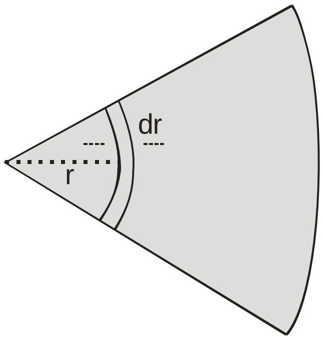
Particle will move towards A due to B.

97. The distance between the vertex and the center of mass of a uniform solid planar circular segment of angular size θ and radius R is given by.



[A] $\frac{4}{3}R\frac{\sin(\theta/2)}{\theta}$ [B] $R\frac{\sin(\theta/2)}{\theta}$ [C] $\frac{4}{3}R\cos\left(\frac{\theta}{2}\right)$ [D] $\frac{2}{3}R\cos(\theta)$

Ans. [A]



Sol.

$$= \frac{\int dm\, r \frac{\sin\theta/2}{\theta/2}}{\int dm}$$

$$dm = \sigma\, r\theta dr$$

$$= \frac{2\sigma \sin\theta/2 \int_0^R r^2.dr}{\sigma\theta\int_0^R r\, dr}$$

$$= \frac{4}{3}R\frac{\sin(\theta/2)}{\theta}$$

98. An object is propelled vertically to a maximum height of 4R from the surface of a planet of radius R and mass M. The speed of object when it returns to the surface of the planet is

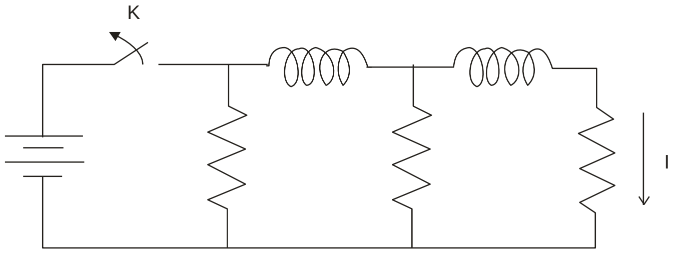
[A] $2\sqrt{\frac{2GM}{5R}}$ [B] $\sqrt{\frac{GM}{2R}}$ [C] $\sqrt{\frac{3GM}{2R}}$ [D] $\frac{GM}{5R}$

Ans. [A]

Sol. $\frac{-GMm}{5R} + 0 = \frac{-GMm}{R} + \frac{1}{2}mv^2$

$$V = 2\sqrt{\frac{2GM}{5R}}$$

99. In the circuit shown below, all the inductors (assumed ideal) and resistors are identical. The current through the resistance on the right is I after the key K has been switched on for a long time. The currents through the three resistors(in order, from left to right) immediately after the key is switched off are

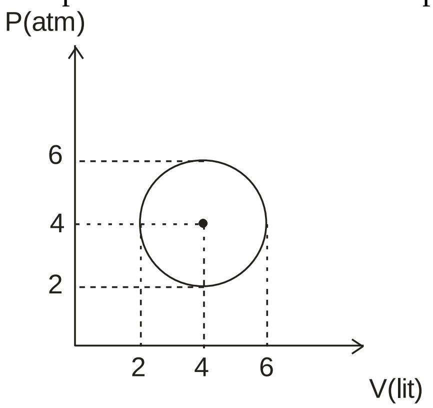


[A] 2 *I* upwards, *I* downwards and *I* downwards.
[B] 2 *I* downwards, *I* downwards and *I* downwards.
[C] *I* downwards, *I* downwards and *I* downwards
[D] 0, *I* downwards and *I* downwards

Ans. **[A]**

Sol. As current does not change through inductor immediately. It remains I through right & middle resistance & 2i upwards in left resistance?

100. An ideal gas undergoes a circular cycle centered at 4atm, 4 lit as shown in the diagram. The maximum temperature attained in this process is close to



[A] 30/R [B] 36/R [C] 24/R [D] 16/R

Ans. **[A]**

Sol. T Will be maximum when product of P.V will be maximum

$$T = \frac{PV}{nR} = \frac{(4+2\sin 45^o)(4+2\cos 45^o)}{nR}$$

$T = \frac{30}{nR}\times 100$ so either A or Bonus

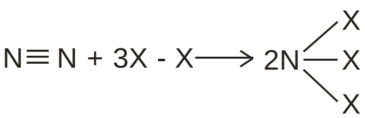
CHEMISTRY

101. For the reaction $N_2 + 3X_2 \rightarrow 2NX_3$ where X = F, Cl (the average bond energies are F-F = 155kJ mol^{-1}, N-F = 272kJ mol^{-1},Cl-Cl kJ mol^{-1} , N-Cl kJ mol^{-1} and N $\equiv$N = 941 kJmol^{-1}). The heats of formation of NF_3 and NCl_3 in kJ mol^{-1}, respectively, are closest to

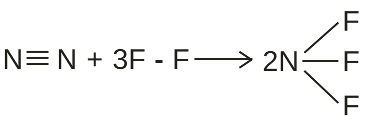
[A] – 226 and + 467 [B] + 226 and –467
[C] –151 and + 311 [D] + 151 and –311

Ans. **[A]**

Sol. **Remark :** – 226 kJ and 467 kJ are heat of reaction not heat of formation.



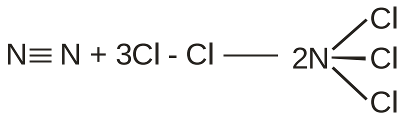
$$\Delta H_r = \in N\equiv N + 3\times \in_{x-x} - 2[3\times \in_{N-x}]$$



$$\Delta H_r = \in_{N\equiv N} + 3\times \in_{F-F} - 2\times 3\times \in_{N-F}$$

$= 941 + 3 \times 155 - 6 \times 272$

$\Delta H_r = -226 kJ$



$\Delta H_r = \in_{N\equiv N} + 3\in_{Cl-Cl} - 6\times\in_{N-Cl}$

$= 941 + 3 \times 242 - 6 \times 200$

$= 467$ kJ

102. The equilibrium constants for the reactions X = 2Y and Z = P + Q are K_1 and K_2, respectively. If the initial concentrations and the degree of dissociation of Z and Z are the same, the ratio K_1/K_2 is.

[A] 4 [B] 1 [C] 0.5 [D] 2

Ans. **[A]**

Sol. $X \rightleftharpoons 2Y$ $\qquad Z \rightleftharpoons P + Q$

$a - a\alpha \quad 2a\alpha$ $\qquad a - a\alpha \quad a\alpha \quad a\alpha$

$k_1 = \dfrac{4a^2\alpha^2}{a(1-\alpha)}$ $\qquad k_2 = \dfrac{a^2\alpha^2}{a(1-\alpha)}$

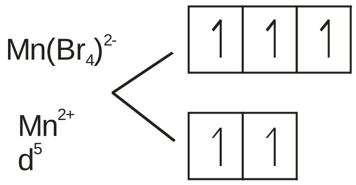
$\dfrac{k_1}{k_2} = 4$

103. The geometry and the number of unpaired electron(s) of $[MnBr_4]^{2-}$, respectively, are

[A] tetrahedral and 1 [B] square planar and 1

[C] tetrahedral and 5 [D] square planar and 5

Ans. **[C]**



Sol. Br^- in a W.F.L. ; C.N. = 4 ; sp^3 hybridization

Hence number of unpaired electrons are 5.

104. The standard cell potential for $Zn|Zn^{2+}\|Cu^{2+}|Cu$ is 1.10V. When the cell is completely discharged, $\log[Zn^{2+}]/[Cu^{2+}]$ is closest to

[A] 37.3 [B] 0.026 [C] 18.7 [D] 0.052

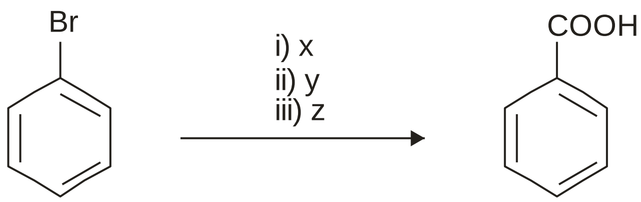
Ans. **[A]**

Sol. $Zn|Zn^{2+}\|Cu^{2+}|Cu$; $E^o_{Cell} = 1.1$ V

$0 = E^o_{Cell} - \dfrac{0.0591}{2}\log\dfrac{[Zn^{2+}]}{[Cu^{2+}]}$; $\qquad -1.1 = -\dfrac{0.0591}{2}\log_{10}\dfrac{[Zn^{2+}]}{[Cu^{2+}]}$

$\log\dfrac{[Zn^{2+}]}{[Cu^{2+}]} = \dfrac{2.2}{0.0591} = 37.3$

105. In the reaction



x,y and z are

[A] x = Mg, dry ether; y = CH_3Cl; z = H_2O

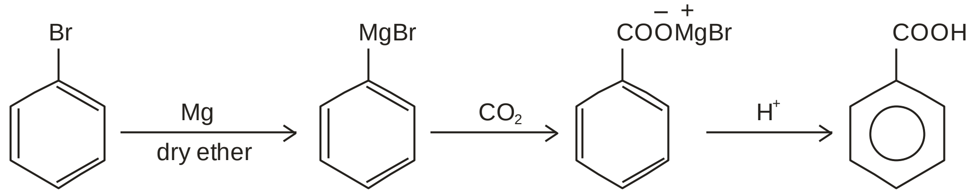
[B] x = Mg, dry methanol; y = CO_2, z = dil. HCl

[C] x = Mg, dry ether; y = CO_2; z = dil. HCl

[D] x = Mg, dry methanol; y = CH_3Cl, z = H_2O

Ans. **[C]**

Sol.



106. An organic compound having molecular formula C_2H_6O under goes oxidation with $K_2Cr_2O_7/H_2SO_4$ to produce X which contains 40% carbon, 6.7% hydrogen and 53.3% oxygen. The molecular formula of the compound X is

[A] CH_2O [B] $C_2H_4O_2$ [C] C_2H_4O [D] $C_2H_6O_2$

Ans. **[B]**

Sol. $C_2H_5OH \xrightarrow{K_2Cr_2O_7/H_2SO_4} CH_3COOH$

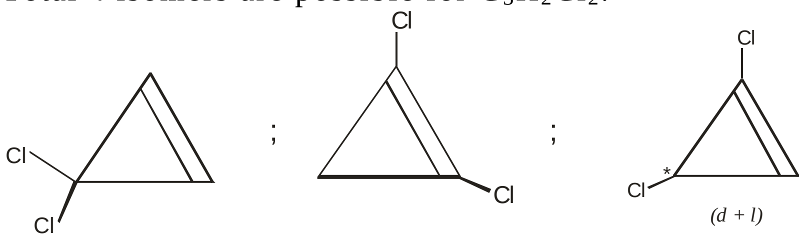
$$\%\,C = \frac{24}{60}\times 100 = 40\%,\ \%\,H = \frac{4}{60}\times 100 = 6.7\%,\ \%\,O = \frac{32}{60}\times 100 = 53.3\%$$

107. The maximum number of cyclic isomers (positional and optical) of a compound having formula $C_3H_2Cl_2$ is

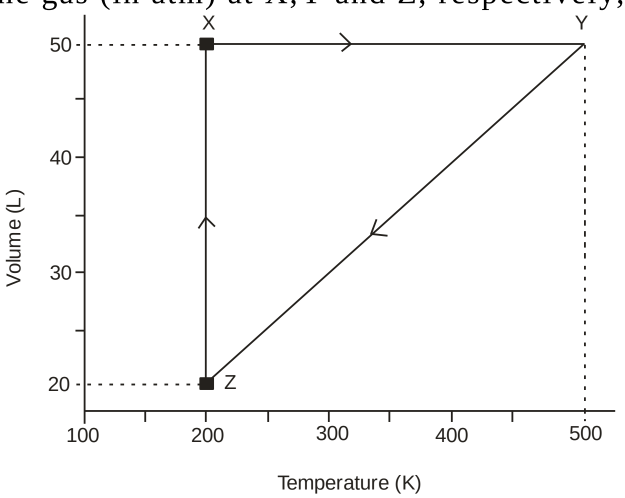
[A] 2 [B] 3 [C] 4 [D] 5

Ans. **[C]**

Sol. Total 4 isomers are possible for $C_3H_2Cl_2$.



108. The volume vs. temperature graph of I mole of an ideal gas is given below. The pressure of the gas (in atm) at X,Y and Z, respectively, are



[A] 0.328,0.820,0.820 [B] 3.28,8.20,3.28

[C] 0.238, 0.280, 0.280 [D] 32.8, 0.280, 82.0

Ans. **[A]**

Sol. Using ideal gas equation, PV = nRT

$$P = \frac{nRT}{V}; \quad P_x = \frac{1 \times 0.082 \times 200}{50} = 0.328 atm$$

$$P_y = \frac{1 \times 0.082 \times 500}{50} = 0.820 atm \quad P_z = \frac{1 \times 0.082 \times 200}{50} = 0.820 atm$$

109. MnO_2 when fused with KOH and oxidized in air gives a dark green compound X. In acidic X. In acidic solution, X undergoes disproportion to give an intense purple compound Y and MnO_2. The compounds X and Y. respectively, are

[A] K_2MnO_4 and $KMnO_4$ [B] Mn_2O_7 and $KMnO_4$

[C] K_2MnO_4 and Mn_2O_7 [D] $KMnO_4$ and K_2MnO_4

Ans. **[A]**

Sol. $2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$

$3K_2MnO_4 + 4HCl \rightarrow \underset{(Purple)}{2KMnO_4} + MnO_2 + 4KCl + 2H_2O$

110. A metal (X) dissolves both in dilute HCl and dilute NaOH to liberate H_2. Addition of NH_4Cl and excess NH_4OH to an HCl solution of X produce Y as a precipitate. Y is also produced by adding NH_4Cl to t he NaOH solution of X. The species X and Y, respectively, are

[A] Zn and $Zn(OH)_2$ [B] Al and $Al(OH)_3$

[C] Zn and Na_2ZnO_2 [D] Al and $NaAlO_2$

Ans. **[B]**

Sol. $Zn + NaOH \rightarrow Na_2ZnO_2$ $Al + NaOH \rightarrow NaClO_2$

$Zn + HCl \rightarrow ZnCl_2 + H_2$ $Al + HCl \rightarrow AlCl_3 + H_2$

$ZnCl_2$ gives no ppt with $NH_4Cl + NH_4OH$ solution.

But $AlCl_3$ gives gelatinious white ppt of $Al(OH)_3$ with $NH_4Cl + NH_4OH$.

BIOLOGY

111. How many bands are seen when immunoglobulin G molecules analysed on a sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS_PAGE) under reducing conditions?

[A] 6 [B] 1 [C] 2 [D] 4

Ans. **[C]**

Sol. IgG have four polypeptide chains. Two short and two long thus form 2 bands.

112. In a mixed culture of slow and fast growing bacteria, penicillin will,

[A] Kill the fast growing bacteria more than the slow growing

[B] Kill slow growing bacteria more than the fast growing

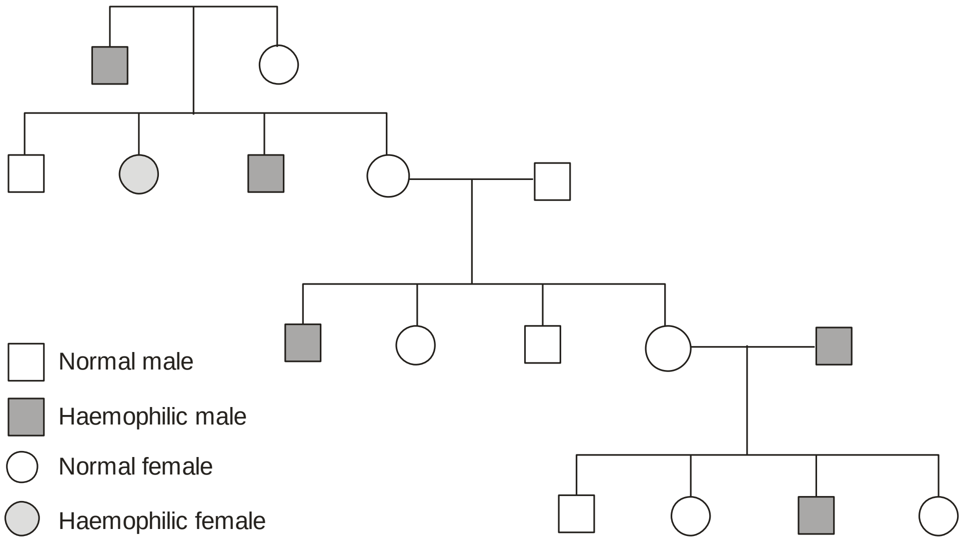
[C] Kill both the fast and slow growing bacteria equally

[D] Will not kill bacteria at all

Ans. **[C]**

Sol. Penicillin prevents formation of cell wall in bacteria.

113. Consider the following pedigree over four generations and mark the correct answer below about the inheritance of haemophilia.



[A] Haemophilia is X-linked dominant
[B] Haemophilia is autosomal dominant
[C] Haemophilia is X-linked recessive
[D] Haemophilia is Y-linked dominant

Ans. **[C]**
Sol. Male is always haemophilic and Female can be carrier and haemophilic lethal.

114. A person has 400 million alveoli per lung with an average radius of 0.1m for each alveolus. Considering the alveoli are spherical in shape, the total respiratory surface of that person is closest to
[A] 500 mm^2 [B] 200 mm^2 [C] 100 mm^2 [D] 1000 mm^2

Ans. **[D]**

115. A mixture of equal numbers of fast and slow dividing cells is cultured in a medium containing a trace amount of radioactively labeled thymidine for one hour. The cells are then transferred to regular (unlabelled) medium. After 24 hrs of growth in regular media.
[A] Fast dividing cells will have maximum radioactivity
[B] Slow dividing cells will have maximum radioactivity
[C] both will have same amount of radioactivity
[D] there will be no radioactivity in either types of cells

Ans. **[D]**
Sol. Due to semi conservative replication very least amount (negliable) will present in cells.

116. If a double stranded DNA has 15% cytosine, what is the % of adenine in the DNA?
[A] 15% [B] 70% [C] 35% [D] 30%

Ans. **[C]**
Sol. C = 15%, G = 15%, T = 35%, A = 35%
(According to chargaff's rule)

117. The mitochondrial inner membrane consists of a number of infoldings called cristae. The increased surface area due to cristae helps in:
[A] Increasing the volume of mitochondria

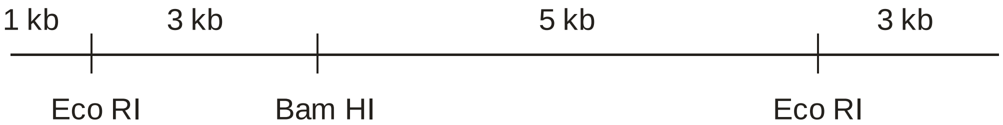
[B] Incorporating more of the protein complexes essential for electron transport chain
[C] Changing the pH
[D] Increasing diffusion of ions.

Ans. **[B]**
Sol. Cristae provides more surface area for oxidative phosphorylation (ETS)

118. The activity of Certain protein is dependent on its phosphorylation. A mutation in its gene changed a single amino acid which affected the function of molecule. Which amino acid change is most likely to account for this observation?
[A] Tyrosine to Tryptophan
[B] Lysine to valine
[C] Leucine to isoleucine
[D] Valine to alanine

Ans. **[A]**
Sol. Tyrosine involves in phosphorylation.

119. Consider the linear double stranded DND shown below. The restriction enzyme sites and the lengths demarcated are shown. This DNA is completely digested with both *Eco*RI and *Bam*HI restriction enzymes. If the Product is analyzed by gel electrophoresis, how many distinct bands would be observed?



[A] 5
[B] 2
[C] 3
[D] 4

Ans. **[C]**
Sol. One band = 1 kb, second band = 5 kb, third band = 3kb

120. Enzymes X catalyzes hydrolysis of GTP into GDP. The GTP-bon from of Z transmits a signal that leads to cell proliferation. The GDP-bound from does not transmit any such signal. Mutations in X are in many cancers. Which of the following alterations of X are most likely to contribute to cancer?

[A] Mutation that increase the affinity of X for GDP.
[B] Mutation that decrease the affinity of X for GDP.
[C] Mutation that decrease the rate of GTP hydrolysis.
[D] Mutation that prevent expression of enzyme X

Ans. **[D]**
Sol. Less X-enzyme will hydrolyze less GTP. So Max GTP available to bound with X-transmits and leads cell proliferation.