KISHORE VAIGYANIK PROTSAHAN YOJANA (KVPY) 2018

Date : 04-11-2017 **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 subject wise 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 candidate 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. Suppose $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is a real matrix with nonzero entries, ad – bc = 0, and $A^2 = A$. Then a + d equals

(A) 1 (B) 2 (C) 3 (D) 4

ekuk y fd $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$,d okLrfod vko;g g] ft lds vo;o v'kwU; gA ;fn ad – bc = 0 vkj $A^2 = A$ g] rc a + d fuEu esa cjkcj g\

(A) 1 (B) 2 (C) 3 (D) 4

Ans. [A]

Sol. $A^2 = \begin{bmatrix} a & b \\ c & d \end{bmatrix}, \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ $ad = bc \Rightarrow \frac{a}{b} = \frac{c}{d} = k$

$= \begin{bmatrix} a^2+bc & ab+bd \\ ac+cd & bc+d^2 \end{bmatrix}$ $a = bk$ $c = dk$

$a^2 + bc = a$; $b(a + d) = b$

$\Rightarrow a + d = 1$

2. On any given are of positive length on the unit circle $|z| = 1$ in the complex plane,

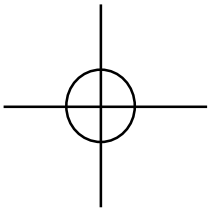
(A) there need not be any root of unity
(B) there lies exactly one root of unity
(C) there are more than one but finitely many roots of unity
(D) there are infinitely many roots of unity

lfEeJ ry e bdkbZ or $|z| = 1$ fn;k gqvk gA bl or ij /kukRed yEckbZ dh pki ij\

(A) bdkbZ dh fdlh Hkh ey (roots of unity) dk gksuk t:jh ugh gA
(B) bdkbZ dk doy ,d ey gA
(C) bdkbZ dh eyksa dh l[;k ,d ls vf/kd] ijUrq lhfer gksxh
(D) bdkbZ dh eyksa dh l[;k vlhfer gksxh

Ans. [D]

Sol.



$|z| = 1$

$Z^n = 1$

$Z^n = e^{i2m\pi}$; $m \in I$, $m \in [0, n-1)$

$Z = e^{i\frac{2m\pi}{n}}$ $|z^n| = |1|$

$z = e^{i(0)}$ $|z|^n = 1$

$z = e^{i\frac{2\pi}{n}}$ So, $|z| = 1$

$z = e^{i\frac{4\pi}{n}}$

All roots of unity will always lies on arc of circle.

So, we can say, there are infinitely many roots of unity on any given cases are of positive lenth on the unit circle $|z| = 1$

3. For $0 < \theta < \frac{\pi}{2}$, four tangents are drawn at the four points $(\pm 3\cos\theta, \pm 2\sin\theta)$ to the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$.

If A(θ) denotes the area of the quadrilateral formed by these four tangents, the minimum value of A(θ) is

(A) 21 (B) 24 (C) 27 (D) 30

vrjky $0 < \theta < \frac{\pi}{2}$ e nh?kor $\frac{x^2}{9} + \frac{y^2}{4} = 1$ d pkj fcUnvk $(\pm 3\cos\theta, \pm 2\sin\theta)$ ij pkj Li'kT;k, [khph x;h gA ;fn A(θ) bu Li'kT;kvk }kjk cuk, x, prHkt dk bfxr djrk g] rc A(θ) dk U;ure eku fuEu gkxk

(A) 21 (B) 24 (C) 27 (D) 30

Ans. [B]

Sol. $\left.\begin{aligned}\frac{x\cos\theta}{3} + \frac{y\sin\theta}{2} = 1\\ \frac{x\cos\theta}{3} - \frac{y\sin\theta}{2} = 1\end{aligned}\right\}$ x = 3secθ, y = 0

$\frac{-x\cos\theta}{3} + \frac{y\sin\theta}{2} = 1$

$\frac{-x\cos\theta}{3} - \frac{y\sin\theta}{2} = 1$

x = 0, y = 2cosθ

area = $4.\frac{1}{2}3\sin\theta \,.\, 2\cos\theta$

$= \frac{12}{\sin\theta\cos\theta} = \frac{24}{\sin 2\theta}$

$\therefore$ min. area = 24

4. Let $S = \left\{x \in R : \cos(x) + \cos\left(\sqrt{2}x\right) < 2\right\}$. Then

(A) $S = \phi$ (B) S is a non–empty finite set

(C) S is an infinite proper subset of R\ {0} (D) S = R\ {0}

Ekku yhft, $S = \left\{x \in R : \cos(x) + \cos\left(\sqrt{2}x\right) < 2\right\}$. rc

(A) $S = \phi$ (B) S ,d vfrfjDr lhfer lePp; gA

(C) S, R\ {0} dk ,d vur mfpr milePp; g (D) S = R\ {0}

Ans. [D]

Sol. cosx + cos $\sqrt{2}x < 2$

cos x ≤ 1 and cos $\sqrt{2}x \le 15$

cosx + cos $\sqrt{2}x \le 2$ at x = 0 cos x + cos $\sqrt{2}x = 2$

$\Rightarrow x \in R - \{0\}$ Ans (D)

5. On a rectangular hyperbola $x^2 - y^2 = a^2$, a > 0, three points A,B,C are taken as follows : A = (–a,0); B and C are placed symmetrically with respect to the x–axis on the branch of the hyperbola not containing A.Suppose that the triangle ABC is equilateral. If the side – length of the triangle ABC is ka, then k lies in the interval

(A) (0, 2] (B) (2, 4] (C) (4, 6] (D) (6, 8]

,d ledk.kh; vfrijoy; (rectangular hyperbola) $x^2 - y^2 = a^2$, a > 0 ij rhu fcUn, A, B, C bl idkj yh xbZ gS fd A = (–a,0); B ,oa C dk x–v{k d lkis{k lefefr; rjhd l ml vfrijoy; dh ,d 'kk[kk ij j[kk tkrk gS ftl ij

A ugh gA eku yhft, fd f=kHkt ABC leckgq gA ;fn f=kHkt ABC dh Hkt k dh yEckbZ ka g] rc k fuEu vrjky e gkxk

(A) (0, 2] (B) (2, 4] (C) (4, 6] (D) (6, 8]

Ans. [B]

Sol. $x^2 - y^2 = a^2$

A (–a 0)

B(a secθ , a tanθ)
C(a secθ, – a tanθ)

$M_{AB} = \tan 30° = \frac{a\tan\theta}{a\sin\theta + a} = \frac{1}{\sqrt{3}}$

$\sqrt{3}$ tna θ = 1 + sinθ

$\sqrt{3}$ sinθ = 1 + secθ

$(\sqrt{3}\tan\theta - 1)^2 = \sec^2\theta$

3 tan² θ – $2\sqrt{3}$ tanθ + 1 = 1 + tan² θ

2tan² θ – $2\sqrt{3}$ tanθ= 0

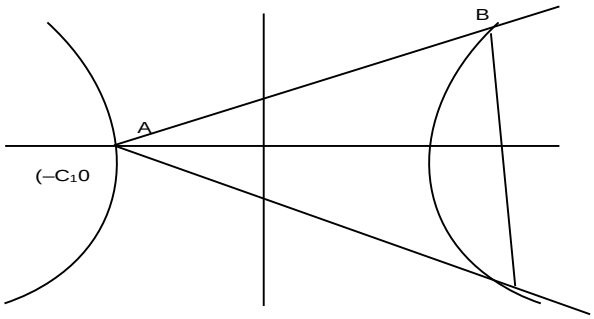
tanθ = $\sqrt{3}$

Side length = 2a tan θ

= $2a\sqrt{3}$

= $2\sqrt{3}$ a

K = $2\sqrt{3}$



6. The number of real solutions x of the equation

$\cos^2(x\sin(2x)) + \frac{1}{1+x^2} = \cos^2 x + \sec^2 x$ is

(A) 0 (B) 1 (C) 2 (D) infinite

fuEu lehdj.k e okLrfod gyk x dh l[;k gkxh %

$\cos^2(x\sin(2x)) + \frac{1}{1+x^2} = \cos^2 x + \sec^2 x$

(A) 0 (B) 1 (C) 2 (D) vur

Ans. [B]

Sol. $\cos^2(x \sin 2x) + \frac{1}{1+x^2} = \cos^2 x + \sec^2 x$

LHS ≤ 2 RHS ≥ 2

LHS = RHS = 2 $\Rightarrow$ x = 0 only solutions

7. Let $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, a > b, be an ellipse with foci F_1 and F_2. Let AO be its semi–minor axis. Where O is the centre of the ellipse. The lines AF_1 and AF_2, when extended, cut the ellipse again at points B and C respectively. Suppose that the triangle ABC is equilateral. Then the eccentricity of the ellipse is

(A) $\frac{1}{\sqrt{2}}$ (B) $\frac{1}{\sqrt{3}}$ (C) $\frac{1}{3}$ (D) $\frac{1}{2}$

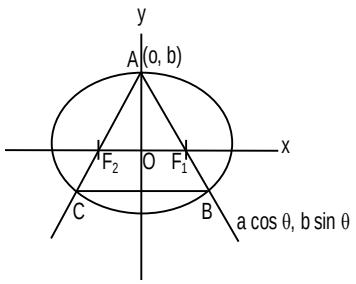
ekuk ;fn nh?kZor $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, a > b ,d nh?kZor g ftldh ukfHk;k¡ F_1 ,oa F_2 gSA AO bldh v/kZ?kq ¼semi–minor) v{k g] vkSj O nh?kZor dk dsUæ gSA j[kk, AF_1 ,oa AF_2 dks c<kus ij ok nh?kZor dk iquZ Øe'k% B ,oa C fcUnqvksa ij dkVrh gSA ekuk ;fn ABC ,d leckgq f=kHkqt g] rc nh?kZor dh mRdsUærk fuEu g\

(A) $\frac{1}{\sqrt{2}}$ (B) $\frac{1}{\sqrt{3}}$ (C) $\frac{1}{3}$ (D) $\frac{1}{2}$

Ans. [D]

Sol. $m_{AB}=\frac{b\sin\theta-b}{a\cos\theta}=-\sqrt{3}$

$\Rightarrow \frac{b}{a}\left(\frac{\sin\theta-1}{\cos\theta}\right)=-\sqrt{3}$



$y-b=-\sqrt{3}(x-0)$

$o+b=+\sqrt{3}\,ae$

$b^2=3a^2e^2=a^2(1-e^2)$

$\Rightarrow 4e^2=1\Rightarrow e=\frac{1}{2}$

8. Let a = cos 1° and b = sin 1°. We say that a real number is algebraic if is a root of a polynomial with integer coefficients. Then

(A) a is algebraic but b is not algebraic (B) b is algebraic but a is not algebraic
(C) both a and b are algebraic (D) neither a nor b is algebraic

Ekkuk ;fn a = cos 1° ,oa b = sin 1°A ;fn ge ,d okLrfod la[;k dk algebraic rc dg] tc og i.kkd x.kkd oky ,d cgin dk ,d ey g] rc

(A) a algebraic g] ijUrq b algebraic ugha g (B) b algebraic g] ijUrq a algebraic ugha g
(C) nkuksa a vkSj b algebraic g (D) uk rks a vkSj uk gh b algebraic g

Ans. [C]

Sol. $\cos x=\frac{e^{ix}+e^{-ix}}{2}$

$\cos 60\,x=\frac{e^{60ix}+e^{-60ix}}{2}$

$\cos 60x=\frac{(\cos x+i\sin x)^{60}+(\cos x-i\sin x)^{60}}{2}$

$\frac{1}{2}=\frac{\cos^{60}+1^\circ+60c_2\cos^{58}i\sin^2 1+.....\infty)^{60}c_{60}\sin^{60}1^\circ}{2}$

Change all sin 1° to cos 1° using the identity $\sin^2 1° = 1 \cos^2 1°$ equation with root cos 1° so it is algebraic.
Similarly for b = sin 1 also algebraic.
let a poly. $-x^2 + 1 \cos^2 1° = 0$

$-x^2 + 1 = -\sin^2 1° = 0$

9. A rectangle with its sides parallel to the x–axis and y–axis is inscribed in the region bounded by the curves $y = x^2 - 4$ and $2y = 4 - x^2$. The maximum possible area of such a rectangle is closest to the integer
(A) 10 (B) 9 (C) 8 (D) 7
,d vk;r] ftldh Hkqtk,a x–v{k ,oa y–v{k d lekukUrj gSa] dk oØ j[kkvk $y = x^2 - 4$,oa $2y = 4 - x^2$ ls f?kjk gS] {k=k dk vf/kdre {ks=Qy fuEu i.kkd d fudVre gksxk \
(A) 10 (B) 9 (C) 8 (D) 7

Ans. [B]

Sol. $y = x^2 - 4$ & $2y = 4 - x^2$

$P(\alpha, \beta) \Rightarrow 2\beta = 4 - \alpha^2$

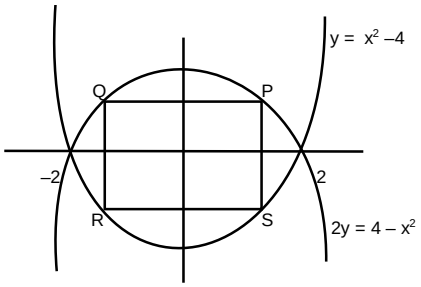
$P\left(\alpha, \frac{4-\alpha^2}{2}\right)$

$Q\left(-\alpha, \frac{4-\alpha^2}{2}\right)$

$PQ = 2\alpha$

$S(\alpha, \alpha^2 - 4)$, $R(-\alpha, -4 + \alpha^2)$

$PS = \left(\alpha^2 - 4 - \frac{4-\alpha^2}{2}\right) = \frac{3\alpha^2 - 12}{2}$



$\text{Area} = PQ\ PS = 2\alpha.\frac{(3\alpha^2 - 12)}{2} = 3\alpha^3 - 12\alpha = A(\alpha)$

$A'(\alpha) = 9\alpha^2 - 12 = 0 \Rightarrow \alpha^2\ \frac{12}{9} = \frac{4}{3}$

$\alpha = \pm\frac{2}{\sqrt{3}}$ maximum at $\alpha = -\frac{2}{\sqrt{3}}$

$\text{Maix.} = A\left(-\frac{2}{\sqrt{3}}\right) = -3.\ \frac{8}{3\sqrt{3}} + 12.\frac{2}{\sqrt{3}} = \frac{16}{\sqrt{3}} = \frac{16\sqrt{3}}{3} = 9.22 \approx 9$

10. Let $f(x) = x\,|\sin x|$, $x \in R$. Then

(A) f is differentiable for all x, except at $x = \eta\pi$, $\eta = 1,2,3,...$

(B) f is differentiable for all x, except at $x = \eta\pi$, $\eta = \pm 1, \pm 2, \pm 3, ...$

(C) f is differentiable for all x, except at $x = \eta\pi$, $\eta = 0, 1, 2, 3, ...$

(D) f is differentiable for all x, except at $x = \eta\pi$, $\eta = 0, \pm 1, \pm 2, \pm 3, ...$

Ekku y fd $f(x) = x\,|\sin x|$, $x \in R$. rc

(A) f, $x = \eta\pi$, $\eta = 1,2,3,...$ d vykok ckdh lHkh x ij vodyuh; gA

(B) f, $x = \eta\pi$, $\eta = \pm 1, \pm 2, \pm 3, ...$ d vykok ckdh lHkh x ij vodyuh; gA

(C) f, $x = \eta\pi$, $\eta = 0, 1, 2, 3, ...$ d vykok ckdh lHkh x ij vodyuh; gA

(D) f, $x = \eta\pi$, $\eta = 0, \pm 1, \pm 2, \pm 3, ...$ d vykok ckdh lHkh x ij vodyuh; gA

Ans. [B]

Sol. $f(x) = x|\sin x| = \begin{Bmatrix} x\sin x, \sin \geq \text{i.e.} \in [2n\pi, 2n\pi, 2\pi] \\ -x\sin x, \sin x < 0 \text{i} \in (2n\pi + \pi, 24n\pi) \end{Bmatrix}$

f' (nπ) = $\lim\limits_{x\to 4\pi} \dfrac{f(x) - f(n\pi)}{x - n\pi} = \lim\limits_{x\to 4\pi} \dfrac{x\,|\sin x|}{x - 4\pi}$

$\Rightarrow$ dist at x = 0

11. Let $f : [-1, 1] \to R$ be a function defined by $f(x) = \begin{cases} x^2 \left|\cos\left(\dfrac{\pi}{x}\right)\right| & \text{for } x \neq 0, \\ \text{for } x = 0, \end{cases}$

The set of points where f is not differentiable is

(A) $\{x \in [-1, 1] x \neq 0\}$ (B) $\{x \in [-1, 1] : x = 0 \text{ or } x = \dfrac{2}{2n+1}, n \in Z\}$

(C) $\{x \in [-1, 1] : x = \dfrac{2}{2n+1}, n \in Z\}$ (D) [–1,1]

Qyu $f : [-1, 1] \to R$ dk fuEu :i ls ifjHkkf"kr fd;k x;k g\

$f(x) = \begin{cases} x^2 \left|\cos\left(\dfrac{\pi}{x}\right)\right| & \text{tc } x \neq 0, \\ \text{tc } x = 0, \end{cases}$

mu fcUnvk dk lecPp; tgk f vodyuh; ugh g\

(A) $\{x \in [-1, 1] x \neq 0\}$ (B) $\{x \in [-1, 1] : x = 0 \text{ or } x = \dfrac{2}{2n+1}, n \in Z\}$

(C) $\{x \in [-1, 1] : x = \dfrac{2}{2n+1}, n \in Z\}$ (D) [–1,1]

Ans. [C]

Sol. $f(x) = \begin{Bmatrix} x^2 \left|\cos\dfrac{\pi}{x}\right| & x \neq 0 \\ 0 & x = 0 \end{Bmatrix}$

The possible points of non differential of f(x) are

X = 0, $\dfrac{2}{2n+1}$ where $n \in I$

When x = 0 f(0) = 0 and $\lim\limits_{x\to 0} x^2 \left|\cos\dfrac{\pi}{x}\right| = 0$

Hence f(x) is continueous at x = 0

Now f(0) = $\lim\limits_{x\to 0} \dfrac{f(0-h) - 0}{-h}$

$= \lim\limits_{x\to 0} \dfrac{h^2 \cos\dfrac{\pi}{h}}{-h} = 0$

Similarly Rf'(0) = 0 hence differentiable at x = 0

Clearly non differentiable at x = $\frac{2}{2n+1}$; n $\in$ I

12. The value of the integral $\int_0^{\pi}(1-|\sin 8x|)\,dx$ is

(A) 0 (B) $\pi - 1$ (C) $\pi - 2$ (D) $\pi - 3$

lekdy $\int_0^{\pi}(1-|\sin 8x|)\,dx$ dk eku fuEu g \

(A) 0 (B) $\pi - 1$ (C) $\pi - 2$ (D) $\pi - 3$

Ans. [C]

Sol. $I = \int_0^{\pi} 1-|\sin 8x|dx$

$= \pi - \int_0^{\pi}(x\,|\sin 8x|)\,dx$

$= \pi - \int_0^{8.\frac{8}{\pi}}(x\,|\sin 8x|)\,dx$

$= \pi - \int_0^{\frac{8}{\pi}} x\,\sin 8x\,dx$

$= \pi - 8\left[\frac{-\cos 8x}{8}\right]^{\frac{\pi}{8}}$

P+(–1–ϕ) = π –2

13. Let In x denote the logarithm of x with respect to the base e. Let $S \subset R$ be the set of all points where the function In ($x^2 - 1$) is well –defined. Then the number of function $f : S \to R$ that are differentiable, satisfy $f'(x)$ = In ($x^2 - 1$) for all $x \in S$ and f (2) =0, is

(A) 0 (B) 1 (C) 2 (D) infinite

In x e vk/kkj d lkis{k x d y?kx.kd dk bfxr djrk gA eku yhft, $S \subset R$ mu lHkh fcUnvk dk lePp; g] tgk Qyu In ($x^2 - 1$) i.krh ifjHkkf"kr gA rc Qyuk $f : S \to R$ dh l[;k tk vodyuh; g ,o $f'(x)$ = In ($x^2 - 1$) dk lHkh $x \in S$ rFkk f (2) =0 dk lr"V djr g \

(A) 0 (B) 1 (C) 2 (D) vur

Ans. [D]

Sol. $\ell n(x^2-1)$

Define for (x^2–1) > 0

S : x$\in(-\infty,-1) \cup (1, \infty)$

f′ (x) = ln(x^2 –1)

$\int$ f′(x)dx = $\int$ $\ell n(x^2 - 1)\,dx$

$f(x) = \ell n(x^2 - 1) \cdot x - \int \frac{2x.x}{x^2-1}dx$

$= x\ell n\,(x^2 - 1) - \int \frac{2x^2 - 2 + 2}{x^2 - 1}dx$

$= x\ell n(x^2-1) - 2x - 2x\ \frac{1}{2}\,\ell n\left(\frac{x-1}{x+1}\right) + C$

$f(x) = x\ell n(x^2-1)\ - 2x - \ell n\left(\frac{x-1}{x+1}\right) + C$

$f(2) = 2\ell n\ 3 - 4 - \ell n\left(\frac{1}{3}\right) + C = 0 \Rightarrow 2\ell n\ 3 - 4 + \ell n\ 3 + C = 0$

C = 4 – 3 ln3

$f(x) = x\ln(x^2-1) - 2x - \ln\left(\frac{x-1}{x+1}\right) + 4 - 3\ln 3$ defined for S

Infinite C values possible in set S such that $f'(x) = \ln(x^2-1)$

14. Let S be the set of real numbers p such that there is no nonzero continuous function $f : R \to R$ satisfying $\int_0^x f(t)\,dt = p\,f(x)$ for all $x \in R$. Then S is

(A) the empty set
(B) the set of all rational numbers
(C) the set of all irrational numbers
(D) the whole set R

ekuk yhft, fd S okLrfod la[;kvksa p dk leqPp; bl izdkj gS fd bl dkbZ Hkh v'kwU;&lrr Qyu $f : R \to R$ ugha gS] tks lHkh $x \in R$ ds fy, $\int_0^x f(t)\,dt = p\,f(x)$ dk lUrq"V djrk gS] rc S

(A) fjDr leqPp; A
(B) lHkh ifje; la[;kvksa dk leqPp; gA
(C) lHkh vifje; la[;kvksa dk leqPp; gA
(D) lEi.kZ R leqPp; gA

Ans. [D]

Sol. $\int_0^x f(t)dt \quad \phi(f(x)) \quad \ldots\ldots(1)$

Differentiable both side with respect to x

$f(x) = pf'(x)$

$\frac{f'(x)}{f(x)} = \frac{1}{p}$

Now, integrating both side w.r.t x.

$\ln f(x) = \frac{x}{p} + C$

$f(x) = k.e^{x/p} \quad \ldots\ldots(2)$

patting x = 0 in original equation (1)

0 = pf(0)

$\Rightarrow$ either p = 0 or {f(0) = 0 & $p \neq 0$}

Let case ; I where f(0) = 0 & $\phi \neq 0$ $\Rightarrow$ k = 0 then from equation (2)

f(x) = 0 $\Rightarrow$ f(x) = 0

$\Rightarrow$ i.e. $p \neq 0$ then there is no non zero continuous to f(x)

case.II p = 0

$\int_0^x f(t)dt = 0 \quad \forall\, x \in R$

It is only possible when f(x) = 0

Thence $\forall p \in R$: There is no nonzero continuous function . satisfying the given condition.

Hence $S \in R$

15. The probability of men getting a certain disease is $\frac{1}{2}$ and that of women getting the same disease is $\frac{1}{5}$. The blood test that identifies the disease gives the correct result with probability $\frac{4}{5}$. Suppose a person is chosen at random from a group of 30 males and 20 females, and the blood test of that person is found to be positive. What is the probability that the chosen person is a man?

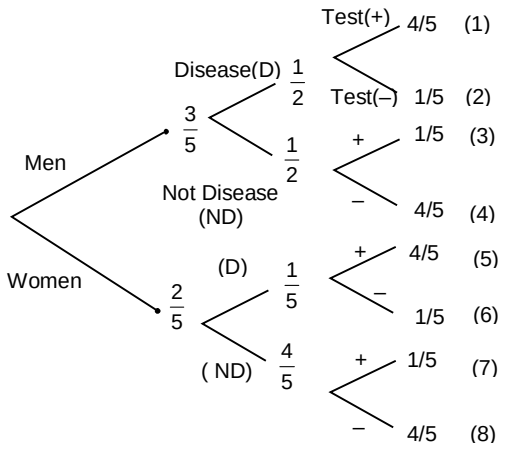
(A) $\frac{75}{107}$ (B) $\frac{3}{5}$ (C) $\frac{15}{19}$ (D) $\frac{3}{10}$

,d chekjh dk i:"kk e gku dh ikf;drk (probability) $\frac{1}{2}$g vkj efgykvk e ogh chekjh d gku dh ikf;drk $\frac{1}{5}$gA chekjh dk igpkuu d fy, jDr tkp e lgh ifj.kke vku dh ikf;drk $\frac{4}{5}$ gA eku y fd ;nPN :i l ,d 0;fDr dk 30 i:"kk vkj 20 efgykvk d ,d leg l puk tkrk g vkj ml 0;fDr dk jDr tkp ldkjkRed vkrk gA ml pu g, 0;fDr d ,d i:"k gku dh fdruh ikf;drk gkxh %

(A) $\frac{75}{107}$ (B) $\frac{3}{5}$ (C) $\frac{15}{19}$ (D) $\frac{3}{10}$

Ans. [A]

Sol.



$$\frac{(1)+(3)}{(1)+(3)+(5)+(7)}$$

$$= \frac{\frac{3}{5}\times\frac{1}{2}\times\frac{4}{5}+\frac{3}{5}\times\frac{1}{2}\times\frac{1}{5}}{\frac{3}{5}\times\frac{1}{2}\times\frac{4}{5}\times\frac{3}{5}\times\frac{1}{2}\times\frac{1}{5}+\frac{2}{5}\times\frac{1}{5}\times\frac{4}{5}+\frac{2}{5}\times\frac{4}{5}\times\frac{1}{5}}$$

$$= \frac{\frac{3}{10}}{\frac{3}{10}+\frac{16}{125}}$$

$$= \frac{75}{107}$$

16. The number of functions $f : [0,1] \to [0,1]$ satisfying $|f(x) - f(x)| = |x - y|$ for all x, y in [0,1] is
(A) exactly 1 (B) exactly 2 (C) more than 2,but finite (D) infinite
Qyuk $f : [0,1] \to [0,1]$ dh l[;k tk $|f(x) - f(x)| = |x - y|$ dk [0,1] e lHkh x, y d fy, lr"V djrk g\
(A) doy 1 (B) doy 2 (C) 2 l vf/kd ijUr lhfer (D) vur

Ans. [B]

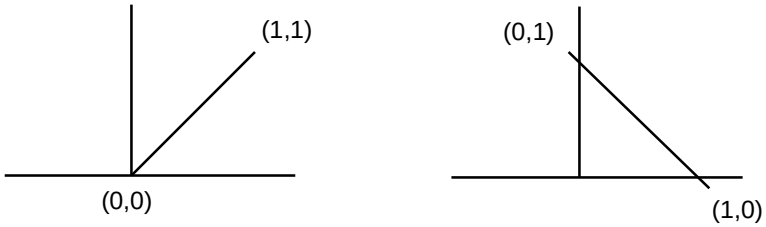
Sol. $|f(x) = f(x)| = |x - y|$

$\Rightarrow \frac{|f(x) - f(x)|}{|x - y|} = 1$

Take $\lim_{x \to y} \left|\frac{f(x) - f(y)}{x - y}\right| = 1$

$\Rightarrow \lim_{x \to y} |f'(x)| = 1$

$\Rightarrow f'(x) = \pm 1$



Hence two function possible

17. Suppose A is a 3 × 3 matrix consisting of integer entries that are chosen at random from the set {–1000,999,….,999,1000}. Let P be the probability that either $A^2 = -I$ or A is diagonal, where I is the 3 × 3 identity matrix. Then

(A) $P < \frac{1}{10^{18}}$ (B) $P = \frac{1}{10^{18}}$ (C) $\frac{5^2}{10^{18}} \le P \le \frac{5^3}{10^{18}}$ (D) $P \ge \frac{5^4}{10^{18}}$

Ekku yhft, A i.kkd dk ,d 3 × 3 vkO;wg g] ftldh vo;o lePp; {–1000,999,….,999,1000} l ;nPN :i l pun x, gA P bl ckr dh ikf;drk g fd $A^2 = -I$ (tgk I ,d 3 × 3 rRled ¼identity) vkO;wg g½ g ;k fQj A d fod.k–vkO;wg g] rc

(A) $P < \frac{1}{10^{18}}$ (B) $P = \frac{1}{10^{18}}$ (C) $\frac{5^2}{10^{18}} \le P \le \frac{5^3}{10^{18}}$ (D) $P \ge \frac{5^4}{10^{18}}$

Ans. [A]

Sol. $A = [\ ]_{3\times3}$

$A^2 = -I$

Taking det

$|A|^2 = -1$ (Not possible)

$A \to$ diagonal matrix

$$\begin{bmatrix} \pm & 0 & 0 \\ 0 & \pm & 0 \\ 0 & 0 & \pm \end{bmatrix}$$

(2001 choices for each diagonal entry)

$P = \frac{(2001)^3}{(2001)^9} = \frac{1}{(2001)^6}$

$P = (1 + 2000)^{-6}$

$= (2000^{-6}) \left(1 + \frac{1}{(2001)}\right)^{-6}$ less then $\perp$

$= \frac{1}{2^6 \times 10^{18}}$ (↓)

$P < \frac{1}{10^{18}}$

18. Let x_k be real numbers such that $x_k \geq k^4 + k^2 + 1$ for $1 \leq k \leq 2018$. Denote $N = \sum_{k=1}^{2018} k$. Consider the following inequalities:

I. $\left(\sum_{k=1}^{2018} kx_k\right)^2 \leq N\left(\sum_{k=1}^{2018} kx_k^2\right)$ **II.** $\left(\sum_{k=1}^{2018} kx_k\right)^2 \leq N\left(\sum_{k=1}^{2018} k^2x_k^2\right)$

Then
(A) both I and II are true (B) I is true and II is false
(C) I is false and II is true (D) both I and II are false

x_k okLrfod l[;k, bl idkj g fd $1 \leq k \leq 2018$ d fy, $x_k \geq k^4 + k^2 + 1$ gA $N = \sum_{k=1}^{2018} k$ vc fuEu nk vlfedkvk ij /;ku n %

I. $\left(\sum_{k=1}^{2018} kx_k\right)^2 \leq N\left(\sum_{k=1}^{2018} kx_k^2\right)$ **II.** $\left(\sum_{k=1}^{2018} kx_k\right)^2 \leq N\left(\sum_{k=1}^{2018} k^2x_k^2\right)$

rc
(A) I ,o II nkuk lR; gA (B) I lR; g ,o II vlR; gA (C) I vlR; g ,o II lR; gA (D) I ,o II nkuk vlR; gA

Ans. [A]

Sol. If $x_1, x_2, \ldots\ldots\ldots\ldots x_n$ be n numbers then using cauch – schurz theorem –

$$\left(\frac{x_1 + x_2 + \ldots . x_n}{n}\right)^2 \leq \left(\frac{x_1^2 + x_2^2 + \ldots\ldots\ldots\ldots x_n^2}{n}\right)$$

Case(i) Consider

$x_1, x_2, x_2, x_3, x_3, x_3 \ldots\ldots\ldots\ldots \underbrace{x_{2018}, x_{2018}, x_{2018}}_{2018 \text{ times}}$

Now using Cauchy-schwarz for above numbers

$$\left(\frac{x_1 + x_2 + x_2 + \ldots\ldots\ldots \frac{x_{2018} + x_{2018} + \ldots x_{2018}}{2018 \text{times}}}{1 + 2 + 3 + \ldots\ldots\ldots 2018}\right)^2$$

$$\leq \frac{x_1^2 + x_2^2 + x_2^2 + \ldots\ldots\ldots \frac{x_{2018}^2 + x_{2018}^2 + \ldots .}{2018 \text{times}}}{1 + 2 + 3 + \ldots . 2018}$$

$$\Rightarrow \left(\frac{x_1 + 2x_2 + 3x_3 + \ldots 2018\, x_{2018}}{\sum_{k=1}^{2018} k}\right)^2 \leq \left(\frac{x_1^2 + 2x_2^2 + 3x_3^2 + \ldots 2018\, x_{2018}^2}{\sum_{k=1}^{2018} k}\right)^2$$

$$\Rightarrow \left(\sum_{k=1}^{2018} k\, x_k\right)^2 \leq \sum_{k=1}^{2018} k \left(\sum_{k=1}^{2018} k\, x_{k^2}\right)$$

$$\left(\sum_{k=1}^{2018} k\, x_k\right)^2 \leq N\left(\sum_{k=1}^{2018} k\, x_{k^2}^2\right)$$

Therefore statement 1 is True.

Case(ii) Consider

$x_1, 2x_2, 3x_3 + \ldots..2018\ x_{2018}$

Now apply chauchy – Schwarz for above number

$$\left(\frac{x_1 + 2x_2 + 3x_3 + \ldots.2018\,x_{2018}}{2018}\right)^2 \le \frac{x_1^2 + 2x_2^2 + \ldots.(2018x_{2018})^2}{2018}$$

$$\Rightarrow (x_1 + 2x_2 + \ldots..2018\ x_{2018})^2 \le 2018\ \left(x_1^2 + 4x_2^2 + \ldots(2018)^2 x_{2018}^2\right)$$

$$\Rightarrow \left(\sum_{k=1}^{2018} kx_k\right)^2 \le 2018\left(\sum_{k=1}^{2018} k^2 x_k^2\right)$$

Since $n = \sum_{k=1}^{2018} k = \frac{2018 \times 2019}{2}$

$\because \left(\sum_{k=1}^{2018} kx_k\right)^2$ is always less than or equal to $2018 \sum_{k=1}^{2018} k^2 x_k^2$

$\therefore$ It will always be less than $N\left(\sum_{k=1}^{2018} k^2 x_k^2\right)$

19. Let $x^2 = 4ky$, $k > 0$, be a parabola with vertex A. Let BC be its latus rectum. An ellipse with center on BC touches the parabola at A, and cuts BC at points D and E such that BD = DE = EC (B, D, E, C in that order). The eccentricity of the ellipse is

(A) $\frac{1}{\sqrt{2}}$ (B) $\frac{1}{\sqrt{3}}$ (C) $\frac{\sqrt{5}}{3}$ (D) $\frac{\sqrt{3}}{2}$

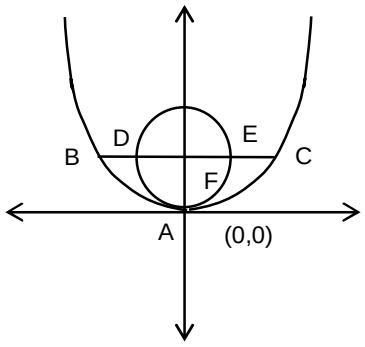
eku yhft, fd $x^2 = 4ky$, $k > 0$,d ijoy; g] ftldk 'kh"k A gA eku y fd BC bldk ukfHk yEc (latus rectum) gA ,d nh?kor] ftldk dUæ BC ij g vkj ijoy; dk A ij Nrk g] BC dk D ,o E fcUnvk ij bl idkj dkVrk g fd BD = DE = EC (B,D,E,C d Øe e)A nh?kor dh mRdUærk ¼eccentricity) fuEu g \

(A) $\frac{1}{\sqrt{2}}$ (B) $\frac{1}{\sqrt{3}}$ (C) $\frac{\sqrt{5}}{3}$ (D) $\frac{\sqrt{3}}{2}$

Ans. [C]

Sol. n For the parabola;
verter A (0,0)
Four F : (o, k)
end point of latus rectum:
B (–2k, k) ; c (2k, k)
Length of BC = 4k;
BD = DE = EC
And BD + DE + EC = 4k

$\Rightarrow$ BD = DE = EC = $\frac{4k}{3}$ ------ (i)



So Major Axis of ellipse = 2AF = 2 × k

minor Axis of Ellipse = DE = $\frac{4k}{3}$

Eccetricity = C = $\sqrt{1-\frac{b^2}{a^2}}$ = $\sqrt{1-\frac{\left(\frac{2k}{3}\right)^2}{k^2}}$ $2 = \frac{\sqrt{5}}{3}$

20. Let $f : [0,1] \to [-1,1]$ and $g : [-1,1] \to [0, 2]$ be two functions such that g is injective and $g \circ f : [0,1] \to [0, 2]$ is surjective. Then

(A) f must be injective but need not be surjective (B) f must be surjective but need not be injective

(C) f must be bijective (D) f must be a constant function

Ekku yhft, fd $f : [0,1] \to [-1,1]$ rFkk $g : [-1,1] \to [0, 2]$ nk Qyu bl idkj g fd $g \circ f : [0,1] \to [0, 2]$ vPNkn (surjective) g] rc

(A) f fuf'pr :i l ,dh g] ijUr bldk vPNknh gkuk t :jh ugh gA

(B) f fuf'pr :i l vPNknh g] ijUr bldk ,dh gkuk t :jh ugh gA

(C) f fuf'pr :i l ,dh vPNknh ¼bijective) gA

(D) f fuf'pr :i l vpj Qyu gA

Ans. [B]

Sol. let h(x) = 9 (f(x))

and n(x) is onto (given)

$\therefore$ Co – domain of h(x) = Range of h(x)

Range of h(x) = [0,2]

and h(x) = 9 (f(x)) it means g is giving [0,2] which is also co- domain of g.

So, g must be onto.

Now, Domain of g = [–1,1] which must be range of f.

But, co-domain of f = [- 1,1]

So,f must be onto

PHYSICS

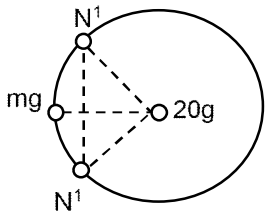
21. A table has a heavy circular top of radius 1m and mass 20 kg, placed on four light (considered massless) legs placed symmetrically on its circumference. The maximum mass that can be kept anywhere on the table without toppling it is close to

,d et ftld Åijh xkykdkj fgLlk dh f=kT;k 1m rFkk n0;eku 20 kg g pkj gYd ijk ¼ftudk Hkkjfoghu ekuk tk ldrk g½ ij fVdh gb gA ;fn et dh ifjf/k ij lefer :i l yx g, gA og vf/kdre n0;eku tk fd et d fdlh Hkh fgLlk ij et dk fcuk fxjk;k g, j[kk tk ldrk g] og g]

(A) 20 kg (B) 34 kg (C) 47 kg (D) 59 kg

Ans. [C]

Sol.



$(M+ 20)g \frac{R}{\sqrt{2}} = mg\, R$

$M+20 = \sqrt{2}\, m$; $M = \frac{20}{\sqrt{2}-1} = 48.3$ kg

22. Air (density ρ) is being blown on a soap film (surface tension T) by a pipe of radius R with its opening right next to the film. The film is deformed and a bubble detaches from the film when the shape of the deformed surface is a hemisphere. Given that the dynamic pressure on the film due to the air blown at speed v is $\frac{1}{2}\rho v^2$, the speed at which the bubble is formed is

T i"B ruko dh ,d lkcu dh f>Yyh] R f=kT;k dh uyh d e[k ij fpidh gA bl uyh l tc ρ ?kuRo dh gok Qdh tkrh g rk f>Yyh Qyrh gA Qyr g, tc bldk vkdkj v)xkykdkj gk tkrk g ;g cycy d :i e fudy tkrh gA ;fn f>Yyh ij v ox dh gok d }kjk vkjkfir xfrd nkc $\frac{1}{2}\rho v^2$ g rk fdl xfr l cycyk fufer gk jgk gA

(A) $\sqrt{\frac{T}{\rho R}}$ (B) $\sqrt{\frac{2T}{\rho R}}$ (C) $\sqrt{\frac{4T}{\rho R}}$ (D) $\sqrt{\frac{8T}{\rho R}}$

Ans. [D]

Sol. $\frac{1}{2}\rho v^2 \times \pi R^2 = 4\pi RT \Rightarrow v = \sqrt{\frac{8T}{\rho R}}$

(Here in question v is asked)

23. For an ideal gas the internal energy is given by U = 5PV/2 + C, where C is a constant. The equation of the adiabats in the PV plane will be

,d vkn'kZ xSl dh vkarfjd ÅtkZ U = 5PV/2 + C g, tgk¡ C ,d fLFkjkad gSA PV ry esa :)"ek (adiabats) dk lehdj.k gksxk]

(A) P^5V^7 = constant (B) P^7V^5 = constant (C) P^3V^5 = constant (D) P^5V^2 = constant

(A) P^5V^7 = fLFkjkad (B) P^7V^5 = fLFkjkad (C) P^3V^5 = fLFkjkad (D) P^5V^2 = fLFkjkad

Ans. [A]

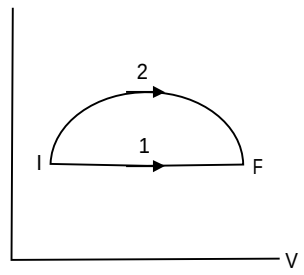
Sol. $U = \frac{5}{2}PV + c = \frac{5}{2}nRT + C$

$f = 5 \quad \gamma = 7/5$

$PV^{7/5}$ = constant $\Rightarrow$ P^5V^7 = constant

24. An ideal gas undergoes change in its state from the initial state I to the final state F via two possible paths as shown. Then

,d vkn'kZ xSl izfØd voLFkk I ls vfre voLFkk F esa vkj[k esa fn[kk;s x, nks jkLrksa ls tkrh gSA rc



(A) there is no change in internal energy along path 1
(B) heat is not absorbed by the gas in both paths
(C) the temperature of the gas first increases and then decreases for path 2
(D) work done by the gas is larger in path 1.

(A) iFk 1 esa vkarfjd ÅtkZ esa dksbZ ifjorZu ugha gksrk gSA
(B) nksuksa iFkksa esa xSl }kjk Å"ek dk dksbZ vo'kks"k.k ugha gksrk gSA
(C) iFk 2 esa xSl dk rkieku igys c<rk gS fQj ?kVrk gSA
(D) iFk 1 esa xSl }kjk fd, x, dk;Z dh ek=kk vf/kd gSA

Ans. [C]

Sol. (A), (B) & (D) are wrong and (C) is correct

25. A thermally insulated rigid container of one litre volume contains a diatomic ideal gas at room temperature. A small paddle installed inside the container is rotated from the outside such that the pressure rises by 10^5 Pa. The change in internal energy is close to

,d yhVj dh lh< Å"ekjks/kh fMCcs esa f}ijekf.od xSl dejs ds rkieku ij Hkjh gSA MCcs esa ,d NksVk iMy yxk;k x;k gS tks fd ckgj ls bl idkj ?kek;k tkrk gS fd nkc 10^5 Pa c< tkrk gSA xSl dh vkarfjd ÅtkZ esa ifjorZu yxHkx gksxkA (A) 0 J (B) 67 J (C) 150 J (D) 250 J

Ans. [D]

Sol. $\Delta U = f/2\ (\Delta P)\ V = 250$ J.

26. In a Young's double slit experiment the amplitudes of the two waves incident on the two slits are A and 2A. If I_0 is the maximum intensity, then the intensity at a spot on the screen where the phase difference between the two interfering waves is ϕ.

;x d f}f>jh i;kx e f>jh;k ij vkifrr nk rjxk d vk;ke A rFkk 2A gA ;fn lokf/kd rhork I0 g rk in d ml fcUn ij rhork D;k gkxh] tgk ij nk 0;frdkjh rjxk dk dykrj ϕ gA

(A) $I_0\cos^2(\phi/2)$ (B) $\frac{I_0}{3}\sin^2(\phi/2)$ (C) $\frac{I_0}{9}(5+4\cos(\phi))$ (D) $\frac{I_0}{9}(5+8\cos(\phi))$

Ans. [C]

Sol. $I = I_1 + I_2 + \sqrt{2I_1}\sqrt{2I_2}\cos\phi$

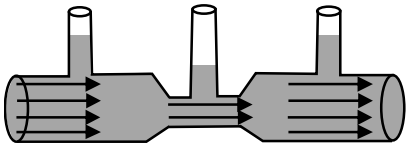
$I = A^2 + 4A^2 + 4A^2\cos\phi = A^2(5+4\cos\phi)$

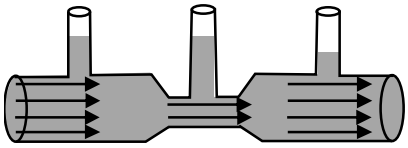
$I_0 = 9A^2 \Rightarrow A^2 = \frac{I_0}{9}$

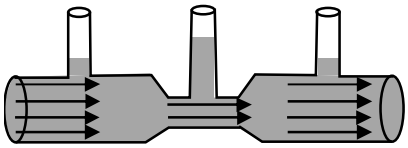
$I = \frac{I_0}{9}(5+4\cos\phi)$

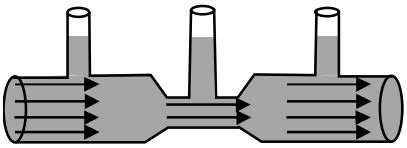
27. Figure below show water flowing through a horizontal pipe from left to right. Note that the pipe in the middle is narrower. Choose the most appropriate depiction of water levels in the vertical pipes.

uhp fn[kk;k x, vkj[kk e ikuh ,d {kfrt ikbi e ck, l nk;h vkj cg jgk gA ikbi e/; e ldjk gA og fp=k pfu; tk fd Å/ok/kj ikbik e ikuh dk Lrj lokf/kd lgh :i e fn[kkrk gA

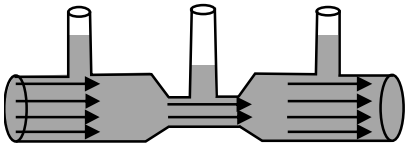
(A) 

(B) 

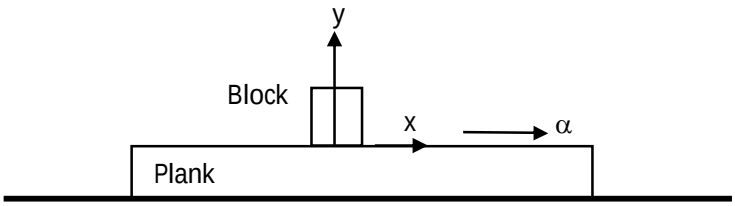
(C) 

(D) 

Ans. [A]

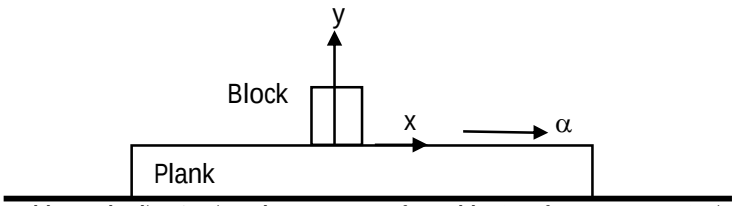
Sol. 

28. A plank is moving in a horizontal direction with a constant acceleration $a\hat{i}$. A uniform rough cubical block of side ℓ rests on the plank, and is at rest relative to the plank.



Let the center of mass of the block be at (0, ℓ/2) at a given instant. If a = g/10, then the normal reaction exerted by the plank on the block at that instant acts at

,d r[rk (plank) {kfrt fn'kk esa vpj Roj.k $a\hat{i}$ l xfreku gA ,d ,dleku [kjnjk (rough) ?kukdkj xVdk (block) ftldh ,d Hkqtk ℓ g] r[rs ij j[kk gvk g vkj r[rs dh ryuk esa fojkekoLFkk esa gA

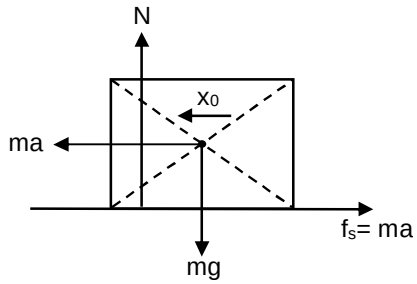


fdlh fn;s g, le; ij xVds dk n0;eku dUn (0, ℓ/2) fcUnq ij gA ;fn a = g/10 gks rk r[rs d }kjk xVds ij ml le; vkjksfir vfHkyEc cy fdl fcUnq ij yxxkA

(A) (0,0) (B) (–ℓ/20,0) (C) (–ℓ/10,0) (D) (ℓ/10,0)

Ans. [B]

Sol.



$mg\, x_0 = ma\, \frac{\ell}{2}$

$mg\, x_0 = \frac{mg}{210}\, \frac{\ell}{2} \Rightarrow x_0 = \frac{\ell}{20}$ (B)

29. Using the Heisenberg uncertainty principle, arrange the following particles in the order of increasing lowest energy possible

(I) an electron in H_2 molecule (II) a H atom in a H_2 molecule

(III) a proton in the carbon nucleus (IV) a H_2 molecule within a nanotube

gkbtucx dh vfuf'prrk fl)kUr dk vuqkj uhps fn;s x, d.kksa dks U;wure lHko Åtk dk vkjksgh Øe esa ltkb,A

(I) H_2 v.kq esa ,d byDVku (II) H_2 v.kq esa ,d H ijek.kq

(III) dkcu dh ukfHkd esa ,d izksVku (IV) uuksV;c esa ,d H_2 v.kq

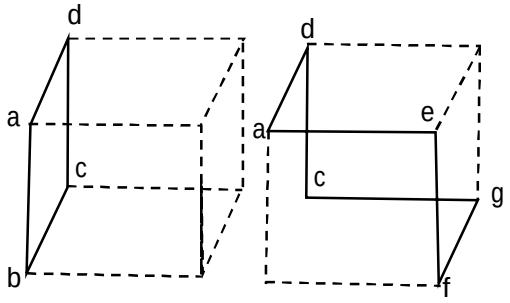
(A) (I) < (III) < (II) < (IV) (B) (IV) < (II) < (I) < (III)

(C) (II) < (IV) < (III) < (I) (D) (IV) < (I) < (II) < (III)

Ans. [C]

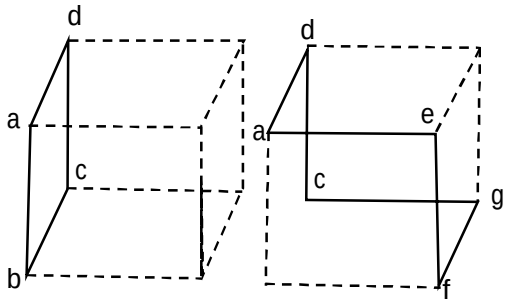
Sol. (II) < (IV) < (III) < (I)

30. The current is flowing along the path abcd of a cube (shown to the left) produces a magnetic field at the centre of cube of magnitude B. Dashed line depicts the non-conducting part of the cube.



Consider a cubical shape shown to the right which is identical in size and shape to the left. If the same current now flows in along the path daefgcd, then the magnitude of magnetic field at the centre will be

ckb vkj fn[kk;k x, ?ku e iFk abcd e cg jgh fo|r /kkjk ?ku d dUn ij B ifjek.k dk pcdh; {k=k mRiUu djrh gA fp=k e fn[kkb xb vlrr j[kk, ?ku d dpkyd Hkkx dk n'kkrh gA

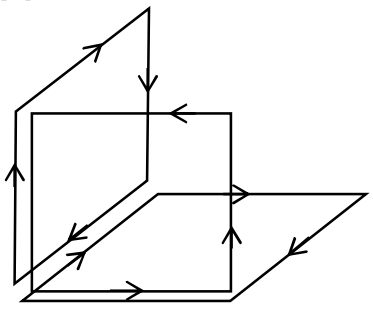


nkb vkj fn[kk;k x, ?ku d vkdkj ij fopkj dhft;k tk vkdkj ,o ifjek.k e ckb vkj fn[kk; x, ?ku d leku gA ;fn leku ek=kk dh /kkjk iFk daefgcd e cgrh g rk ?ku d dUn ij pEcdh; {k=k dk ifjek.k gkxk

(A) zero 'kU; (B) $\sqrt{2}B$ (C) $\sqrt{3}B$ (D) B

Ans. [C]

Sol.



$B_{net} = \sqrt{3}B$

31. A thin metallic disc is rotating with constant angular velocity about a vertical axis that is perpendicular to its plane and passes through its centre. The rotation causes the free electrons in the disc to redistribute. Assume that there is no external electric or magnetic field. Then

/kkrq dh ,d iryh pdrh viu dUnz l xtjr g, ,d Å/okZ/kj v{k d ifjr% ,d leku dk.kh; ox l ?k.kq dj jgh gA ?k.kq d dkj.k pdrh d eDr by DVku iuq% forfjr gk tkr gA dkbZ Hkh ckg fo|r ;k pEcdh; {ks=k vuifLFkr gA rc]

(A) a point on the rim of the disc is at a higher potential than the centre.
(B) a point on the rim of the disc is at a lower potential than the centre.
(C) a point on the rim of the disc is at the same potential as the centre
(D) the potential in the material has an extremum between center and the rim

(A) pdrh dh ifjf/k ij dkbZ fcUnq pdrh d dUnz dh vi{kk T;knk foHko ij gksxkA
(B) pdrh dh ifjf/k ij dkbZ fcUnq pdrh d dUnz dh vi{kk de foHko ij gksxkA
(C) pdrh dh ifjf/k ij dkbZ fcUnq pdrh d dUnz d leku foHko ij gksxkA
(D) foHko dk eku pdrh d dUnz vkj ifjf/k d e/; fdlh fcUnq ij pjeeku (extremum) gA

Ans. [B]

Sol. $-e\vec{E} = \frac{mv^2}{R} \quad \Rightarrow$ Electric field will be directed away from centre, so centre will be at higher potential

32. One mole of a monatomic gas and one mole of a diatomic gas are initially in the same state. Both gases are expanded isothermally and then adiabatically such that they acquire the same final state. Choose the correct statement.

,d ,dijekf.od vkj ,d f}ijekf.od xl e iR;sd eky ikjEHk e leku voLFkk e gA nkuk xlk dk igy lerkih; :l l rFkk fQj :)k"e :l l bl idkj foLrkfjr fd;k tkrk g fd nkuk dh vfre voLFkk ,dleku gA fueu e l lR; dFku dk p;u dhft ;

(A) work done by diatomic gas is more than that by monatomic gas
(B) work done by monatomic gas is more than that by diatomic gas
(C) work done by both the gases are equal
(D) change in internal energies of both the gases are equal

(A) f}ijekf.od xl d }kjk fd;k x;k dk; ,dijekf.od dh vi{kk vf/kd gA
(B) f}ijekf.od xl d }kjk fd;k x;k dk; ,dijekf.od dh vi{kk de gA
(C) nkuk xl d }kjk fd;k x;k dk; leku gA
(D) nkuk xl dh vkrfjd Åtk e ifjoru leku gA

Ans. [B]

Sol. $W = nRT \ln\left(\frac{V_2}{V_1}\right) + \frac{nR\Delta T}{1-\gamma}$

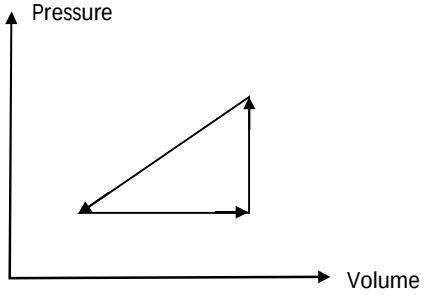
and $TV_2^{r-1} = T_f V_f^{\gamma-1}$

$V_2 = \left(\frac{T_f}{T}\right)^{\frac{1}{\gamma-1}} V_f$

V_2 is greater for monotonic

33. An ideal gas is made to undergo the cyclic process shown in the figure below. Let ΔW depict the work done, ΔU be the change in internal energy of the gas and Q be the heat added to the gas. sign of each of these three quantities for the whole cycle will be (0 refers to no change)

,d vkn'kZ xl dk pf=k e fn[kk;k vuqlkj ,d pØh; iØe l xtkjk tkrk gA eku yhft;s fd fd;s x, dk;Z dk ΔW vkrfjd Åtk ifjorZu dk ΔU rFkk xl dk nkh x;h Å"ek dk Q d }kjk n'kk;k tkrk gA bu rhu jkf'k;k dk fpUg ij pØ d fy, Øe'k% D;k gksxk (;gk o dk vFk dkb ifjorZu u gksus l g)



(A) –, 0, – (B) +, 0, + (C) 0,0,0 (D) +,+,+

Ans. [A]

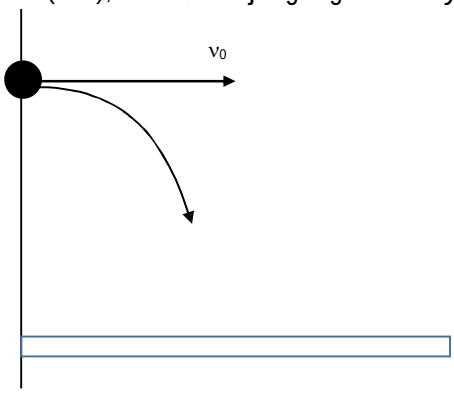
Sol. $\Delta w = -$

$\Delta U = 0$

$\Delta Q = -$

34. Two balls of mass M and 2M are thrown horizontally with the same initial velocity v_0 from top of a tall tower and experience a drag force of –kv (k>0), where v is the instantaneous velocity. Then

nk xn ftud n0;eku M rFkk 2M g] ,d Åph ehukj d lcl Åp LFkku l leku vkjfHkd ox v_0 l {kfrt fn'kk e Qdh tkrh gA ; xn d"k.k cy –kv (k>0), dk vuHko djr g tgk v rkRdkfyd ox g rc



(A) the heavier ball will hit the ground further away than the lighter ball

(B) the heavier ball will hit the ground closer than the lighter ball

(C) both balls will hit the ground at the same point

(D) both balls will hit the ground at the same time

(A) Hkkjh xn] gYdh xn dh vi{kk /kjkry ij vf/kd njh ij fxjxhA

(B) Hkkjh xn] gYdh xn dh vi{kk /kjkry ij de njh ij fxjxhA

(C) nkuk xn /kjkry ij ,d txg ij gh fxjxhA

(D) nkuk xn /kjkry ij ,d gh le; ij fxjxhA

Ans. [A]

Sol. Heavier will retard less, it will have more range.

35. Consider a glass cube slab of dielectric bound by the planes x = 0, x = a ; u = 0, y = b; z = 0, z = c; with b > a > c. The slab is placed in air and has a refractive index of n. The minimum value of n such that all rays entering the dielectric at y = 0 reach y = b is

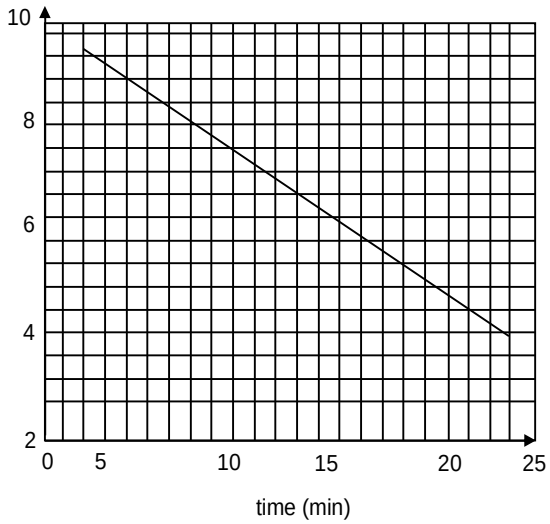
dkp dh ,d ijko|r ?ku iVVh ryk x = 0, x = a ; u = 0, y = b; z = 0, z = c; tgk b > a > c, f?kjh gb gA iVVh dk viorukd ng rFkk bl ok;q e j[kk x;k gA n dk og fuEure eku] ft ld fy, lHkh fdj.k tk fd ijko|r y = 0 l ifo"V gkrh gb y = b rd igp gkxk

(A) 1 (B) $\sqrt{2}$ (C) $\sqrt{3}$ (D) 2

Ans. [B]

36. The graph shows the log of activity (log R) of a radioactive material as a function of time t in minutes

fuEu vky[k ,d jfM;k/keh inkFk dh lØh;rk d y?kx.kd (log R) dk le; ¼feuV e½ d lkFk ifjoru n'kkrk gA



The half-life (in minutes) for the decay is closest to

{k; dh v/k vk; ¼feuV e½ yxHkx gkxh

(A) 2.1 (B) 3.0 (C) 3.9 (D) 4.4

Ans. [B]

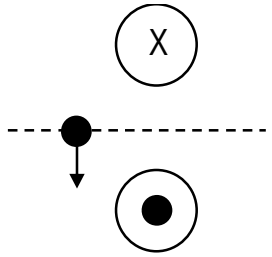
Sol. $R = R_0e^{-\lambda t}$

$\ln R = -\lambda t + \ln R_0$

comparing we get (B)

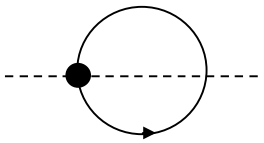
37. The magnetic field is uniform for y > 0 and points into the plane. The magnetic field is uniform and points out of the plane for y < 0. A proton denoted by filled circle leaves y = 0 in the -y direction with some speed as shown below .

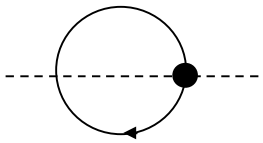
fuEu fp=k e] y > 0 d fy, ry d vnj dh vkj ,d leku pEcdh; {k=k yxk gvk gA y < 0 d fy, pEcdh; {k=k ,d leku g rFkk ry d ckgj dh rjQ nfxr djrk gA ,d ikVku tk fd Hkj g, oRr d }kjk fn[kk;k x;k g] y = 0 l -y fn'kk e dN xfr l pyrk gA

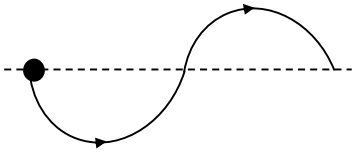


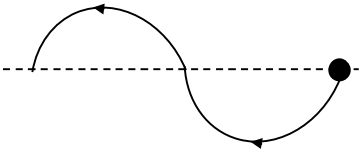
Which of the following best denotes the trajectory of the proton .

ikVku dk lokf/kd lgh i{ki iFk fuEu esa fdl vkj[k e n'kk;k x;k gA

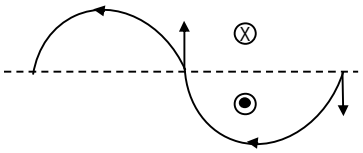
(A) 

(B) 

(C) 

(D) 

Ans. [D]



Sol.

38. The Hitomi satellite recently observed the Lyman alpha emission line (n = 2 to n = 1) of Hydrogen-like iron ion (atomic number of iron is 26) from the Perseus galaxy cluster. The wavelength of the line is closest to
gky gh e fgrkeh mixg u ijfl;l vkdk'kxxk leg l gkbMkt u d leku ykg vk;u (ykg dk ijek.k Øekd 26 g) dh yk;eu (Lyman) vYQk mRltu j[kk (n = 2 to n = 1) n[kh gA bl j[kk dh rjxn/; yxHkx gkxhA

(A) 2 Å (B) 1 Å (C) 50 Å (D) 10 Å

Ans. [A]

Sol. $\frac{1}{\lambda} = RZ^2 \left|\frac{1}{m^2} - \frac{1}{n^2}\right|$; n = 2, m = 1

39. Assume that the drag force on a football depends only on the density of the air, velocity of the ball and the cross-sectional area of the ball. Balls of different sizes but the same density are dropped in an air column. The terminal velocity reached by balls of masses 250 g and 125 g are in the ratio :
eku yhft;s fd ,d QVcky ij yxu okyk d"k.k cy ek=k gok d ?kuRo] QVcky d ox rFkk Qvcky dh vui"B dkV d {k=kQy ij fuHkj djrk gA fHkUu vkdkj fdUr leku ?kuRo dh nk QVcky dk gok e fxjk;k tkrk gA ;fn QVcky d n0;eku Øe'k% 250 g rFkk 125 g g] rk mudk lhekr oxk (terminal velocities) dk vuikr gkxk%

(A) $2^{1/6}$ (B $2^{1/3}$ (C) $2^{1/2}$ (D) $2^{2/3}$

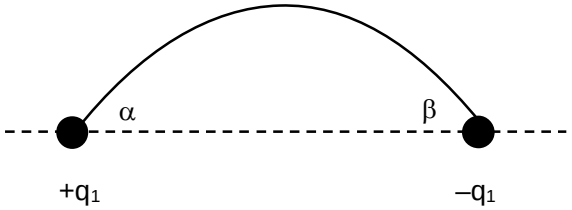
Ans. [A]

Sol. $F_a = K\rho_a VR^2 = K'\rho_a Vm^{2/3}$

$Mg = K'\rho_a Vm^{2/3} \Rightarrow V \propto m^{1/3} \Rightarrow \frac{v_1}{v_2} = (2)^{1/3}$

40. An electrostatic field line leaves at an angle α from point charge q_1 and connects with point charge $-q_2$ at an angle β (q_1 and q_2 are positive) (see figure below). If $q_2 = \frac{3}{2}q_1$ and $\alpha = 30°$, then

fp=kkuk lkj ,d fLFkjo|qr {ks=k j[kk] fcUnq vko'ks q1 ls dks.k α ij fudyrh gqbZ rFkk fcUnq vko'ks –q2 ls dks.k β ij feyrh gA ;gk q1 rFkk q2 nksuksa /kukRed gA ;fn $q_2 = \frac{3}{2}q_1$ rFkk α = 30°, rc



(A) $0^0 < \beta < 30°$ (B) $\beta = 30°$ (C*) $30° < \beta \le 60°$ (D) $60° < \beta \le 90°$

Ans. [C]

Sol. $q_1(1-\cos\alpha) = q_2(1-\cos\beta)$ solving we get $30° < \beta \le 60°$

CHEMISTRY

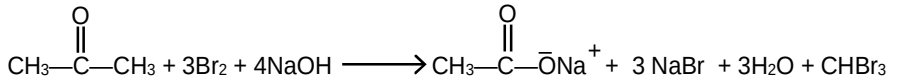
41. The amount (in mol) of bromoform ($CHBr_3$) produced when 1.0 mol of acetone reacts completely with 1.0 mol of bromine in the presence of aqueous NaOH is

tc 1.0 eqy ,lhVksu] tyh; NaOH dh mifLFkfr e 1.0 eqy cksehu d lkFk i.kr;k vfHkfØ;k djrk g rk cuu oky ckekQkse dh ek=kk ¼eqy e½ gksxh \

(A) $\frac{1}{3}$ (B) $\frac{2}{3}$ (C) 1 (D) 2

Ans. (A)

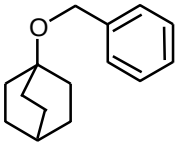
Sol.



Moles of bromoform produced = $\frac{1}{3}$ mole

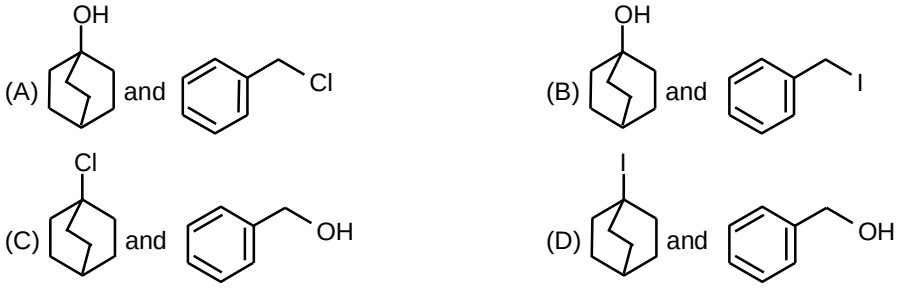
42. The following compound

fuEu ;kSfxd

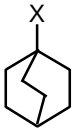


can readily be prepared by Williamson ether synthesis by reaction between

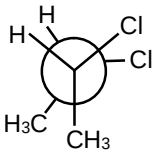
fofy;e lu bFkj l'y"k.k }kjk vklkuh ls fuEu esa ls fdu ;kSfxdksa dh vfHkfØ;k }kjk fufer fd;k tk ldrk g\



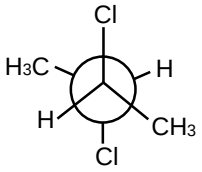
Ans. (B)

Sol. Here I is the better leaving group and the substitution can not occur at bridgehed carbon 

43. X and Y



X



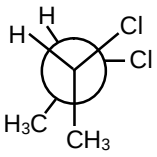
Y

are

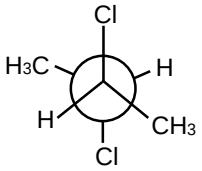
(A) enantiomers (B) diastereomers

(C) constitutional isomers (D) conformers

X vkj Y



X



Y

g

(A) ifrfcc :i (enantiomers) (B) vifrfcfcd :i (diastereomers)

(C) l?kVukRed leko;oh (constitutional isomers) (D) l:ih (conformers)

Ans. (D)

Sol. Both x and y represent meso-2,3-dichlorobutane. They are conformers, where X is eclipsed and Y is anti form.

44. The higher stabilities of tert-butyl cation over isopropyl cation, and trans-2-butene over propene, respectively, are due to orbital interactions involving.

(A) $\sigma \rightarrow \pi$ and $\sigma \rightarrow \pi^*$ (B) $\sigma \rightarrow$ vacant p and $\pi \rightarrow \pi^*$

(C) $\sigma \rightarrow \sigma^*$ and $\sigma \rightarrow \pi$ (D) $\sigma \rightarrow$ vacant p and $\sigma \rightarrow \pi^*$

VV&C;fVy /kuk;u dh] vkblkikfiy /kuk;u dk lki{k e vf/kd LFkkf;Ro rFkk Vkl-2-C;Vhu dh ikihu dk lki{k e vf/kd LFkkf;Ro Øe'k fuEu vkfcVy vrjfØ;kvk (interactions) d dkj.k gkrh gA

(A) $\sigma \rightarrow \pi$ vkj $\sigma \rightarrow \pi^*$ (B) $\sigma \rightarrow$ fjDr p vkj $\pi \rightarrow \pi^*$

(C) $\sigma \rightarrow \sigma^*$ vkj $\sigma \rightarrow \pi$ (D) $\sigma \rightarrow$ fjDr p vkj $\sigma \rightarrow \pi^*$

Ans. (D)

Sol. tert-Butyl cation is more stable than isopropylcation because of better hyperconjugation (σ- vacant p orbital overlap), Whereas trans-2-butene is more stable than propene becuase of σ–π^* orbital overlap.

45. Benzaldehyde can be converted to benzyl alcohol in concentrated aqueous NaOH solution using

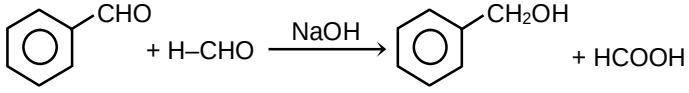
(A) acetone (B) acetaldehyde (C) formic acid (D) formaldehyde

ctfYMgkbM dk lkn tyh; NaOH d foy;u e fuEu e l fdld }kjk cfty ,Ydkgy e :ikrfjr fd;k tk ldrk g \

(A) ,lhVku (acetone) (B) ,lhVyfMgkbM (acetaldehyde)

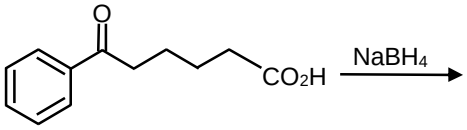
(C) Qkfed vEy (formic acid) (D) QkeyfMgkbM (formaldehyde)

Ans. (D)

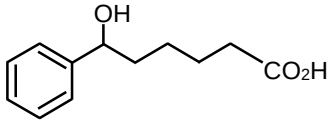
Sol. 

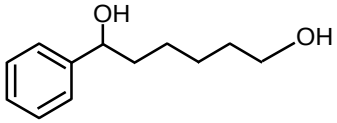
Cannizzaro reaction

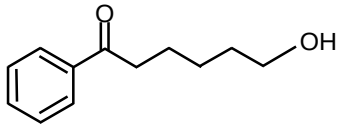
46. The major product of the following reaction
fuEu vfHkfØ;k dk e[; mRikn

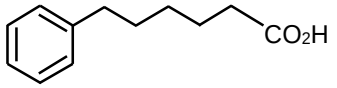


is g

(A) 

(B) 

(C) 

(D) 

Ans. (A)

Sol. Since $NaBH_4$ does not reduce –COOH or  , therefore the correct answer is (A).

47. Among the following species, the H–X–H angle (X=B,N or P) follows the order
fuEufyf[kr v.kvk e] H–X–H dk.k (X=B,N vFkok P) dk Øe gkxk

(A) $PH_3 < NH_3 < NH_4^+ < BF_3$ (B) $NH_3 < PH_3 < NH_4^+ < BF_3$

(C) $BF_3 < PH_3 < NH_4^+ < NH_3$ (D) $BF_3 < NH_4^+ < NH_3 < PH_3$

Ans. (A)

Sol. $\underset{120^\circ}{BF_3} > \underset{109^\circ 28}{NH_4^+} > \underset{107^\circ}{NH_3} > \underset{92^\circ}{PH_3}$

48. The ionic radii of Na^+, F^-, O^{2-}, N^{3-} follow the order
Na^+, F^-, O^{2-}, N^{3-} dh vk;fud f=kt ;kvk dk Øe gkxk

(A) $O^{2-} > F^- > Na^+ > N^{3-}$ (B) $N^{3-} > Na^+ > F^- > O^{2-}$

(C) $N^{3-} > O^{2-} > F^- > Na^+$ (D) $Na^+ > F^- > O^{2-} > N^{3-}$

Ans. (C)

Sol.

$$N^{3-} > O^{2-} > F^- > Na^+ \longrightarrow$$

effective nuclear charge increases

size decreases

49. The oxoacid of phosphorus having the strongest reducing property is
QkLQkjl dk vkDlk,flM ftldk vip;u x.k vf/kdre g

(A) H_3PO_3 (B) H_3PO_2 (C) H_3PO_4 (D) $H_4P_2O_7$

Ans. (B)

Sol. H_3PO_2 is has strong reducing property because of smaller oxidation state = +1 and due to 2 P–H bond.

50. Among C, S and P, the element(s) that produce (s) SO_2 on reaction with hot conc. H_2SO_4 is/are
(A) only S (B) only C and S
(C) only S and P (D) C, S and P
C, S ,oa P e dku lk ¼l½ rIr xe lkn H_2SO_4 d lkFk vfHkfØ;k djds SO_2 fufer djrk¼djr½ g
(A) flQ S (B) flQ C vkSj S
(C) flQ S vkSj P (D) C, S vkSj P

Ans. (D)

Sol. $C + H_2SO_4 \longrightarrow CO_2 + SO_2 + H_2O$

$S + H_2SO_4 \longrightarrow SO_2 + H_2O$

$P_4 + H_2SO_4 \longrightarrow H_2SO_4 + SO_2 + H_2O$

51. The complex that can exhibit linkage isomerism is
fuEu eog ldj] tk cU/kd leko;ork dk n'kk ldrk g
(A) $[Co(NH_3)_5(H_2O)]Cl_3$ (B) $[Co(NH_3)_5(NO_2)]Cl_2$
(C) $[Co(NH_3)_5(NO_3)](NO_3)_2$ (D) $[Co(NH_3)_5Cl]SO_4$

Ans. (B)

Sol. $-NO_2$ is ambidentate ligand as it connect with metal by N or O atom.

52 The tendency of X in BX_3 (X = F,Cl, OMe, NMe) to form a π bond with boron follows the order
BX_3 (X = F,Cl, OMe, NMe) e X dk ckjku d lkFk π c/k cuku dh izofÙk dk Øe gkxkA
(A) $BCl_3 < BF_3 < B(OMe)_3 < B(NMe_2)_3$ (B) $BF_3 < BCl_3 < B(OMe)_3 < B(NMe_2)_3$
(C) $BCl_3 < B(NMe_2)_3 < B(OMe)_3 < BF_3$ (D) $BCl_3 < BF_3 < B(NMe_2)_3 < B(OMe)_3$

Ans. (A)

Sol. Reason : Better extent of back bonding, Note –Cl can't donate 3p electron pair to boron as fluorine because of larger size 3p orbital.

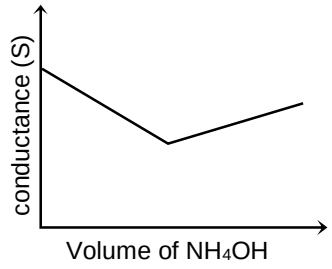
53. Consider the following statements about Langmuir isotherm :
(i) The free gas and adsorbed gas are in dynamic equilibrium
(ii) All adsorption sites are equivalent
(iii) The initially adsorbed layer can act as a substrate for further adsorption
(iv) The ability of a molecule to get adsorbed at a given site is independent of the occupation of neighboring sites
The correct statements are
(A) (i) , (ii), (iii) and (iv) (B) only (i), (ii) and (iv)
(C) only (i), (iii) and (iv) (D) only (i), (ii) and (iii)
yxebj lerkih d ckj e fuEu dFkuk ij fopkj djA
(i) eDr rFkk vf/k'kkf"kr xl xfrd lkE;koLFkk e gA
(ii) lHkh vf/k'kk"k.k LFky leku gA
(iii) ikjfEHkd vf/k'kkf"kr ijr Hkkoh vf/k'kk"k.k d fy, fØ;k/kkjd (substrate) dk dk; dj ldrh gA
(iv) fn; g, LFkku ij ,d v.k d vf/k'kkf"kr gku dh {kerk fudVorh LFkkuk d vf/k"Bku (occupation) ij fuHkj ugh djrh gA
lgh dFku g
(A) (i) , (ii), (iii) ,o (iv) (B) doy (i), (ii) ,o (iv)
(C) doy (i), (iii) ,o (iv) (D) doy (i), (ii) ,o (iii)

Ans. (C)

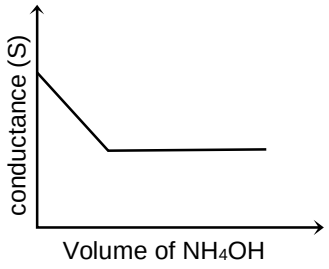
Sol. Factually incorrect.
The initially adsorbed layer cannot act as a substrate for further adsorption.

54. Among the following, the plot that correctly represents the conductometric titration of 0.05 M H_2SO_4 with 0.1 M NH_4OH is
fuEu e ls dku lk j[kkfp=k 0.05 M H_2SO_4 rFkk 0.1 M NH_4OH dh pkydrk&eyd vuekiu (conductometric titration) dk lgh rjg ls n'kkrk g\ ;gk y v{k ij pkydrk (S) rFkk x v{k ij NH4OH dk vk;ru g

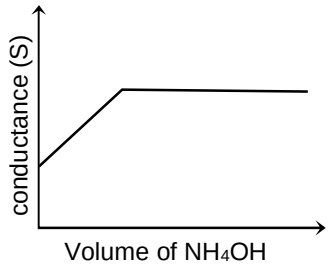
(A)



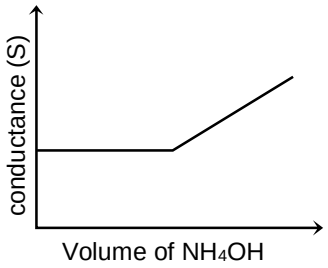
(B)



(C)



(D)



Ans. (B)

Sol. On adding NH_4OH

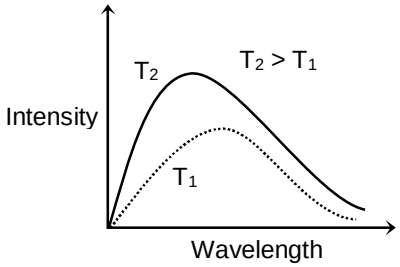
(A) Initially the fast moving H^+ ion get neutralized as H_2O and is replaced by slow moving NH_4^+ ion upto neutralisation point.

(B) After neutralisation point, weak electrolyte NH_4OH is added gradually, which does not affect the conductance.

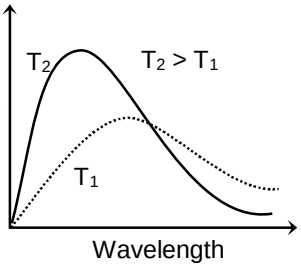
55. The correct representation of wavelength intensity relationship of an ideal blackbody radiation at two different temperatures T_1 and T_2 is

nk fofHkUu rkieku T1 rFkk T2 ij ,d vkn'kZ 'kjhj fiM fofdj.k (blackbody radiation) d rjxn/; rFkk fofdj.k rhork d e/; lc/k dk lgh fu:i.k gk (;gk y v{k ij rhork rFkk x v{k ij rjxn/; g)

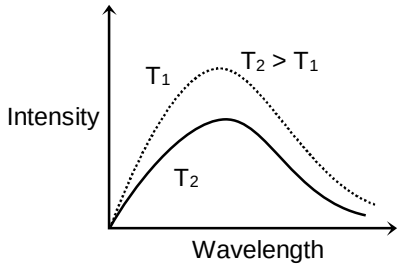
(A)



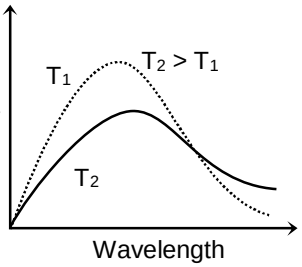
(B)



(C)

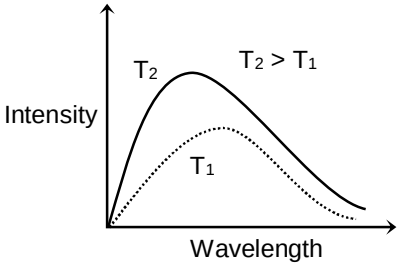


(D)

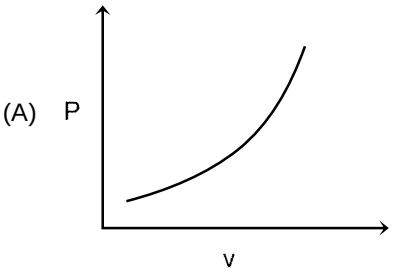


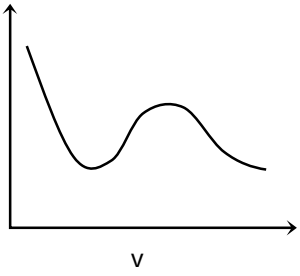
Ans. (A)

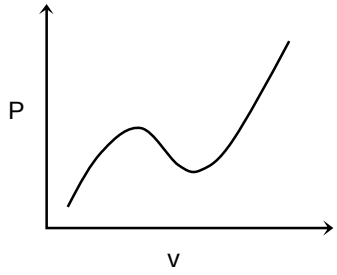
Sol.

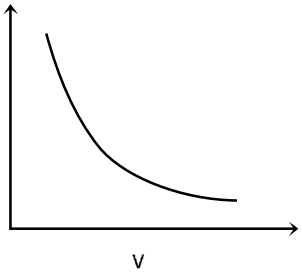


56. The pressure (P)-volume (V) isotherm of a van der Waals gas, at the temperature at which it undergoes gas to liquid transition, is correctly represented by
fuEu esa ls dku ls vkj[k ok.Mj xl d nkc (P)-vk;ru (V) lerkih; oØ dk no&xl lØe.k rkieku ij lgh :i l n'kkrk g

(A) 

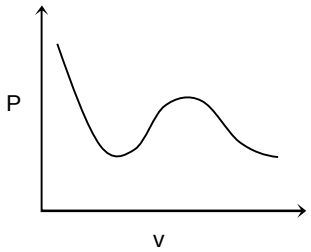
(B) 

(C) 

(D) 

Ans. (B)

Sol. Gas $\longrightarrow$ Liquid, Valume $\downarrow$; P$\uparrow$



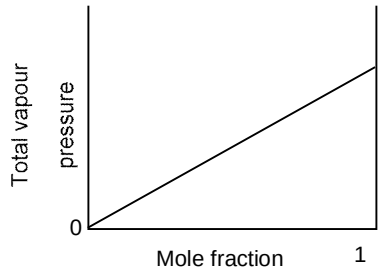
57. A buffer solution can be prepared by mixing equal volumes of
(A) 0.2 M NH_4OH and 0.1 M HCl (B) 0.2 M NH_4OH and 0.2 M HCl
(C) 0.2 M NaOH and 0.1 M CH_3COOH (D) 0.1 M NH_4OH and 0.2 M HCl
,d mHk; ifrjk/kh (buffer) foy;u dk fuEu esa ls fdlds leku vk;ru d feJ.k }kjk cuk;k tk ldrk g \
(A) 0.2 M NH_4OH vkj 0.1 M HCl (B) 0.2 M NH_4OH vkj 0.2 M HCl
(C) 0.2 M NaOH vkj 0.1 M CH_3COOH (D) 0.1 M NH_4OH vkj 0.2 M HCl

Ans. (A)

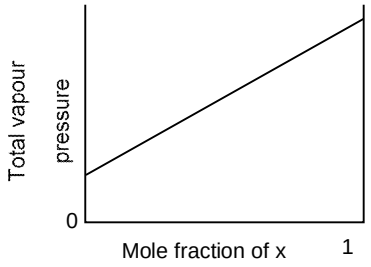
Sol. Mixing equal volume of NH_4OH (0.2 M) and HCl (0.1M) result in formation of NH_4OH + NH_4Cl basic buffer mixture.

58. The plot of total vapour pressure as a function of mole fraction of the components of an ideal solution formed by mixing liquids X and Y is
X rFkk Y nksa d feJ.k d ,d vkn'k foy;u d ?kVdk d dy ok"i nkc (x v{k ij) rFkk ekyk'k (y v{k ij) dk lgh vkj[k gS (;gk dy ok"i nkc y v{k ij rFkk x dk ekyk'k x v{k ij g)

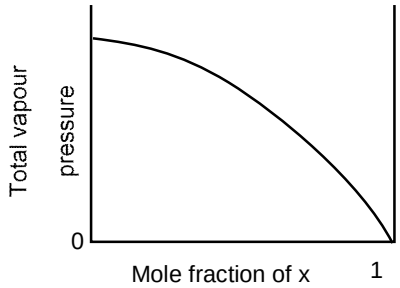
(A)



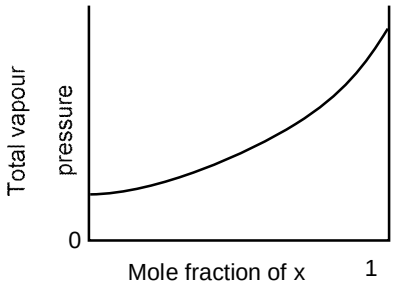
(B)



(C)

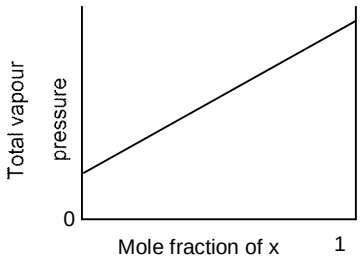


(D)



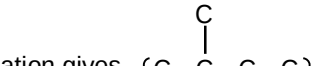
Ans. (B)

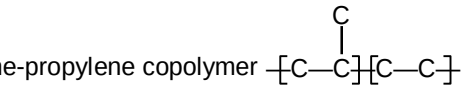
Sol.



59. On complete hydrogenation, natural rubber produces
(A) polyethylene (B) ethylene-propylene copolymer
(C) polyvinyl chloride (D) polypropylene
ikÑfrd jcj d lEi.k gkbMkstuhdj.k l curk gA
(A) ikyh,fFkyhu (B) ,fFkyhu&ikiihyhu lgcgyd
(C) ikyhfoukby DykjkbM (D) ikyhikfiyhu

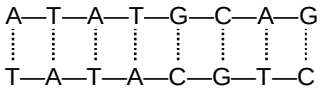
Ans. (B)

Sol. Natural rubber i.e. polyisoprene or hydrogenation gives 

skeleton which can be considered as ethylene-propylene copolymer 

60. The average energy of each hydrogen bond in A-T pair is x kcal mol^{-1} and that in G-C pair is y kcal mol^{-1}. Assuming that no other interaction exists between the nucleotides, the approximate energy required in kcal mol^{-1} to split the following double stranded DNA into two single strands is

A-T ;Xe e iR;d gkbMk tu c/k dh vklr Åtk x kcal mol^{-1} rFkk G-C ;Xe e y kcal mol^{-1} gA ;g ekurs g, fd U;fDyvkVkbM l d chp dkb vU;kU; fØ;k mifLFkr ugh g] fuEu f}dMyh; (double stranded) DNA dk nk ,dy dMfy;k e foyfxr dju (split) d fy, yxHkx fdruh Åtk (kcal mol^{-1} e) dh vko';drk gkxh \



[Each dashed line may represent more than one hydrogen bond between the base pairs]

[iR;d vlrr j[kk ,d l vf/kd gkbMk tu c/kk dk inf'kr dj ldrh gA]

(A) 10x + 9y (B) 5x + 3y (C) 15x + 6y (D) 5x + 4.5y

Ans. (A)

Sol. Number of H-bond is A–T pair = 2, while no of H-bond in G–C pair is 3. Therefore

(i) Total number of A–T. H-bond = number of A–T pair × Number of H bond
= 5×2 = 10

(ii) Total number of G–C H-bond = number of G–C pair × number of H bond
= 3× 3= 9

Total energy required to dissociate the stand = 10x+9y Kcal mol^{-1}

BIOLOGY

61. What is the maximum number of oxygen atoms that a molecule of hemoglobin can bind?

gheksXykfcu d ,d v.k l vkDlhtu d vf/kdre fdrus ijek.k c/k ldrs g\

(A) 2 (B) 4 (C) 8 (D) 16

Ans. (C)

62. Bt toxin produced by *Bacillus thuringiensis* does not kill the producer because the toxin is

(A) In an inactive protoxin form (B) Rapidly secreted outside

(C) Inactivated by an antitoxin (D) In unfolded form

Bacillus thuringiensis }kjk mRikfnr Bt thfo"k mRiknd tho dk D;k ugh ekjrk g\

(A) fo"k ,d vfØ; ikd&thofo"k :i e gkrk gA (B) fo"k Rofjr :i l ckgj lkfor gk tkrk gA

(C) fo"k ,d ifrfo"k }kjk vfØ; gk tkrk gA (D) fo"k foÑr :i e jgrk gA

Ans. (A)

63. An angiosperm was identified with its ebndosperm of 6n. Assuming that is a self-pollinating species, which ONE of the following is the correct ploidy of the parent?

(A) 3n (B) 4n (C) 6n (D) 8n

,d vkoÙkchth ik/k dk Hk.kik"k 6n gA ,lk ekurs g, fd ;g ,d Lo&ldfjr itkfr g] fuEu e l dku lk fodYi tudk dh lyk;Mh d fo"k; e lgh g\

(A) 3n (B) 4n (C) 6n (D) 8n

Ans. (B)

64. Which ONE of the following statements is TRUE about viruses?

(A) All viruses possess a protein coat around its genetic material at all stages of their life cycle

(B) All viruses contain RNA as genetic material

(C) All viruses contain DNA as genetic material

(D) All viruses replicate only within the host cell

fuEufyf[kr e l dku lk dFku fo"kk.kvk d fo"k; e lgh g\

(A) lHkh fo"kk.kvk e thou pØ dh lHkh voLFkkvk e thuh inkFk ikVhu d vkoj.k l <dk gkrk gA

(B) lHkh fo"kk.kvk e thuh inkFk RNA l cuk gkrk gA

(C) lHkh fo"kk.kvk e thuh inkFk DNA l cuk gkrk gA

(D) lHkh fo"kk.kvk dk ifrfØ;u doy ik"kh ¼gkLV½ dkf'kdkvk d vnj gh gkrk gA

Ans. (D)

65. Mitochondrial cristae are infoldings of the

(A) Outer membrane and they increase the surface area

(B) Outer membrane and they decrease the surface area

(C) Inner membrane and they increase the surface area

(D) Inner membrane and they decrease the surface area

l=kdkf.kdk d fØLV d fo"k; e fuEufyf[kr e l dku lk dFku lgh g\

(A) ;s cká>Yyh d vroyu ¼buQkfYMx½ l cur g vkj i"B d {k=kQy dk c<kr gA

(B) ;s cká>Yyh d vroyu l cur g vkj i"B d {k=kQy dk ?kVkr gA

(C) ;s vr% >Yyh d vroyu l cur g vkj i"B d {k=kQy dk c<kr gA

(D) ;s vr% >Yyh d vroyu l cur g vkj i"B d {k=kQy dk ?kVkr gA

Ans. (C)

66. In biological nitrogen fixation the enzyme nitrogenase converts

(A) Nitrate to nitrite

(B) Atmospheric nitrogen to nitrite

(C) Nitrite to ammonia

(D) Atmospheric nitrogen to ammonia

tfod ukbVkstu fLFkjhdj.k ifØ;k e] ukbVkstust ,tkbe fuEufyf[kr e l fdl ifjoru dk ifjr djrk g\

(A) ukbVV dk ukbVkbV e

(B) ok;eMyh; ukbVkstu dk ukbVkbV e

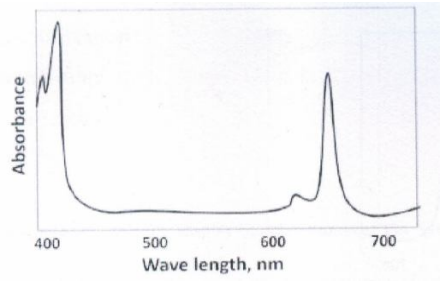
(C) ukbVkbV dk vekfu;k e

(D) ok;eMyh; ukbVkstu dk vekfu;k e

Ans. (D)

67. The graph below represents the absorption spectrum of major pigment contributing to photosynthesis?

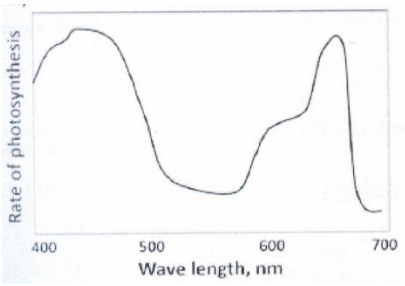
uhp fn;k x;k j[kkfp=k idk'k l'y"k.k e lgk;d ie[k o.kd ¼fixeV½ d vo'kk"k.k o.kØe ¼LiDVe½ n'kkrk g ¼tgk x-v{k ij rjxn/; (nm) vkj y-v{k ij vo'kk"k.k g½A



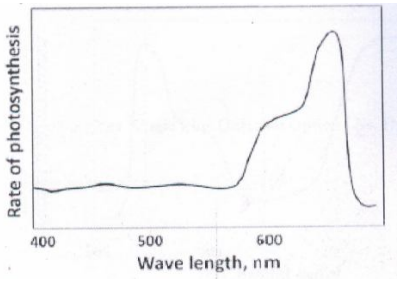
Which ONE of the following best represents the photosyntheic efficiency or the pigment?

fuEu e l dkuk j[kkfp=k o.kd dh idk'k l'y"k.k; n{krk dk lcl lVhd :i l n'kkrk g ¼ftle x-v{k ij rjxn/; (nm) e vkj y-v{k ij idk'k l'y"k.k dh nj g½\

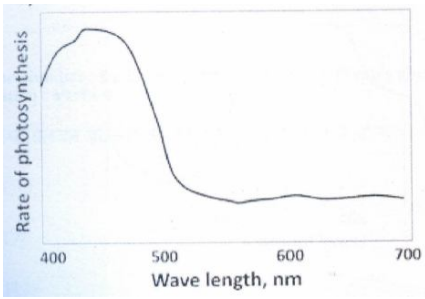
(A)



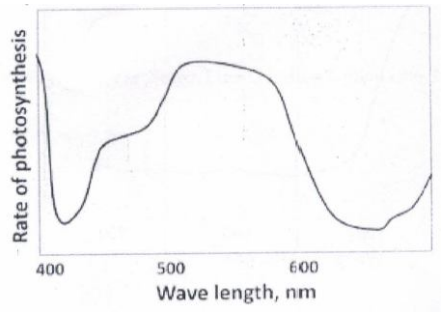
(B)



(C)



(D)



Ans. (A)

68. ONE of the following properties of normal cell is lost during its transtion to cancerous cell?

(A) Gluratamine utilizauon (B) Contact inhibition

(C) Glucose utilization (D) Membrane fluidity

fdlh lkekU; dkf'kdk dk fuEufyf[kr e l dku lk x.k dd dkf'kdk e lØe.k d le; á l ¼ykLV½ n'kkrk g\

(A) XyVkfeu dk mi;ksx (B) lLi'k lneu (C) Xydkt dk mi;ksx (D) lykTek f>Yyh dh n0;rk

Ans. (B)

69. Which ONE of the following gases is produced during fermentation by yeast?

;hLV e fd.ou ifØ;k d nkjku fuEufyf[kr e l dkuh xl mRiUu gkrh g\

(A) CO_2 (B) O_2 (C) H_2 (D) N_2

Ans. (A)

70. Serine proteases are called so because they?

(A) Require free serine for their activity

(B) Cleave after serine residues in the substrate

(C) Are inhibited by the presence of free serine

(D) Have a serine residue at their active site

fuEufyf[kr e l dku lk dFku ljhu ikVh,t d fo"k; e lgh g\

(A) bUg lfØ;rk d fy, eDr ljhu dh vko';drk gkrh gA

(B) ; vfHkded d ljhu vehuk vEyk d ckn fonyu dju gA

(C) budh lfØ;rk eDr ljhu dh mifLFkfr e vo:) gk tkr gA

(D) bud lfØ;krk LFkku ¼,fDVo lkbV½ ij ljhu vehuk vEy ik;k tkrk gA

Ans. (D)

71. The maximum number of genotypes of the pollens produced by a tall pea plant with round, yellow seeds of the genotype TtRrYY, if the three loci are unlinked, would be :

;fn fdlh yc eVj d ik/k d cht xky vkj ihyk gk ftudk thu&ik:i TtRrYY g vkj ; rhuk thu fcUn vlgYxu gA bl ik/k l fofHkUu thu ik:i oky vf/kdre fdru idkj d ijkxd.k mRiUu gk ldr g\

(A) 1 (B) 2 (C) 4 (D) 8

Ans. (C)

72. ONE of the following statements is TRUE with respect to human ovary?

(A) Estrogen is secreted by Graafian follicles and progesterone by corpus luteum

(B) Estrogen is secreted by corpus luteum and progesterone by Graafian follicles

(C) Both estrogen and progesterone are secreted by Graafian follicles

(D) Both estrogen and progesterone are secreted by corpus luteum

ekuo v.Mk'k; d fo"k; e fuEufyf[kr e l dku lk dFku lgh g\

(A) bLVkrtu dk lko.k xfQ;u ifVdkvk l vkj ikrtLVku dk dkil Y;fV;e l gkrk gA

(B) bLVkrtu dk lko.k dkil Y;fV;e l vkj ikrtLVku dk xfQ;u ifVdkvk l gkrk gA

(C) bLVkrtu vkj itLVku nkuk dk gh lko.k xfQ;u ifVdkvk l gkrk gA

(D) bLVkrtu vkj ikrtLVku nkuk dk gh lko.k dkil Y;fV;e l gkrk gA

Ans. (A)

73. Which ONE of the following statements is INCORRECT with respect to human antibodies?
(A) They can neutralize microbes (B) They are synthesised by T cells
(C) They are made up of four polypeptide chains (D) Milk contains antibodies
fuEufyf[kr e l dku dFku ekuo ifrj{kh d fo"k; e xyr g\
(A) ; l{ethfo;k dk mnklhu dj ldr gA (B) budk l'y"k.k T-dkf'kdkvk }kjk gkrk gA
(C) ; pkj ikyh&ilVkbM l cu g, gkr gA (D) n/k e ifrj{kh ik; tkr gA

Ans. (B)

74. Concentration (%) of NaCl isotonic to human blood is
(A) 0.085–0.09 % (B) 1.7 – 1.8 % (C) 3.4 – 3.6 % (D) 0. 85–0. 9 %
fuEufyf[kr e l NaCl dk dku lk lkUn.k ekuo :f/kj d leijkljh g\
(A) 0.085–0.09 % (B) 1.7 – 1.8 % (C) 3.4 – 3.6 % (D) 0. 85–0. 9 %

Ans. (D)

75. Which ONE of the following statements is TRUE about the Golgi apparatus?
(A) It is found only in animals
(B) It is found only in prokaryotes
(C) It modifies and targets proteins to the plasma membrane
(D) It is a site for ATP production
fuEufyf[kr e l dku lk dFku xkYth midj.k d fo"k; e lgh g\
(A) ;g doy tarvk e ik;k tkrk gA
(B) ;g doy io&dUndh; dkf'kdkvk e ik;k tkrk gA
(C) ;g ikVhu dk :ikrfjr djd mUg lykTek f>Yyh ij Hktr gA
(D) ;g dkf'kdk e ATP mRiknu dk LFkku gA

76. Creutzfeldt Jakob Disease (CJD) is a transmissible disease caused by a :
(A) Virus (B) Bacterium (C) Fungus (D) misfolded protein
ÑVtQYV tdkc chekjh (CJD) ,d lpkfjr ¼Vkfelhcy½ chekjh g tk fuEu e l fdld }kjk gkrh g\
(A) fo"kk.k (B) thok.k (C) dod (D) foÑr ikVhu

Ans. (D)

77. A researcher found petrified dinosaur faeces. Which ONE of the following is unlikely to be found in this fossil?
(A) Decayed conifer wood (B) Bamboo
(C) Cycad (D) Giant fern

,d 'kks/kdrk dk Mkbuklkj d iFkjk; g, ey ikIr g,A bl thok'e e fuEu e l fdl pht d ik; tku dh lHkkouk lcl de g\
(A) dkuhQj dh {KhfMr ydMh d v'k (B) ckl
(C) lkbdM (D) fo'kkydk; Qu

Ans. (B)

78. Which ONE of the pairs of amino- acids contains two chiral centres?
(A) Isoleucine and threonine (B) Leucine and valine
(C) Valine and isoleucine (D) Threonine and leucine
fuEufyf[kr e l vehuk vEyk d fdl ;Xe e nk dkbjy dUn g\
(A) vkblkY;flu vkj fFk;kuhu (B) y;flu vkj oyhu
(C) oyhu vkj vkblkY;flu (D) fFk;kuhu vkj Y;flu

Ans. (A)

79. In photosynthetic carbon fixation, which ONE of the following reacts with CO_2?

(A) Phosphoglycolate (B) 3-Phosphoglycerate

(C) Ribulose-1,5-bisphosphate (D) Ribulose-5-phosphate

idk'k l'y"k.kh; dkcu fLFkjhdj.k e fuEufyf[kr esa dkuk v.k CO_2 ls vfHkfØ;k djrk g\

(A) QkLQkXykbdkyV (B) 3-QkLQkfXyjsV

(C) fjcykst-1,5-fcQkLQsV (D) fjcykst-5-QkLQsV

Ans. (C)

80. Match the diseases in **Column-I** with the routes of infection in **Column-II**. Choose the CORRECT combination :

	Column-I	**Column-II**
P.	Tuberculosis	i. Contaminated food and water
Q.	Dysentry	ii. inhalation of aerosol
R.	Filariasis	iii. Contact via skin
S.	Syphilis	iv. Sexual intercourse
		v. Mosquito bite

LrEHk-I esa nh xbZ chekfj;k dk LrEHk-II esa crk;s x;s lØe.k d rjhdk ls feyk;sA

	LrEHk-I	**LrEHk-II**
P.	{k; jksx	i. nf"kr Hkkstu vkSj ikuh
Q.	ifp'k	ii. ok;foy; ¼jkLrs½ dk vrh'olu
R.	Qkbyfj;kfll	iii. Ropk }kjk Li'k
S.	flfQfyl	iv. ePNj
		v. ePNj dk dkVuk

(A) P-ii, Q-i, R-v, S-iv (B) P-ii, Q-i, R-iii, S-v

(C) P-i, Q-iii, R-v, S-iv (D) P-ii, Q-iii, R-iv, S-v

Ans. (A)

PART-II
Two Marks Questions

MATHEMATICS

81. Let R be a rectangle, C be a circle, and T be a triangle in the plane. The maximum possible number of points common to the perimeters of R, C, and T is

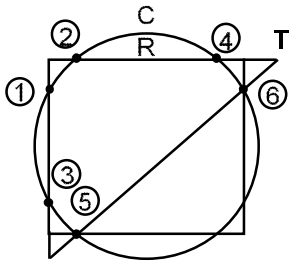
(A) 3 (B) 4 (C) 5 (D) 6

,d ry e R ,d o`Ùk C ,d or rFkk T ,d f=kHkt gA R, C, rFkk T dh ifjf/k;k ij vf/kdre lHko lofu"B fcUnvksa dh l[;k gksxh %

(A) 3 (B) 4 (C) 5 (D) 6

Ans. **(D)**

Sol.



82. The number of different possible values for the sum x + y + z, where x, y, z are real numbers such that $x^2 + 4y^4 + 16z^4 + 64 = 32xyz$ is

(A) 1 (B) 2 (C) 4 (D) 8

x , y , z okLrfod l[;k, bl idkj g fd $x^4 + 4y^4 + 16z^4 + 64 = 32xyz$, rc x + y + z d fdru vyx & vyx eku lHko g \

(A) 1 (B) 2 (C) 4 (D) 8

Ans. **(C)**

Sol. Applying Am ≥ gm.

$$\frac{x^4 + 4y^4 + 16z^4 + 64}{4} \geq (4^6x^4y^4z^4)^{1/4}$$

$x^4 + 4y^4 + 16z^4 + 64 \geq 32 \mid xyz \mid$

so equal when each term is equal.

$\therefore \quad x^4 = 4y^4 = 16z^4 = 64$

$\Rightarrow \quad x = \pm 2\sqrt{2}$

$y = \pm 2$

$z = \pm\sqrt{2}$

For x.y.z

For $x^4 + 4y^4 + 16z^4 + 64 = 32xyz$

Either each of x, y, z is (+)ve $\rightarrow$ 1 case/

Or two of x,y, z are (–) ve $\rightarrow$ 3 cases

$\therefore$ 4 cases of different (x, y, z) triplets

$\therefore$ 4 possible x + y + z values (as $x \neq y \neq z$)

83. Let Γ be a circle with diameter AB and centre O. Let ℓ be the tangent to Γ at B. For each point M on Γ different from A. consider the tangent t at M and let it intersect ℓ at P. Draw a line parallel to AB through P intersecting O M at Q. The locus of Q as M varies over Γ is

(A) an are of a circle (B) a parabola

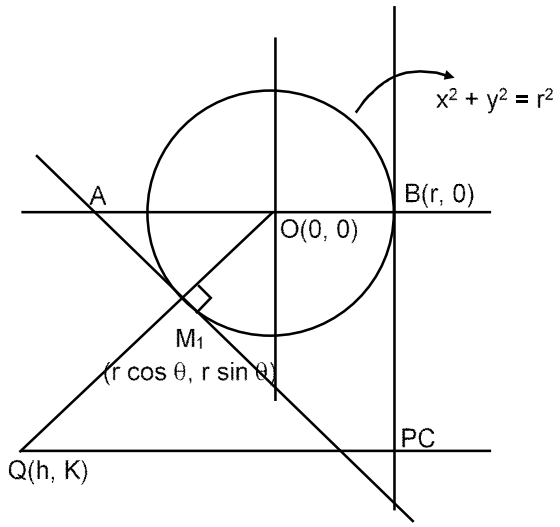
(C) an are of an ellipse (D) a branch of a hyperbola

Γ ,d or g ftldk 0;kl AB ,o dUæ O gA eku yhft, fd ℓ or Γ d fcUnq B ij Li'k j[kk gA A dk NkMdj or Γ ij fLFkr gj fcUnq M l Li'k j[kk, t [kfp, tk Li'k j[kk ℓ dk P ij dkVA P l xtjr g, AB d lekUrj ,d j[kk [kfp, tk OM dk Q ij dkVA tl&tl M dk LFkku or Γ ij cnyrk] rc Q dk fcUnqiFk gkrk \

(A) or dk ,d pki (B) ,d ijoy; (C) nh?kZor dk ,d pki (D) vfrijoy; dh ,d 'kk[kk

Ans. **(B)**

Sol.



Equation of tangent at M, $x \cos\theta + y \sin\theta = r$

put x = r, to get y-coordinate of point P.

$r\cos\theta + y\sin\theta = r$

$\Rightarrow \quad y = \dfrac{r(1-\cos\theta)}{\sin\theta} = \dfrac{r\cdot 2\cdot \sin^2\frac{\theta}{2}}{2\sin\frac{\theta}{2}\cdot\cos\frac{\theta}{2}} = r\tan\dfrac{\theta}{2}$

$\therefore \quad P \equiv \left(r,\ r\tan\dfrac{\theta}{2}\right)$

$\therefore$ Q has y –coordinate same as point P

$\therefore \quad K = r\tan\dfrac{\theta}{2} \quad \Rightarrow \quad \tan\dfrac{\theta}{2} = \dfrac{K}{r}$

Slope of tangent at M = $-\cot\theta$

Slope of OQ = $\dfrac{K}{h}$

$\therefore \quad \dfrac{K}{h}, (-\cot\theta) = -1 \quad \Rightarrow \quad \tan\theta = \dfrac{K}{h}$

$\Rightarrow \quad \dfrac{2\tan\frac{\theta}{2}}{1-\tan^2\frac{\theta}{2}} = \dfrac{K}{h} \quad \Rightarrow \quad \dfrac{2\cdot\frac{K}{r}}{1-\frac{K^2}{r^2}} = \dfrac{K}{h}$

$\Rightarrow \quad \dfrac{2h}{r} = 1-\dfrac{K^2}{r^2} \quad \Rightarrow \quad \dfrac{2h}{r} = \dfrac{r^2-K^2}{r^2}$

$\Rightarrow \quad 2hr = r^2 - K^2$

$\Rightarrow \quad y^2 = r^2 - 2Kr$

$y^2 = -2r\,(x - r/2)$

$\therefore$ Parabola

84. The number of solution x of the equation $\sin(x + x^2) - \sin(x^2) = \sin x$ in the interval [2,3] is

(A) 0 (B) 1 (C) 2 (D) 3

[2,3] vrjky e leh dj.k sin $(x + x^2) - \sin(x^2) = \sin$ d fdru gy x lHko g \

(A) 0 (B) 1 (C) 2 (D) 3

Ans. **(C)**

Sol. $2\cos\left(x+\dfrac{2x^2}{2}\right).\sin\dfrac{x}{2} = 2\sin\dfrac{x}{2}.\cos\dfrac{x}{2}$

$\Rightarrow \quad \sin\dfrac{x}{2}\left[\cos\left(\dfrac{x+2x^2}{2}\right) = \cos\dfrac{x}{2}\right] = 0$

$\sin\dfrac{x}{2} = 0$ or $2\sin\left(\dfrac{2x+2x^2}{4}\right).\sin\left(\dfrac{2x^2}{4}\right) = 0$

$\dfrac{x}{2} = 0, \pi, 2\pi$ or $\sin\left(\dfrac{x+x^2}{2}\right) = 0$ or $\sin\dfrac{x^2}{2} = 0$

$X = 0, 2\pi, 4\pi$ or $\dfrac{x+x^2}{2} = 0, \pi, 2\pi$

$\dfrac{x+x^2}{2} = \pi \qquad x^2 = 2\pi$

$\Rightarrow \quad X^2 + x - 2\pi = 0 \quad \Rightarrow \quad x = \sqrt{2\pi}$

$X = \dfrac{-1\pm\sqrt{1+8\pi}}{2} \qquad 2 > \sqrt{2\pi} < 3$

$\sqrt{1+8\pi} \approx \sqrt{25.14}$

≈ 5.2

$\therefore \quad x = \frac{5.2-1}{2} = \frac{4.2}{2} = 2.1$

$\therefore$ total number of solution lies between (2, 3) = 2

85. The number of polynomials p: R→R satisfying p(0) = 0, $p(x) > x^2$ for all $x \neq 0$, and $p''(0) = \frac{1}{2}$ is

(A) 0 (B) 1 (C) more than 1, but finite (D) infinite

cgink p: R→R ft ld fy, p(0) = 0, lHkh $x \neq 0$, d fy, $p(x) > x^2$ rFkk $p''(0) = \frac{1}{2}$ g] dh l[;k gkxh

(A) 0 (B) 1 (C) 1 l vf/kd ij lhfer (D) vur

Ans. [A]

Sol. Assume $g(x) = p(x) - x^2$ (g(x) is polynomial → differentiable function)

given $p(x) > x^2 \Rightarrow p(x) - x^2 > 0 \ \forall \ x \neq 0$

$\Rightarrow g(x) > 0 \quad \forall \ x \neq 0$

and g(0) = p(0) – 0 = 0

As $g(x) > 0 \ \forall \ x \neq 0$

$\Rightarrow$ x = 0 should be a minima

$\therefore$ g''(x) should be ≥ 0 at x = 0

Now g'(x) = p'(x) – 2x

and g''(x) = p''(x) – 2

$= \frac{1}{2} - 2$

$= -\frac{3}{2}$ so, contradiction

$\therefore$ No such polynomial exist

86. Suppose the limit $L = \lim_{n\to\infty} \sqrt{n} \int_0^1 \frac{1}{(1+x^2)^n} dx$ exists and is larger than $\frac{1}{2}$. Then

(A) $\frac{1}{2} < L < 2$ (B) $2 < L < 4$ (C) $3 < L < 4$ (D) $L \geq 4$

Ekku y fd lhek $L = \lim_{n\to\infty} \sqrt{n} \int_0^1 \frac{1}{(1+x^2)^n} dx$ dk vfLrRo g vkj ;g $\frac{1}{2}$ l vf/kd gA rc

(A) $\frac{1}{2} < L < 2$ (B) $2 < L < 4$ (C) $3 < L < 4$ (D) $L \geq 4$

Ans. **(A)**

87. Consider the set A_n of points (x,y) such that $0 \le x \le n$, $0 \le y \le n$ where n, x, y are integers. Let S_n be the set of all lines passing through at least two distinct points from A_n. Suppose we choose a line ℓ at random from S_n. Let P_n be the probability that ℓ is tangent to the circle $x^2 + y^2 = n^2\left(1+\left(1-\frac{1}{\sqrt{n}}\right)^2\right)$. Then the limit $\lim_{n\to\infty} P_n$ is

(A) 0 (B) 1 (C) $1/\pi$ (D) $1/\sqrt{2}$

fcUnvk (x, y) dk ,d lePp; A_n bl idkj g fd $0 \le x \le n, 0 \le y \le n$ tgk n, x, y i.kkd gA eku yhft, fd S_n mu lHkh j[kkvk dk lePp; g tk A_n d lde l de nk fHkUu fcUnvk l xtjrh gA S_n l ;nPN :i l ,d j[kk ℓ puh tkrh gA eku yhft, fd ℓ d or $x^2 + y^2 = n^2\left(1+\left(1-\frac{1}{\sqrt{n}}\right)^2\right)$ ij Li'k j[kk gku dh ikf;drk P_n g] rc lhek $\lim_{n\to\infty} P_n$ dk eku gkxk \

(A) 0 (B) 1 (C) $1/\pi$ (D) $1/\sqrt{2}$

Ans. **(A)**

Sol. Equation of line passing through (x_1,y_1) and (x_2,y_2) is

$$\frac{y-y_1}{x-x_1} = \frac{y_2-y_1}{x_2-x_1}$$

$\Rightarrow (x_2 = -x_1)y + (y_1 - y_2)x + y_1(x_1 - x_2) + x_1(y_2 - y_1) = 0$

$\Rightarrow ax + by + c = 0$ where $a, b, c \in I$

$a = x_2 - x_1$, $b = y_1 - y_2$, $c = y_1(x_1 - x_2) + x_1(y_2 - y_1)$

square of distance of (0, 0) from $\left(\frac{c}{\sqrt{a^2+b^2}}\right)^2 = \frac{c^2}{a^2+b^2}$ = rational

Case -1 : if n is not perfect square

And square of radius $= n^2\left(1+\left(1-\frac{1}{\sqrt{n}}\right)^2\right)$ = irrational

$\Rightarrow r^2 \ne \frac{c^2}{a^2+b^2}$ s

$\Rightarrow ax + by + x = 0$ never be tangent to given circle

$\Rightarrow \lim_{n\to\infty} P_n = 0$

Case -2 : if n is perfect square

In this case number of tangents passing through two points from given set are few, but total number of lines are in much quantity when n approaches to infinite.

$\Rightarrow \lim_{n\to\infty} P_n = 0$

88. Let $f : [0,1] \to R$ be an injective continuous function that satisfies the condition $-1 < f(0) < f(1) < 1$.

Then the number of functions $g : [-1,1] \to [0,1]$ such that $(gof)\,x = x$ for all $x \in [0,1]$ is

(A) 0 (B) 1 (C) more then 1, but finite (D) infinite

Ekku yhft, fd $f : [0,1] \to R$,d ,ddh ¼injective) lrr Qyu g tk fuEu lr"V djrk g \

$-1 < f(0) < f(1) < 1$.

rc Qyu $g : [-1,1] \to [0,1]$ dh dy l[;k D;k gkxh] tk lHkh $x \in [0,1]$ d fy, $(gof)\,x = x$ lr"V djrh g \

(A) 0 (B) 1 (C) 1 l vf/kd, ijUr lhfer (D) vur

Ans. [D]

Sol. Only condition that g(x) should satisfy for $gof(x) = x \ \forall\ x \in [0, 1]$ is that g(x) should attain all values in [0, 1] when range of f(x) a subset of (–1, 1) is used as image for g(x). Thus there can be infinite such functions g(x) with domain [–1, 1] and range [0, 1]

89. The maximum possible area bounded by the parabola $y = x^2 + x + 10$ and a chord of the parabola of length 1 is

(A) $\frac{1}{12}$ (B) $\frac{1}{6}$ (C) $\frac{1}{3}$ (D) $\frac{1}{2}$

ijoy; $y = x^2 + x + 10$ rFkk mld 1 yEckbZ dh thok l ifjo/k {k=k dk vf/kdre {k=kQy dk eku gkxk

(A) $\frac{1}{12}$ (B) $\frac{1}{6}$ (C) $\frac{1}{3}$ (D) $\frac{1}{2}$

Ans. (B)

90. Suppose z is any root of $11z^8 + 20iz^7 + 10iz - 22 = 0$, where $i = \sqrt{-1}$. Then $S = |z|^2 + |z| + 1$ satisfies

(A) $S \le 3$ (B) $3 < S < 7$ (C) $7 \le S < 13$ (D) $S \ge 13$

lehdj.k $11z^8 + 20iz^7 + 10iz - 22 = 0$, tgk $i = \sqrt{-1}$. g] dk z dkbZ ey gA rc $S = |z|^2 + |z| + 1$ bue l fdl lc/k dk lr"V djrk g\

(A) $S \le 3$ (B) $3 < S < 7$ (C) $7 \le S < 13$ (D) $S \ge 13$

Ans. (B)

PHYSICS

91. In steady state heat conduction , the equations that determine that heart current $\vec{j}(\vec{r})$ [heat flowing Per unit area] and temperature $\boldsymbol{T}(\vec{r})$ in space are exactly the same as those governing the electric $\vec{E}(\vec{r})$ and electrostatic potential $V(\vec{r})$ with the equivaleance give in the table below:

Heat flow	Electrostatics
$\boldsymbol{T}(\vec{r})$	$V(\vec{r})$
$\vec{j}(\vec{r})$	$\vec{E}(\vec{r})$

We exploit this equivalence to predict the rate $\dot{Q}$ of total heat flowing by conduction from the Surfaces of spheres of varying radii , all maintained at same temperature . If $Q \propto R^n$, where R is the radius , then the value of n is

Å"ek lpkyu dh LFkk;h voLFkk (steady state) e Å"ek /kkjk $\vec{j}(\vec{r})$ ifr {k=kQy l ifr ldM iokfgr gku okyh Å"ekh rFkk rkieku $\boldsymbol{T}(\vec{r})$ dk fdlh LFkku ij fu/kkfjr dju okyk lehdj.k] fo|r {k=k $\vec{E}(\vec{r})$ rFkk fLFkj o|r foHko $V(\vec{r})$ dk fu/kkfjr dju oky lehdj.k d tlk gh fn[krk gA bu pjk dh vkil e rY;rk uhp lkj.kh e n'kkbZ xbZ gA

Å"ek lpj.k	fLFkj o|r
$\boldsymbol{T}(\vec{r})$	$V(\vec{r})$
$\vec{j}(\vec{r})$	$\vec{E}(\vec{r})$

bl rY;rk dh lgk;rk l leku rki ij j[k x, fdUr fHkUu fHkUu f=kT;kvk d xkyk dh lrg l iokfgr gku okyh dy Å"ek dh nj $\dot{Q}$ dk vuekU yxk;k tkrk gA ;fn $Q \propto R^n$, tgk R f=kT;k g] rk n dk eku gkxk

(A)1 (B)2 (C) -1 (D) -2

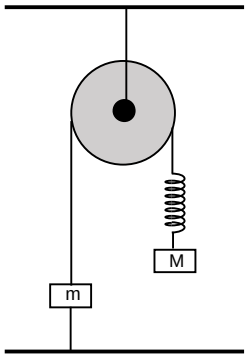
Ans. (B)

Sol. $Q = -K\ 4\pi R^2 \frac{dT}{dR}$

$Q \propto R^2$

92. An arrangement of spring , strings, pulley and masses is shown in the figure . the pulley and the String are massless and M > m . the spring is light with spring constant k. If the string Connecting m to the ground detached , then immediately after detachment

fLix] jLlh rFkk f?kjh dk ,d 0;oLFkk fp=k e n'kk;k x;k gA f?kjh rFkk jLlh nkuk Hkkjfoghu g vkj M > m fLix gYdh g ftldk fLix fLFkjkd k gA ;fn m rFkk /kjkry dk tkMu okyh jLlh dk vyx dj fn;k tk, rk rjr vyx gkr gh



(A) the magnitude of the acceleration of is zero and of M is .

(B) the magnitude of the acceleration of m is (M-m)g/m and that of M is zero

(C) the accelerations of both masses are same.

(D) the elongation in the spring is (M-m) g /k .

(A) m dk Roj.k dk ifjek.k 'kU; rFkk M dk g gA

(B) m dk Roj.k dk fjek.k (M-m)g/m rFkk M dk 'kU; gA

(C) nkuk n0;ekuk dk Roj.k leku gA

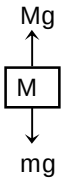
(D) fLix dk foLrkj.k (M-m) g /k gA

Ans. **(B)**

Sol. F = Mg = T

When spring is cut a_M =0

For M



$$\Uparrow a_m = \left(\frac{M-m}{m}\right)g$$

93. The potential due to an electrostatic charge distribution is

$$V(r) = \frac{qe^{-\alpha r}}{4\pi\varepsilon_0 r}$$

Where α is positive. Net charge within a sphere centered at the origin and of radius $1/\alpha$ is

fdlh fLFkjo|r vko'k forj.k dk foHko fuEu lehdj.k d }kjk fn;k x;k g

$$V(r) = \frac{qe^{-\alpha r}}{4\pi\varepsilon_0 r}$$

tgk α /kukRed gA ,d 1/α f=kT;k d xkyh] ftldk dUn ey fcUn (origin) ij g] d vnj dy vko'k gkxk

(A) 2q/*e* (B) (1-1/e) *q* (C) q/e (D) (1+1/e) q

Ans. **(C)**

Sol. $E = -\frac{dv}{dr}$

$\phi = 4\pi r^2 E = \frac{q_{enc.}}{\varepsilon_0}$

$q_{enclosed}$ = q/e

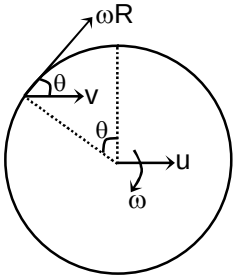
94. A wheel of radius R is trapped in a mud pit and spinning. As the wheel is spinning , it splashes mud blobs with initial speed u from various points on its circumference . the maximum height from the center of the wheel , to which mud blob can reach is

R f=kT;k dk ,d ifg;k dhpM e Ql x;k g vkj ,d gh LFkku ij ?ke jgk gA tc ifg;k ?ke jgk g] vkjfHkd pky u l dhpM d NhV dh ifjf/k d lHkh Hkkxk l fNVd jg gA ifg; d dUn l lokf/kd Åpkb tgk rd dhpM dk dkb NhVk igp ldrk g] og g

(A) $u^2/2g$ (B) $\frac{u^2}{2g}+\frac{gR^2}{2u^2}$ (C) $\frac{u^2}{2g}$ (D) $R+\frac{u^2}{2g}$

Ans. **(B)**

Sol.

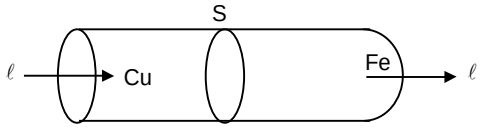


$$h_{max}=\frac{u^2\sin^2\theta}{2g}+R\cos\theta$$

$$\text{for } h_{max} \Rightarrow \frac{dh_{max}}{d\theta}=0$$

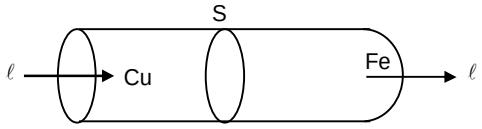
Solving we get $h_{max}=\frac{u^2}{2g}+\frac{gR^2}{2u^2}$

95. Two rods of copper and iron with the same cross sectional area are joined at S and a steady current I flows through the rods as shown in the figure.



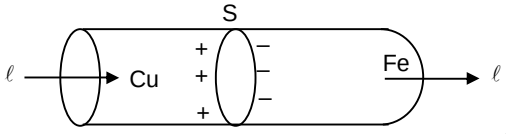
Choose the most appropriate representation of charges accumulated near the junction S .

rkc vkj ykg dh nk NM (rods) ftud vuiLFk dkV {k=kQy leku g] dk S ij tkMk x;k gA ,d fLFkj /kkjk i nkuk NMk e fp=kkulkj cgrh gA

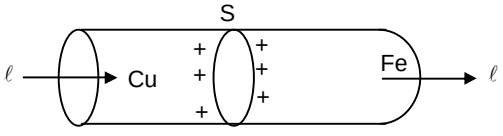


og fp=k pfu; tk fd lf/k LFkku S ij lfpr gku oky vko'kk dk lokf/kd lgh rjhd l fu:fir djrk gA

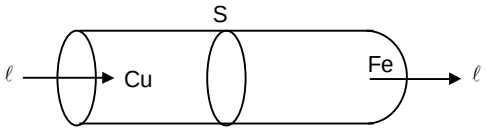
(A)



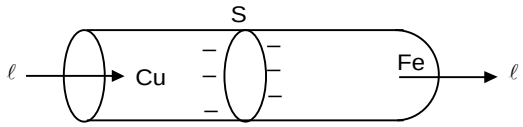
(B)



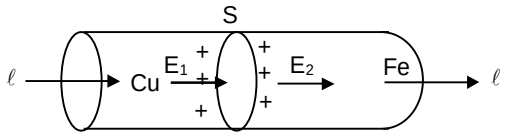
(C)



(D)



Ans. **(B)**



Sol.

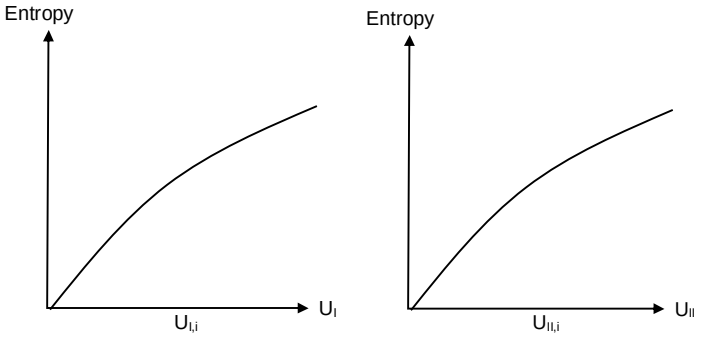
$\phi = (E_2 - E_1)A$, since $\sigma_1 E_2 = \sigma_1 E_1$ & $\sigma_2 < \sigma_1 \Rightarrow E_2 > E_1$

so ϕ = +ve. $Q_{enclosed}$ = positive

96. Graphs below show the entropy vs energy (*U*) of two systems I and II at constant volume. The initial energies of the systems are indicated by UI,i and UII,i respectively. Graphs are drawn to the same scale. The same scale . the systems are then brought into thermal contact with each other . Assume that at all Time the combined energy of the two systems remains constant. Choose the most appropriate option indicating the energies of the two systems and the total entropy after they achieve the equilibrium.

fu;r vk;ru d nk fudk;k I rFkk II dh ,UVkih rFkk Åtk (U) d e/; ifjoru uhp vkyf[kr e n'kk;k x;k g ¼nkuk vkj[kr dk iekuk leku g½A nkuk fudk;k dh vkjfHkd Åtk dk Øe'k% UI,i rFkk UII,i d }jk funf'kr fd;k x;k gA xkQ ,d gh iekuk (scale) ij gA

fudk;k dk ,d nlj d lkFk rkih; lid e yk;k tkrk gA eku yhft ; fd nkuk fudk;k dh lfEefyr Åtk lHkh le;k ij vifjofrr jgrh gA lkE;koLFkk ij nkuk fudk;k dh Åtk vkj dy ,UVkih d ckj e lokf/kd lgh fodYi pfu;A



(A) UI increases and UII decreases and the total entropy remains the same
(B) UI decreases and UII increases and thes total entropy remains the same.
(C) UI increases and UII decreases and the total entropy increases.
(D) *UI* decreases and UII increases and the total entropy increases.

(A) UI c<rh g rFkk UII ?kVrh gj vkj dy ,UVkih vifjofrr jgrh gA
(B) UI ?kVrh g rFkk UII c<rh g vkj dy ,UVkih vifjofrr jgrh gA
(C) UI c<rh g rFkk UII ?kVrh g vkj dy ,UVkih c<rh gA
(D) UI ?kVrh g rFkk UII c<rh g vkj dy ,UVkih c<rh gA

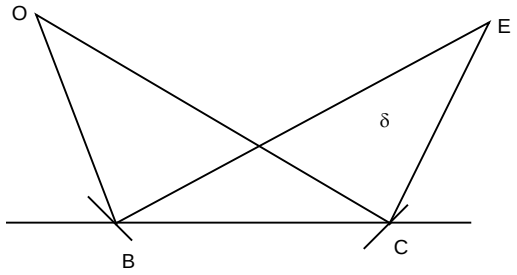
Ans. **(C)**

Sol. UI increases and UII decreases and the total entropy increases.

UI c<rh g rFkk UII ?kVrh g vkj dy ,UVkih c<rh gA

97. The image of an object O due to reflection from the surface of a lake is elongated due to the ripples on the water surface caused by a light breeze. This is because the ripples act as tilted mirrors as shown. Consider the case where O and the observer E are at the same height above the surface of the lake. If the maximum angle that the ripples make with the horizontal is a, the angular extent δ of the image will be

,d oLrq O dk ifrfcac >hy dh lrg ls ,d gYdh lh gok ds }kjk ikuh dh fgyus dh dkj.k dN vkfjr fn[kkbZ nsrk gSA bl dkj.k ;g gks ldrk gS fd ygjsa fp=kkuqlkj >qdh gqbZ gksa ds }kjk ikuh dh lrg ij ,d gh ÅapkbZ ij gSA ;fn ygjksa dk {kSfrt ls cuk;k x;k lokf/kd dks.k α g rks ifrfcac dk dks.kh; foLrkj δ dk eku gksxk



(A) $\frac{\alpha}{2}$ (B) α (C) 2α (D) 4α

Ans. (C)

98. A spiral galaxy can be approximated as an infinitesimally thin disk of a uniform surface mass density (mass per unit area) located at z = 0. Two stars A and B start from rest from heights $2z_0$ and z_0 (z_0 << radial extent of the disk), respectively, and fall towards the disk, cross over to the other side, and execute periodic oscillations. The ratio of time periods of A and B is

,d dqMfyr vkdk'kxaxk (spiral galaxy) dks ,d vR;Yi (infinitesimally) iryh pdrh d rjg ekuk tk ldrk gSA ,d ,sls vkdk'kxaxk ds z = 0 ij fLFkr g ft lds ,dleku i"B ?kuRo ¼ifr bdkbZ {ks=kQy esa ?kuRo½ gSA nks rkjs A vkSj B Øe'k% $2z_0$ rFkk z_0 ÅapkbZ (;gk z_0 << pdrh dk f=kt ;h; foLrkj) ls LFkk;h voLFkk ls pdrh dh rjQ fxjrs g, nsf[kr vkSj fudy tkrs gSa vkSj vkorhZ nksyu djrs gSA A vkSj B ds vkorZ dky dk vuqikr gksxk

(A) $2^{-1/2}$ (B) 2 (C) 1 (D) $2^{1/2}$

Ans. (D)

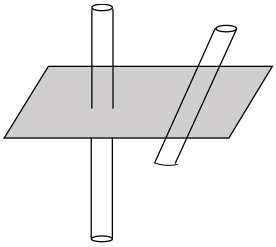
Sol. $F = mE_g = ma \Rightarrow a = E_g$ = content

$d = \frac{1}{2}at^2 \Rightarrow t \propto dt^{1/2}$

$\frac{T_A}{T_B} = \sqrt{2}$

99. Two mutually perpendicular infinitely long straight conductors carrying uniformly distributed charges of linear densities λ_1 and λ_2 are positioned at a distance r from each other

vuar yckbZ ds nks ijLij yEcor fLFkr pkydksa ij ,dleku jf[kd vko'k ?kuRo Øe'k% λ_1 rFkk λ_2 forfjr fd;s x;s gSA bu pkydksa ds ,d nwljs ls nwjh ij j[kk x;k gSA

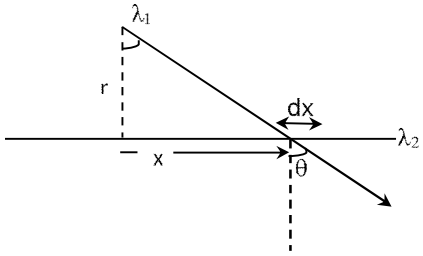


Froce between the conductors depends on r as

nksuksa pkydksa ds e/; yxus okys cy dh fuHkjrk r ij gksxh

(A) 1/r (B) $1/r^2$ (C) r (D) r^0

Ans. (D)



Sol.

$\frac{x}{r} = \tan\theta \Rightarrow dx = r\sec^2\theta d\theta$

$$dF = \frac{2K\lambda_1}{r\sec\theta}\lambda_2 dx$$

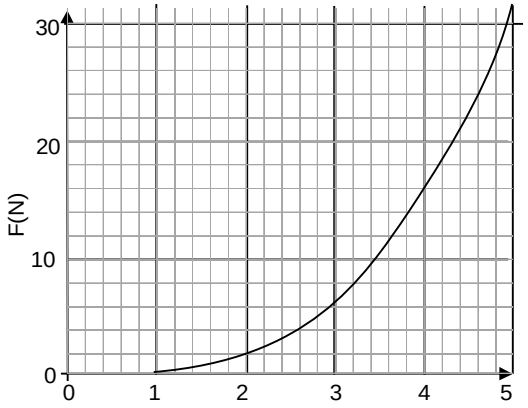
$$dF = \frac{2K\lambda_1\lambda_2}{r\sec\theta} r\sec^2\theta d\theta$$

$$= 2K\lambda_1\lambda_2 \sec\theta d\theta$$

$$F_{net} = 2\int_0^{\pi/2} dF\cos\theta$$

$= 2K\lambda_1\lambda_2$ Ans.

100. The graph below shows the variation of a force (F) with time (t) on a body which is moving in a straight line. Dependence of force on time is $F \propto t^n$. Initially body is at rest.
uhp fn;k x;k vky[k ,d lh/kh fn'kk e xfr djrh gb oLr ij yx g, cy (F) dk le; (t) d lkFk ifjoru fn[kkrk gA cy dh le; ij fuHkjrk $F \propto t^n$ gA oLr fLFkj voLFkk l ikjEHk djrh gA



If the speed of the object is 2 m/s at 3 s, the speed at 4 s will be approximately (in m/s)
;fn oLr dh xfr 3 s ij 2 m/s g rk 4 s ij xfr (m/s e) yxHkx gksxh
(A) 2.5 (B) 6.5 (C) 7.8 (D) 3.1

Ans. (B)

Sol. Let $f = Kt^n$

At $t = 2$ $F = 2 = K2^n$

$t = 4$ $F = 16 = K^4$

$$\Rightarrow \frac{16}{2} = \left(\frac{4}{2}\right)^n = 2^n \Rightarrow n = 3$$

$$F = K2^3 = 2 \Rightarrow K = \frac{1}{4}$$

$$F = \frac{t^3}{4}$$

$dp = \int_0^t Fdt = \frac{t^4}{16} = m(V_f - V_t)$

$t = 3$ sec $\quad \frac{81}{16} = 2$ m

$t = 4 \quad \frac{256}{16} = mV_f$

$\frac{V_t}{2} = \frac{256}{81} \Rightarrow V_f = 6.32$

CHEMISTRY

101. For the electrochemical cell shown below

$Pt|H_2(P=1\ atm)|H^+(aq., x\ M)||\ Cu^{2+}\ (aq., 1.0M)|\ Cu(s)$

the potential is 0.49 V at 298 K. The pH of the solution is closest to

[Given: Standard reduction potential E^o for Cu^{2+}/Cu is 0.34 V

Gas constant, R is 8.31 J K–1 mol^{-1}

Faraday constant, F is 9.65 × 104 $JV^{-1}\ mol^{-1}$]

(A) 1.2 (B) 8.3 (C) 2.5 (D) 3.2

uhp fn;k x, fo|r&jlk;fud ly

$Pt|H_2(P=1\ atm)|H^+(aq., x\ M)||\ Cu^{2+}\ (aq., 1.0M)|\ Cu(s)$

dk foHko 298K ij 0.49 V gA foy;u d pH dk eku yxHkx gkxkA

[fn;k x;k g Cu2+/C dk ekud vip;u foHko Eº = 0.34V

xl fLFkjkd] R = 8.31 J K–1 mol^{-1}

QjkM fLFkjkd, F = 9.65 × 104 $JV^{-1}\ mol^{-1}$]

(A) 1.2 (B) 8.3 (C) 2.5 (D) 3.2

Ans. (C)

Sol. $E = E^o = \frac{0.0591}{n}\log\frac{[Oxidation]}{[Reaction]}$

$0.49 = 0.37 - \frac{0.0591}{n}\log\frac{[H^+]^2}{P_{H_2}\times 1}$

$0.15 = \frac{0.055}{2}\times 2 - \frac{\log[H^+]}{pH}$

$0.15 = 0.055 \times pH$

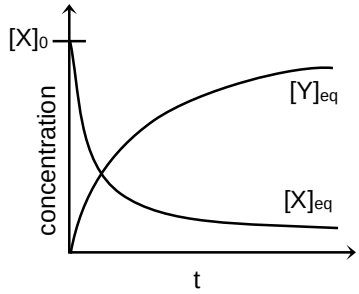
$pH = 2.5$

102. Consider the following reversible first-order reaction of X at an initial concentration $[X]_0$. The values of the rate constants are $k_f = 2\ s^{-1}$ and $k_b = 1\ s^{-1}$

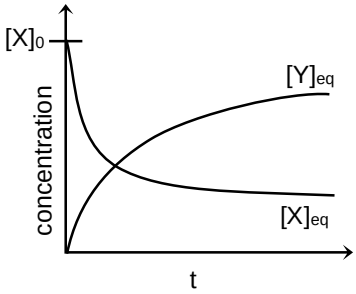
$$X \underset{k_b}{\overset{k_f}{\rightleftharpoons}} Y$$

A plot of concentration of X and Y as function of time is

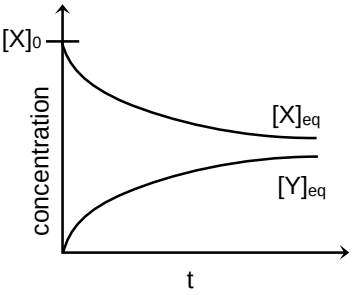
(A)



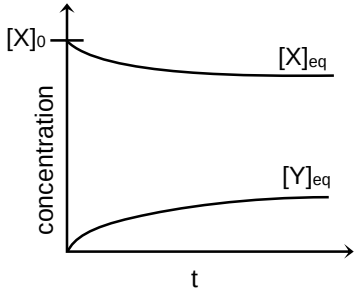
(B)



(C)



(D)



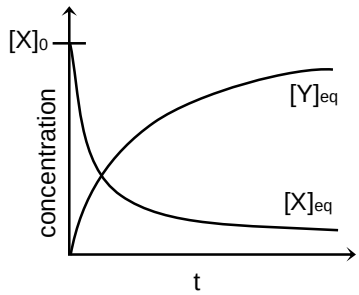
X dh fuEufyf[kr iFke dkfV dh mRØe.kh; vfHkfØ;k ft le X dh ikjfEHkd lkUnzrk $[X]_0$ g] ij fopkj djA

$$X \underset{k_b}{\overset{k_f}{\rightleftharpoons}} Y$$

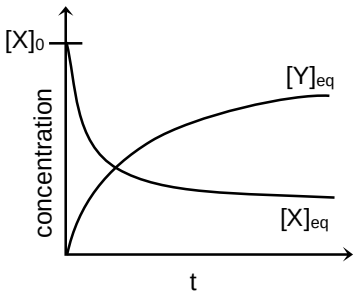
nj fu;rkd d eku $k_f = 2\ s^{-1}$ vkj $k_b = 1\ s^{-1}$ gA

X rFkk Y dh lkUnzrk dk le; d lkFk ifjoru dk vkj[k g (;gk x v{k ij le; rFkk y v{k ij lkUnzrk n'kk;h xb gA)

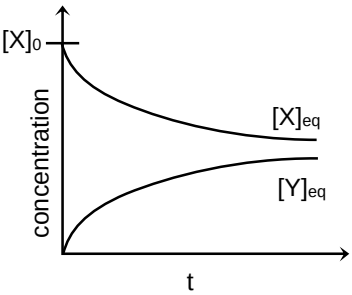
(A)



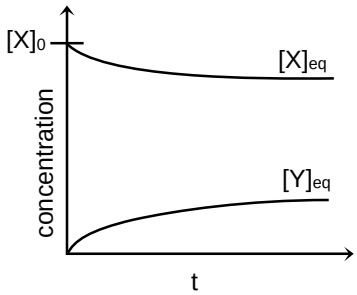
(B)



(C)

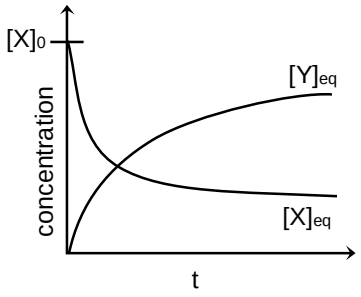


(D)



Ans. (B)

Sol. $X \underset{k_b}{\overset{k_f}{\rightleftharpoons}} Y$, $K_{eq} = \frac{k_r}{k_b} = 2$



at equation concentration of [Y] > [X] $\Rightarrow$ [Y] = 2[X]

103. Nitroglycerine (MW = 227.1) detonates according to the following equation :
$2C_3H_5(NO_3)_3(l) \rightarrow 3\ N_2(g) + \frac{1}{2}O_2(g) + 6\ CO_2(g) + 5\ H_2O(g)$
The standard molar enthalpies of formation, ΔH_f° for the compounds are given bellow :

$\Delta H_f^\circ\ [C_3H_5(NO_3)_3] = -364$ kJ/mol

$\Delta H_f^\circ\ [CO_2(g)] = -393.5$ kJ/mol

$\Delta H_f^\circ\ [H_2O(g)] = -241.8$ kJ/mol

$\Delta H_f^\circ\ [N_2(g)] = 0$ kJ/mol

$\Delta H_f^\circ\ [O_2(g)] = 0$ kJ/mol

The enthalpy change when 10g of nitroglycerine is detonated is
(A) – 100.5 kJ (B) –62.5 kJ (C) – 80.3 kJ (D) –74.9 kJ

ukbVkfXyjhu (MW = 227.1) fuEu vfHkfØ;k d vuqkj foLQkfVr gkrk gA
$2C_3H_5(NO_3)_3(l) \rightarrow 3\ N_2(g) + \frac{1}{2}O_2(g) + 6\ CO_2(g) + 5\ H_2O(g)$
lHkh ;kfxdk d fuekZ.k dh ekud ekyj ,UFkYih, ΔH_f° fuEu idkj g %

$\Delta H_f^\circ\ [C_3H_5(NO_3)_3] = -364$ kJ/mol

$\Delta H_f^\circ\ [CO_2(g)] = -393.5$ kJ/mol

$\Delta H_f^\circ\ [H_2O(g)] = -241.8$ kJ/mol

$\Delta H_f^\circ\ [N_2(g)] = 0$ kJ/mol

$\Delta H_f^\circ\ [O_2(g)] = 0$ kJ/mol

tc 10g ukbVkfXyjhu foLQkfVr gkrk g rk ,UFkkYih e ifjoru fuEu gkxkA
(A) – 100.5 kJ (B) –62.5 kJ (C) – 80.3 kJ (D) –74.9 kJ

Ans. (B)

Sol.

$$2C_3H_5(NO_3)_3(l) \rightarrow \underset{\downarrow \Delta H_F^\circ = 0}{3\ N_2(g)} + \underset{\downarrow \Delta H_F^\circ = 0}{\frac{1}{2}O_2(g)} + \underset{\downarrow \Delta H_F^\circ = -393.5}{6\ CO_2(g)} + \underset{\downarrow \Delta H_F^\circ = -2.418}{5\ H_2O(g)}$$

$$\Delta H^\circ_{reaction} = 3\times 0 + \frac{1}{2}\times 0 + 6\times -393.5 + 5\times -241.8 - 2\times -364$$

= –2842 kJ $\longrightarrow$ for 2 mole of nitroglycerine

for 1 mole or for 227.1g = $-\frac{2842}{2}$

for 1 g = $-\frac{2842}{2\times 227.1}\times 10 = -62.5$ KJ

104. The heating of $(NH_4)2Cr_2O_7$ produces another chromium compound along with N_2 gas. The change of oxidation state of Cr in the reaction is
$(NH_4)2Cr_2O_7$ dk xe dju ij N_2 xl d lkFk ,d vkj Økfe;e ;kfxd dk mRiknu gkrk gA bl fØ;k e Cr dh mip;u voLFkk e ifjoru fuEu gkxkA
(A) +6 to +2 (B) +7 to +4 (C) +8 to +4 (D) +6 to +3

Ans. (D)

Sol. $(NH_4)\underset{\underset{+6}{\downarrow}}{Cr_2}O_4 \longrightarrow N_2 + \underset{\underset{+3}{\downarrow}}{Cr_2}O_3 + 4H_2O$

+6 to +3

105. The complex having the highest spin-only magnetic moment is
fuEu e l dku l ldj dk doy&ipØ.k pEcdh; vk?k.k (spin-only magnetic moment) vf/kdre gkxkA
(A) $[Fe(CN)_6]^{3-}$ (B) $[Fe(H_2O)_6]^{2+}$ (C) $[MnF_6]^{4-}$ (D) $[NiCl_4]^{2-}$

Ans. (C)

Sol.

(A) $[Fe(CN)_6]^{3-}$	d^5	Low spin	n =1	$\mu = \sqrt{2}$
(B) $[Fe(H_2O)_6]^{2+}$	d^6	High spin	n =4	$\mu = \sqrt{4}$
(C) $[MnF_6]^{4-}$	d^5	High spin	n =5	$\mu = \sqrt{35}$
(D) $[NiCl_4]^{2-}$ Tetrahedral	d^8	High spin	n =2	$\mu = \sqrt{6}$

106. Among Ce ($4f^1\ 5d^1\ 6s^2$), Nd ($4f^4\ 6s^2$), Eu ($4f^7\ 6s^2$) and Dy ($4f^{10}\ 6s^2$), the elements having highest and lowest 3rd ionization energies, respectively, are
(A) Nd and Ce (B) Eu and Ce (C) Cu and Dy (D) Dy and Nd
Ce ($4f^1\ 5d^1\ 6s^2$), Nd ($4f^4\ 6s^2$), Eu ($4f^7\ 6s^2$) rFkk Dy ($4f^{10}\ 6s^2$) e l dku l rRok dh rhljh vk;uu Åtk] Øe'k% vf/kdre rFkk U;ure gkxh \
(A) Nd vkj Ce (B) Eu vkj Ce (C) Cu vkj Dy (D) Dy vkj Nd

Ans. (B)

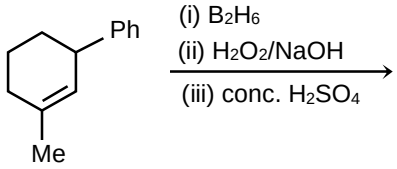
Sol. Highest 3rd I.E. = E4 ($4f^7 6s^2$)

3rd I.E. $Eu^{2+} \longrightarrow Eu^{3+} + e^{\Theta}$ removal of E^{Θ} from half filled E^{Θ} configuration

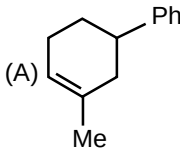
Lowest 3rd I.E. = Ce ($4f^1\ 5d^1\ 6s^2$)

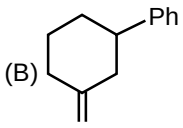
3rd E^{Θ} removal from 5d

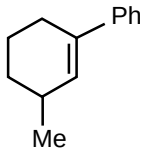
107. The major product of the following reaction sequence
fuEu vfHkfØ;k vuØe dk ie[k mRikn gkxkA

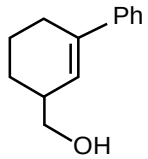


is

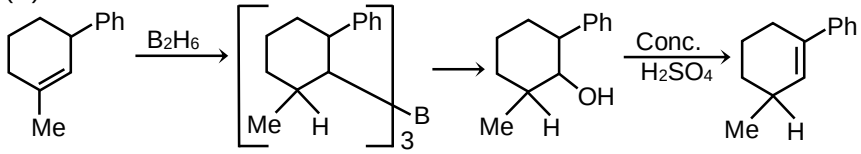
(A) 

(B) 

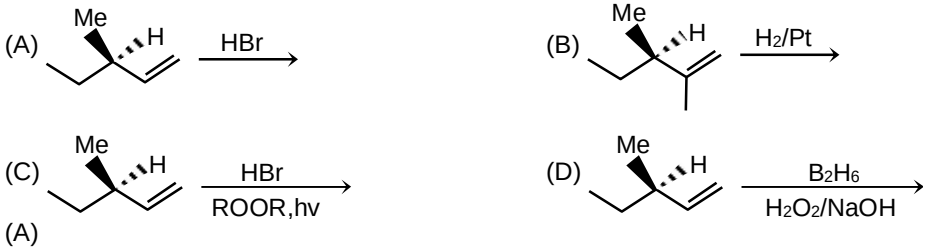
(C) 

(D) 

Ans. (C)

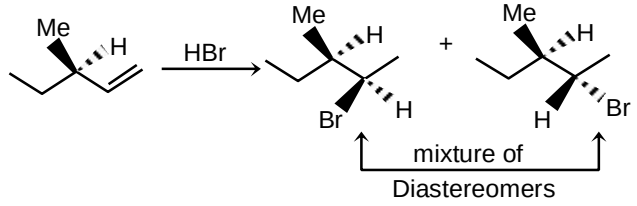
Sol. 

108. Among the following reactions, a mixture of diastereomers is produced form
fuEu e l fdl vfHkfØ;k }kjk vifrfcfcd leko;o (diastereomers) d ,d feJ.k dk fuek.k gkxk

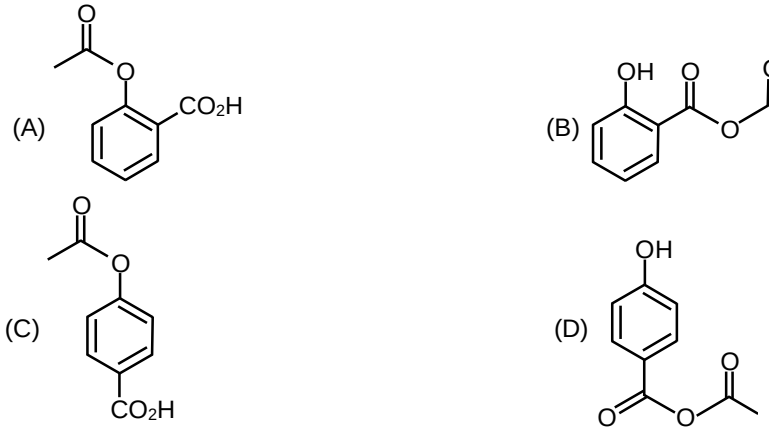


Ans. (A)

Sol.

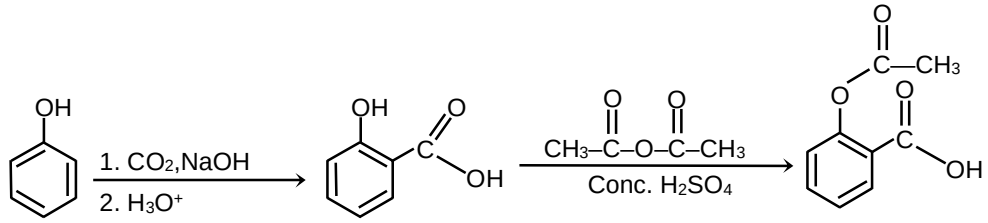


109. Reaction of phenol with NaOH followed by heating with CO_2 under high pressure, and subsequent acidification gives compounds X as the major product, which can be purified by steam distillation. When reacted with acetic anhydride in the presence of a trace amount of conc. H_2SO_4 compound X produces Y as the major product.
Compound Y is
fQuky dh NaOH d lkFk vfHkfØ;k djku d i'pkr CO_2 d lkFk mPp nkc ij xe fd;k tkrk gA rRi'pkr vEyhdj.k dju ij ,d e[; ;kfxd X curk g tk fd Hkki vklou }kjk 'kq)f/kr fd;k tk ldrk gA ;kfxd X dk lkn H_2SO_4 dh l{e ek=kk e ,lfVd ,ugkbMkbM d lkFk fØ;k djku ij ,d e[; ;kfxd Y mRikfnr gkrk gA ;kfxd Y gkxkA



Ans. (A)

Sol.



110. Tetrapeptide is made of naturally occurring alanine, serine, glycine and valine. If the C-terminal amino acid is alanine and the N-terminal amino acid is chiral, the number of possible sequences of the tetrapeptide is
,d VVkiIVkbM ikÑfrd ,ykuhu] ljhu] Xykblhu rFkk oyhu l cuk gA vxj C-Vfeuy vehuk vEy ,ykuhu g rFkk N- Vfeuy vehuk vEy dkbjy gk rk VVkiIVkbM d lHkkfor vuØek dh l[;k gkxh %

(A) 12 (B) 8 (C) 6 (D) 4

Ans. (D)

Sol. Note glycine ia achiral , therefore possible combinations are :

(A) Valine serine glycine alanine (B) Serine valine glycine alanine

(C) Valine glycine serine alanine (D) Serine glycine valine alanine

BIOLOGY

111. What is the probability that a human individual would receive the entire haploid set of chromosomes from his her grandfather?

fdlh ekuo d viu nknk@ukuk l lEi.k vxf.kr x.kl=k lV ikIr dju dh ikf;drk fdruh g\

(A) 1/2 (B) $(1/2)^{23}$ (C) $(1/2)^{2}$ (D) $(1/2)^{46}$

Ans. (B)

112. Which ONE of the following primer pairs would amplify the fragment of DNA given below?

fuEufyf[kr e l dkulk miØked ¼ikbej½ ;Xe uhp fn;s x;s DNA d VdM dk o/ku djxk\

5'-CTAGTCGTCGAT-$(N)_{300}$-GACTGAGCTGAGCTG-3'

3'-GATCAGCAGCTA-$(N)_{300}$-CTGACTCGACTCGAC-5'

(A) 5'-CTAGTCGTCGAT-3' and vkj 5'-GACTGAGCTGAGCTG-3'

(B) 5'-CTGACTCGACTCGAC-3' and vkj 5'-CTAGTCGTCGAT-3'

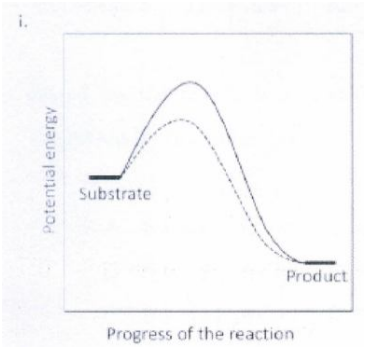
(C) 5'-CTAGTCGTCGAT-3' and vkj 5'-CAGCTCAGCTCAGTC-3'

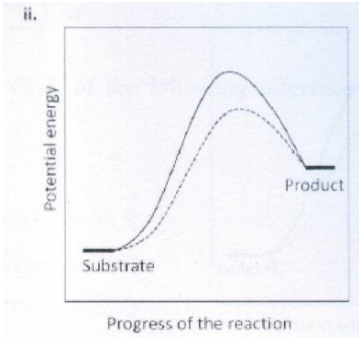
(D) 5'-CTAGTCGTCGAT-3' and vkj 5'-GTCGAGTCGAGTCAG-3'

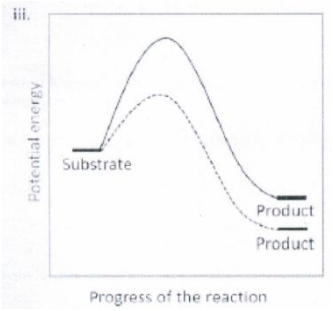
Ans. (C)

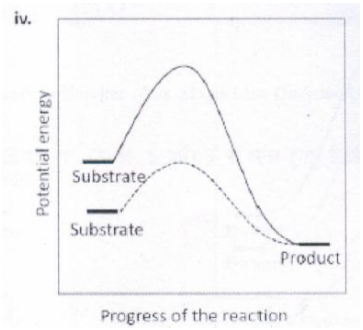
113. The following graphs with the solid and dotted lines correspond to the reactions without and with enzyme, respectively. Which of the following graph(s) correctly represent the concept of activation energy?

uhp fn; x; j[kkfp=kk e Bkl vkj fo[kf.Mr j[kkvk l Øe'kk ,tkbe d vHkko vkj mifLFkfr e gku okyh vfHkfØ;kvk dk fn[kk;k x;k g ¼tgk x-v{k ij vfHkfØ;k dh ixfr vkj y-v{k ij fLFkfrt Åtk g½A fuEufyf[kr e l dku lk@dku l j[kkfp=k fØ;kRed Åtk dk lcl lVhd rjhd l n'kkr g\









(A) (i) only (B) (iii) and (iv) (C) (ii) only (D) (i) and (ii)

(A) doy (i) (B) (iii) vkj (iv) (C) doy (ii) (D) (i) vkj (ii)

Ans. (D)

114. A novel **s**pecies witl double stranded genetic material consists of 5 bases namely P, Q, R, S, & T with percentages given below

	P	Q	R	S	T
Percentage	**22**	**28**	**22**	**12**	**16**

Based on the above information which, ONE of the following inferences is NOT supported by the observations?

(A) S base pairs with T, and Q base Pairs with R

(B) S base pairs with Q, and T base pairs with Q

(C) P base pairs with R, and S base pairs with Q

(D) P base pairs with R, and T base pairs with Q

,d vuk[kh itkfr dk f}&d.Mfyr thuh inkFk ikp fof'k"V {kkj P, Q, R, S, vkj T l cuk gvk g vkj thuh inkFk e mudh ifr'krrk uhp nh x;h gA

	P	Q	R	S	T
ifr'kr	22	28	22	12	16

Äij nh xb tkudkjh d vk/kkj ij fuEufyf[kr e l dku lk fu"d"k xyr g\

(A) {kkj S, T d lkFk vkj {kkj Q, R d lkFk ;Xe cukrk gA

(B) {kkj S, Q d lkFk vkj {kkj T, Q d lkFk ;Xe cukrk gA

(C) {kkj P, R d lkFk vkj {kkj S, Q d lkFk ;Xe cukrk gA

(D) {kkj P, R d lkFk vkj {kkj T, Q d lkFk ;Xe cukrk gA

Ans. (A)

115. How many different blood groups are possible in a diploid species with ABCO blood grouping system involving I^A, I^B, I^C and I^O alleles (I^O is recessive and others are co-dominant)

,d f}&xf.kr ABCO jDr leg i.kkyh okyh itkfr] ftle I^A, I^B, I^C vkj I^O vyhYl g (tgk I^O viHkkoh vkj vU; lHkh iHkkoh g½] e fdru fofHkUu idkj d jDr leg gku dh lHkkouk g\

(A) 4 (B) 6 (C) 7 (D) 8

Ans. (C)

116. Within the exponential phase of growth, if the initial surface area and the growth rate of a leaf are 10 mm^2 and 0.015 mm^2/hour respectively, the area of the leaf after 4 days would range from :

(A) 10 to 12 mm^2 (B) 20 to 24 mm^2 (C) 30 to 36 mm^2 (D) 40 to 48 mm^2

?kkrkdh of) d nkjku fdlh iÙkh ftldk vkjfHkd {k=kQy vkj of) nj Øe'k% 10 mm^2 vkj 0.015 mm^2/h g] rk pkj fnuk ckn iÙkh d {k=kQy dk eku fdruk gkxk\

(A) 10 l 12 mm^2 (B) 20 l 24 mm^2 (C) 30 l 36 mm^2 (D) 40 l 48 mm^2

Ans. (D)

117. If the acidic, basic and hydrophobic residues of proteins are considered to be red, green and blue in color respectively then a globular protein in aqueous solution would have

(A) Red and blue on the surface and green at the core

(B) Red and green on the surface and blue at the core

(C) Blue on the surface and red and green at the core

(D) Blue and green on the surface and red at the core

;fn fdlh ikVhu d vEyh;] {kkjh; vkj tyjk/kh vehuk vEyk dk Øe'k yky] Hkj vkj uhy jxk l n'kkrk tkrk g] rk ty; foy;u e ,d xkykdkj ikVhu dlk fn[kkb nxk\

(A) yky vkj uhy jx ikVhu dh lrg ij vkj gjk jx dUn e gkxkA

(B) yky vkj gjk jx ikVhu dh lrg ij vkj uhyk jx dUn e gkxkA

(C) uhyk jx ikVhu dh lrg ij vkj yky vkj gjk jx dUn e gkxkA

(D) uhyk vkj gjk jx ikVhu dh lrg ij vkj yky jx dUn e gkxkA

Ans. (B)

118. A lysosome vesicle of 1 μm diameter has an internal pH of 5.0. The total number of H^+ ions inside this vesicle would range from

(A) 10^3 to 10^4 (B) 10^4 to 10^5 (C) 10^5 to 10^{10} (D) 10^{10} to 6.023×10^{23}

1 μm 0;kl oky ,d y;udk; dk'k (ykblkle ofldy) dk vkrfjd pH 5.0 gA bl dk'k d vnj H^+ vk;uk dh dy l[;k dk eku fdruk gkxk\

(A) 10^3 l 10^4 (B) 10^4 l 10^5 (C) 10^5 l 10^{10} (D) 10^{10} l 6.023×10^{23}

Ans. (A)

119. Match the vitamins listed in **Column-I** with their respective coenzyme form in **Column-II**. Choose the correct combination.

Column-I	**Column-II**
P. Vitamin B_1	i. Thiamine pyrophosphate
Q. Vitamin B_2	ii. Flavine adenine dinucleotide
R. Vitamin B_6	iii. Methylcobalamin
S. Vitamin B_{12}	iv. Coenzyme A
	v. Pyridoxal phosphate

LrEHk-I e mifLFkr foVkfeUl dk **LrEHk-II** e mudh dk ,tkbe :i l feyk;A

LrEHk-I	**LrEHk-II**
P. foVkfeu B_1	i. Thiamine pyrophosphate
Q. foVkfeu B_2	ii. Flavine adenine dinucleotide
R. foVkfeu B_6	iii. Methylcobalamin
S. foVkfeu B_{12}	iv. Coenzyme A
	v. Pyridoxal phosphate

bl vk/kkj ij lgh l;ktu dk puko djA

(A) P-v, Q-iii, R-i, S-iv (B) P-iii, Q-iv, R-ii, S-i

(C) P-i, Q-ii, R-v, S-iii (D) P-i, Q-iv, R-ii, S-iii

Ans. (C)

120. Two independent experiments related to photosynthesis were conducted-one with ^{18}O-labelled water (experiment P) and the other with ^{14}C- labelled CO_2 (experiment Q). Which ONE of the following options lists the first labelled products in experiments P and Q respectively?

(A) P : O_2 Q : 3- phosphoglycerate

(B) P : 3- Phosphoglycerate Q : NADPH

(C) P : O_2 Q : ATP

(D) P : 3- Phosphoglycerate Q : 3- phosphoglycerate

idk'k l'y"k.k d Lor=k i;kx fd, x; ftle igyk i;kx "P" ^{18}O-fpfUgr H_2O dh mifLFkfr e vkj nljk i;kx "Q" ^{14}C fpfUgr CO_2 dh mifLFkfr e fd;k x;kA fuEufyf[kr e l dku lk fodYi Øe'k% i;kx P vkj Q d iFke fpfUgr mRikn dk n'kkrk g\

(A) P : O_2 Q : 3- QkLQkfXyljV

(B) P : 3- QkLQkfXyljV Q : NADPH

(C) P : O_2 Q : ATP

(D) P : 3- QkLQkfXyljV Q : 3- QkLQkfXyljV

Ans. (A)

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