KVPY QUESTION PAPER-2017 (STREAM SA)

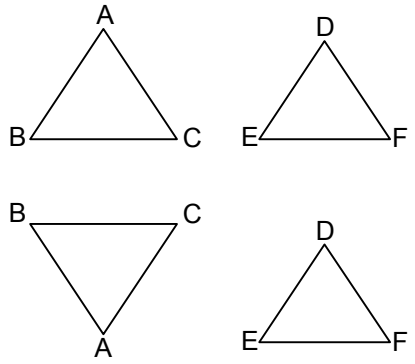
Date : 19 /11/2017

1. Suppose BC is a given line segment in the plane and T is a scalene triangle. The number of points A in the plane such that the triangle with vertices A,B,C (in some order) is similar to triangle T is **[2017]**

(A) 4 (B) 6 (C) 12 (D) 24

Sol. **[C]**

Let triangle T is DEF possibilities



$\therefore$ A can take two positions if $\Delta ABC \sim \Delta DEF$

We can arrange order of A, B, C in 3 ! = 6 ways

Total positions which A can take = 6 × 2 = 12

2. The number of positive integers n in the set {2,3,....,200} such that $\frac{1}{n}$ has a terminating decimal expansion is **[2017]**

(A) 16 (B) 18 (C) 40 (D) 100

Sol. **[B]**

The numbers will be

2, 4, 8, 16, 32, 64, 128,

5, 25, 125,

10, 20, 40, 50, 80, 100, 160, 200

3. If a,b,c are real numbers such that a + b + c = 0 and $a^2 + b^2 + c^2 = 1$, then $(3a + 5b - 8c)^2 + (-8a + 3b + 5c)^2 + (5a - 8b + 3c)^2$ is equal to **[2017]**

(A) 49 (B) 98 (C) 147 (D) 294

Sol. **[C]**

Expanding are get

$98 (a^2 + b^2 + c^2) - 98 (ab + bc + ca)$

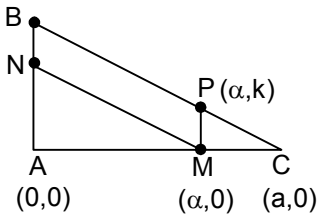
$= 98 - 98 \left(-\frac{1}{2}\right)$

$= 147$

4. Let ABC be a triangle and M be a point on side AC closer to vertex C than A. Let N be a point on side AB such that MN is parallel to BC and let P be a point on side BC such that MP is parallel to AB. If the area of the quadrilateral BNMP is equal to $\frac{5}{18}$ th of the area of triangle ABC, then the ratio AM/MC equals. **[2017]**

(A) 5 (B) 6 (C) $\frac{18}{5}$ (D) $\frac{15}{2}$

Sol. **[A]**



To find $\frac{AM}{MC} = \frac{\alpha}{a-\alpha}$ .....(i)

$\therefore \Delta BAC \sim \Delta PMC$

$\frac{PM}{CM} = \frac{BA}{AC}$

$\frac{k}{a-\alpha} = \frac{BA}{a}$

$BA = \frac{ak}{a-\alpha}$

$\therefore$ Area of $\Delta ABC = \frac{1}{2}$ AC. AB $= \frac{1}{2}$ a. $\frac{ak}{a-\alpha}$ ...(ii)

Area of quad. BNMP = Ar trap. AMPB – ar ΔAMN ...(iii)

Also $\Delta NAM \sim \Delta BAC$

$\frac{AN}{AM} = \frac{AB}{AC}$

$\frac{AN}{\alpha} = \frac{ak}{(a-\alpha)a}$

$AN = \frac{k\alpha}{a-\alpha}$

Put in (iii)

Area quad. BNMP $= \frac{1}{2}$ (AB + PM) × AM – $\frac{1}{2}$ AM × AN

$$= \frac{1}{2}\left|\frac{ak}{a-\alpha}+k\right| \times \alpha - \frac{1}{2}\,\alpha \times \frac{k\alpha}{a-\alpha}$$

$$= \frac{1}{2}\left[\frac{2ak\alpha - k\alpha^2 - k\alpha^2}{a-\alpha}\right]$$

$$= \frac{ak\alpha - k\alpha^2}{a-\alpha}$$

$= k\alpha$

Given $\alpha k = \frac{5}{18}\cdot\frac{1}{2}\cdot\frac{a^2k}{a-\alpha}$

$$\frac{36}{5} = \frac{a^2}{\alpha(a-\alpha)}$$

$36a\alpha - 36\alpha^2 = 5a^2$

$5a^2 - 36a\alpha + 36\alpha^2 = 0$

$5a^2 - 30a\alpha - 6a\alpha + 36\alpha^2 = 0$

$5a(a-6\alpha) - 6\alpha(a-6\alpha) = 0$

$5a = 6\alpha$ or $a = 6\alpha$

Not true as M is near to C than A

$$\therefore \frac{\alpha}{a-\alpha} = \frac{1}{\frac{a}{\alpha}-1} = \frac{1}{\frac{6}{5}-1} = 5$$

5. Let $n \geq 4$ be a positive integer and let ℓ_1, ℓ_2,....., ℓ_n be the lengths of the sides of arbitrary n–sided non-degenerate polygon P. Suppose

$$\frac{\ell_1}{\ell_2}+\frac{\ell_2}{\ell_3}+....\frac{\ell_{n-1}}{\ell_n}+\frac{\ell_n}{\ell_1} = n.$$

Consider the following statements:

I. The lengths of the sides of P are equal.

II. The angles of P are equal.

III. P is a regular polygon if it is cyclic.

Then **[2017]**

(A) I is true and I implies II (B) II is true

(C) III is false (D) I and III are true

Sol. **[D]**

given : $\frac{\ell_1}{\ell_2}+\frac{\ell_2}{\ell_3}$ .....+ $\frac{\ell_n}{\ell_1}$ = n .....(i)

$\therefore$ Use A.M $\geq$ G.M

We get

$$\frac{\left(\frac{\ell_1}{\ell_2}+\frac{\ell_2}{\ell_3}.....+\frac{\ell_n}{\ell_1}\right)}{n} \geq \sqrt[n]{\frac{\ell_1}{\ell_2}\cdot\frac{\ell_2}{\ell_3}.....\frac{\ell_n}{\ell_1}}$$

$\therefore \frac{n}{n} \geq 1$

$\Rightarrow n = n$

So A.M = G.M

Hence $\frac{\ell_1}{\ell_2} = \frac{\ell_2}{\ell_3} \ldots\ldots\ldots = \frac{\ell_n}{\ell_1} = k$

$\Rightarrow k = \frac{\ell_1 + \ell_2 \ldots\ldots + \ell_n}{\ell_2 + \ell_3 \ldots\ldots + \ell_n + \ell_1} = 1$

$\Rightarrow \ell_1 = \ell_2 \ldots\ldots = \ell_n$

6. Consider the following statements. For any integer n,

I. $n^2 + 3$ is never divisible by 17.

II. $n^2 + 4$ is never divisible by 17.

Then **[2017]**

(A) both I and II are true (B) both I and II are false

(C) I is false and II is true (D) I is true and II is false

Sol. **[D]**

$n^2 + 4$ is divisible by 17 check at n = 9

$\because \frac{n^2+3}{17} = \frac{n^2+4}{17} - \frac{1}{17}$ not divisible by 17

7. Let S be the set of all ordered pairs (x,y) of positive integers, with HCF (x,y) = 16 and LCM (x,y) = 48000. The number of elements in S is **[2017]**

(A) 4 (B) 8 (C) 16 (D) 32

Sol. **[B]**

48000 = 16 × 3000

= 16 × [$3^1 \times 2^3 \times 5^3$]

As H.C.F. is 16 So 2^3 can be selected in 1 way & $3^1 \times 5^3$ can be seleted in (1+ 1) (3 +1) = 8 ways

No of ordred pairs = 8

8. Consider the set A of natural numbers n whose units digit is nonzero, such that if this units digit is erased, then the resulting number divides n. If K is the number of elements in the set A, then **[2017]**

(A) K is infinite (B) K is finite but K > 100

(C) $25 \leq K \leq 100$ (D) K < 25

Sol. **[D]**

Such numbers are = 9 from 11 to 19

4 i.e. (22, 24, 26, 28)

3 i.e. (33, 36, 39)

2 i.e. (44, 48)

5 i.e. (55, 66, 77, 88, 99)

23

9. There are exactly twelve sundays in the period from january 1 to march 31 in a certain year. Then the day corresponding to february 15 in that year is **[2017]**

(A) Tuesday (B) Wednesday

(C) Thursday (D) not possible to determine from the given data

Sol. **[C]**

Obviously, 1st Jan will be monday as there will be 90 days from jan. 1 to march 31 (Non leap year)
(If year is leap year then days will be 91 = 13 weaks not possible
$\therefore$ 15th February will be Thursday

10. Consider a three-digit number with the following properties:

I. If its digits in units place and tens place are interchanged, the number increases by 36;

II. If its digits in units place and hundreds place are interchanged, the number decreases by 198.

Now suppose that the digits in tens place and hundreds place are interchanged. Then the number. **[2017]**

(A) increases by 180 (B) decreases by 270
(C) increases by 360 (D) decreases by 540

Sol. **[D]**

Let Three digit No is 100 a + 10 b + c
Given 100 a + 10 b + c = 100 a + 10 c + b – 36
9b – 9c + 36 = 0
c = b + 4
b = c – 4 ...(i)
Also given 100 a + 10 b + c = 100c + 10 b + a + 198
99 a – 99 c = 198
a = c + 2 ...(ii)
$\therefore$ Now 100 a + 10 b + c – (100 b + 10 a + c)
= 90 (a – b)
= 90 (c + 2 – c + 4) (use (i) & (ii))
= 540
$\therefore$ value decrease by 540

11. Consider four triangles having sides (5,12,9), (5,12,11), (5,12,13) and (5,12,15). Among these, the triangle having maximum area has sides **[2017]**

(A) (5,12,9) (B) (5,12,11) (C) (5,12,13) (D) (5,12,15)

Sol. **[C]**

Clearly area of Δ having sides (5, 12, 13)

is greatest (use $\Delta = \sqrt{s(s-a)(s-b)(s-c)}$

12. In a classroom, one-fifth of the boys leave the class and the ratio of the remaining boys to girls is 2:3. If further 44 girls leave the class, the ratio of boys to girls is 5 : 2. How many more boys should leave the class so that the number of boys equals that of girls? **[2017]**

(A) 16 (B) 24 (C) 30 (D) 36

Sol. **[B]**

Let no of Boys = x
& Let no of girls = y

Given $\frac{\left(\frac{4x}{5}\right)}{y} = \frac{2}{3}$

$\frac{2x}{5y} = \frac{1}{3}$

$y = \frac{6x}{5}$ ...(i)

Also, $\frac{\left(\frac{4x}{5}\right)}{y-44} = \frac{5}{2}$

$8x = 25\,(y - 44)$

$8x = 25\left(\frac{6x}{5} - 44\right)$ (use 1)

$x = 50$

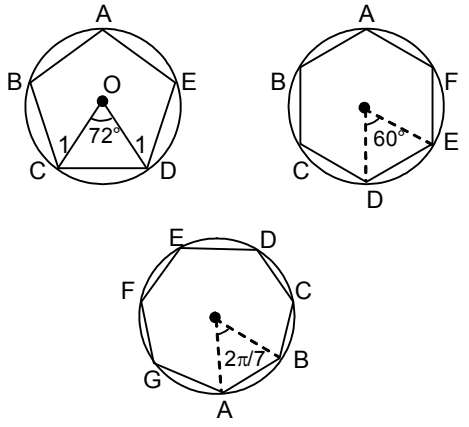
$y = 60$

13. Let X,Y,Z be respectively the areas of a regular pentagon, regular hexagon and regular heptagon which are inscribed in a circle of radius 1. Then **[2017]**

(A) $\frac{x}{5} < \frac{Y}{6} < \frac{Z}{7}$ and $X < Y < Z$ (B) $\frac{x}{5} < \frac{Y}{6} < \frac{Z}{7}$ and $X > Y > Z$

(C) $\frac{x}{5} > \frac{Y}{6} > \frac{Z}{7}$ and $X > Y > Z$ (D) $\frac{x}{5} > \frac{Y}{6} > \frac{Z}{7}$ and $X < Y < Z$

Sol. **[D]**



Area of Pentagon = $5 \times \frac{1}{2} \sin 72° = 2.377 = x$

Area of hexagon = $6 \times \frac{1}{2} \sin 60° = 3 \times \frac{\sqrt{3}}{2} = 2.598 = y$

Area of heptagon = $7 \times \frac{1}{2} \sin \frac{360°}{7} = 2.73 = z$

14. The least value of a natural number n such that $\binom{n-1}{5} + \binom{n-1}{6} < \binom{n}{7}$, where $\binom{n}{r} = \frac{n!}{(n-r)!r!}$, is **[2017]**

(A) 12 (B) 13 (C) 14 (D) 15

Sol. **[C]**

$^{n-1}C_5 + {}^{n-1}C_6 < {}^nC_7$

$^nC_6 < {}^nC_7$

$$\frac{n!}{6!(n-6)!} < \frac{n!}{7!(n-7)!}$$

$n - 6 > 7$

$n > 13$

$n_{min} = 14$

15. In a Mathematics test, the average marks of boys is x% and the average marks of girls is y% with $x \neq y$. If the average marks of all students is z%, the ration of the number of girls to the total number of students is **[2017]**

(A) $\frac{z-x}{y-x}$ (B) $\frac{z-y}{y-x}$ (C) $\frac{z+y}{y-x}$ (D) $\frac{z+x}{y-x}$

Sol. **[A]**

Given

Let no. of Boys = B & no of girls = G

$\therefore$ Sum of marks obtained by boys = B.x

$\therefore$ Sum of marks obtained by girls = G.y

Now, given

$$\frac{Bx + Gy}{B + G} = z$$

$B(x - z) = G(z - y)$

$$\frac{B}{G} = \frac{z-y}{x-z}$$

Add 1

$$\frac{B}{G} + 1 = \frac{z-y}{x-z} + 1$$

$$\Rightarrow \frac{B+G}{G} = \frac{x-y}{x-z}$$

$$\Rightarrow \frac{G}{B+G} = \frac{z-x}{y-x}$$

Section 2-Part A-Physics

16. Particle sused in the Rutherford's scattering experiment to deduce the structure of atoms **[2017]**

(A) had atomic number 2 and were fully ionised. (B) had atomic number 2 and were neutral.

(C) had atomic number 4 and were fully ionised. (D) had atomic number 4 and were neutral.

Sol. **[A]**

α-particle bombard during experiment

α-particles ionized helium

17. The number of completely filled shells for the element $_{16}S^{32}$ is **[2017]**

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

Sol. **[B]**

Electronic configuration of sulphur is $1S_2, 2S_2, 2P_6, 3S_2, 3P_4$

18. In an experiment on simple pendulum to determine the acceleration due to gravity, a student measures the elngth of the thread as 632 cm and diameter of the pendulum bob as 2.256 cm. The student should take the lenght of the pendulum to be **[2017]**

(A) 64.328 cm (B) 64.36 cm (C) 65.456 (D) 65.5 cm

Sol. **[B]**

length should be taken up to com

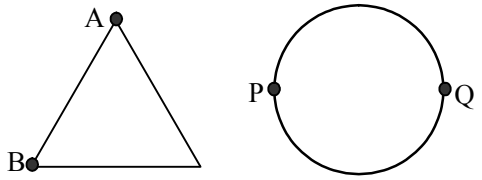
$$\ell_{net} = 63.2 + \frac{2.256}{2}$$

$\Rightarrow 64.328$

by signlicont figures

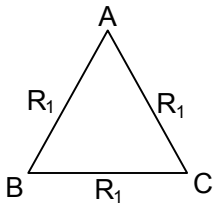
$\ell_{net} \Rightarrow 64.3$ cm

19. A uniform metallic wire of lenght L is mounted in two configurations. In configuration I (triangle), it is an equilateral triangle and a voltage V is applied to corners A and B. In configuration 2 (circle), it is bent in the form of a circle, and the potential v is applied at diametericallly opposite points P and Q. The ratio of the power dissipated in configuration 1 to configuration 2 is. **[2017]**



(A) 2/3 (B) 9/8 (C) 5/4 (D) 7/8

Sol. **[B]**



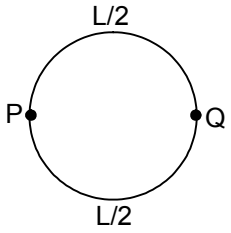
$$R = \frac{\rho\ell}{A}$$

$$\left(R_1 = \frac{\rho\frac{\ell}{3}}{A}\right)$$

$$\frac{1}{R_{ep}} \Rightarrow \frac{1}{2R_1} + \frac{1}{R_1} \Rightarrow 2$$

$$R_{eq} = \frac{2R_1}{3} = \frac{2\rho\frac{\ell}{3}}{3A}$$

$$i_1 = \frac{V}{R_{eq}} = \frac{V}{2e\ell}\ 9A$$

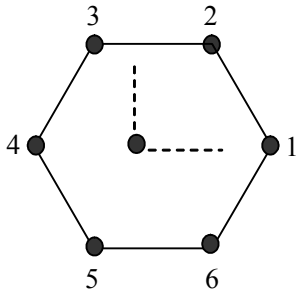


$R_{eq} \Rightarrow \frac{R}{2} \Rightarrow \frac{1}{2}\left(\frac{\rho.\ell/2}{A}\right)$

$i_2 = \frac{V}{R_{eq}} \Rightarrow \frac{V}{\rho\ell} 4A$.

$\frac{i_1}{i_2} = \frac{9}{8}$

20. Six objects are placed at the vertices of a regular hexagon. The geometric center of the hexagon is at the origin with objects 1 and 4 on the x-axis (see figure). The mass of the k^{th} object is mk = k M $|\cos q_k|$ where i is an integer, M is a constant with dimension of mass, and q_k is the angular position of the kth verted measured from the positive x-axis in the counter-clockwise sense. If the net gravitational force on a body at the centroid vanishes, the value of i is **[2017]**



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

Sol. **[A]**

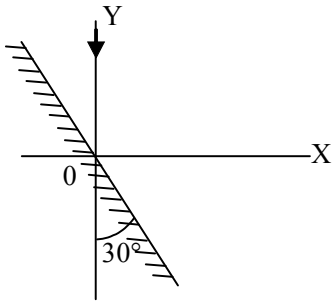
For Gravitational equilibrium $(F_{Net}) \Rightarrow 0$

All Diagonal opposite should have equal mass

$2i° M \cos 60° \Rightarrow 4i° M \cos(60° + 180°)$

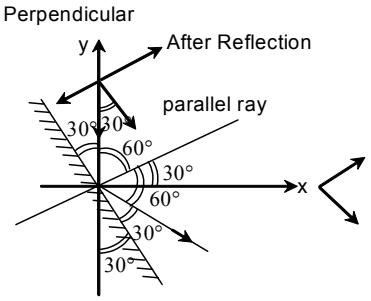
Thus i = 0

21. A mirror is placed at an angle of 30° with respect to y-axis (see figure). A light ray travelling in the negative y-direction strikes the mirror. The direction of the reflected ray is given by the vector **[2017]**



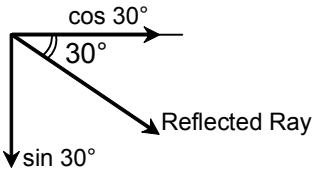
(A) $\hat{i}$ (B) $\hat{i} - \sqrt{3}\hat{j}$ (C) $\sqrt{3}\hat{i} - \hat{j}$ (D) $\hat{i} - 2\hat{j}$

Sol. **[C]**



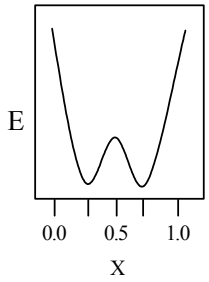
Incident Ray = $-\hat{j}$

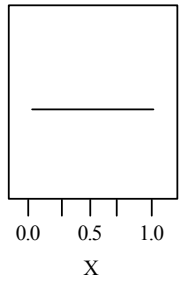
Reflected Ray

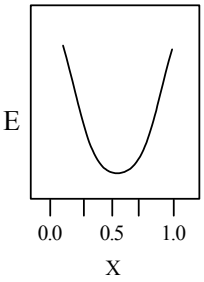


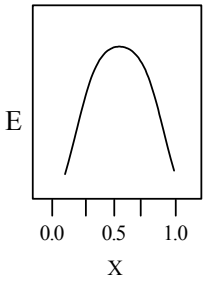
Vector $\Rightarrow \frac{\sqrt{3}}{2}\hat{i} - \frac{1}{2}\hat{j}$

22. A total charge q is divided as q_1 and q_2 which are kept at two of the vertices of an equilateral triangle of side a. The magnitude of the electric field $\vec{E}$ at the third vertex of the triangle is to be depicted schematically as a function of $x = q_1/q$. Choose the correct figure. **[2017]**

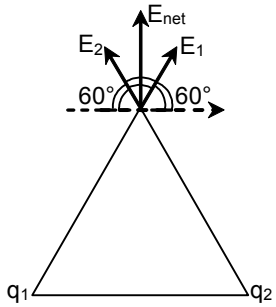
(A)


(B)


(C)


(D)


Sol. **[C]**



$E_{net} = \vec{E}_1 + \vec{E}_2$

$q = q_1 + q_2$

$$|\vec{E}_{net}| = \sqrt{\left(\frac{kq_1}{a}\right)^2 + \left(\frac{kq_2}{a}\right)^2 + \frac{2k^2q_1q_2}{a^2}\cdot\cos 60^\circ}$$

$$E_{net} = \frac{k}{a}\sqrt{q_1^2 + q_2^2 + q_1q_2}$$

$$E_{net} = \frac{k}{a}\sqrt{q_1^2 + (q-q_1)^2 + q_1(q-q_1)}$$

$$= \frac{k}{aq} \times \sqrt{\left(\frac{q_1}{q}\right)^2 + 1^2 + \left(\frac{q_1}{q}\right)^2 - \frac{2q_1}{q} + \frac{q_1}{q} - \frac{q_1^2}{q^2}}$$

$$= \frac{k}{aq}\sqrt{x^2 + 1 - x}$$

$$E_{net} = \frac{k}{aq}\left(\sqrt{(x-1/2)^2 + 3/4}\right)$$

Minima must be at $|x = 1/2|$

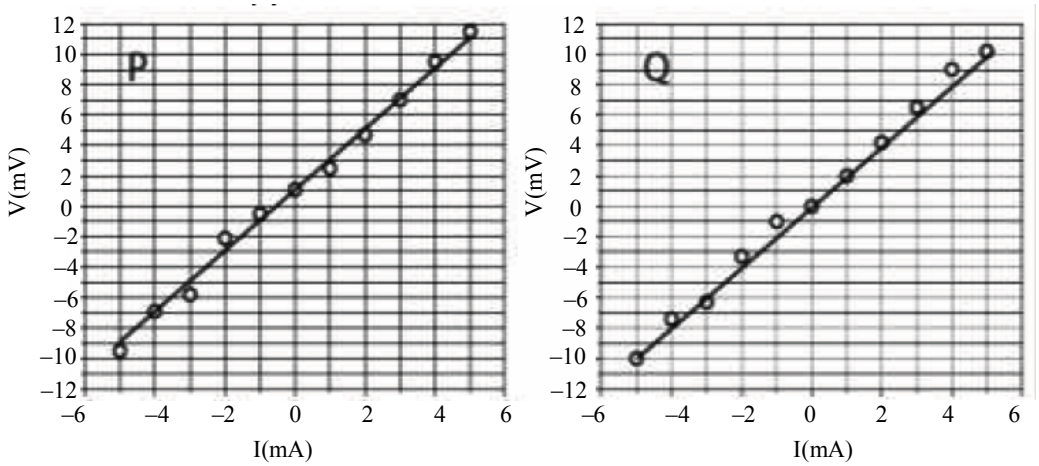
23. The refractive index of water in a biology laboratory tank veries as $1.33 + 0.002/\lambda^2$, where λ is the wavelength of light. Small pieces of organic matter of different colours are seen at the bottom of the tank using a travelling microscope. Then the image of the orgainc matter appears **[2017]**

(A) deeper for the violet pieces than the green ones.
(B) shallower for the blue pieces than the orange ones.
(C) at the same depth for both the blue and orange pieces.
(D) deeper for the green pieces than the red ones.

Sol. **[B]**

Theoritical

24. Two students P and Q perform an experiment to verify Ohm's law for a conductor with resistance R. They use a current source and a voltmeter with least counts of 0.1 mA and 0.1 mV, respectively. The plots of the variation of voltage drop (V) across R with current (I) for both are shown below **[2017]**

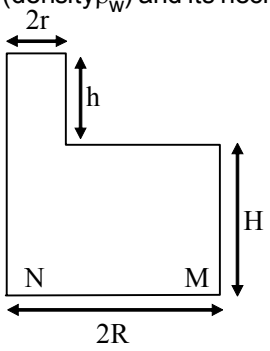


The statement which is most likely to be correct is:

(A) P has only random error (s).
(B) Q has only systematic error (s).
(C) Q has both random and systematic errors.
(D) P has both random and systematic errors.

Sol. **[D]**
Theoritical

25. A cylindrical vessel of base radius R and height H has a narrow neck of height h and radius r at one end (see figure). The vessel is filled with water (density ρ_w) and its neck is filled with immiscible oil (density ρ_O). Then the pressure at **[2017]**



(A) M is $g(h\rho_0 + H\rho_w)$

(B) N is $g(h\rho_0 + H\rho_w)\frac{r^2}{R^2}$

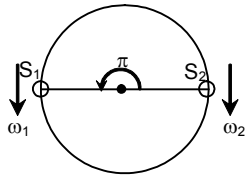
(C) M is g $H\rho_w$

(D) N is $g\frac{\rho_w HR^2 + \rho_0 hr^2}{R^2 + r^2}$

Sol. **[A]**
Pressure at same height is same
$P_M = P_N = \rho_0 gH + \rho_w gH$

26. Two cars S_1 and S_2 are moving in coplanar concentric circular tracks in the opposite sense with the periods of revolution 3 min and 24 min, respectively. At time t = 0, the cars are farthest apart. Then, the two cars will be **[2017]**
(A) closest to each other at t = 12 min and farthest at t = 18 min.
(B) closest to each other at t = 3 min and farthest at t = 24 min
(C) closest to each other at t = 6 min and farthest at t = 12 min
(D) colsest to each other at t = 12 min and farthest at t = 24 min

Sol. **[D]**



$\omega_1 = \frac{2\pi}{3}$

$\omega_2 = \frac{2\pi}{24}$

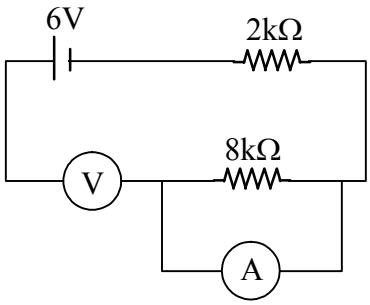
time for meet (closest) $= \frac{\pi(2\pi+1)}{\omega_1 + \omega_2} \Rightarrow \frac{4}{3}$ (2n + 1)

$t \Rightarrow \frac{4}{3}$ sec, 4, $\frac{20}{3}$, $\frac{28}{3}$, 12

time of farthest $\Rightarrow \dfrac{2\pi n}{\omega_1 + \omega_2}$

$t \neq 2n/\dfrac{4}{3}$

27. In the circuit shown below, a student performing Ohm's law experiment accidently puts the voltmeter and the ammeter as shown in the circuit below; the reading in the voltmeter will be close to **[2017]**



(A) 0V (B) 4.8 V (C) 6.0 V (D) 1.2 V

Sol. **[C]**

Voltmeter has very high Resistane thus it is put in parallel. If it is put in series maximum of potential difference will be across voltmeter

28. The bhagirathi and the Alaknanda merge at Deoprayag to form the Ganga with their speeds in the ratio 1 :1.5. The cross-sectional areas of the Bhagirathi, the Alaknanda and the Ganga are in the ratio 1 : 2 :3. Assuming stremline flow, the ratio of the speed of Ganga to that of the Alaknands is **[2017]**

(A) 7 : 9 (B) 4 :3 (C) 8 : 9 (D) 5 :3

Sol. **[C]**

By equation of continuity

Area of Bhagirathi $\Rightarrow$ A

Area of Alaknanda $\Rightarrow$ 2A

Area of Ganga $\Rightarrow$ 3A

$V_B : V_{AL} : V_G : \Rightarrow V : \dfrac{3}{2}V : V_1$

By equation of continuity

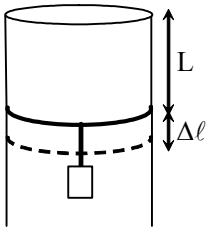
$AV + \dfrac{3}{2}A \cdot 2.V \Rightarrow 3A \cdot V_1$

$V_{ganga} = \dfrac{4}{3}V$

$\dfrac{V_{Alaknanda}}{V_{ganga}} \Rightarrow \dfrac{\frac{3}{2}V}{\frac{4}{3}V} = \dfrac{9}{8}$

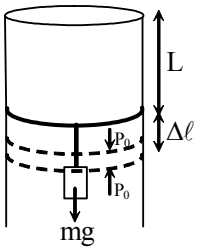
$V_{ganga} : V_{Alaknanda} = 8 : 9$

29. A long cylindrical pipe of radius 20 cm is closed at its upper end and has an airtight piston of negligible mass as shown. When a 50 Kg mass is attached to the other end of the pistion, it moves down by a distance Δl before coming to equilibrium. Assuming air to be an ideal gas, $\Delta l/L$ (see figure) is close to ($g = 10\ ms^2$, atmospheric pressure is 10^5 Pascal), **[2017]**



(A) 0.01 (B) 0.02 (C) 0.04 (D) 0.09

Sol. **[C]**



Process is isothermal

$P_1V_1 = P_2V_2$

$(P_0)(A)(\ell) \Rightarrow PA(\ell + \Delta\ell)$

$$P_{final} \Rightarrow \frac{P_0A\ell}{A(\ell+\Delta\ell)} \Rightarrow \frac{P_0\ell}{\ell+\Delta\ell}$$

By force equilibrium

$(P_0 - P)A \Rightarrow mg$

$$\left(P_0 - \frac{P_0\ell}{\ell+\Delta\ell}\right)A = mg$$

$$\frac{\Delta\ell}{\ell} \approx 0.04$$

30. The word ''KVPY'' is written on a board and viewed through different lense such that board is at a distance beyond the focal length of the lens. **[2017]**

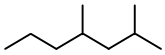
(i) (ii)

Ignorging magnification effects, consider the following statements
(I) Image (i) has been viewed from the planar side of a plano-convex lens and image (ii) from the planar side of a plano-convex lens.
(II) Image (i) has been viewed from the concave side of a plano-concave lens and image (ii) from the convex side of a plano-convex lens.
(iii) Image (i) has been viewed from the cocave side of a plano-concave lens and image (ii) from the planar side of a plano-convex lens.
(iv) Image (i) has been viewed from the planar side of a plano-concave lens and image (ii) from the convex side of a plano-convex lens.
Which of the above statements are correct ?
(A) Only (III) (B) Only (IV). (C) Only (III) and (IV). (D) All four.

Sol. **[D]**
(i) For plano-concave lens or concave lens if object is placed beyond focus image is erected
(ii) For convex lens If object is placed beyond focus image is inverted

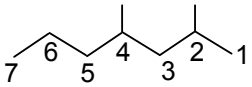
Section 3 Part 1 Chemistry

31. The IUPAC name for the following compound is **[2017]**



(A) 4,6-dimethylheptane (B) 1,3,5 -trimethylhexane
(C) 2,4-dimethylheptane (D) 2,4,6--trimethylhexane

Sol. **[C]**



2, 4 – dimethyl heptane.

32. The stability of carbocations **[2017]**

$(CH_3)_3\overset{\oplus}{C}$ $(CH_3)_2\overset{\oplus}{C}(OCH_3)$ $CH_3CH_2CH_2\overset{\oplus}{C}H_2$ $CH_3\overset{\oplus}{C}HCH_2CH_3$
I II III IV

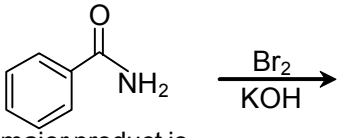
follows the order
(A) III < IV < II < I (B) III < IV < I < II (C) IV < III < II < I (D) IV < III < I < II

Sol. **[B]**
(II) is most stable due to resonance then **3° > 2° > 1°** carbocation

33. The acidity of compounds I-IV in water
I. Ethanol
II. Acetic Acid
III. Phenol
IV. Acetonitrile
follows the order **[2017]**
(A) IV < I < III < II (B) I < II < III < IV (C) IV < I < II < III (D) IV < III < I < II

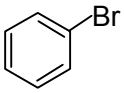
Sol. **[A]**
Acetic acid is most acidic due to equivalent resonating structure.

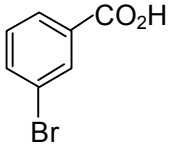
34. In the following reaction

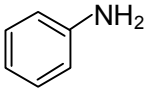


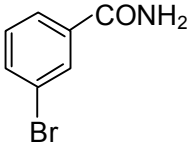
[2017]

the major product is

(A) 

(B) 

(C) 

(D) 

Sol. **[C]**

This is a Name Reaction to prepare 1° amine.

35. The reddish brown precipitate formed in the Fehling's test for aldehydes (RCHO) is due to the formation of **[2017]**

(A) Cu (B) Cu_2O (C) CuO (D) $(RCOO)_2Cu$

Sol. **[B]**

Theoritical

36. The reducing ability of the metals K, Au, Zn and Pb follows the order **[2017]**

(A) K > Pb > Au > Zn (B) Pb > K > Zn > Au (C) Zn > Au > K > Pb (D) K > Zn > Pb > Au

Sol. **[D]**

Theoritical

37. White phosphorous catches fire in air to produce dense white fumes. This is due to the formation of **[2017]**

(A) P_4O_{10} (B) PH_3 (C) H_3PO_3 (D) H_3PO_2

Sol. **[A]**

Theoritical

38. The maximum number of electrons that can be filled in the shell with the principal quantum number n = 4 is **[2017]**

(A) 64 (B) 26 (C) 18 (D) 32

Sol. **[D]**

4s, 4p, 4d & 4f contains total 32 electrons.

39. At a constant pressure P, the plot of volume (V) as a function of temperature (T) for 2 moles of an ideal gas gives a straight line with a slope 0.328 L K^{-1}. The value of P (in atm) is closest to

[Gas constant, R = 0.0821 L atm mol^{-1} K^{-1}] **[2017]**

(A) 0.25 (B) 0.5 (C) 1.0 (D) 2.0

Sol. **[B]**

$PV = nRT$

$$\Rightarrow \frac{V}{T} = \frac{nR}{P} = \text{slope}$$

$$\Rightarrow P = \frac{nR}{\text{slope}} = \frac{2 \times 0.0821}{0.328} = 0.5$$

40. Which of the following transformations can be carried out by using HI as a rducing agent, under acidic conditions ? **[2017]**

[Given : $I_2(s) \rightarrow 2I^-$ $E^\theta = 0.54$ V]

(i) $Cu^+ \rightarrow Cu(s)$ $E^\theta = 0.52$ V

(ii) $Cr^{3+} \rightarrow Cr^{2+}$ $E^\theta = -0.41$ V

(iii) $Fe^{3+} \rightarrow Fe^{2+}$ $E^\theta = 0.77$ V

(iv) $Fe^{2+} \rightarrow Fe(s)$ $E^\theta = -0.44$ V

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

Sol. **[C]**

$Fe^{+3} \rightarrow Fe^{+2}$ is having maximum SRP value.

41. C_{60} emerging from a source at a speed (v) has a de Broglie wavelength of 11.0 Å. The value of v (in m s^{-1}) is closest to

[Planck's constant h = 6.626×10^{-34} J s] **[2017]**

(A) 0.5 (B) 2.5 (C) 5.0 (D) 30

Sol. **[A]**

$$\lambda = \frac{h}{mv} \Rightarrow v = \frac{h}{m.\lambda} = \frac{6.62\times10^{-34}}{720\times10^{-3}\times11\times10^{-10}}$$

42. The lattice energies of NaCl, NaF, KCl and RbCl follow the order **[2017]**

(A) KCl < RbCl < NaCl < NaF (B) NaF < NaCl < KCl < RbCl

(C) RbCl < KCl < NaCl < NaF (D) NaCl < RbCl < NaF < KCl

Sol. **[C]**

$$\uparrow U \propto \frac{1}{\text{size} \downarrow}$$

43. The oxidation states of P atom in $POCl_3$, H_2PO_3 and $H_4P_2O_6$, respectively, are **[2017]**

(A) +5, +4, +4 (B) +5, +5, +4 (C) +4, +4, +5 (D) +3, +4, +5

Sol. **[A]**

	O. No.
$POCl_3$	+ 5
H_2PO_3	+ 5
$H_4P_2O_6$	+ 4

44. A solution (5 mL) of an acid X is completely neutralized by y mL of 1M NaOH. The same volume (y ML) of 1M NaOH is required to neutralize 10 mL of 0.6 M of H_2SO_4 completely. The normality (N) of the acid X is **[2017]**

(A) 1.2 (B) 2.4 (C) 4.8 (D) 0.6

Sol. **[B]**

$(\text{No. of eq.})_{NaOH} = (\text{No. of eq.})_{H_2SO_4}$

$\Rightarrow (1\times1) \times y = (0.6 \times 2) \times 10$

$\Rightarrow y = 12$ ml

Now, $(\text{No. of eq.})_{acid} = (\text{No. of eq.})_{NaOH}$

$\Rightarrow N \times 5 = (1 \times 1) \times 12$

$$\Rightarrow N = \frac{12}{5} = 2.4$$

45. 1.25 g of a metal (M) reacts with oxygen completely to produce 1.68 g of metal oxide. The empirical formula of the metal oxide is **[2017]**
[molar mass of M and O are 69.7 g mol^{-1} and 16.0 g mol^{-1}, respectively]
(A) M_2O (B) M_2O_3 (C) MO_2 (D) M_3O_4

Sol. **[B]**

$$M + O_2 \longrightarrow MO$$
$$1.25 \qquad\qquad 1.68$$

$$\Rightarrow \frac{1.25}{E} = \frac{1.68}{E+8}$$

$$\Rightarrow \boxed{E = 23.25}$$

$$\text{n - factor} = \frac{69.7}{23.25} \approx 3$$

$\therefore$ **Emprical formula = M_2O_3**

Section 4 Part-A Biology

46. According to Watson-Crick model, hydrogen bonding in a double-stranded DNA occures between **[2017]**
(A) Adenine and guanine (B) Adenine and thymine
(C) Cytosine and adenine (D) guanine and thymine

Sol. **[B]**
A pairs with T & G pairs with C in DNA.

47. Which ONE of the following statements about mitosis is CORRECT ? **[2017]**
(A) One nucleus gives rise to 4 nuclei
(B) Homologous chromosomes synapse during anaphase
(C) The centromeres separate at the onset of anaphase
(D) Non-sister chromatids recombine

Sol. **[C]**
In anaphase sister chromatids seperates from centromeres so number of chromosome becomes double.

48. Gaseous exchange of oxygen and carbon dioxide between alveolar air and capillaries takes place by **[2017]**
(A) Active transport (B)Diffusion (C) Carrier-mediated transport (D) Imbibition

Sol. [B]
By diffusion along concentration gradient.

49. Of the periods listed below, which ONE is the earliest period when Ostracoderms, the jawless and finless fishes, appeared? **[2017]**
(A) Devonian period (B) Cambrian period (C) Carboniferous period (D) Silurian period

Sol. [D]
Period is time

50. Scurvy is caused by the deficiency of **[2017]**
(A) Nicotinic acid (B) Ascorbic acid (C) Pantothenic acid (D) Retinoic acid

Sol. [B]
Ascorbic acid is required for a variety of biosynthetic pathway. It is required for collagen synthesis during wound healing.

51. Optical activity of DNA is due to its **[2017]**
(A) Bases (B) Sugars (C) Phosphate (D) Hydrogen bonds
Sol. [B]
Fact based questions

52. The monarch butterfly avoids predators such as birds by **[2017]**
(A) Changing color frequently
(B) Flying away from the predator swiftly
(C) Producing a chemical obnoxious to the predator
(D) Producing ultrasonic waves
Sol. [C]
Pray may have some defence mechanism to protect itself from predator like producing toxic substance.

53. Filariasis is caused by **[2017]**
(A) *Entamoeba histolytica* (B) *Plasmodium falciparum*
(C) *Trypanosoma brucei* (D) *Wuchereria bancrofti*
Sol. [D]
Wuchereria bancrofti lives in lymphatic vessels and causes swelling of lower limps and scrotum

54. Which ONE of the following conversions does NOT happen under anaerobic conditions ? **[2017]**
(A) Glucose to ethanol by *Saccharomyces.* (B) Lactose to lactic acid by *Lactobacillus.*
(C) Glucose to CO_2 and H_2O by *Saccharomyces.* (D) Cellulose to glucose by *Cellulomonas.*
Sol. [C]
Glucose to CO_2 and H_2O is formed during aerobic respiration.

55. An amont of 18 g glucose corresponds to **[2017]**
(A) 1.8 mole (B) 1 mole (C) 0.18 mole (D) 0.1 mole
Sol. [D]

$$\text{Mole} = \frac{\text{mass in gram}}{\text{molecular weight}} = \frac{18}{180} = 0.1$$

56. The number of electrons required to reduce one molecule of oxygen to water during mitochondrial oxidation is **[2017]**
(A) 4 (B) 3 (C) 2 (D) 1
Sol. [A]
$O_2 + 4e^- + 4H^+ \longrightarrow 2H_2O$

57. Which ONE of the following molecules is dervied from pantothenic acid ? **[2017]**
(A) Thiamine pyrophosphate (B) Nicotinamide adenine dinucleotide phosphate
(C) Flavin adenine dinucleotide phosphate (D) Acetyl-CoA
Sol. [D]
Vitamin B_5 is pantothenic acid, that synthesize Co-enzyme A (CoA)

58. Match the disease given in Column I with the principal causal organism in Column II and choose the correct combination. **[2017]**

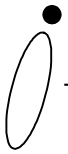
Colum I	**Column II**
(P) AIDS	(i) HBV
(Q) Syphilis	(ii) *Neisseria sp.*
(R) Viral hepatitis	(iii) *Treponema sp.*
(S) Gonorrhoea	(iv) HIV

(A) P-iv, Q-iii, R-i, S-ii (B) P-iv, Q-ii, R-i, S-iii
(C) P-i, Q-ii, R-iv, S-iii (D) P-i, Q-iv, R-ii, S-ii
Sol. [A]

59. Chromosomes are classified based on the position of centromere. A chromosome having a terminal centromere is called **[2017]**

(A) metacentric (B) telocentric (C) sub-metacentric (D) acrocentric

Sol. **[B]**



Telocentric Chromosome

60. Which ONE of the following options lists the primary energy source (s) for all forms of life on earth ? **[2017]**

(A) Light, Inorganic substances (B) Inorganic substances, Organic substances

(C) Light, Organic substances (D) N_2, CO_2

Sol. [A]

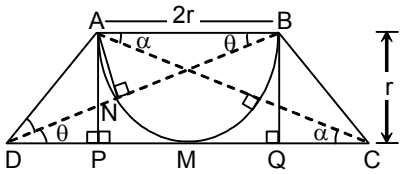
Autotrophs uses light for photosynthesis and some bacteria inorganic compound for chemosynthesis these organisms are produces in ecosystem.

Section 5-Part B-Mathematics

61. Let ABCD be a trapezium with parallel sides AB and CD such that the circle S with AB as its diameter touches CD. Further, the circle S passes through the midpoints of the diagonals AC and BD of the trapezium. The smallest angle of the trapezium is **[2017]**

(A) $\frac{\pi}{3}$ (B) $\frac{\pi}{4}$ (C) $\frac{\pi}{5}$ (D) $\frac{\pi}{6}$

Sol. [D]



Join AN

$\because \angle ANB = 90°$

In ΔANB,

$\cos\theta = \frac{BN}{2r}$

$BN = 2r\cos\theta$

$BD = 2BN = 4r\cos\theta$

In ΔBQD

$\sin\theta = \frac{BQ}{BD} = \frac{r}{4r\cos\theta}$

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

$\theta = 15°$

Now similarly $\alpha = 15° = \theta$ & $AC = 4r\cos\alpha$

$\therefore$ Trapezium will be isosceles

$\because \angle ADB = 30°$

62. Let S be the set of all points $\left(\frac{a}{b}, \frac{c}{d}\right)$ on the circle with radius 1 centred at (0,0) where a and b are relatively prime integers, c and d are relatively prime integers (that is HCF (a, b) = HCF (c,d) = 1), and the integers b and d are even. Then the set S **[2017]**

(A) is empty (B) has four elements (C) has eight elements (D) is infinite

Sol. [A]

circle is $x^2 + y^2 = 1$

$$y = \pm\sqrt{1-\frac{a^2}{b^2}} \qquad \left(\because\ x = \frac{a}{b}\right)$$

$$y = \pm\frac{1}{b}\sqrt{b^2 - a^2}$$

As y is retional so

$b^2 - a^2 = p^2$

$\downarrow \quad \downarrow \quad \downarrow$

even odd odd

$b^2 = a^2 + p^2$

$= (2k + 1)^2 + (2\lambda + 1)^2$

$= 4k^2 + 4k + 1 + 4\lambda^2 + 4\lambda + 1$

$b^2 = 4 (k^2 + \lambda^2 + k + \lambda) + 2$ impossilbe

as L.H.S. is multiple of 4 but R.H.S is not multiple of 4

63. Suppose we have two circles of radius 2 each in the plane such that the distance between their centres is $2\sqrt{3}$. The area of the region common to both circles lies between **[2017]**

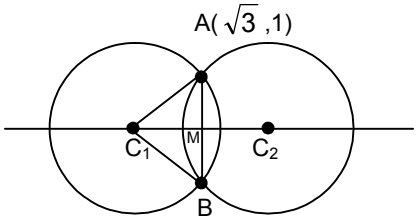
(A) 0.5 and 0.6 (B) 0.65 and 0.7 (C) 0.7 and 0.75 (D) 0.8 and 0.9

Sol. [C]

Let two circles are

$x^2 + y^2 = 4$ & $(x - 2\sqrt{3})^2 + y^2 = 4$

$\therefore$ equation of common chord is $x = \sqrt{3}$



$\therefore$ A ($\sqrt{3}$, 1) , B($\sqrt{3}$, –1)

So $\angle AC_1B = 60°$

AB = 2 & $MC_1 = \sqrt{3}$

Required area = 2 [area of sector C_1AB – ar ΔC_1AB]

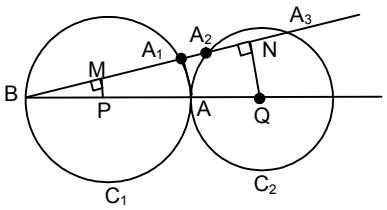
$$= 2\left[\frac{1}{2}\times 2^2 \times \frac{\pi}{3} - \frac{1}{2}\times 2\times\sqrt{3}\right]$$

$$= .723$$

64. Let C_1, C_2 be two circles touching each other externally at the point A and let AB be the diameter of circle C_1. Draw a secant BA_3 to circle C_2, intersecting circle C_1 at a point $A_1(\neq A)$, and circle C_2 at points A_2 and A_3. If $BA_1 = 2$, $BA_2 = 3$ and $BA_3 = 4$, then the radii of circles C_1 and C_2 are respectively **[2017]**

(A) $\frac{\sqrt{30}}{5}, \frac{3\sqrt{30}}{10}$ (B) $\frac{\sqrt{5}}{2}, \frac{7\sqrt{5}}{10}$ (C) $\frac{\sqrt{6}}{2}, \frac{\sqrt{6}}{2}$ (D) $\frac{\sqrt{10}}{3}, \frac{17\sqrt{10}}{30}$

Sol. [A]



$BM = A_1M = 1$
$A_1A_2 = 1$

$$A_2N = A_3N = \frac{1}{2}$$

Let radius of C_1 is r_1
Let radius of C_2 is r_2

$$PM = \sqrt{r_1^2 - 1}, \quad QN = \sqrt{r_2^2 - \frac{1}{4}}$$

$\because \Delta QNB \sim \Delta PMB$

$$\therefore \frac{\sqrt{r_2^2 - \frac{1}{4}}}{\sqrt{r_1^2 - 1}} = \frac{BN}{BM} = \frac{7/2}{1}$$

$$\Rightarrow 4r_2^2 = 49r_1^2 - 48 \quad ...(i)$$

Also, in ΔQNB

$BQ^2 = BN^2 + NQ^2$

$$(2r_1 + r_2)^2 = \frac{49}{4} + r_2^2 - \frac{1}{4}$$

$$\Rightarrow r_1^2 + r_1 r_2 = 3 \quad ....(ii)$$

Solve (i) & (ii)

$$r_1 = \sqrt{\frac{6}{5}} = \frac{\sqrt{30}}{5} \text{ \& } r_2 = \frac{3\sqrt{30}}{10}$$

65. Let a, b, c, d be real numbers between – 5 and 5 such that $|a| = \sqrt{4-\sqrt{5-a}}$, $|b| = \sqrt{4+\sqrt{5-b}}$, $|c| = \sqrt{4-\sqrt{5+c}}$, $|d| = \sqrt{4+\sqrt{5+d}}$. **[2017]**

Then the product abcd is

(A) 11 (B) –11 (C) 121 (D) –121

Sol. [A]

Given $|a| = \sqrt{4-\sqrt{5-a}}$

squaring

$a^2 = 4 - \sqrt{5-a}$

$\Rightarrow a^4 + 16 - 8a^2 = 5 - a$

$\Rightarrow a^4 - 8a^2 + a + 11 = 0$

Similarly squaring other given equations

& solving we can say that a,b, –c, –d are roots

of $x^4 - 8x^2 + x + 11 = 0$

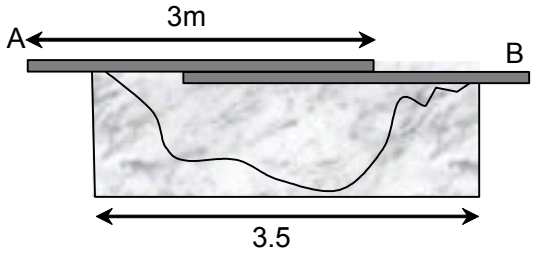
$\therefore$ product of roots

$ab(-c)(-d) = 11$

$abcd = 11$

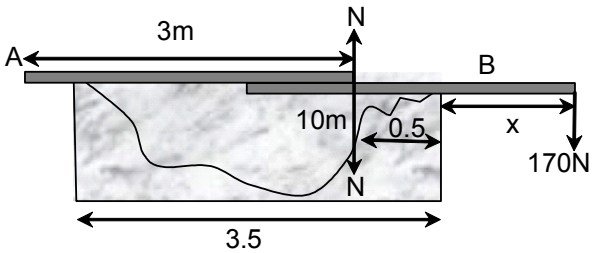
Section 6-Part B-Phsysics

66. Persons A and B are standing on the opposite sides of a 3.5 m wide water stream which they wish to cross. Each one of them has a rigid wooden plank whose mass can be neglected. However, each plank is only slightly longer than 3 m. So they decide to arrange them together as shown in the figure schematically. With B (mass 17 kg) standing, the maximum mass of A, who can walk over the plank is close to , **[2017]**



(A) 17 kg. (B) 65 kg. (C) 80 kg. (D) 105 kg.

Sol. **[C]**

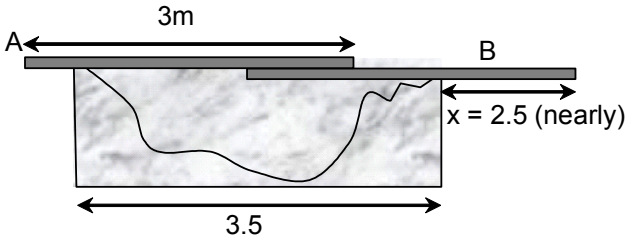


N = 10 m

N × 0.5 = 170 x

$10m \times \frac{5}{10} = 170x \Rightarrow m = \frac{170x}{5}$

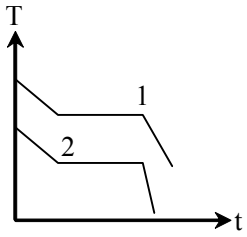
Maximum value is near to 2.5 infact shift by less than 2.5



Maximum vlaue of $m = \frac{170}{5} \times 2.5 = 85$

Opction (C) is correct

67. Two different liquids of same mass are kept in two identical vessels, which are placed in a freezer that extracts heat from them at the same rate causing each liquid to transform into a solid. The schematic figure below shows the temperature T vs time t plot for the two materials. We denote the specific heat of metrials in the liquid (solid) states to be C_{L1} (C_{S1}) and C_{L2} (C_{S2}) respectively. **[2017]**



(A) $C_{L1} < C_{L2}$ and $C_{S1} < C_{S2}$ (B) $C_{L1} > C_{L2}$ and $C_{S1} > C_{S2}$

(C) $C_{L1} > C_{L2}$ and $C_{S1} > C_{S2}$ (D) $C_{L1} < C_{L2}$ and $C_{S1} > C_{S2}$

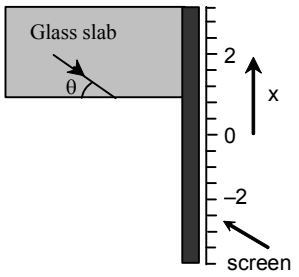
Sol. **[B]**

Let Refrigerater extract Q joul/per second

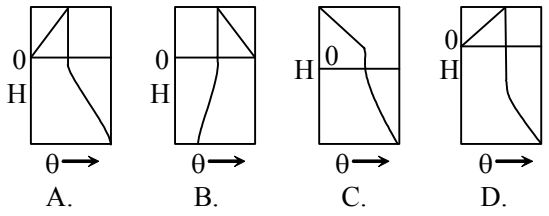
$Q.t \Rightarrow ms(T_f - T)$

Higher the specific heat, Higher the slope

68. A ray of light originates from inside a glass slab and is incident on its inner surface at an angle θ as shown, **[2017]**



In this experiment the location x of the spot where the ray hits the screen is recorded. Which of the following correctly shows the plot of variation of x with the angle θ ?



(A) A (B) B (C) C (D) D

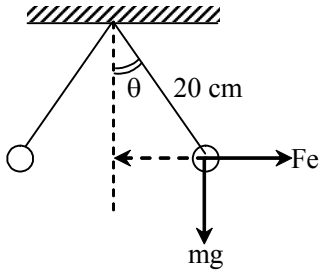
Sol. **[A]**

This is case of Total Internal Reflector
(90– θ) is incident angle. As θ increases thus incident angle decreaes. Initially Ray will be Reflected at θ_C angle will be TIR after words Refraction takes place

69. Four identical pendulums are made by made by attaching a small ball of mass 100 g on a 20 cm long thread and suspended from the same point. Now each ball is given charge Q so that balls move away from each other with each thread making an angle of 45° from the vertical. The value of Q is close to ($\frac{1}{4\pi \in_0} = 9 \times 10^9$ in SI units) **[2017]**

(A) 1μC (B) 1.5 μC (C) 2μC (D) 2.5 μC

Sol. **[B]**



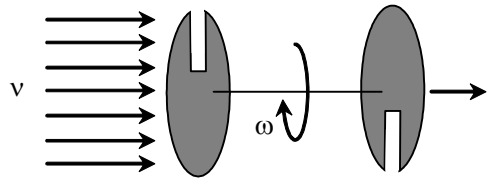
$$\tan\theta \Rightarrow \frac{Fe}{mg}$$

$$\tan 45° \Rightarrow \frac{kQ^2}{\left(\frac{20\times10^{-2}}{\sqrt{2}}\right)^2}{100\times10\times10^{-3}}$$

$$\theta = \sqrt{\frac{20}{9}\times10^{-12}} = 1.5\ \mu c$$

70. Two parallel discs are connected by a rigid rod of length L = 0.5 m centrally. Each disc has a slit oppositely placed as shown in the figure. A beam of neutral atoms are incident on one of the discs axially at different velocities v, while the system is rotated at angular speed of 600 rev/second so that atoms only with a specific velocity emerge at the other end. Calculate the two largest speeds (in meter/second) of the atoms that will emerge at the other end.

[2017]



(A) 75, 25 (B) 100, 50 (C) 300,100 (D) 600, 200

Sol. **[D]**

Time gap between two disc should

$$t = \frac{\pi}{\omega}, \frac{3\pi}{\omega}, \frac{5\pi}{\omega}$$

$$V_1 = \frac{0.5}{\frac{\lambda}{600}\times 2\pi} \Rightarrow 600 \text{ m/s}$$

$$V_2 = \frac{0.5}{3\pi/600\times 2\pi} \Rightarrow 200 \text{ m/s}$$

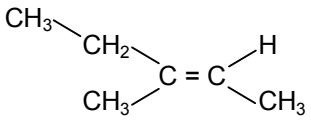
Section 7 -Part-B chemistry

71. Among the following compouds, E/Z isomerism is possible for **[2017]**

(A) 2-methylbut-2-ene (B) 2-methylbut-1-ene

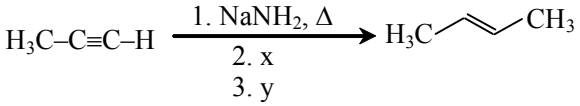
(C) 3-methylpent-1-ene (D) 3-methylpent-2-ene

Sol. **[D]**



This show E / Z isomerism

72. In the reaction



x and y, respectively, are **[2017]**

(A) x = CH_3OH ; y = $Pd/BaSO_4$,quinoline, H_2

(B) x = CH_3I ; y = $Pd/BaSO_4$,quinoline, H_2

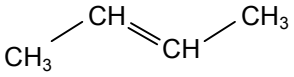
(C) x = CH_3I ; y = Na in liq. NH_3

(D) x = CH_3OH ; y = Na in liq. NH_3

Sol. **[C]**

$CH_3–C \equiv C–H$

↓ 1. $NaNH_2$ 2. CH_3I 3. Na/liq. NH_3

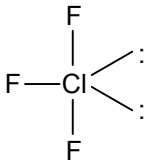


(Trans alkene)

73. Among the following molecules, the one with the largest bond angle at the central atom is **[2017]**

(A) ClF_3 (B) $POCl_3$ (C) BCl_3 (D) SO_3

Sol. **[A]**



T-Shape, sp^3d hybridisation

74. A compound has the following composition by weight ; Na = 18.60 %, S = 25.80 %, H = 4.02 % and O = 51.58 % Assuming that all the hydrogen atoms in the compound are part of water of crystallization, the correct molecular formula of the compound is **[2017]**

(A) $Na_2S_2O_3.3H_2O$ (B) $Na_2SO_4.5H_2O$ (C) $Na_2SO_4.10H_2O$ (D) $Na_2S_2O_3.5H_2O$

Sol. **[D]**

Elements	%	moles	Simplest ratio
Na	18.6	$\frac{18.6}{23} = 0.8$	1 × 2
S	25.8	$\frac{25.8}{32} = 0.8$	1 × 2
O	51.58	$\frac{51.58}{16} = 3.22$	4 × 2
H	4.02	$\frac{4.02}{1} = 4.02$	5 × 2

$\Rightarrow$ Formula is $Na_2S_2O_3 \cdot 5H_2O$

75. X g of ice at 0 °C is added to 340 g of water at 20° C. The final tempeature of the resultant mixture is 5 °C. The value of X (in g) is closest to

[Heat of fusion of ice = 333 J/g ; Specific heat of water = 4.184 J/g. K] **[2017]**

(A) 80.4 (B) 52.8 (C) 120.6 (D) 60.3

Sol. **[D]**

Use the concept of calorimetry and solve to get the answer.

Section 8-Part B-Biology

76. Considering ABO blood grouping system in humans, during blood transfusion some combinations of blood groups are compatible (√), whereas the others are incompatible (X). Which ONE of the following options is CORRECT ? **[2017]**

(A)

Donor \ Recipient	O	A	B	AB
O	X	X	X	√
A	√	X	√	X
B	√	√	X	X
AB	√	√	√	√

(B)

Donor \ Recipient	O	A	B	AB
O	X	X	X	X
A	√	X	√	X
B	√	√	X	X
AB	√	√	√	X

(C)

Donor \ Recipient	O	A	B	AB
O	√	X	X	X
A	√	√	X	X
B	√	X	√	X
AB	√	√	√	√

(D)

Donor \ Recipient	O	A	B	AB
O	√	√	√	√
A	X	√	X	√
B	X	X	√	√
AB	X	X	X	√

Sol. [D]
O → Universal Donor
AB → Universal recipient

77. A 25,000 Da protein contains a single binding site for a molecule (ligand), whose molecular weight is 2,500 Da. Assuming high affinity and phsiologically irreversible blinding, the amount of the ligand required to occupy all the binding sites in 10 mg protein will be **[2017]**

(A) 0.1 mg (B) 1 mg (C) 10 mg (D) 100 mg

Sol. [B]

$$\frac{25000}{2500} = \frac{10}{x} \quad (x = 1 \text{ mg})$$

78. In an *in vitro* tanslation experiment, poly (UC) RNA template produced poly (Ser-Leu), while poly (AG) RNA template produced poly (Arg-Glu) polypeptide. Which ONE of the following options represents correct interpretations of the codons assignments for Ser, Leu, Arg, and Glu. **[2017]**

(A) Ser – UCU, Leu – CUC, Arg – AGA, Glu – GAG
(B) Ser – CUC, Leu – GAG, Arg – UCU, Glu – AGA
(C) Ser – AGA, Leu – UCU, Arg – GAG, Glu – CUC
(D) Ser – GAG, Leu – AGA, Arg – CUC, Glu – UCU

Sol. [A]
Sequence of 3 nitrogenous base is one codon.

79. A single bacterium is actively growing in a medium that supports its growth to a number of 100 million. Assuming the division time of the bacterium as 3 hours and the life span of non-dividing bacteria as 5 hours, which ONE of the following represents the maximum number of bacteria that would be present at the end of 15 hour ? **[2017]**

(A) 10 (B) 64 (C) 24 (D) 32

Sol. [D]

Time = $\frac{15}{3}$ = 5 times division occur. No. of bacteria = $2^5 = 32$

80. A couple has two sons and two daughters. Only one son is colour blind and the rest of the siblings are normal. Assuming colour blindness is sex-linked, which ONE of the following would be the phenotype of the parents ? **[2017]**

(A) Mother would be colour blind, father would be normal.

(B) Father would be colour blind, mother would be normal.

(C) Both the parents would be normal.

(D) Both the parents would be colour blind.

Sol. [C]

Male child recieve X-chromosome from mother only. Another normal son indicates that mother is carrier.