KISHORE VAIGYANIK PROTSAHAN YOJANA (KVPY) 2018

Date : 04-11-2018 **Time: 3 Hours** **Max. Marks : 100**

STREAM - SA

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 **80** questions.

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

MARKING SCHEME :

PART-I :

MATHEMATICS

Question No. **1 to 15** consist of **ONE (1)** mark for each correct response.

PHYSICS

Question No. **16 to 30** consist of **ONE (1)** mark for each correct response.

CHEMISTRY

Question No. **31 to 45** consist of **ONE (1)** mark for each correct response.

BIOLOGY

Question No. **46 to 60** consist of **ONE (1)** mark for each correct response.

PART-II :

MATHEMATICS

Question No. **61 to 65** consist of **TWO (2)** marks for each correct response.

PHYSICS

Question No. **66 to 70** consist of **TWO (2)** marks for each correct response.

CHEMISTRY

Question No. **71 to 75** consist of **TWO (2)** marks for each correct response.

BIOLOGY

Question No. **76 to 80** 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.

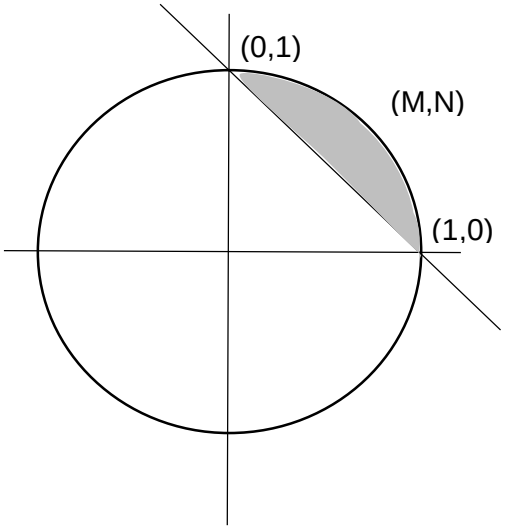
8. Do not fold or make any stray marks on the Answer Sheet.

PART-I
One Mark Questions

MATHEMATICS

1. The number of pairs (a, b) of positive real numbers satisfying $a^4 + b^4 < 1$ and $a^2 + b^2 > 1$ is
/kukRed okLrfod la[;kvksa d ,l ;qXe (a, b) tks $a^4 + b^4 < 1$,oa $a^2 + b^2 > 1$ dks lUrq"V djrk gS] dh la[;k gksxh
(A) 0 (B) 1 (C) 2 (D) more than 2 ¼2 ls vf/kd½

Sol. Let $a^2 = m$ & $b^2 = N$ then $m > 0$ and $N > 0$
Now given condition is $M + N > 1$ and $M^2 + N^2 < 1$



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(M,N) lies inside circle $x^2 + y^2 < 1$ and above line $x + y > 1$
$\Rightarrow$ (M, N) lies in shaded region and number of points in shaded region are infinite, so number of pair (a,b) are also infinite.
Ans. (D)

2. The number of real roots of the polynomial equation $x^4 – x^2 + 2x – 1 = 0$ is
cgin leehdj.k $x^4 – x^2 + 2x – 1 = 0$ ds okLrfod ey dh la[;k gS
(A) 0 (B) 2 (C) 3 (D) 4

Sol. $x^4 – x^2 + 2x – 1 = 0$
$X^2 – (x –1)^2 = 0$
$\Rightarrow (x^2 + x – 1)(x^2 – x + 1) = 0$
$x^2 + x – 1 = 0$ has two real roots.
Ans. (B)

3. Suppose the sum of the first m terms of an arithmetic progression is n and the sum of its first n terms is m, where $m \neq n$. Then the sum of the first (m + n) terms of the arithmetic progression is
Ekku yks fd ,d lekarj J.kh (arithmetic progression) ds igys m inksa dk ;ksx n gS ,oa bl igys n inksa dk ;ksx m gS ;gk $m \neq n$ gS rc bl J.kh ds igys (m + n) inksa dk ;ksx gksxk
(A) 1 – mn (B) mn – 5 (C) – (m + n) (D) m + n

Sol. $S_m = \frac{m}{2}[2a + (m –1)d] = n$ ….(1)

$S_n = \frac{n}{2}[2a + (n – 1)d] = m$ ….(2)

By (1) and (2)

$(m-n)a + (m-n)\{m+n-1\}\frac{d}{2} = -(m-n)$

$\Rightarrow 2a + (m+n-1)d = -2 \ (m \neq n)$

$\Rightarrow S_{m+n} = \frac{m+n}{2}[2a + (m+n-1)d] = -(m+n)$

Ans. (C)

4. Consider the following two statements:
I. Any pair of consistent linear equations in two variables must have a unique solutions.
II. There do not exist two consecutive integers, the sum of whose squares is 365.
Then
(A) Both I and II are true (B) both I and II are false
(B) I is true and II is false (D) I is false and II is true.

bu nk dFkuk ij fopkj djsa
I. nk pjk oky lxr j[kh; leh dj.kk (consistent linear equations) d fdlh Hkh ;Xe dk vf}rh; gy gA
II. ,sl nk Øekxr i.kkdk dk vfLrRo ugh g ftud oxk dk ;kx 365 gA
rc
(A) I ,o II nkuk lR; g (B) I ,o II nkuk vlR; g
(B) I lR; g ,o II vlR; g (D) I vlR; g ,o II lR; g

Sol. Clearly statement 1 is false as they can have infinite solutions statement 2 is also false as
$13^2 + 14^2 = 365$
Ans. (B)

5. The number of polynomials p(x) with integer coefficients such that the curve y = p(x) passes through (2, 2) and (4, 5) is
(A) 0 (B) 1
(C) more than 1 but finite (D) infinite
cgin p(x) d lHkh x.kkd (coefficients) i.kkd gA ;fn oØ j[kk y = p(x) fcUnqvk (2, 2) ,o (4, 5) ls xtjrk g] rc ,sls cgink dh l[;k gksxh
(A) 0 (B) 1
(C) 1 ls vf/kd] ijr lhfer (D) vuar

Sol. $y = P(x) = a_0 + a_1 \times a_2 x^2 + \ldots\ldots + a_n x^n \quad a_0, a_1, a_2, a_3, \ldots\ldots\ldots a_n \in I$
$2 = P(2)$ ....(1)
$5 = P(4)$ ....(2)
By (1) & (2)
$\Rightarrow 3 = a_1(4-2) + a_2(4^2 - 2^2) + a_3(4^3 - 2^3) + \ldots\ldots\ldots + a_n(4^n - 2^n)$
Clearly RHS is even and LHS is odd no polynomial exists.
Ans. (A)

6. The median of all 4-digit numbers that are divisible by 7 is
4-vadk okyh o lHkh l[;k,a tks 7 ls foHkkftr gksa tkrh g d ekf/;dk (median) dk eku g
(A) 5497 (B) 5498.5 (C) 5499.5 (D) 5490

Sol. Four digit numbers which are divisible by 7 are.
1001, 1008, 1015, ……. , 9996
Hence total number of such numbers = 1286

$\Rightarrow \text{Median} = \frac{\left(\frac{N}{2}\right)^{th}\text{value} + \left(\frac{N}{2}+1\right)^{th}\text{value}}{2} = \frac{(643)^{th}\text{value} + (644)^{th}\text{value}}{2}$

$= 1001 + \frac{1285 \times 7}{2}$
$= 1001 + 4497.5$
$= 5498.5$
Ans. (B)

7. A solid hemisphere is attached to the top of a cylinder, having the same radius as that of the cylinder. If the height of the cylinder were doubled (keeping both radii fixed), the volume of the entire system would have increased by 50%. By what percentage would the volume have increased if the radii of the hemisphere and the cylinder were doubled (keeping the height fixed)?

,d BksI v/kxkyq dk ,d cyu d Åij j[kk x;k gA v/kxkyq ,o cyu dh f=kT;k, leku gA ;fn cyu dh Åpkbk nk xuh dj nh tk, vkj mudh f=kT;kvk dk eku ugh cnyk tk,] rc ij fudk; dk vk;ru 50% c< tkrk gA ;fn Åpkbk dk eku vpj j[kr g, v/kxkyq ,o cyu dh f=kT;kvk dk nk xuk dj fn;k tk;] rc fudk; dk vk;ru fuEu ifr'kr l c< tk,xk%

(A) 300% (B) 400% (C) 500% (D) 600%

Sol. Let height of radius of cylinder are h & r respectively.

Then volume $V_1 = \pi r^2 h + \frac{2}{3}\pi r^3$ ....(1)

When height of cylinder is doubled then volume $V_2 = 2\pi r^2 h + \frac{2}{3}\pi r^3$ ...(2)

Given that $\frac{V_2}{V_1} = \frac{3}{2} \Rightarrow \frac{2h+\frac{2}{3}r}{h+\frac{2}{3}r} = \frac{3}{2}$

$\Rightarrow 2h + \frac{2}{3}r = \frac{3}{2}h + r$

$\Rightarrow \frac{h}{2} = \frac{r}{3} \Rightarrow h = \frac{2}{3}r$ ....(3)

When radius is doubled then volume $V_2^1 = 4\pi r^2 h + \frac{16}{3}\pi r^3$

$\frac{V_2^1}{V_1} = \frac{4h+\frac{16}{3}r}{h+\frac{2}{3}r}$

By (3) $\frac{V_2^1}{V_1} = \frac{4h+8h}{h+h} = 6$

Hence volume will be increased by 500%

Ans. (C)

8. Consider a triangle PQR in which the relation $QR^2 + PR^2 = 5PQ^2$ holds. Let G be the point of intersection of medians PM and QN. Then $\angle QGM$ is always

(A) less than 45º (B) obtuse

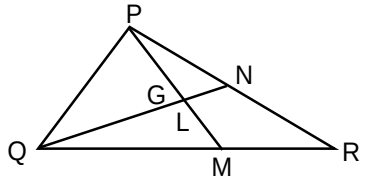
(C) a right angle (D) acute and larger than 45º

,d f=kHkt PQR dh Hkktkvk dh fy, lc/k $QR^2 + PR^2 = 5PQ^2$ ekU; gA ;fn ekf/;dk;sa (medians) PM ,o QN fcUnq G ij foPNfnr (intersect) djrh g] rc $\angle QGM$ ge'kk%

(A) 45º l de gkxk (B) vf/kdk.k (obtuse) gkxk

(C) ledk.k gkxk (D) U;udk.k ,o 45º l vf?kd

Sol.



Let QR= p, PR = q, PQ =r

Given $p^2 + q^2 = 5r^2$

Now $QG^2 + GM^2 = \left(\frac{2QN}{3}\right)^2 + \left(\frac{PM}{2}\right)^2$

$= 4\frac{QN^2}{9} + \frac{PM^2}{9}$

$= \frac{1}{9}\left[4.\frac{1}{4}\left(2r^2 + 2p^2 - q^2\right) + \frac{1}{4}\left(2r^2 + 2q^2 - p^2\right)\right]$

$= \frac{p^2}{4} = QM^2$

Hence Angle QGM is 90º.

Ans. (C)

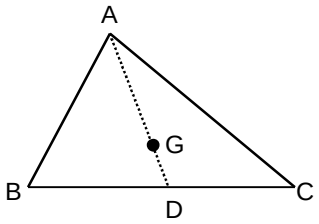
9. Let a, b, c be the side-lengths of a triangle, and ℓ, m, n be the lengths of its medians. Put $K = \frac{\ell + m + n}{a + b + c}$.

Then, as a, b, c vary, K can assume every value in the interval

,d f=kHkt dh Hkqtkvk dh ykckbZ a, b, c g ,oa bldh ef/;dkvk (median) dh ykckbZ ℓ, m, n gA eku yhft, $K = \frac{\ell + m + n}{a + b + c}$A ;fn a, b, c dk cnyk tk,] rc K bl vUrjky esa lHkh eku ysrk gSA

(A) $\left(\frac{1}{4}, \frac{2}{3}\right)$ (B) $\left(\frac{1}{2}, \frac{4}{5}\right)$ (C) $\left(\frac{3}{4}, 1\right)$ (D) $\left(\frac{4}{5}, \frac{5}{4}\right)$

Sol.



As AD is medium $\Rightarrow AD < \frac{AB + AC}{2}$

$\Rightarrow \ell < \frac{b + c}{2}$

Similarly $m < \frac{c + a}{2}$ and $n < \frac{a + b}{2}$

$\Rightarrow \ell + m + n < a + b + c$

$\Rightarrow \ell + m + n < a + b + c$

$\Rightarrow \frac{\ell + m + n}{a + b + c} < 1$ (i)

Also in the Δ BGC

BG + GC > BC

$\Rightarrow \frac{2}{3}(m + n) > a$

Similarly $\frac{2}{3}(n + \ell) > b$

and $\frac{2}{3}(\ell + m) > c$

Hence $\frac{4}{3}(\ell + m + n) > a + b + c$

$$\frac{\ell+m+n}{a+b+c} > \frac{3}{4} \qquad \text{(ii)}$$

By (i) and (ii) $\frac{\ell+m+n}{a+b+c} \in \left(\frac{3}{4},1\right)$

Ans. (C)

10. Let x_0, y_0 be fixed real numbers such that $x_0^2 + y_0^2 > 1$. If x, y are arbitrary real numbers such that $x^2 + y^2 \le 1$, then the minimum value of $(x - x_0)^2 + (y - y_0)^2$ is

ekuk y fd x_0, y_0 vpj (fixed) okLrfod la[;k,a gSa $x_0^2 + y_0^2 > 1$ ekU; gA ;fn x, y dksbZ okLrfod la[;k,a gSa ftudk fy, $x^2 + y^2 \le 1$ ekU; gS] rc $(x - x_0)^2 + (y - y_0)^2$ dk U;wure eku gksxk

(A) $\left(\sqrt{x_0^2 + y_0^2} - 1\right)^2$ (B) $x_0^2 + y_0^2 - 1$ (C) $(|x_0| + |y_0| - 1)^2$ (D) $(|x_0| + |y_0|)^2 - 1$

Sol. $x_0^2 + y_0^2 > 1$ $x_0 - y_0$ fixed

x, y arbitrary

$x^2 + y^2 \le 1$, Let $x = \cos\theta$

$y = \sin\theta$

for men

$z = (x - x_0)^2 + (y - y_0)^2$

$z = x^2 + x_0^2 + y^2 + y_0^2 - 2(x x_0 + y y_0)$

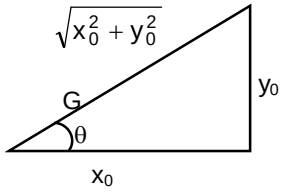
put $x - \cos\theta$, $y = \sin\theta$

$z = x_0^2 + y_0^2 - 2(x_0 \cos\theta + y_0 \sin\theta)$

$\frac{dz}{d\theta} \Rightarrow 0 - 2(-x_0 \sin\theta + y_0 \cos\theta)$

$\frac{dz}{d\theta} = 0$

$-x_0 \sin\theta = -y_0 \cos\theta$



$\tan\theta = \frac{y_0}{x_0}$

$\sin\theta = \frac{y_0}{\sqrt{x_0^2 + y_0^2}}$

$\cos\theta = \frac{x_0}{\sqrt{x_0^2 + y_0^2}}$

$x = \frac{x_0}{\sqrt{x_0^2 + y_0^2}}$, $y = \frac{y_0}{\sqrt{x_0^2 + y_0^2}}$

$$z = \left(\frac{x_0}{\sqrt{x_0^2 + y_0^2}} - x_0\right)^2 + \left(\frac{y_0}{\sqrt{x_0^2 + y_0^2}} - y_0\right)^2$$

$$x_0 2\left(\frac{1}{\sqrt{x_0^2 + y_0^2}} - 1\right)^2 + y_0 2\left(\frac{1}{\sqrt{x_0^2 + y_0^2}} - 1\right)^2$$

$$\left(x_0^2+y_0^2\right)\frac{\left(1-\sqrt{x_0^2+y_0^2}\right)}{\left(\sqrt{x_0^2+y_0^2}\right)^2}$$

$$\left(1-\sqrt{x_0^2+y_0^2}\right)^2 \Rightarrow \left(\sqrt{x_0^2+y_0^2}-1\right)^2$$

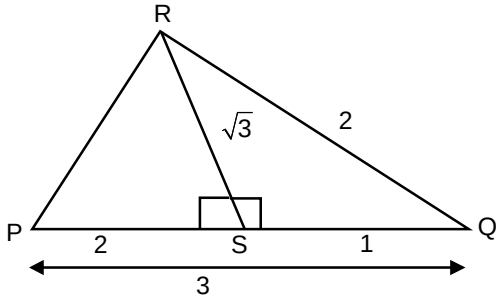
Ans. (A)

11. Let PQR be a triangle which PQ = 3. From the vertex R, draw the altitude RS to meet PQ at S. Assume that RS = $\sqrt{3}$ and PS = QR. Then PR equals

f=kHkt PQR e Hkt k PQ = 3 gA "kh"k R l ,d (altitude) RS [khpk tkrk g] tk Hkt k PQ e S ij feyrk gA eku yh fd RS = $\sqrt{3}$,o PS = QR gA rc PR fuEu d cjkcj gkxkA

(A) $\sqrt{5}$ (B) $\sqrt{6}$ (C) $\sqrt{7}$ (D) $\sqrt{8}$

Sol.



PS = QR

PS + SQ = 3

in ΔRSQ SQ = 3 – PS = 3 – QR

$QR^2 = RS^2 + SQ^2$

$QR^2 = 3 + (3 - QR)^2$

$QR^2 = 3 + 9 + QR^2 - 6QR$

6QR = 12

QR = 2

SQ = 1 PS = 2

in ΔRSP

$PR^2 = RS^2 + PS^2$

= 3 + 4

$PR^2 = 7$

$PR = \sqrt{7}$

Ans (C)

12. A 100 mark examination was administered to a class of 50 students. Despite only integer marks being given, the average score of the class was 47.5. Then, the maximum number of students who could get marks more than the class average is

50 fo|kFkh ,d 100 vdk oky h ijh{kk nr gA ;|fi fo|kfFk;k dk i.kkd e vd fn, tkr g] d{kk e lHkh dk vkl r vd 47.5 gA ,l h fLFkfr e ,l fo|kfFk;k dh vf/kdre l[;k gkxh] tk d{kk d vkl r l vf/kd vd yk, g%

(A) 25 (B) 35 (C) 45 (D) 49

Sol. Total students = 50

Average = 47.5

Total marks = 2375

Now, student can obtain only integer marks. Hence for maximum students we will divide total marks by 48°

$$\Rightarrow \left[\frac{2375}{48}\right] = 49$$

13. Let s be the sum of the digits of the number $15^2 \times 5^{18}$ in base 10. Then
Lk[;k $15^2 \times 5^{18}$ dk ;fn vk/kkj (base) 10 e fy[kk tk,] rc bld vdk dk ;kx s gA rc
(A) $s < 6$ (B) $6 \le s < 140$ (C) $140 \le s < 148$ (D) $s \ge 148$

Sol. $15^2 \times 5^{18}$

$= 9 \times 5^{20}$

$\left[\log_{10}\left(9\times5^{20}\right)\right] = \left[2\log_{10}^{3} + 20\log_{10}5\right]$

$= \left[2\times4771 + 20(1-0.3010)\right]$

= 14 {characteristic}

Hence the number have 15 digits

At worst all digit can have value 9

Hence sum should less then 135

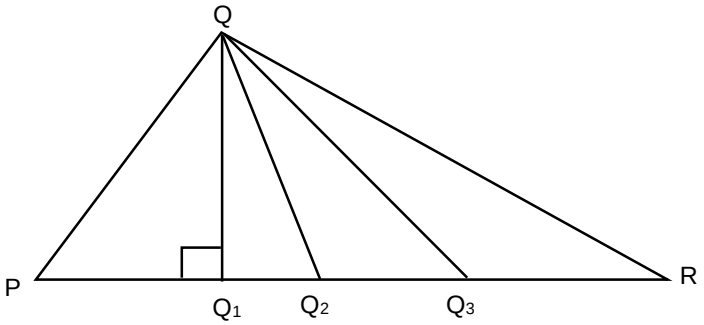
And the last digit should be 5 Hence

Sum should greater than Or equal to 6

Ans. (B)

14. Let PQR be am acute-angled triangle in which PQ < QR. From the vertex Q draw the altitude QQ_1, the angle bisector QQ_2 and the median QQ_3, with Q_1, Q_2, Q_3 lying on PR. Then
PQR ,d U;udks.k f=kHkt g] ftlesa PQ < QRA 'kh"kZ Q ls ,d 'kh"kyc (altitude) QQ_1, ,d dks.k f}Hkkt d (angle bisector) QQ_2 ,oa ekf/;dk (median) QQ_3 [kha p tkrs gA ;fn Q_1, Q_2, Q_3 Hkt k PR ij vofLFkr g] rc
(A) $PQ_1 < PQ_2 < PQ_3$ (B) $PQ_2 < PQ_1 < PQ_3$ (C) $PQ_1 < PQ_3 < PQ_2$ (D) $PQ_3 < PQ_1 < PQ_2$

Sol.



$PQ_3 = Q_3R$ ($\therefore$ QQ_3 ie median)

$PQ_3 = \frac{1}{2}PR$

$PQ_2 : Q_2R = r : p$ (By property of angle bisector)

$PQ_2 = \left(\frac{r}{r+P}\right)PR$

But r < P (Given)

$PQ_2 < \frac{1}{2}PR$

Comparison between Altitude and angle bisector

$\Rightarrow \angle QPQ_2 + \angle PQ_2Q + \angle PQQ_2 = \angle RQQ_2 + \angle QQ_2R + \angle QRQ_2$

$\therefore \angle PQQ_2 = \angle RQQ_2$ {Since angle bisector}

$\angle QPQ_2 + \angle PQ_2Q = \angle QQ_2R + \angle QRQ_2$

$\therefore$ PQ < QR then $<QPQ_2 > \angle QRQ_2$

Hence $\angle Q\,Q_2P < \angle QQ_2R$

But $\angle QQ_2P + \angle QQ_2R = 180°$

Hence $\angle QQ_2P < 90°$ & $\angle QQ_2R > 90°$

$\Rightarrow$ Foot from Q to side PR lies inside ΔPQQ_2

$\Rightarrow PQ_1 < PQ_2 < PQ_3$

Ans (A)

15. All the vertices of a rectangle are of the form (a, b) with a, b integers satisfying the equation $(a-8)^2-(b-7)^2=5$. Then the perimeter of the rectangle is

,d vk;r dh lHkh 'kh"k (a, b) idkj d g] tgk a, b i.kkd gA ;fn a, b lehdj.k $(a-8)^2-(b-7)^2=5$ dk lr"B djrk g] rc bl vk;r dh ifjf/k gksxh

(A) 20 (B) 22 (C) 24 (D) 26

Sol. $(a-8)^2-(b-7)^2=5$

$(a-b-1)(a+b-15)=5$

I_1 I_2

Four cases

I_1	I_2
5	1
1	5
–5	–1
–1	–5

Case-1

$a-b-1=5$ & $a+b-15=1$

$\Rightarrow a=11, b=5$

Case-2

$a-b-1=-5$ & $a+b-15=-1$

$\Rightarrow a=5, b=9$

Case-3

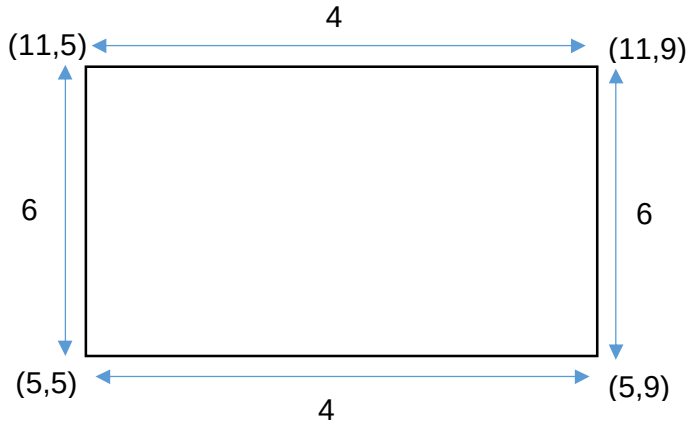
$a-b-1=1$ & $a+b-15=5$

$\Rightarrow a=11, b=9$

Case-4

$a-b-1=-1$ & $a+b-15=-5$

$\Rightarrow a=5, b=5$



Perimeter = 4 + 4 + 6 + 6 = 20

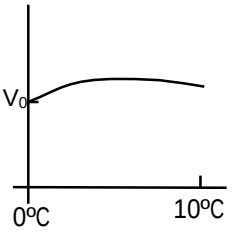
Ans. (A)

PHYSICS

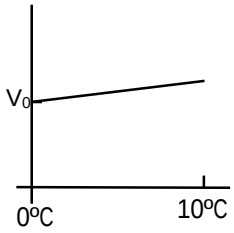
16. A block of wood is floating on water at 0ºC with volume V_0 above water. When the temperature of water increases from 0 to 10ºC, the change in the volume of the block that is above water is best described schematically by the graph

,d ydMh dk VdMk 0ºC rkieku d ty e rjrk g] ftldk vk;ru V_0 ty d lrg l Åij gA ;fn ty d rkieku d o l 10ºC rd c<k fn;k tk,] rk fuEu e dkuls vkj[k rkieku d lkis{k bl VdM d ml vk;ru dk tk ty d lrg l Åij g] e g, ifjoru dk n'kkrk g

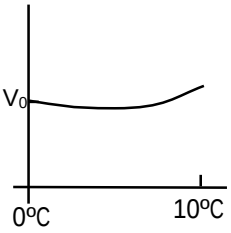
(A)



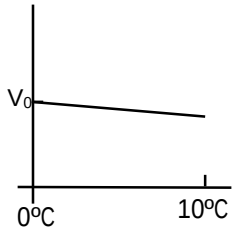
(B)



(C)



(D)



Sol. Since when temperature of water rises from 0°C to 10°C, its density first increase, becomes maximum at 4°C and then decrease, therefore fractional submergence will first decrease and then increase.

Ans. (A)

17. A very large block of ice of the size of a volleyball court and of uniform thickness of 8m is floating on water. A person standing near its edge wishes to fetch a bucketful of water using a rope. The smallest length of rope required for this is about

,d okyhcky d enku d cjkcj d cgr cM cQ d VdM dh ,dleku ekVkb 8 m gA ;g cQ dk vQdMk ikuh e rj jgk gA ,d 0;fDr tk bld ,d Nkj ij [kMk g] og ,d ckYVh e jLlh ck/k dj ikuh fudkyuk pkgrk gA jLlh dh U;ure yckb fdruh gkxh\

(A) 3.6m (B) 1.8m (C) 0.9m (D) 0.4m

Sol. Since $\rho_i = 0.9\ \rho_w$

Minimum Length required =0.8m.

Ans. (C)

18. A box filled water has a small hole on its side near the bottom. It is dropped from the top of a tower. As it falls, a camera attached on the side of the box records the shape of the water stream coming out of the hole. The resulting video will show

(A) the water coming down forming a parabolic stream.
(B) the water going up forming a parabolic stream.
(C) the water coming out in a straight line.
(D) no water coming out.

,d ikuh l Hkj cDl dh fupyh lrg d Nkj ij ,d fNn gA bl cDl dk ,d Åp ehukj dh Nr l fxjk;k tkrk gA ckDl d fxjr le;, bldh lrg ij yxk dejk cDl l ckgj vkr g; ikuh d iFk dk vfHkfyf[kr (record) djrk gA dej }kjk vfHkfyf[kr pyfp=k e fn[kxk fd

(A) ty ,d ijoy;kdkj iFk d vulkj uhp fxjrk gA

(B) ty ,d ijoy;kdkj iFk d vulkj Åij tkrk gA

(C) ty ,d lh/kh j[kk e ckgj vk;xkA

(D) cDl l ckgj ty ugh vk;xkA

Sol. Since bucket and water both are in state of free fall so water will not come out of the hole.

Ans. (D)

19. An earthen pitcher used in summer cools water in it essentially by evaporation of water from its porous surface. If a pitcher carries 4 kg water and the rate of evaporation is 20 g per hour, temperature of water in it decreases by ΔT in two hours. The value of ΔT is close to (ratio of latent of evaporation to specific heat of water is 540°C)

xfe;k e feVVh d ?kM e j[kk ty, ?kM dh lj/k lrg ij gk jg ty d ok"iu d }kjk BMk gkrk gA ;fn ?kM e 4 kg ty g] ftldk ok"iu 20 g/h dh nj l gkrk gA ;fn nk ?kV ckn ty d rkieku e ΔT dk ifjoru gkrk g] rk ΔT dk eku D;k gkxk ¼ty d fy, ok"iu dh xlr Å"ek d lkFk vuikr 540 °C

(A) 2.7 °C (B) 4.2 °C (C) 5.4 °C (D) 10.8 °C

Sol. Vaporization rate of water = 20 g/h

Water vaporized in 2 hour = 20 × 2 gm

$$dm = \frac{40}{1000} kg$$

$$\frac{\text{Latent heat of vaparisation}}{\text{specific heat of water}} = 540 = \frac{L}{C}$$

heat contain in vaporised vapor = (dm).L = (dm).L

Heat lost by water in earthen pitcher = mc. dT

m = 4 Kg

heat loss by water in earthen pitcher = heat contain in vaporised water

dm. L = m.C. dT

$$\frac{40}{1000}\left(\frac{L}{C}\right) = 4.dT$$

$$dT = \frac{1}{100} \times 540 = 5.4°C$$

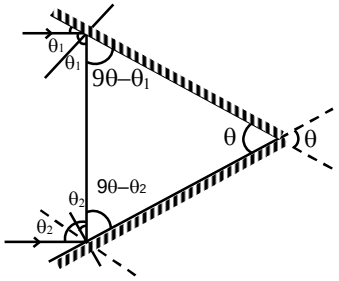
dT = 5.4°C

Ans. (C)

20. Two plane mirrors are kept on a horizontal table making an angle θ with each other as shown schematically in the figure. The angle θ is such that any ray of light reflected after striking both the mirrors returns parallel to tis incident path. For this to happen, the value of θ should be

nk lery ni.k] tk ,d nlj θ dk.k cukr g] dk fp=kkulkj ,d {kfrt Vcy ij j[kk x;k gA dk.k θ bl idkj g fd idk'k dh fdj.k nkuk ni.kk l ijkofrr gkdj vkifrr fdj.k d lekukUrj gk tkrh gA dk.k θ dk eku gkxk

(A) 30° (B) 45° (C) 60° (D) 90°



Sol.

$9\theta - \theta_1 + 90 - \theta_2 + \theta = 180$ $2\theta_1 + 2\theta_2 = 180$

$\theta = \theta_1 + \theta_2$ $\theta_1 + \theta_2 = 90$

$\theta = 90°$

Ans. (D)

21. A certain liquid has a melting point of – 50° C and a boiling point of 150° C. A thermometer is designed with this liquid and its melting and boiling points are designated as 0° L and 100° L. The melting and boiling points of water on this scale are

(A) 25° L and 75° L, respectively, (B) 0° L and 100° L, respectively,

(C) 20° L and 70° L, respectively, (D) 30° L and 80° L, respectively,

,d no dk xyukd – 50°C rFkk DoFkukd 150° C gA bl no l ,d rkiekih cuk;k tkrk g] tk no d xyukd rFkk DoFkukd dk Øe'k 0° L rFkk 100° L n'kkrk gA bl iekus (scale) ij ty dk xyukd rFkk DoFkukd Øe'k

(A) 25° L rFkk 75° L gA (B) 0° L rFkk 100° L gA

(C) 20° L rFkk 70° L gA (D) 30° L rFkk 80° L gA

Sol. 100°L = 200°C

1°L = 2°C

0°C = 25°L

100°C = 75°L.

Ans. (A)

22. One can define an alpha-Volt (αV) to be the energy acquired by an a particle when it is accelerated by a potential of 1 Volt. For this problem you may take a proton to be 2000 times heavier than an electron. Then vYQk d.k dk 1 V d foHko l Rofjr dju ij tk Åtk ikIr gkrh g mldk vYQk&okYV (αV) l ifjHkkf"kr fd;k tkrk gA ;fn eku fyft, fd ikVku] byDVku l 2000 xuk T;knk Hkkjh g rk fuEu esa l dku lk fodYi lgh gkxk\

(A) 1 αV = 1 eV/4000 (B) 1 αV = 2 eV

(C) 1 αV = 8000 eV (D) 1 αV = 1 eV

Sol. q = +2e

1αV = + 2 ev.

Ans. (B)

23. In a particle accelerator, a current of 500 μA is carried by a proton beam in which each proton has speed of 3×10^7m/s. The cross sectional area of the beam is 1.50 mm^2. The charge density in this beam in Coulomb/m^3 is close to

,d d.k Rojd (Particle accelerator) e] ikVku iqt dh 500 μA fo|qr /kkjk iokfgr gk jgh g bl iqt esa iR;d ikVku dh pky 3×10^7 m/s gA iqt d vuiLFk dkV dk {k=kQy 1.5 mm^2 gA bl iqt esa vko'k dk ?kuRo Coulomb/m^3 ek=kd esa yxHkx gkxkA

(A) 10^{-8} (B) 10^{-7} (C) 10^{-6} (D) 10^{-5}

Sol. I = neAv

$$ne = \frac{I}{Av} \quad \frac{500\times10^{-6}}{15\times10^{-7}\times3\times10^{7}} = \frac{100}{9}\times10^{-6} \text{ c/m}^3 \sim 10^{-5} \text{ c/m}^3$$

Ans. (D)

24. Which of the following is NOT true about the total lunar eclipse?
(A) A lunar eclipse can occur on a new moon and full moon day.
(B) The lunar eclipse would occur roughly every month is the orbits of earth and moon were perfectly coplanar.
(C) The moon appears red during the eclipse because the blue light is absorbed in earth's atmosphere and red is transmitted.
(D) A lunar eclipse can occur only on a full moon day.
fuEu esa ls dkSu lk dFku iw.kZ pUnzg.k ds fy, lgh ugha gS\
(A) pUnzg.k vekoL;k rFkk if.kek dk gks ldrk gSA
(B) ;fn iFoh vkSj pUnek dh d{kk i.kr% leryh; gks rks pUnzg.k yxHkx gj eghus gksxkA
(C) pUnzg.k ds le; pUnek yky fn[kkbZ nsxk] D;ksafd iFoh ds okrkoj.k esa uhyk idk'k vo'kks"kr gksrk gS rFkk yky idk'k ikjxr gksrk gSA
(D) pUnzg.k dsoy if.kek dk gh gksrk gSA

Sol. A lunar eclipse can occur on a new moon and full moon day.
pUnzg.k vekoL;k rFkk if.kek dk gks ldrk gSA

Ans. (D)

25. Many exoplanets have been discovered by the transit method, wherein one monitors a dip in the intensity of the parent star as the exoplanet moves in front of it. The exoplanet has a radius R and the parent star has radius 100R. If I_0 is the intensity observed on earth due to the parent star, then as the exoplanet transits,
(A) The minimum observed intensity of the parent star is 0.9 I_0
(B) The minimum observed intensity of the parent star is 0.99 I_0
(C) The minimum observed intensity of the parent star is 0.999 I_0
(D) The minimum observed intensity of the parent star is 0.9999 I_0
cgr lkjs xSj&lkSjh; (exoplanet) xgksa dk VkfIV (transit) fof/k }kjk [kkstk tkrk gSA bl fof/k esa tc xg viuh eq[; rkjs dh lkeus ls xtjrk gS] rc rkjs dh rhozrk esa vk;h deh dk voyksdu (monitor) djds xg dk [kkstk tkrk gSA ,d xSj&lkSjh; xg dh f=kT;k R gS rFkk bldh eq[; rkjs dh f=kT;k 100R gSA ;fn eq[; rkjs dh iSBh ij ekih xbZ rhozrk I_0 gS] rks tc ;g xSj&lkSjh; xg rkjs dh lkeus ls xtjrk gS
(A) eq[; rkjs dh rhozrk dk U;wure if{kr eku 0.9 I_0
(B) eq[; rkjs dh rhozrk dk U;wure if{kr eku 0.99 I_0
(C) eq[; rkjs dh rhozrk dk U;wure if{kr eku 0.999 I_0
(D) eq[; rkjs dh rhozrk dk U;wure if{kr eku 0.9999 I_0

Sol. The minimum observed intensity of the parent star is 0.9999 I_0
eq[; rkjs dh rhozrk dk U;wure if{kr eku 0.9999 I_0

Ans. (D)

26. A steady current I is set up in a wire whose cross-sectional area decreases in the direction of the flow of the current. Then, as we examine the narrowing region
(A) the current density decreases in value.
(B) the magnitude of the electric field increases.
(C) the current density remains constant.
(D) the average speed of the moving charges remains constant.
,d vifjorhZ fo|qr /kkjk I ,d ,slh rkj esa izokfgr gksrh gS ftldk vuiLFk dkV dk {ks=kQy fo|qr /kkjk dh izokg dh fn'kk esa de gksrk tkrk gSA rkj ds ldh.k {ks=k esa
(A) fo|qr /kkjk ?kuRo dk eku ?kV tkrk gSA
(B) fo|qr {ks=k dk ifjek.k c< tkrk gSA
(C) fo|qr /kkjk ?kuRo fLFkj jgrk gSA
(D) xfreku fo|qr vkos'kksa dh vkSlr xfr fLFkj jgrh gSA

Sol. $I = neAv_d$

$$J = \frac{I}{A} = \sigma E$$

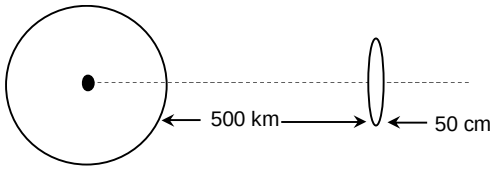
Ans. (B)

27. Select the correct statement about rainbow:
(A) We can see a rainbow in the western sky in the late afternoon.
(B) The double rainbow has red on the inside and violet on the outside.
(C) A rainbow has an arc shape since the earth is round.
(D) A rainbow on the moon is violet on the inside and red on the outside.
bUn/ku"k d ckj e dku lk dFku lgh g
(A) bUn/ku"k dk if'peh vkdk'k e nj&nkigj (late afternoon) e n[k ldr gA
(B) f}bUn/ku"k (double rainbow) e yky jx vnj rFkk cxuh jx ckgj dh rjQ gkxkA
(C) iFoh d xky gku d dkj.k bUn/ku"k oØ (arc) vkdkj dk gkrk gA
(D) pnek ij bUn/ku"k e cxuh jx vnj rFkk yky jx ckgj dh rjQ gkxkA

Sol. The double rainbow has red on the inside and violet on the outside.
f}bUn/ku"k (double rainbow) e yky jx vnj rFkk cxuh jx ckgj dh rjQ gkxkA
Ans. (B)

28. Remote sensing satellites move in an orbit that is at an average height of about 500 km from the surface of the earth. the camera onboard one such satellite has a screen of area A on which the images captured by it are formed. If the focal length of the camera lens is 50 cm, then the terrestrial area that can be observed from the satellite is close to
,d lnj lonu mixg] iFoh dh lrg l vkl lru 500 km dh njh ij viuh d{kk e xfr djrk gA bl mixg e yx dej] ft ld ini dk {k=kQy A g] ij fp=k curk gA ;fn dej e yx y Ul dh Qkdl njh 50 cm g] rk mixg d dej d }kjk fdruk LFkyh; {k=k if{kr (observed) fd;k tk ldrk gA
(A) 2×10^3 A (B) 10^6 A (C) 10^{12} A (D) 4×10^{12} A

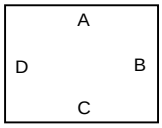
Sol. $\leftarrow 500$ km $\rightarrow 50$ cm.



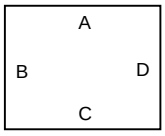
$$\frac{A_0}{A} = \left[\frac{u}{v}\right]^2 \Rightarrow A_0 = 10^{12} \text{ A}$$

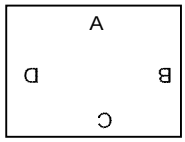
Ans. (C)

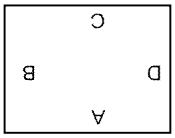
29. fp=kkuqlkj v{kj A, B, C vkj D ,d dkxt d r[r ij fy[k x; g %

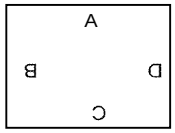


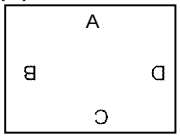
bl r[r dk ,d [kkyh ikjn'kh cyukdkj fxyk l d ihN ,d mfpr njh ij j[kk x;k gA ;fn bl fxyk l e ikuh Hkj fn;k tk,] rk fxyk l n[ku ij cu v{kjk d Øe dk mYVk ifrfcEc (inverted image) fn[krk gA vko/ku dk ux.; ekur g, fuEu e dkuqlk ifrfcEc lgh gA

(A) 

(B) 

(C) 

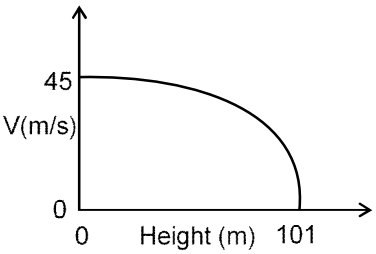
(D) 

Sol. 

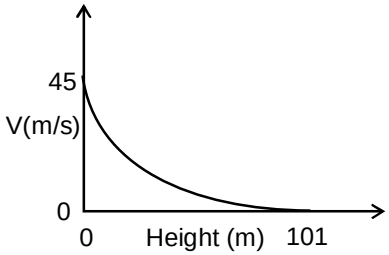
Ans. (C)

30. If a ball is thrown at a velocity of 45 m/s in vertical upward direction, then what would be the velocity profile as function of height ? Assume g = 10 m/s^2.

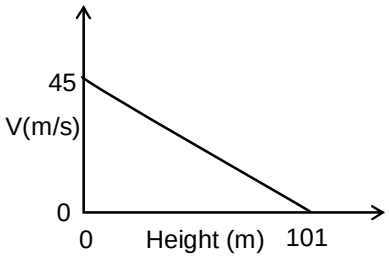
(A)



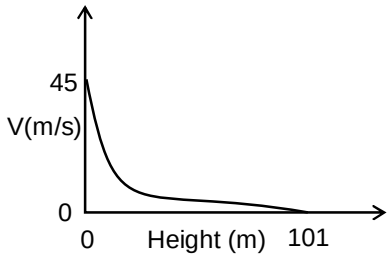
(B)



(C)

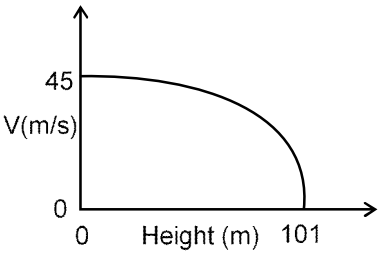


(D)

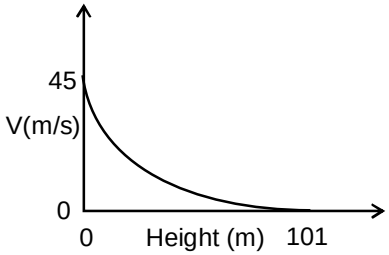


,d xn dk 45 m/s d ox l Å/okk/kj fn'kk e Åij dh vkj Qdk tkrk gA ox dk Åpkb d lkis{k e lgh vkj[k D;k gkxk ? eku yhft, g = 10 m/s^2.

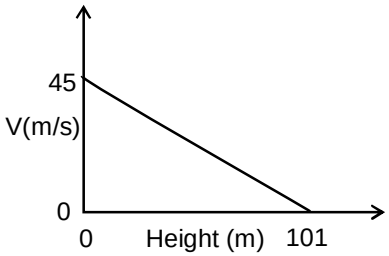
(A)



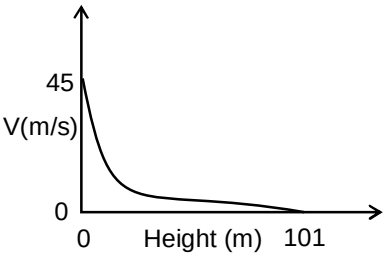
(B)



(C)



(D)



Sol. $v^2 = v^2 - 2gh \rightarrow$ parabola

Ans. (A)

CHEMISTRY

31. The number of water molccules in 250 mL of water is closest to
[Given: Density of water is 1.0 g mL^{-1}; Avogadro's number = 6.023×10^{23}]
250 mL ty e ty d v.kvk dh l[;k fuEu d fudVre gkxh
[fn;k g% ty dk ?kuRo 1.0 g mL^{-1}; vokxknk l[;k= 6.023×10^{23}]
(A) 83.6×10^{23} (B) 13.9×10^{23} (C) 1.5×10^{23} (D) 33.6×10^{23}

Sol. Volume of H_2O = 250ml,
Weight of water = 250 gm,
Number of male of H_2O = $\frac{250}{18}$
Number of molecule of H_2O = $\frac{250}{18}\times N_A = 83.6\times10^{23}$

Ans. (A)

32. Among the following, the correct statements is
(A) pH decreases when solid ammonium chloride is added to a dilute aqueous solution of NH_3
(B) pH decreases when solid sodium acetate is added to a dilute aqueous solution of acetic acid.
(C) pH decreases when solid NaCl is added to a dilute aqueous solution of NaOH
(D) pH decreases when solid sodium oxalate is added to a dilute aqueous solution of oxalic acid
fuEufyf[kr e lgh dFku g
(A) pH ?kVrk g] tc Bkl vekfu;e DykjkbM dk NH_3 d ,d ru ty h; foy;u e feyk;k tkrk gA
(B) pH ?kVrk g] tc Bkl lkfM;e ,lhVV dk ,lhfVd ,flM d ,d ru ty h; foy;u e feyk;k tkrk gA
(C) pH ?kVrk g] tc Bkl NaCl dk NaOH d ,d ru ty h; foy;u e feyk;k tkrk gA
(D) pH ?kVrk g] tc Bkl lkfM;e vkDlyV dk vkDlfyd d ,d ru ty h; foy;u e feyk;k tkrk gA

Sol. Dil aqueous Solution of NH_3 is NH_4OH solution

$$NH_4OH \rightleftharpoons NH_4^+ + \bar{O}H$$

On adding solid ammonium chloride

$$NH_4 \longrightarrow NH_4^+ + Cl^-$$

The reaction moves backward due to common ion effect. The concentration of OH^- decreases and pH decressess.

Ans. (A)

33. The solubility of $BaSO_4$ in pure water (in g L^{-1}) is closest to
[Given: K_{sp} for $BaSO_4$ is 1.0×10^{-10} at 25 ºC. Molecular weight of $BaSO_4$ is 233 g mol^{-1}]
'k) ty e BaSO4 dh foy;rk (g L^{-1} e) fuEu d fudVre g
[fn;k g% 25 ºC ij $BaSO_4$ dh K_{sp} 1.0×10^{-10} gA $BaSO_4$ dk vkf.od Hkkj 233 g mol^{-1}]
(A) 1.0×10^{-5} (B) 1.0×10^{-3} (C) 2.3×10^{-5} (D) 2.3×10^{-3}

Sol. Given Ksp = 10^{-10}
For $BaSO_4$, Ksp = S^2.
S=10^{-5} mol/L $\Rightarrow 2.33\times10^{-3}$ g/L

Ans. (D)

34. Among the following, the INCORRECT statement is
(A) No two electrons in an atom can have the same set of four quantum numbers.
(B) The maximum number of electron in the shell with principal quantum number, n, is equal to n^2+2
(C) Electrons in an orbital must have opposite spin.
(D) In the ground state, atomic orbitals are filled in the order of their increasing energies.
fuEufyf[kr e l xyr dFku g%
(A) ,d ijek.k e dkbZ Hkh nk byDVku dh pkjk DokUVe l[;k,a leku ugh gk ldrh gA
(B) ,d dk'k e ftldh ie[k DokUVe l[;k n g] vf/kdre byDVkuk dh l[;k n^2+2 A
(C) ,d vkfcVy (orbital) e byDVkuk d ipØ.k (spin) vfuok;r% foijhr gkxA
(D) Hkfet voLFkk (ground state) e] ijek.k d vkfcVy (orbitals) dk mudh Åtk d vkjkgh Øek e Hkjk tkrk gA

Sol. The maximum number of electrons in the n^{th} shell is $2n^2$.
Ans. (B)

35. A container of volume 2.24 L can withstand a maximum pressure of 2 atm at 298 K before exploding. The maximum amount of nitrogen (in g) that can be safely put in this container at this temperature is closest to
,d ik=k ftldk vk;ru 2.24 L g] foLQkfVr gku l igy 298 K d rki ij 2 atm dk nkc lgu dj ldrk gA bl rkieku ij ukbVkt u dh vf/kdre ek=kk (g e) tk bl ik=k e ljf{kr rjhd l j[kh tk ldrh g] fuEu d fudVre g

(A) 2.8 (B) 5.6 (C) 1.4 (D) 4.2

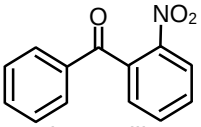
Sol. The maximum amount of nitrogen that can be safely put in this container must, exert a pressure less than 2 atom at 298K.

i.e. maximum moles in container $n = \frac{PV}{RT}$

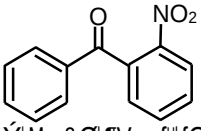
$$= \frac{2 \times 2.24}{0.0821 \times 298} = 0.18$$

i. e. maximum weight of N_2 in container = 0.183 × 28 = 5.127 gm.
The correct answer is, (D) 4.2 grams
for safety concern, we can't go for adding more nitrogen.
Ans. (B)

36. The compound shown below

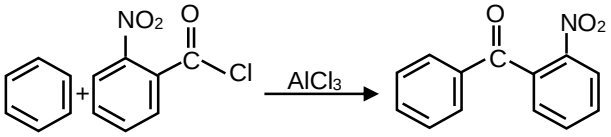


can be readily prepared by Friedel-Crafts reaction between
(A) benzene and 2-nitrobenzoyl chloride
(B) benzyl chloride and nitrobenzene
(C) nitrobenzene and benzoyl chloride
(D) benzene and 2-nitrobenzyl chloride
uhp fn[kk;k x;k ;kfxd



ÝhMy&Økk¶V vfHkfØ;k }kjk uhp fn; x; fuEu ;kfxdk d chp dh vfHkfØ;k l ljyrk l cuk;k tk ldrk g\
(A) cthu vkj 2-ukbVkcUtkby (2-nitrobenzoyl) DykjkbM
(B) ctkby (benzyl) DykjkbM vkj ukbVk cthu
(C) ukbVk cthu vkj cUtkby (benzoyl) DykjkbM
(D) cthu vkj 2-ukbVkcUtkby (2-nitrobenzyl) DykjkbM

Sol.



37. The correct statement about the following compounds

X **Y**

is

(A) both are chiral (B) Both are achiral

(C) X is chiral and Y is achiral (D) X is achiral and Y is chiral

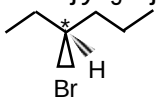
fuEu ;kfxdk

X **Y**

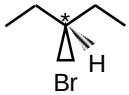
d ckj e lgh dFku dkuk g&

(A) nkuk dkbjy gA (B) nkuk dkbjy ugh gA

(C) X dkbjy g ijUr Y dkbjy ugh gA (D) X dkbjy ugh g ijUr Y dkbjy gA

Sol. **(X)** 

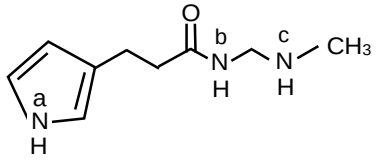
Here the * marked carbon is Chiral, as it has 4 different groups attached.

(Y) 

Here the * marked carbon is achiral as it has two identical ethyl group attached.

Ans. (C)

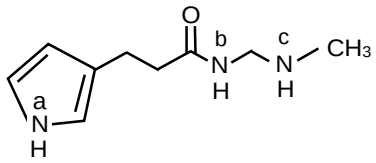
38. The most acidic proton and the strongest nucleophilic nitrogen in the following compound



respectively, are

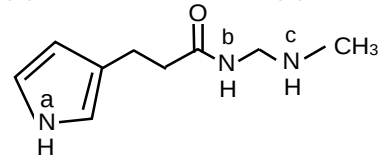
(A) N^a–H; N^b (B) N^b–H; N^c (C) N^a–H; N^c (D) N^c–H; N^a

fuEu ;kfxd



e vf/kdre vEyh; ikVku rFkk lcl l'kDr ukfHkdLugh ukbVkt u Øe'k gk

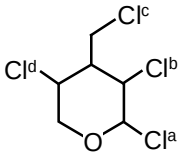
(A) N^a–H; N^b (B) N^b–H; N^c (C) N^a–H; N^c (D) N^c–H; N^a

Sol. 

Most acidic proton = "b" as the conjugate base is resonance stabilized and the most nucleophilic nitrogen is "c" as the lone pair electron on nitrogen is localized in sp^3 hybrid orbital.

Ans. (B)

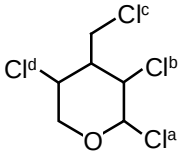
39. The chlorine atom of the following compound



that reacts most readily with $AgNO_3$ to give a precipitate is

(A) Cl^a (B) Cl^b (C) Cl^c (D) Cl^d

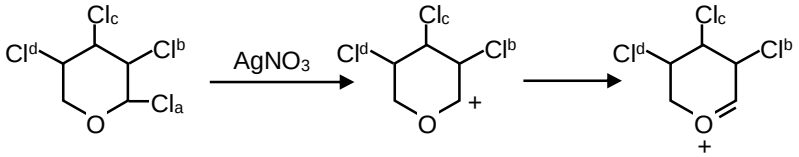
fueu ;kfxd e Dykjhu ijek.k]



tk $AgNO_3$ d lkFk vf/kdre ljyrk l fØ;k dj vo{ki cukrk g

(A) Cl^a (B) Cl^b (C) Cl^c (D) Cl^d

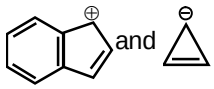
Sol. The resulting carbocation formed by loss of $Cl^{(a)}$ is resonance stabilized.

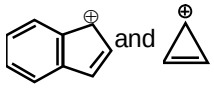


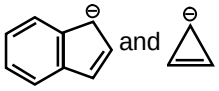
Ans. (A)

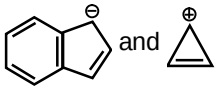
40. Among the following sets, the most stable ionic species are

fuEufyf[kr legk e] vf/kdre LFkk;h vk;fud ;Xe fuEu g

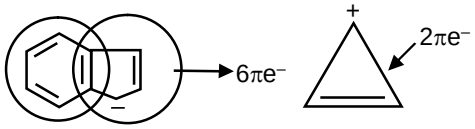
(A)  and

(B)  and

(C)  and

(D)  and

Sol. In option "D" both the ions are aromatic



Ans. (D)

41. The correct order of energy of 2s orbitals in H,Li, Na and K, is

H,Li, Na rFkk K e 2s vkjfcVy (orbital) dh Åtk dk lgh Øe fuEu g

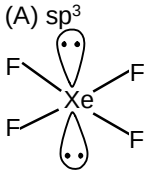
(A) K < Na < Li < H (B) Na < Li < K < H

(C) Na < K < H < Li (D) H < Na < Li < K

Sol. As the atomic number increases the energy of orbitals decreases.

42. The hybridisation of xenon atom in XeF_4 is
XeF_4 e Xe ijekk.k dk ldj.k fuEu g
(A) sp^3 (B) dsp^2 (C) sp^3d^2 (D) d^2sp^3

Sol.



$\Rightarrow$ 4 bond pair + 2 lone pair. $\Rightarrow$ Steric Number = 6
$= sp^3d^2$.
Ans. (C)

43. The formal oxidation number of Cr and Cl in the ions $Cr_2O_7^{2-}$ and ClO_3^-, respectively, are
(A) +6 and +7 (B) +7 and +5 (C) +6 and +5 (D) +8 and +7
$Cr_2O_7^{2-}$ vkj ClO_3^- e Cr ,o Cl dh lkekU; vkDlhdj.k l[;k Øe'k% fuEu g
(A) +6 vkj +7 (B) +7 vkj +5 (C) +6 vkj +5 (D) +8 vkj +7

Sol. Oxidation number of Cr in $Cr_2O_7^{2-}$ = + 2x – 14 = – 2 $\Rightarrow$ x = + 6
Oxidation number of Cl in ClO_3^- = x – 6 = – 1 $\Rightarrow$ x = + 5
Ans. (C)

44. A filter paper soaked in salt X turns brown when exposed to HNO_3 vapor. The salt X is
,d fQYVj iij tk fd X yo.k l Hkhxk g] HNO_3 dh ok"i d lid e vku ij Hkjk jx nrk gA yo.k X fuEu g
(A) KCl (B) KBr (C) KI (D) K_2SO_4

Sol. $2\,KI + 4\,HNO_3 \longrightarrow I_2 + 2\,NO_2 + 2\,KNO_3 + 2\,H_2O$
Iodide ion is a strong reducing agent and reduces HNO_3 vapours to NO_2 (Brown gas)
Ans. (C)

45. The role of haemoglobin is to
(A) store oxygen in muscles
(B) transport oxygen to different parts of the body
(C) convert CO to CO_2
(D) convert CO_2 into carbonic acid
fgeksXykfcu dk dk;Z fuEu g
(A) vkDlhtu dk if'k;k e lfpr djukA
(B) vkDlhtu dk 'kjhj d fofHkUu Hkkxk e y tkukA
(C) CO dk CO_2 e cnyukA
(D) CO_2 dk dkcksfuy vEy e cnyukA

Sol. Haemoglobin is oxygen carrier.
Ans. (B)

BIOLOGY

46. Which ONE of the following molecules is a secondary metabolite?
(A) Ethanol (B) Lactate (C) Penicillin (D) Citric Acid
fuEufyf[kr e l dkulk v.k f}rh;d mikip;t g?
(A) bFkuky (B) yDVV (C) ifuflfyu (D) flfVd vEy
Ans. (C)

47. Lecithin is a ?
(A) Carbohydrate (B) Phpspholipid (C) Nucleoside (D) Protein
yflfFku D;k g?
(A) dkckgkbMV (B) QkLQkfyfiM (C) U;fDyvkslkbM (D) ikVhu
Ans. (B)

48. The water potential (Ψ^P) of pure water at standard temperature and atmospheric pressure is?
(A) 0 (B) 0.5 (C) 1.0 (D) 2.0
ekud rki vkj ok;e.Myh; nkc ij 'k) ty dk foHko (Ψ^P) fdruk gkrk g?
(A) 0 (B) 0.5 (C) 1.0 (D) 2.0
Ans. (A)

49. Action potential in neurons is generated by a rapid influx of ?
(A) Chloride ions (B) Potassium ions (C) calcium ions (D) sodium ions
rf=kdk dkf'kdk e fØ;kRed foHko mRiknu fdld Rofjr vrokg l gkrk g ?
(A) Dykjkb M vk;UI (B) ikVf'k;e vk;UI (C) dfY'k;e vk;UI (D) lkfM;e vk;UI
Ans. (D)

50. Erythropoietin is produced by ?
(A) Heart (B) Kidney (C) Bone marrow (D) Adrenal gland
bfjFkkikbfVu dk mRiknu dgk gkrk g?
(A) ân; (B) oDd (C) vfLFk eTtk (D) vf/koDd xfFk
Ans. (B)

51. Tendrils are modifications of ?
(A) Stem or leaf (B) Stem only (C) Leaf only (D) Aerial roots only
irku ¼VfMy½ fuEu e l fdldk ifjofrr :i g ?
(A) iÙkh ;k ru dk (B) doy ru dk (C) doy iÙkh dk (D) doy ok;oh; tMk dk
Ans. (A)

52. Which one of the following combinations of biomolecules is present in the ribosomes ?
(A) RNA, DNA and protein (B) RNA lipids and DNA
(C) RNA and protein (D) RNA and DNA
fuEufyf[kr e l tfod v.kvk dk dkulk l;ktu jkbckslkEl e ekt n gkrk g ?
(A) RNA, DNA vkj ikVhu (B) RNA fyfiMl vkj DNA
(C) RNA vkj ikVhu (D) RNA vkj DNA
Ans. (C)

53. Which one of the following proteins does not play a role in skeletal muscle contraction?
(A) Actin (B) Myosin (C) Troponin (D) Microtubule
fuEufyf[kr e l dkulk ikVhu vfLFk if'k;k d ldpu e dkb Hkfedk ugh fuHkkrk g?
(A) ,fDVu (B) ek;kflu (C) Vkikfuu (D) ekbdkV;C;y
Ans. (D)

54. Which one of the following reactions is catalyzed by high-energy ultraviolet radiation in the stratosphere?
(A) $O_2 + O \rightarrow O_3$ (B) $O_2 \rightarrow O + O$ (C) $O_3 + O_3 \rightarrow 3O_2$ (D) $O + O \rightarrow O_2$
fuEufyf[kr e l dku lh vfHkfØ;k lerki&e.My e mPp&Åtk dh ijkcxuh fofdj.kk l mRifjr gkrk g?
(A) $O_2 + O \rightarrow O_3$ (B) $O_2 \rightarrow O + O$ (C) $O_3 + O_3 \rightarrow 3O_2$ (D) $O + O \rightarrow O_2$
Ans. (B)

55. Which ONE of the following statements is True about trypsinogen ?
(A) It is activated by enterokinase (B) It is activated by renin
(C) It is activated by pepsin (D) It does not need activation
fVfllukt u d fo"k; e fuEufyf[kr e l dkulk dFku lR; g ?
(A) bldk lfØ;.k ,Vjkdkbut }kjk gkrk g (B) bldk lfØ;.k jfuu (Renin) }kjk gkrk g
(C) bldk lfØ;.k ifllu }kjk gkrk g (D) bl lfØ;.k dh vko';drk ugh gkrh g
Ans. (A)

56. Which ONE of the following organisms respire through the skin?
(A) Blue whale (B) Salamander (C) platypus (D) Peacock
fuEufyf[kr e l dkulk tho viuh Ropk }kjk 'olu djrk g ?
(A) Cy 0gy (B) lykeMj (C) lyfVil (D) ekj
Ans. (B)

57. Which ONE of the following human cells lacks a nucleus?
(A) Neutrophil (B) neuron
(C) Mature erythrocyte (D) Keratinocyte
fuEufyf[kr e l dkulh ekuo dkf'kdk dUnd foghu gkrh g ?
(A) U;VkfQy (B) rf=kdk
(C) ifjiDo yky :f/kjk.k (D) fdjfVuk lkbV
Ans. (C)

58. The first enzyme that the food encounters in human digestive system is?
(A) Pepsin (B) Trypsin (C) Chymotrypsin (D) Amylase
eu"; d ikpu r=k e Hkkt u lcl igy fdl ,tkbe d lEid e vkrk g ?
(A) ifllu (B) fVfllu (C) Økbekf Vfllu (D) ,ekby t
Ans. (D)

59. Glycoproteins are formed in which ONE of the following organelles?
(A) Peroxisome (B) Lysosome (C) Golgi apparatus (D) Mitochondria
fuEufyf[kr e l fdl dkf'kdkx e Xykbdkik Vhu dk fuek.k gkrk g?
(A) ij&vkDlhlke (B) y;udk; ¼ykblkle½ (C) xkYth midj.k (D) l=kdf.kdk
Ans. (C)

60. An example of nastic movement?
(A) Folding up of the leaves of mimosa pudica (B) Climbing of tendrils
(C) Growth of roots from seeds (D) Growth of pollen tube towards the ovule
ufLVd lpyu ¼ckÁ mnnhiu vkØkfjr lpyu½ dk ,d mnkgj.k g?
(A) feekl ifMdk ¼Nb eb½ dh ifÙk;k dk ej>kuk (B) irkuk dk p<uk
(C) chtk l tMk dh of) (D) ijkx&ufydk dk chtk.Mk dh fn'kk e of)
Ans. (A)

PART-II
Two Mark Questions

MATHEMATICS

61. What is the sum of all natural numbers n such that the product of the digits of n (in base 10) is equal to $n^2 - 10n - 36$?

;fn vk/kkj 10(base 10) e ikdfrd l[;kvk n d vdk dk x.kuQy $n^2 - 10n - 36$ g rc ,sh lHkh ikdfrd l[;kvk dk ;kxQy gkxk

(A) 12 (B) 13 (C) 124 (D) 2612

Sol. Product of digits of natural number will be a non negative integer

so, $n^2 - 10^n - 36 \geq 0$

$\Rightarrow n \in (-\infty, 5 - \sqrt{61}] \cup (5 + \sqrt{61}, \infty)$

but $n \in IN$

so $n \geq 13$; where $n \in N$

case-1 for all 2 digit natural numbers max value of product of digits = $9 \times 9 = 81$

so $n^2 - 10n - 36 \leq 81$

$\Rightarrow n \in [5 - \sqrt{142}, 5 + \sqrt{142}]$

but n is taken as a 2 digit natural no.; so $13 \leq n < 17$;

$\Rightarrow$ product of digits = 3, 4, 5 or 6 for 13, 14, 15 and 16 respectively

checking n = 12

product of digits = $1 \times 3 = 3$

and $13^2 - 10 \times 13 - 36 = 3$

so 13 satisfies the given condition

Hence it is a solution

chcking for n = 14

product = $1 \times 4 = 4$

$142 - 10 \times 14 - 36 = 196 - 140 - 36 = 20 > 6$

and $n^2 - 10n - 36$ is increasing function for $n > 5$; rest of the 2 digit integers won't satisfy the given condition

case-2 for all 3-digit integers max product = $9 \times 9 \times 9 = 729$

The smallest 3 digit no. is 100

$f(n) = n^2 - 10n - 36$; $f(100) = 100^2 - 10 \times 100 - 36 = 8964 > 729$

and f(n) is increasing Hence no 3 digit Integers and similary any higher integer will not satisfy

$\Rightarrow$ n = 13 is the only answer.

Ans. (B)

62. Let m (respectively, n) be the number of 5-digit integers obtained by using the digits 1,2,3,4,5 with repetitions (respectively, without repetitions) such that the sum of any two adjacent digits is odd. Then $\frac{m}{n}$ is equal to

vd 1,2,3,4,5 dk feykdj 5- vdk dh i.kkd l[;k, m ,o n cukb tkrh g l[;k m e vdk dk iujkoru (repetition) gkrk g ,o l[;k n e vdk dk iujkoru lHko ugh gA bu nkuk idkj d i.kkdk e Lyxu (adjacent) vdk dk ;x fo"ke g rc $\frac{m}{n}$ dk eku gkxk

(A) 9 (B) 12 (C) 15 (D) 18

Sol. Digits are 1, 2, 3, 4, 5

Even digits = 2, 4 ; number of Even digits = 2

Total marks = 2375 ; number of Odd digits = 3

Sum of any 2 adjacent digits is odd

$\Rightarrow$ Odd and even digits will alternate

Case I For n; Repetition is not allowed

$\Rightarrow$ OEOEO is the only possibility of arrangement of digits, Where O = Odd digit, E = Even digit.

So number of Arrangements n = $\frac{3}{O}\times\frac{2}{E}\times\frac{2}{O}\times\frac{1}{E}\times\frac{1}{O}$ = 12

Case I For m ; Repetition is allowed

$\Rightarrow$ Two possipilities

(a) OEOEO

Number of such arrangements = $\frac{3}{O}\times\frac{2}{E}\times\frac{3}{O}\times\frac{2}{E}\times\frac{3}{O}$ = 108

(b) EOEOE

Number of such arrangements = $\frac{2}{E}\times\frac{3}{O}\times\frac{2}{E}\times\frac{3}{O}\times\frac{2}{E}$ = 72

So m = 108 + 72 = 180

$\frac{m}{n}=\frac{180}{12}$ **= 15**

Ans. (C)

63. The number of solid cones with integer radius and integer height each having its volume numerically equal to its total surface area is

i.kk d f=kT;k ,o i.kk d Åpkb oky iR;d 'kd dk vk;ru dk l[;kRed eku bld dy i"Bh; {k=kQy d cjkcj gA ,l 'kdvk dh l[;k gA

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

Sol. Leh Height of cone = h

Radius of base = r

And slant height = ℓ ; = $\ell = \sqrt{r^2+h^2}$

Given volume = surface area.

$\Rightarrow \frac{1}{3}\pi r^2 h = \pi r\ell + \pi r^2$

$\Rightarrow rh = 3\ell + 3r \Rightarrow \ell = \frac{1}{3}(rh - 3r)$

$\Rightarrow \sqrt{r^2+h^2} = \frac{r}{3}(h-3)$

$\Rightarrow r^2 + h^2 = \frac{r^2}{9}(h^2 - 6h + 9)$

$\Rightarrow h^2 = \frac{r^2 h^2}{9} - \frac{2hr^2}{3}$

$\Rightarrow h = \frac{6r^2}{r^2-9} = 6 + \frac{54}{r^2-9}$

Since h and r must be integers, and r^2 – g must be a factor of 54

r^2 – 9 must be divisible by 3

$\Rightarrow r = 3k$.

$h = 6 + \frac{54}{9k^2-9} = 6 + \frac{6}{k^2-1}$

Since O < k^2 – 1 < 6

$\Rightarrow$ k = 2 is only such value; for which h is integer.

So, r = 2 × 3 = 6 i

h = 6 + $\frac{6}{3}$ = 8

$\ell = 10$

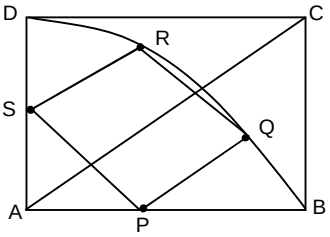
is the only possible values for r and h. **Ans. (B)**

64. Let ABCD be a square. An arc of a circle with A as center and AB as radius is drawn inside the square joining the points B and D. Points P on AB, S on AD, Q and R on are BD are taken such that PQRS is a square. Further suppose that PQ and RS are parallel to AC. Then $\frac{\text{areaPQRS}}{\text{areaABCD}}$ is

ABCD ,d oxZ gA ,d or d pki (arc) dk bl oxZ d vUnj f[kpk tkrk gA bl pki dk dUnz A g] bldh f=kT;k AB g vkj ;g fcUnq B ,oa D dk tkMrk gA ij ,d fcUnq ij ,d fcUnq rFkk pki ij fcUnq ,oa bl idkj fy, tkr g fd ,d oxZ cu tkrk gA bld vykok] ;fn eku y fd ,o j[kk d lekukUrj gA] rc $\frac{\text{areaPQRS}}{\text{areaABCD}}$ dk eku gkxk

(A) $\frac{1}{8}$ (B) $\frac{1}{5}$ (C) $\frac{1}{4}$ (D) $\frac{2}{5}$

Sol.



Let A (0,0), B(1,0), C(1,1) & D(0, 1) $\Rightarrow$ Area ABCD = 1

Again let Q $(\cos\alpha, \sin\alpha)$ & R $(\cos\beta, \sin\beta)$

$\Rightarrow$ coordinate of P $(\cos\alpha - \sin\alpha, 0)$ & S $(0, \sin\beta - \cos\beta)$

PQRS is a square $\Rightarrow$ PQ $\perp$ QR $\Rightarrow$ slope of QR = –1 = slope of SP

$$\Rightarrow \frac{\sin\beta - \sin\alpha}{\cos\beta - \cos\alpha} = -1 = \frac{\sin\beta - \cos\beta}{\sin\alpha - \cos\alpha}$$

$$\Rightarrow \sin\beta - \sin\alpha = -\cos\beta + \cos\alpha$$

$$\Rightarrow \sin\beta - \cos\beta = \sin\alpha + \cos\alpha \quad \text{.....(i)}$$

$$\text{and } \sin\alpha + \sin\beta = \cos\alpha + \cos\beta \quad \text{.....(ii)}$$

$$\Rightarrow \cos\alpha = \sin\beta$$

$$\Rightarrow \cos\alpha = \cos(90 - \beta)$$

$$\Rightarrow \alpha + \beta = 90^\circ$$

Also PQ = QR

$$\Rightarrow \tan\alpha = \frac{1}{2}$$

Area of PQRS = $2\sin^2\alpha = 2\left(\frac{1}{5}\right)$

$$\frac{\text{Area of PQRS}}{\text{Area of ABCD}} = \frac{2/5}{1} = \frac{2}{5}$$

Ans. (D)

65. Suppose ABCD is a trapezium whose sides and height are integers and AB is parallel to CD. If the area of ABCD is 12 and the sides are distinct, then |AB-CD|

(A) 2 (B) 4

(C) 8 (D) cannot be determined from the data

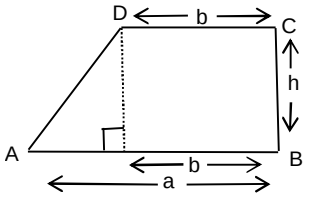
Lkeyc ABCD dh Hkqtk,] ,oa AB rFkk CD lekukUrj g A ;fn ABCD dk {k=kQy 12 g A ,oa bldh Hkqtk, fofHkUu g rc |AB – CD| dk eku gkxk

(A) 2 (B) 4

(C) 8 (D) dk fn;s x, vkdMk l irk ugh yxk;k tk ldrk g A

Ans. (B)

65.



Given : $\frac{1}{2}(a+b)\times h = 12$

$(a+b)\times h = 24$

24 × 1

12 × 2

6 × 4

8 × 3

In height angle. Δ AED Possible height for integer sides.

h = 4, 3

Case–I When h = 4

Then possible triplet (3, 4, 5)

i.e. DE = 4, AE = 3, AD = 5

if AE = 3, 2b = 3

b = 3/2

(Not possible because $b \in I$)

Case–II When h = 3

Then AE = 4, 2b = 4

b = 2

$\therefore$ CD = 2, AB = 6

$\therefore |AB - CD| = 4$

Ans. (B)

PHYSICS

66. A coffee maker makes coffee by passing steam through a mixture of coffee powder, milk and water. If the steam is mixed at the rate of 50 g per minute in a mug containing 500 g of mixture, then it takes about t_0 seconds to make coffee at 70°C when the initial temperature of the mixture is 25°C. The value of t0 is close to (ratio of latent heat of evaporation to specific heat of water is 540°C) and specific heat of the mixture can taken to be the same as that of water)

,d dkQh e'khu] dkQh p.k] n/k vkj ikuh d feJ.k e Hkki dk feykdj dkQh cukrh g A ,d ex e 500 gm dk feJ.k 25°C ij g] vkj mle 50 g/minute dh nj l Hkki dk feyk dj t_0 lsdM 70° C e rkieku okyh dkQh cuk;h tkrh g A t_0 dk fudVre eku D;k gkxk (ty d ok"iu dh xlr Å"ek d lkFk vuikr g] rFkk feJ.k ,o ty dh fof'k"B Å"ek d lkFk vuikr g] rFkk feJ.k ,o ty dh fof'k"B Å"ek dk leku ekuk tk ldrk g)

(A) 30 (B) 45 (C) 60 (D) 90

Sol. 50 t_0 (540) + 50 to (100-70) = 500 (1) (70-25)

28500 t_0 = 22500

t_0 = 0.789 min = 47 sec.

Ans. (B)

67. A person in front of a mountain is beating a drum at the rate of 40 per minute and hears no distinct echo. If the person moves 90 m closer to the mountain, he has to beat the drum at 60 per minute to not hear any distinct echo. The speed of sound is

,d 0;fDr ior d lkeu [kM gkdj 40 / feuV dh nj l <ky ctkrk g vkj ml dkbZ fHkUu ifr/ofu luk;h ugh nrh gA ;fn og

0;fDr ior dh vkj 90 m py] rk fHkUu ifr/ofu ugh luu d fy; ml <ky dk 60 / feuV dh nj l ctkuk iMrk gA /ofu dh xfr D;k gkxh

(A) 320 ms^{-1} (B) 340 ms^{-1} (C) 360 ms^{-1} (D) 380 ms^{-1}

Sol. $\frac{60}{40} = \frac{2d}{v}$

$\frac{60}{60} = \frac{2(d-90)}{v} = \frac{2d}{v} - \frac{180}{v}$

$1 = \frac{3}{2} - \frac{180}{v} \Rightarrow \frac{180}{v} = \frac{1}{2}$

V = 360 m/s.

Ans. (C)

68. A glass beaker is filled with water up to 5 cm. It is kept on top of a 2 cm thick glass slab. When a coin at the bottom of the glass slab is viewed at the normal incidence from above the beaker, its apparent depth from the water surface is d cm. Value of d is close (the refractive indices of water and glass are 1.33 and 1.50,respectively)

,d dkp d chdj e 5 cm d ÅpkbZ rd ty Hkjk gA bl chdj dk 2 cm ekVkbZ dh dkp dh ,d f'kyk ij j[kk tkrk gA ,d flDd dk f'kyk d fupyh ry ij j[kk gA ;fn bl flDd dk chdj d Åij l yEcor fn'kk e n[kk tkrk g] rc bldh vkHkklh xgjkbZ ikuh dh lrg l d cm gkrh g A d dk fudVre ekuk gkxk (ikuh rFkk dkp dk viorukd de'k 1.33 rFkk 1.50 g] chdj dh ekVkbZ dk ux.k ekfu,A)

(A) 2.5 (B) 5.1 (C) 3.7 (D) 6.0

Sol. $d = \frac{5}{4/3} + \frac{2}{3/2} = \frac{15}{4} + \frac{4}{3} = 5.08\text{cm}$

Ans. (B)

69. A proton of mass m and charge e is projected from a very large distance towards an α particle with velocity v. Intially, α particle is at rest, but it is free to move. If gravity is neglected, then the minimum separation along the straight lline of their motion will be

,d m n0;eku rFkk e vko'k d ikVkZu dk yEch njh l α d.k dh vkj ox l ifjfir fd;k tkrk gA α d.k 'k:vkr e fLFkj voLFkk e g] ijr xfr dju d fy; Lor=k gA x:Ro dk ux.k ekur g,] mudh xfr dh j[kk e] α d.k vkj ikVkZu d chp dh U;ure njh D;k gkxh ?

(A) $e^2/4\pi\varepsilon_0\, mv^2$ (B) $5e^2/4\pi\,\varepsilon_0 mv^2$ (C) $2e^2/4\pi\,\varepsilon_0 mv^2$ (D) $4e^2/4\pi\,\varepsilon_0 mv^2$

Sol. $\frac{1}{2}\left(\frac{m.4m}{m+4m}\right)v^2 = \frac{1}{4\pi\varepsilon_0}\frac{2e^2}{r}$

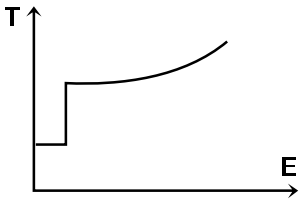
$r = \frac{5e^2}{4\pi\varepsilon_0 mv^2}$

Ans. (B)

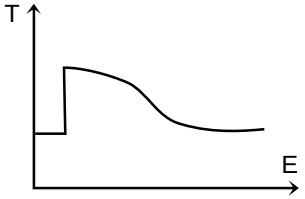
70. A potential is given by $V(x) = (x + \alpha)^2/2$ for $x < 0$ and $V(X) = k(X - \alpha)^2/2$ for $x > 0$. The schematic varitation of oscillation period (T) for a performating periodic motion in this potential as a function of its energy E is:

fdlh fLFkfrt Åtk] V(x) dk x d lki{k lehdj.k $V(x) = k(x+a)^2/2$, tc $x < 0$, vkj $V(x) = k(x-a)^2/2$, tc $x > 0$,(a ,d /kukRed fLFkjkd g) l fu:fir fd;k tkrk gA ,d vkor dky dk d.k dh Åtk E d lki{k ifjoru fdl vkj[k }kjk lgh :Ik n'kk;k x;k g

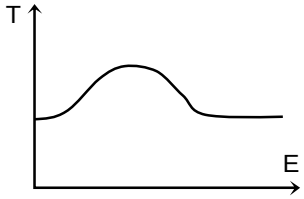
(A)



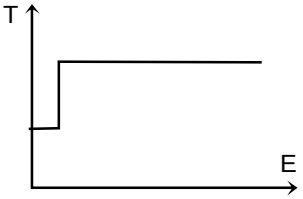
(B*)



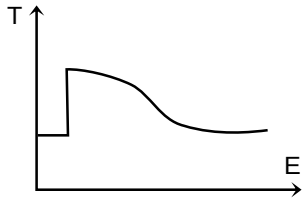
(C)



(D)



Sol.



Ans. (B)

CHEMISTRY

71. Among the followig, the species with identical bond order are

(A) CO and O_2^{2-} (B) O_2^- and CO (C) O_2^{2-} and B_2 (D) CO and N_2^+

fuEu ;Xek e l fdl ;Xe e ,dleku vkc/k Øe ¼cM+k vkMj½ ik;k tkrk g

(A) CO vkj O_2^{2-} (B) O_2^- vkj CO (C) O_2^{2-} vkj B_2 (D) CO vkj N_2^+

Sol.

	Number of electron	Bond order
O_2^{2-}	18	BO = $\frac{10-8}{2} = 1$
B_2	10	BO = $\frac{6-4}{2}$

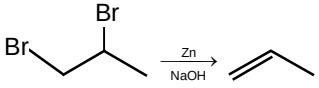
Ans. (C)

72. The quantity of heat (in J) required to raise the temperature of 1.0 kg of ethanol from 293.45 K to the boilig point and then change the liquid to vapor at that temperature is closest to
[Given: Boiling point of ethanol 351.45K]
Specific heat capacity of liquid ethanol 2.44 J g^{-1} K^{-1}
Latent heat of vaporization of ethanol 855 J g^{-1}]
(A) 1.42×10^2 (B) 9.97×10^2 (C) 1.42×10^5 (D) 9.97×10^5
1.0 kg bFkuky d rkieku dk 293.45 K l DoFkukd rd vkj fQj ml rkieku ij no dk okf"ir dju d fy, vko';d Å"ek dh ek=kk (J e) dk fudVre eku fuEu e l dku l k gkxk \
[fn;k g % bFkuky dk DoFkukd 351.45K
no bFkuky dh fof'k"V Å"ek /kkfjrk 2.44 J g^{-1} K^{-1}
vkj bFkuky d ok"ihdj.k dh xlr Å"ek 855 J g^{-1}]
(A) 1.42×10^2 (B) 9.97×10^2 (C) 1.42×10^5 (D) 9.97×10^5

Sol. q = mc Δt + heat of vapourisation
= 1000 x 2.44 (351.45 – 293.45) + 855 x 1000 J
= 9.97 x 10^5 J
Ans. (D)

73. A solution of 20.2 g of 1,2-dibromopropane in MeOH upon heating with excess Zn produces 3.58 g of an unsaturated X. The yield (%) is closest to
[Atomic weight of Br is 80]
ehFkuky e 20.2 g 1,2-Mkbckekikiu dk feykdj Zn dh vf/kdrk e xje dju ij 3.58 g ,d vlrlr ;kfxd X mRiUu gkrk gA X dk mRikn (ifr'krrk e) fuEu e l fdld fudVre gA \
[Br dk ijek.k Hkkj 80]
(A) 18 (B) 85 (C) 89 (D) 30

Sol.



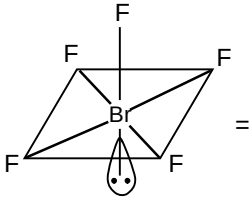
Mole = $\frac{20.2}{202}$ = 0.1 Mole = $\frac{3.58}{42}$ 0.085

% yield = $\frac{0.085}{0.1} \times 100 = 85\%$
Ans. (B)

74. The lowest stability of ehthyl anion compared to methyl anion and the higher stability of ethyl radical compared to methyl radical, respectively, are due to
(A) +I effect of the methyl group in ethyl anion and $\sigma \rightarrow$ p-orbital conjugation in ethyl radical.
(B) –I effect of the methyl group in ethyl anion and $\sigma \rightarrow \sigma^*$ conjugation in ethyl radical.
(C) +I effect of the methyl group in both cases
(D) +I effect of the methyl group in ethyl anion and $\sigma \rightarrow \sigma^*$ conjugation in ethyl radical.
,fFky _.kk;u dk efFky _.kk;u dh ryuk e de LFkk;h gkuk vkj ,fFky eyd dk efFky eyd dh ryuk e T;knk LFkk;h gku dk Øe'k% fuEu e l dku l k dkj.k g \
(A) ,fFky _.kk;u e efFky leg dk +I iHkko vkj eyd e σ l p vkjfcVy (orbital) dk l;Xeu
(B) ,fFky _.kk;u e efFky leg dk –I iHkko vkj eyd e σ l σ^* vkjfcVy (orbital) dk l;Xeu
(C) nkuk gh n'kkvk e efFky leg dk +I iHkko
(D) ,fFky _.kk;u e efFky leg dk +I iHkko vkj eyd e σ l σ^* vkjfcVy (orbital) dk l;Xeu

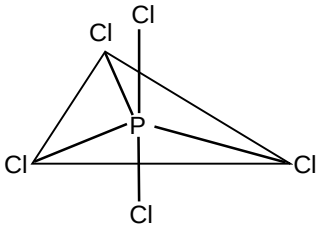
Sol. $CH_3 - \overline{C}H_2$ is less stable than $\overline{C}H_3$ as the CH_3– group exert +I effect $CH_3 - \dot{C}H_2$ radical is more stable than $\dot{C}H_3$, this is due to σ-p conjugation, also known as hyperconjugation.
Ans (A)

75. The F-B-F bond angels in BrF_5 and Cl-P-Cl bond angles in PCl_5, respectively, are
(A) identical in BrF_5 but non-identical in PCl_5
(B) identical in BrF_5 and identical in PCl_5
(C) non-identical in BrF_5 but identical in PCl_5
(D) non-identical in BrF_5 and non-identical in PCl_5
BrF_5 e F-B-F vkj PCl_5 e Cl-P-Cl d c/kd dk.k Øe'k% fuEu e fdl dFku d vulkj g \
(A) BrF_5 e le:i vkj PCl_5 e vle:i
(B) BrF_5 e le:i vkj PCl_5 e le:i
(C) BrF_5 e vle:i vkj PCl_5 e le:i
(D) BrF_5 e vle:i vkj PCl_5 e vle:i

Sol. $BrF_5 \longrightarrow$ 

= Square pyramidal

The lone pair occupy more space around the central atom and push away the four planar F atom. Here the axial Br–F bond length is 170 pm but equatorial Br–F bond length is 177 pm.

$PCl_5 \longrightarrow$ 

= Triangular peramidal
Two type of P–Cl bond.
P–Cl axial > P–Cl equatorial.
Ans. (D)

BIOLOGY

76. If the genotypes determining the blood groups of a couple are I^AI^B and I^AI^B, then the probability of their first child having type O blood is
(A) 0 (B) 0.25 (C) 0.50 (D) 0.75
;fn fdlh tkM d jDr leg dk fu/kkj.k dju oky thuk dk thu ik:i I^AI^B vkj I^AI^B g rk mud igy cPp dk jDr leg O gku dh ikf;drk fdruh g?
(A) 0 (B) 0.25 (C) 0.50 (D) 0.75
Ans. (A)

77. A Cross was carried out between two individuals heterozygous for two pairs genes was carried out. Assuming segregation and independent assortment the number of different genotype and phenotypes obtained respectively would be ?
(A) 4 and 9 (B) 6 and 3 (C) 9 and 4 (D) 11 and 4
thu d nk tkMk d fy, nk fo"ke;Xeth 0;f"V;k d e/; ldj.k djkr gA iFDdj.k vkj Lor=k vi0;gu d fl)krk dk viukr g,] bl ldj.k l ikIr g, fofHkUu thu&ik:i vkj y{k.k&ik:i Øe'k% fdru gkx ?
(A) 4 and 9 (B) 6 and 3 (C) 9 and 4 (D) 11 and 4
Ans. (C)

78. If the H^+ concentration of aqueous solutions is 0.001M, then the pOH of the solution would be?
(A) 0.001 (B) 0.999 (C) 3 (D) 11
;fn fdlh tyh; foy;u e H+ vk;u dk lkn.k 0.001 M g rk bl foy;u dk pOH fdruk gkxk\?
(A) 0.001 (B) 0.999 (C) 3 (D) 11

Ans. (D)

79. Consider the following vision defects listed in Column-I & II and the corrective measures in Column III. Choose the correct combination?

Column-I	**Column-II**	**Column-III**
P. Hypermetropia	i. near-sightedness	a. convex lens
Q. Myopia	ii. far-sightedness	b. concave lens

(A) P-ii-b (B*) Q-i-b (C) P-i-a (D) Q-i-a
LrEHk-I vkj II e lphc) fofHkUu nf"V ck/kkvk rFkk LrEHk III e fn, x, bu nk"kk dk l'kk/kuk dk rjhdk ij fopkj dhft,A lgh l;kstu dk p;u dhft,&

LrEHk -I	**LrEHk -II**	**LrEHk -III**
P. nj nf"Vnk"k	i. fudV nf"Vnk"k	a. mÙky yal
Q. fudV nf"Vnk"k	ii. njnf'krk	b. vory yal

(A) P-ii-b (B) Q-i-b (C) P-i-a (D) Q-i-a

Ans. (B)

80. Which ONE of the following properties causes the plant tendrils to coil around a bomboo stick?
(A) Tendril has spines
(B) The base of tendril grows faster than the tip
(C) Part of the tendril in contact with the bamboo stick grows at a slower rate than the part away from it
(D) The tip of the tendril grows faster than the base
fuEufyf[kr e l dku lk x.k ik/kk d irkuk dk ckl dh NMh d pkjk vkj fyiVu e lgk;d gkrk g?
(A) irkuk e dkV gkr gA
(B) irku dk v/kkj mld f'k[kj dh ryuk e rth l of) djrk gA
(C) irku dk og fgLlk tk ckl dh NMh d Li'k e jgrk g] vUl fgLl tk Li'k e ugh g fd ryuk e /kheh nj l of) djrk gA
(D) irku dk f'k[kj mld vk/kkj dh ryuk e rth l of) djrk gA

Ans. (C)