KVPY QUESTION PAPER-2017 (STREAM SX)

Date : 05 /11/2017

Part A-Mathematics

1. Let BC be a fixed line segment in the plane. The locus of a point A such that the triangle ABC is isosceles, is (with finitely many possible exceptional points) **[2017]**

(A) a line

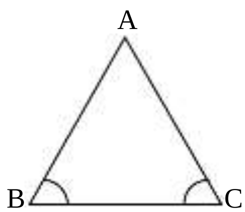
(B) a circle

(C) the union of a circle and a line

(D) the union of two circles and a line

Sol. [D] Case (i)

:

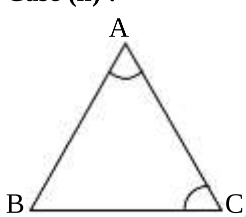


If B = C

locus of A is bisector of BC

So it is straight line

Case (ii) :



If A = C

BC fixed B(a, 0), C(0, a)

BC=AB

So, $(x – a)^2 + y^2 = 2a^2$

Circle

Case (iii) :

A = B

AC=BC

$\sqrt{h^2 \quad (k \quad a)^2} = \sqrt{2a^2}$

$x^2 + (y – a)^2 = 2a^2$

also a circle

So union of two circle and a line.

2. The number of solution pairs (x, y) of the simultaneous equations

$\log_{1/3} (x + y) + \log_3 (x – y) = 2$ and $2y^2 = 512^{x+1}$ is **[2017]**

(A) 0 (B) 1

(C) 2 (D) 3

Sol. **[B]**

$\log_{3^{\ 1}} (x \quad y) + \log_3(x – y) = 2$

$– \log_3(x + y) + \log_3(x – y) = 2$

$\log_3 \frac{x \ y}{x \quad y} = 2$

$\frac{x \quad y}{x \quad y} = 9$

$2^{y^2} \quad (2^9)^{x \ 1}$

$2^{y^2} \ 2^{9(x \ 1)}$

$y^2 = 9(x + 1)$

Solve eliminate y

$16x^2 – 225x – 225 = 0$

$x = 15, \ \frac{15}{16}$

At x = 15, y = –12

$x = \frac{15}{16}, y = \frac{3}{4}$ (not possible)

only sol. x = 15, y = –12

only one sol.

3. The value of the limit $\lim_{x \ –} \sqrt{4x^2 – x} \ \ 2x$ is **[2017]**

(A) – (B) $– \frac{1}{4}$

(C) 0 (D) $\frac{1}{4}$

Sol. **[D]**

Rationalise

$\lim_{x} (\sqrt{4x^2 x} \; 2x) \quad \frac{\sqrt{4x^2 x} \; 2x}{\sqrt{4x^2 x} \; 2x}$

$\lim_{x} \frac{x}{|x|\sqrt{4 \frac{1}{x}} \; 2x}$ at x – |x| = –x

$\lim_{x} \frac{x}{x \sqrt{4 \frac{1}{x}} \; 2x} = \frac{1}{2} \; \frac{}{2} = \frac{1}{4}$

4. Let R be a relation on the set of all natural numbers given by a R b a divides b^2.

Which of the following properties does R satisfy ?

I. Reflexivity

II. Symmetry

III. Transitivity **[2017]**

(A) I only (B) III only

(C) I and III only (D) I and II only

Sol. **[A]**

(I) This relation is reflexive relation because every natural no. divides square of itself a R a a divides a^2

(II) not symmetric eg. 5 R 10 5 Divide 100

But 10 R 5 10 Divide 25

(III) Not transitivity for example

if 8 R 4 & 4 R 2 8 R 2 only (I)

Option

5. The fractional part of a real number x is x –[x], where [x] is the greatest integer less than or equal to x. Let F_1 and F_2 be the fractional parts of $(44 - \sqrt{2017})^{2017}$ and $(44 + \sqrt{2017})^{2017}$ respectively. Then $F_1 + F_2$ lies between the numbers **[2017]**

(A) 0 and 0.45 (B) 0.45 and 0.9

(C) 0.9 and 1.35 (D) 1.35 and 1.8

Sol. **[C]**

$I+F_2 = \sqrt{2017} \; 44^{\;2017}$

$F_2 = \sqrt{2017} \; 44^{\;2017}$; $0<F_2<1$

$I+F_2 - F_2 = 2 \; {}^{2017}C_1 \; \sqrt{2017}_{2016} \quad (44)$ ....

$F_2 = F_2$

$F_2 = (0.911)^{2017}$

Now, $F_1 = (44 \; \sqrt{2017})^{2017} = -(0.911)^{2017}$

Fractional part can not –ve.

So, $F_1 = 1 - (0.911)^{2017}$

So, $F_1 + F_2 = 1$

1 lie Between 0.9 & 1.35

6. The number of real solutions of the equation 2sin 3x + sin 7x – 3 = 0 which lie in the interval [–2 , 2] is **[2017]**

(A) 1 (B) 2

(C) 3 (D) 4

Sol. **[B]**

only possible when sin 3x = 1 & sin 7x = 1 sin 3x = 1

sin 3x = sin (4n + 1) —, n I

$3x = (4n+1)\frac{}{2} \quad x = (4n+1)\frac{}{6}$

$\sin 7x = \sin(4m+1)\frac{}{2}$, m I

$x = (4m+1)\frac{}{14}$

for common solution

$(4n+1)\frac{}{6} = (4m+1)\frac{}{14}$

Solving these 1 = 3m – 7n First solution is m = 5, n = 2 Second solution is m = 12, n = 5 So two solutions are possible

7. Suppose p, q, r are real numbers such that q = p (4 – p), r = q (4 – q), p = r (4 – r). The maximum possible value of p + q + r is **[2017]**

(A) 0 (B) 3

(C) 9 (D) 27

Sol. **[C]**

Add all these $p + q + r = \frac{p^2 q^2 \quad r^2}{3}$

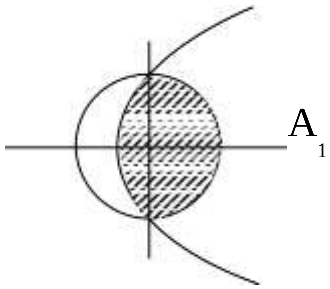
for maximum value p = 3, q = 3, r = 3 Answer is 9.

8. The parabola $y^2 = 4x + 1$ divides the disc $x^2 + y^2$ 1 into two regions with areas A_1 and A_2. Then $|A_1 - A_2|$ equals **[2017]**

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

Sol. **[B]**

$A_1 = 2\int_{1/4}^{0}\sqrt{4x \quad 1}\,dx + 2\int_{0}^{1}\sqrt{1 \quad x^2}\,dx$



1

Solve A_1 = – – + 1

2

A_2= (1) –A_1= – – –

2

$|A_1 - A_2|$ = –

9. A shooter can hit a given target with probability $\frac{1}{4}$. She keeps firing a bullet at the target until she hits it successfully three times and then she stops firing. The probability that she fires exactly six bullets lies in the interval **[2017]**

(A) (0.5272, 0.5274) (B) (0.2636, 0.2638)

(C) (0.1317, 0.1319) (D) (0.0658, 0.0660)

Sol. **[D]**

3^{rd} time target will hit in sixth time

So, In first 5 attempt these will be 3L, 2W and at 6^{th} attempt shot will be hit

So,

$^5C_3 \left(\frac{3}{4}\right)^3 \times \left(\frac{1}{4}\right)^2 \times \frac{1}{4} = \frac{270}{4096} = 0.06591$

10. Consider the following events :

E_1 : Six fair dice are rolled and at least one die shows six.

E_2 : Twelve fair dice are rolled and at least two dice show six.

Let p_1 be the probability of E_1 and p_2 be the probability of E_2. Which of the following is true ? **[2017]**

(A) $p_1 > p_2$ (B) $p_1 = p_2 = 0.6651$

(C) $p_1 < p_2$ (D) $p_1 = p_2 = 0.3349$

Sol. **[A]**

p_1 = 1 – (no die show six)

$1 - \left(\frac{5}{6}\right)^6 = 0.6651$

p_2 = 1 – (no die shown two + one die shown two)

$p_2 = 1 - \left(\frac{5}{6}\right)^{12} - {}^{12}C_1\left(\frac{5}{6}\right)^{11}\left(\frac{1}{6}\right)^1$

= 0.61866

$p_1 > p_2$

11. For how many different values of a does the following system have at least two distinct solutions ?

$ax + y = 0$

$x + (a + 10)y = 0$ **[2017]**

(A) 0 (B) 1

(C) 2 (D) Infinitely many

Sol. **[C]**

$\frac{a}{1} = \frac{1}{(a\ \ 10)}$

$a^2 + 10a - 1 = 0$

12. Let R be the set of real numbers and f : R R be defined by $f(x) = \frac{\{x\}}{1\ \ [x]^2}$, where [x] is the greatest integer less than or equal to x, and {x} = x – [x]. Which of the following statements are true ?

I. The range of f is a closed interval

II. f is continuous on R.

III. f is one-one on R. **[2017]**

(A) I only

(B) II only

(C) III only

(D) None of I, II and III

Sol. **[D]**

$f(x) = \frac{\{x\}}{1\ \ [x]^2}$

$\frac{x\ \ 1}{2}$; $1\ \ x\ \ 0$

x; $0\ \ x\ \ 1$

$f(x) = \frac{x\ \ 1}{2}$; $1\ \ x\ \ 2$

$\frac{x\ \ 2}{5}$; $2\ \ x\ \ 3$

So on

Now check accordingly

13. Let $x_n = (2^n + 3^n)^{1/2n}$ for all natural numbers n. Then **[2017]**

(A) $\lim_{n} x_n =$

(B) $\lim_{n} x_n = \sqrt{3}$

(C) $\lim_{n} x_n = \sqrt{3} + \sqrt{2}$

(D) $\lim_{n} x_n = \sqrt{5}$

Sol. **[B]**

$_{n}$ $\lim (3^n)^{1/2n}$ $\frac{2}{3}^{n}$ $1^{1/2n}$

Put $\lim_{n} \sqrt{3}$

14. One of the solutions of the equation

$8 \sin^3 \ - 7 \sin \ + \ 3 \cos \ = 0$ lies in the interval **[2017]**

(A) (0, 10°] (B) (10°, 20°]

(C) (20°, 30°] (D) (30°, 40°]

Sol. **[B]**

6 sin – 2 sin 3 – 7 sin + $\sqrt{3}$ cos = 0

$\sqrt{3}$ cos – sin = 2 sin 3

It can be written as

2 (sin (60º –)) = 2 sin 3

sin (60º –) = sin 3

60º=4

= 15º is one of the value

15. Let a, b, c, d, e, be real numbers such that a + b < c + d, b + c < d + e, c + d < e + a, d + e < a + b. Then **[2017]**

(A) The largest is a and the smallest is b

(B) The largest is a and the smallest is c

(C) The largest is c and the smallest is e

(D) The largest is c and the smallest is b

Sol. **[A]**

(i) a + b < c + d

(ii) b + c < d + e

(iii) c + d < e +

a (iv) d + e < a +

b from (i) & (iii)

a + b < e + a b <

e from (ii) &

(iv) b + c < a +

b c < a

(i) – (ii)

a – c < c – e

c > e

(i) – (iv)

(a – e) + (b – d) < (c – a) + (d –

b) from thus d > b

(i) + (iii) –

(ii) c > d

overall a is greatest, b is least

16. If a fair coin is tossed 5 times, the probability that heads does not occur two or more times in a row is **[2017]**

(A) $\frac{12}{2^5}$ (B) $\frac{13}{2^5}$ (C) $\frac{14}{2^5}$ (D) $\frac{15}{2^5}$

Sol. **[B]**

Case (1) : All tail $\frac{1}{2}^{5}$

Case (2) : 4T, 1H $\ {}^5C_4 \ \frac{1}{2}^{4} . \ \frac{1}{2}^{5} = \frac{5}{2^5}$

Case (3) : × T × T × T ×

$\frac{1}{2}^{3} \times {}^4C_2 \times \ \frac{1}{2}^{2} = \frac{1}{2^5} \times 6 = \frac{6}{2^5}$

Case (4) : × T × T ×

$\frac{1}{2}^{2} \times \frac{1}{2}^{3} = \frac{1}{2^5}$

overall $\frac{13}{2^5}$

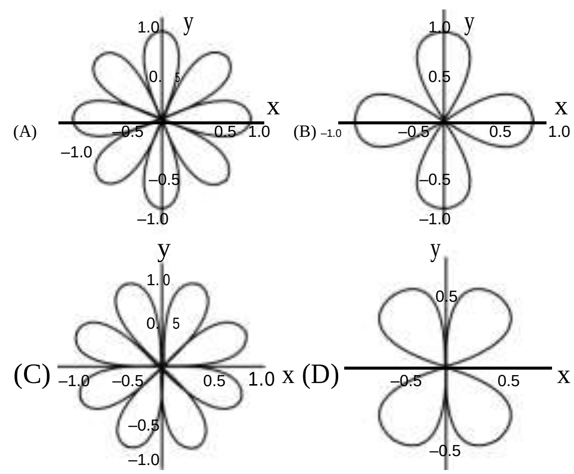
17. Consider the following parametric equation of a curve :

x ( ) = | cos 4 | cos

y( ) = | cos 4 | sin

for 0 2

Which one of the following graphs represents the curve ? **[2017]**



Sol. **[A]**

Make graph and observe yourself

18. Let A = (a_1, a_2) and B = (b_1, b_2) be two points in the plane with integer coordinates. Which one of the following is not a possible value of the distance between A and B ? **[2017]**

(A) $\sqrt{65}$ (B) $\sqrt{74}$

(C) $\sqrt{83}$ (D) $\sqrt{97}$

Sol. **[C]**

$AB = \sqrt{(a_1 \ \ b_1)^2 \ \ (a_2 \ \ b_2)^2}$

Square + Square = $\sqrt{65}$ possible when =64+1

$\sqrt{74}$ = 49 +25

$\sqrt{97}$ =81+16

But $\sqrt{83}$ not possible

19. Let $f(x) = \max\left\{3, x^2, \frac{1}{x^2}\right\}$ for $\frac{1}{2} \ \ x \ \ 2$. Then the value of the integral $\int_{1/2}^{2} f(x)dx$ is **[2017]**

(A) $\frac{11}{3}$ (B) $\frac{13}{3}$ (C) $\frac{14}{3}$ (D) $\frac{16}{3}$

Sol. **[C]**

Given Integral can be distributed into

$$\int_{1/2}^{1/\sqrt{3}} \frac{1}{x^2} \, .dx \int_{1/\sqrt{3}}^{\sqrt{3}} 3 \, dx \int_{\sqrt{3}}^{2} x^2 \, .dx = \frac{14}{3}$$

20. Let $a_i = i + \frac{1}{i}$ for i = 1,2, ..., 20. Put

$p = \frac{1}{20}(a_1 + a_2 + ... + a_{20})$ and

$q = \frac{1}{20}\left(\frac{1}{a_1} + \frac{1}{a_2} + ... + \frac{1}{a_{20}}\right)$. Then **[2017]**

(A) $q \ \ 0, \frac{22-p}{21}$

(B) $q \ \ \frac{22-p}{21}, \frac{2(22-p)}{21}$

(C) $q \ \ \frac{2(22-p)}{21}, \frac{22-p}{7}$

(D) $q \ \ \frac{22-p}{7}, \frac{4(22-p)}{21}$

Sol. **[A]**

q > 0, try to the contra prove that $q < \frac{22 \ \ p}{21}$

$q + \frac{p}{21} < \frac{22}{21}$

$q + \frac{p}{21} = \frac{1}{20}\sum_{i=1}^{20}\left(\frac{1}{a_i} + \frac{1}{21}a_i\right)$

$= \frac{1}{20}\sum_{i=1}^{20}\left(\frac{i}{i^2+1} + \frac{1}{21}\left(i + \frac{1}{i}\right)\right)$

$= \frac{1}{2} + \frac{1}{20}\sum_{i=1}^{20}\left(\frac{i}{i^2+1} + \frac{1}{21 i}\right)$

$= \frac{1}{2} + \frac{1}{20}\left[\frac{1}{2} + \sum_{i=2}^{20}\frac{i}{i^2+1} + \sum_{i=1}^{20}\frac{1}{21 i}\right]$

$< \frac{1}{2} + \frac{1}{20}\left[\frac{1}{2} + \sum_{i=2}^{20}\frac{2}{5} + \frac{1}{21}\sum_{i=1}^{20} 1\right]$

$< \frac{1}{2} + \frac{1}{20}\left[\frac{1}{2} + \frac{2}{5}19 + \frac{1}{21}20\right]$

$< \frac{1}{2} + \frac{1}{20}(1+8+1)$

$< \frac{1}{2} + \frac{1}{2}$

$< \frac{22}{21}$

Section 2-Part A-Physics

21. The magnitude of acceleration of the electron in the n^{th} orbit of hydrogen atom is a_H and that of singly ionized helium atom is a_{He}. The ratio $a_H : a_{He}$ is **[2017]**

(A)1:8 (B)1:4

(C)1:2 (D) dependent on n

Sol. **[A]**

$r \ \ \frac{1}{z}$ & $v \ \ z$

according $\frac{v^2}{r} \ \ z^2 \times \frac{1}{(1/z)} = z^3$

$\frac{a_H}{a_{He}} = \left(\frac{z_H}{z_{He}}\right)^3 = \left(\frac{1}{2}\right)^3 = \frac{1}{8}$

22. A carrot looks orange in colour because of the β carotene molecule in it. This means that the β carotene molecule absorbs light of wavelengths **[2017]**

(A) longer than 550 nm.

(B) shorter than 550 nm.

(C) longer than 700 nm.

(D) shorter than 700 nm.

Sol. **[B]**

VIBG | YOR
400 nm | 700 nm
Absorbed Reflected
therefore seen

23. If some charge is given to a solid metallic sphere, the field inside remains zero and by Gauss's law all the charge resides on the surface. Suppose now that Colomb's force between two charges varies as $1/r^3$. Then, for a charged solid metallic sphere **[2017]**

(A) field inside will be zero and charge density inside will be zero.
(B) field inside will not be zero and charge density inside will not be zero.
(C) field inside will not be zero and charge density inside will be zero.
(D) field inside will be zero and charge density inside will not be zero.

Sol. **[D]**

If coloumb's force $\frac{1}{r^3}$ gauss's law is not valid

$$\frac{q_{en}}{0}$$

For static condition E = 0 in both of conductor through a Gaussian surface just under the surface of conductor = 0 but as

$= \frac{q_{en}}{0}$ is not valid

So $q_{en} = 0$ is not correct statement. Some charge will present insider bulk of conductor.

24. Using dimensional analysis the resistivity in terms of fundamental constants h, m_e, c, e, $_0$ can be expressed as **[2017]**

(A) $\frac{h}{{}_0 m_e c e^2}$

(C) $\frac{h^2}{m_e c e^2}$

(D) $\frac{m_e\,{}_0}{c e^2} h$

Sol. **[C]**

$= \frac{E}{J}$

$E = [M\,L\,T^{-3}\,I^{-1}]$ $J = [I\,L^{-2}]$

$h = M\,L^2\,T^{-1}$

$m_e = M$

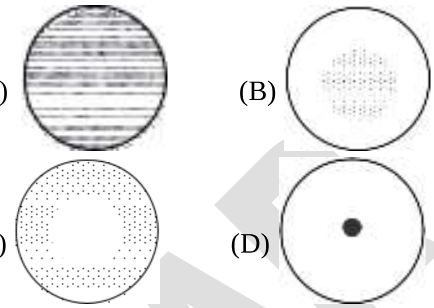
$c = LT$

$_0 = M^{-1}\,L^{-3}\,T^4\,I^2$

$= \frac{h^2}{m_e c e^2}$

25. Consider a bowl filled with water on which some black pepper powder have been sprinkled uniformly. Now a drop of liquid soap is added at the centre of the surface of water. The picture of the surface immediately after this will look like **[2017]**

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



Sol. **[C]**

due to soap bubble surface tension is reduced therefore in that area. Black paper powder will sink.

26. It was found that the refractive index of material of a certain prism varied as $1.5 + 0.004/{}^2$, where is the wavelength of light used to measure the refractive index. The same material was then used to construct a thin prism of apex angle 10°. Angles of minimum deviation ($_m$) of the prism were recorded for the sources with wavelengths $_1$ and $_2$ respectively. Then **[2017]**

(A) $_m(_1) < {}_m(_2)$ if $_1 < {}_2$.
(B) $_m(_1) > {}_m(_2)$ if $_1 > {}_2$.
(C) $_m(_1) > {}_m(_2)$ if $_1 < {}_2$.
(D) $_m$ is the same in both the cases.

Sol. **[C]**

$$n = \frac{\sin i}{\sin r} = \frac{\sin\frac{A + {}_m}{2}}{\sin\frac{A}{2}}$$

$$1.5 + \frac{0.004}{{}^2} = \frac{\sin\frac{A + {}_m}{2}}{\sin\frac{A}{2}}$$

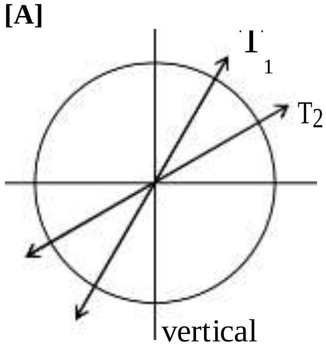
$$_m \propto \frac{1}{{}^2}$$

$_m(_1) > {}_m(_2)$ if $_1 < {}_2$

27. Two circularly shaped linear polarisers are placed coaxially. The transmission axis of the first polarizer is at 30° from the vertical while the second one is at 60°, both in the clockwise sense. If an unpolarised beam of light of intensity $I = 20\ W/m^2$ is incident on this pair of polarisers, then the intensities I_1 and I_2 transmitted by the first and the second polarisers, respectively, will be close to **[2017]**

(A) $I_1 = 10.0\ W/m^2$ and $I_2 = 7.5\ W/m^2$
(B) $I_1 = 20.0\ W/m^2$ and $I_2 = 15\ W/m^2$
(C) $I_1 = 10.0\ W/m^2$ and $I_2 = 8.6\ W/m^2$
(D) $I_1 = 15.0\ W/m^2$ and $I_2 = 0.0\ W/m^2$

Sol. **[A]**



$I_0 = 20\ W/m^2$

$I_1 = \frac{I_0}{2} = \frac{20}{2} = 10\ W/m^2$

$I_2 = I_1 \cos^2 30°$

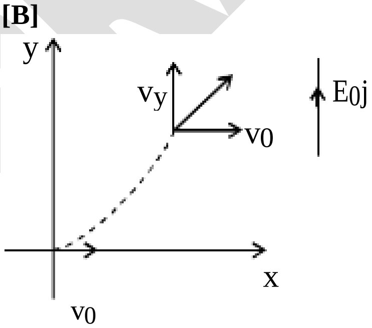
$\left(\frac{\sqrt{3}}{2}\right)^2 \quad \frac{3}{4}$

$= 7.5\ w/m^2$

28. An electron in an electron microscope with initial velocity $_0\ \hat{i}$ enters a region of a stray transverse electric field $E_0\ \hat{j}$. The time taken for the change in its de-Broglie wavelength from the initial value of to /3 is proportional to **[2017]**

(A) E_0 (B) $\frac{1}{E_0}$ (C) $\frac{1}{\sqrt{E_0}}$ (D) $\sqrt{E_0}$

Sol. **[B]**



$= \frac{h_1}{mvv}$

$v = \sqrt{v_y^2 \quad v_0^2}$

$v_y = u_y + a_y t$

$v_y = 0 + \frac{qE_0 t}{m}$

$(3v_0) = \sqrt{v_y^2 \quad v_0^2}$

$v_y^2 = 8v_0^2$

$\frac{qE_0}{m} t = 2\sqrt{2}\ v_0$

$t = \frac{2\sqrt{2}m}{qE_0} v_0\ t \quad \frac{1}{E_0}$

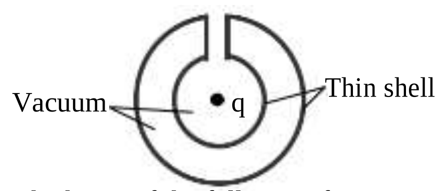
29. A bird sitting on a single high tension wire does not get electrocuted because **[2017]**

(A) the circuit is not complete.
(B) the bird feet has an insulating covering.
(C) capacitance of the bird is too small and the line frequency is too small.
(D) resistance of the bird is too high

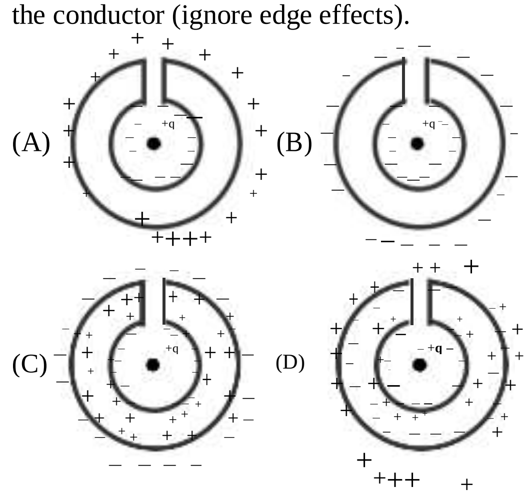
Sol. **[C]**

$X_c = \frac{1}{\ }$ = is very large therefore bird does C after very high capacitive reactance in the path of A.C. current.

30. A positive charge q is placed at the center of a neutral hollow cylindrical conducting shell with its cross section as shown in the figure below. **[2017]**



Which one of the following figures correctly indicates the induced charge distribution on the conductor (ignore edge effects).



Sol. **[A]**

Option 'A' is correct option. According charge conservation & Gauss's law.

31. A transverse wave of frequency 500 Hz and speed 100 m/s is traveling in the positive x direction on a long string. At time t = 0 s the displacements at x = 0.0 m and at x = 0.25 m are 0.0 m and 0.02 m, respectively. The displacement at x = 0.2 m at $t = 5 \times 10^{-4}$ s is **[2017]**

(A) –0.04 m (B) –0.02 m
(C) 0.04 m (D) 0.02 m

Sol. **[D]**

y = A sin(kx – t)

at x = 0.025, y = 0.02

v =

$= \frac{100}{500} = \frac{1}{5}$ m

y = 0.02 = A sin $\frac{2}{}\cdot\frac{1}{4}$

y = 0.002 = A sin $\frac{5}{2}$

A = 0.02m

y = 0.02 sin (kx – t)

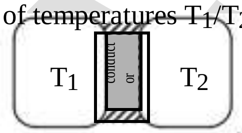
$= 0.02 \sin(10 \times 0.2 – 1000 \times 5 \times 10^{-4}]$

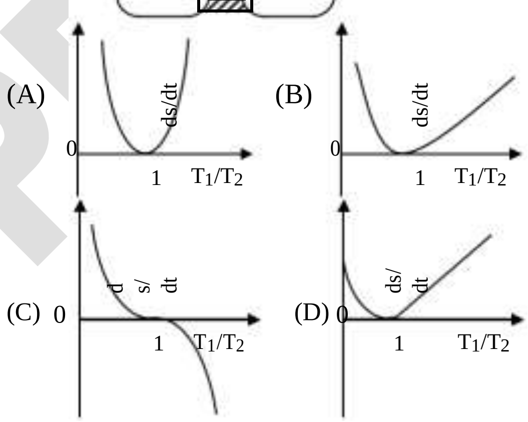
= 0.02 sin[2 – 0.5]

$= 0.02 \sin\frac{3}{2} = –0.02$m

32. A thin piece of thermal conductor of constant thermal conductivity insulated on the lateral sides connects two reservoirs which are maintained at temperatures T_1 and T_2 as shown. Assuming that the system is in steady state, which of the following plots best represents the dependence of the rate of change of entropy of

the ratio of temperatures T_1/T_2 **[2017]**





Sol. **[B]**

$ds = \frac{-Qdt}{T_1} + \frac{Qdt}{T_2}$

$\frac{ds}{dt} = -Q\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

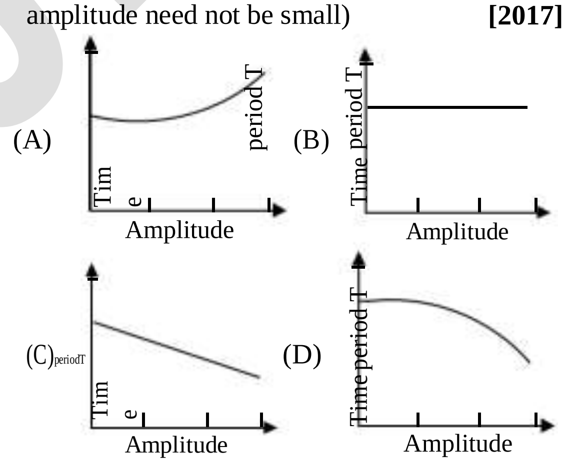
$= \frac{-(T_1 - T_2)}{R}\left(\frac{T_2 - T_1}{T_1T_2}\right)$

$= +\frac{T_1^2 - T_2^2}{T_1T_2}\cdot\frac{1}{R}$

$\frac{ds}{dt} = \frac{T_1}{T_2} - \frac{T_2}{T_1}\cdot\frac{1}{R}$

$= x - \frac{1}{x}\cdot\frac{1}{R}$

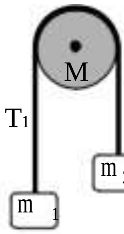
33. Which of the following plots represents schematically the dependence of the time period of a pendulum if measured and plotted as a function of its oscillations? (Note : amplitude need not be small) **[2017]**

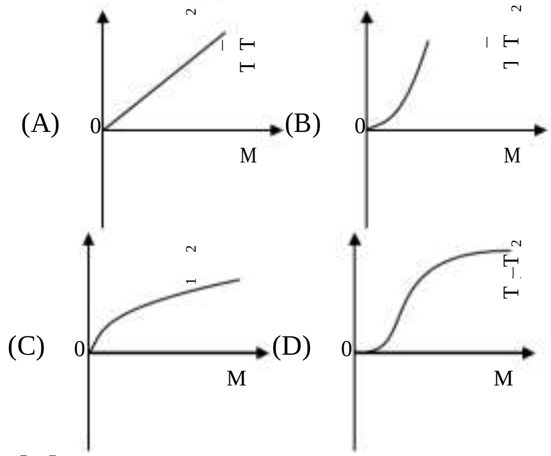


Sol. **[A]**

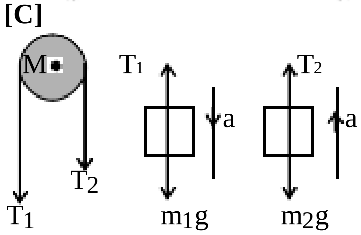
Time period will increase as the amplitude is increases.

34. On a pulley of mass M hangs a rope with two masses m_1 and m_2 ($m_1 > m_2$) tied at the ends as shown in the figure. The pulley rotates without any friction, whereas the friction between the rope and the pulley is large enough to prevent any slipping. Which of the following plots best represents the difference between the tensions in the rope on the two sides of the pulley as a function of the mass of the pulley ? **[2017]**





Sol. **[C]**



$mg - T_1 = m_1a$ ...(1)

$T_2 - m_2g = m_2a$ ...(2)

$(T_1 - T_2) \times R = I$ [a = r]

$= \frac{Ia}{R}$

(1) + (2)

$(m_1 - m_2)g + (T_2 - T_1) = (m_1 + m_2)a$

$(T_1 - T_2) = \frac{I}{R^2} \frac{(m_1 \; m_2)g \; (T_2 \; T_1)}{m_1 \; m_2}$

$(T_1 - T_2) \; 1 \quad \frac{I}{k^2(m_1 \; m_2)}$

$= \frac{I}{k^2} \frac{(m_1 \; m_2)}{m_1 \; m_2} g$

$T_1 - T_2 = \frac{I(m_1 m_2)g}{I \; (m_1 \; m_2)R^2}$

$= \frac{\frac{1}{2}MR^2 (m_1 \; m_2)g}{\frac{1}{2}MR^2 \; (m_1 \; m_2)R^2}$

$T_1 - T_2 = \frac{M(m_1 \, m_2)g}{M \; 2(m_1 \; m_2)}$

35. Two satellites S_1 and S_2 are revolving around a planet in the opposite sense in coplanar circular concentric orbits. At time t = 0, the satellites are farthest apart. The periods of revolution of S_1 and S_2 are 3 h and 24 h respectively. The radius of the orbit of S_1 is 3×10^4 km. Then the orbital speed of S_2 as observed from **[2017]**

(A) the planet is 4×10^4 km h^{-1} when S_2 is closest from S_1.

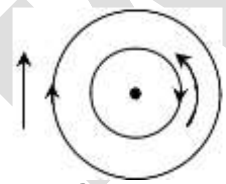
(B) the planet is 2×10^4 km h^{-1} when S_2 is closest from S_1.

(C) S_1 is $\times 10^4$ km h^{-1} when S_2 is closest from S_1

(D) S_1 is $3 \; \times 10^4$ km h^{-1} when S_2 is closest from S_1

Sol. **[D]**

$T^2 \quad r^3$



$\frac{9}{24^2} = \frac{3 \; 10^{4 \; 3}}{r^3}$

$\frac{3 \;\; 3}{24 \;\; 24} = \frac{3 \; 10^{4 \; 3}}{r}$

$\frac{1}{4} = \frac{3 \; 10^4}{r}$

$r = 12 \times 10^4$

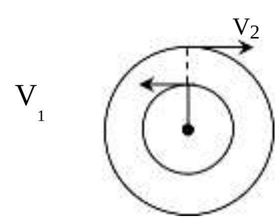
orbital speed of S_2 seen from planet = $2 \; r$

$= \frac{2}{24} \times 12 \times 10^4$

$= \times 10^4$ km h^{-1}

$V_1 = \; _1r_1 = \frac{2}{} \times 3 \times 10^4$

$2 \; \times 10^4$ km h^{-1}



$\frac{2}{3} \quad \frac{2}{24} \; t =$

$\frac{9t}{24} = \frac{1}{2}$

$t = \frac{12}{} \; hr$

Angle rotate by both satellite

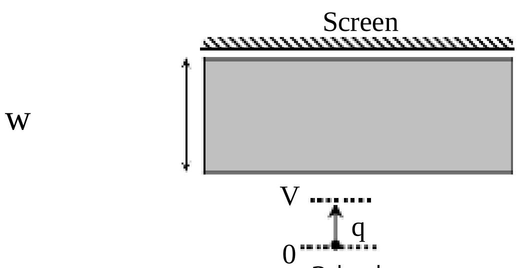
$_1 = \frac{2}{3} \times \frac{12}{9}$ $\frac{8}{9}$

$_2 = \frac{2}{24} \times \frac{12}{9}$ $\frac{}{9}$

velocity of S_2 seen from $S_1 = V_1 + V_2$

$= 3 \times 10^4$ km h^{-1}

36. A rectangular region of dimensions w × *l* (w *l*) has a constant magnetic field into the plane of the paper as shown. On one side the region is bounded by a screen. On the other side positive ions of mass m and charge q are accelerated from rest and towards the screen by a parallel plate capacitor at constant potential difference V < 0, and come out through a small hole in the upper plate. Which one of the following statements is correct regarding the charge on the ions that hit the screen ? **[2017]**



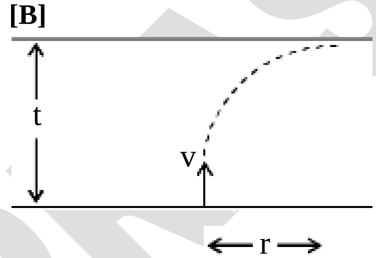
(A) Ions with $q > \frac{2|v|m}{B^2w^2}$ will hit the screen.

(B) Ions with $q < \frac{2|v|m}{B^2w^2}$ will hit the screen.

(C) All ions will hit the screen.

(D) Only ions with $q = \frac{2|v|m}{B^2w^2}$ will hit the screen.

Sol. **[B]**



Ions will hit if r > w.

w = q V

$\frac{1}{2}mv^2 = qV$

$v = \sqrt{\frac{2qV}{m}}$

$\frac{mv^2}{r} = qvB$

$r = \frac{mv}{qB} = \frac{m}{qB}\sqrt{\frac{2qV}{m}}$

$r = \frac{1}{B}\sqrt{\frac{2mV}{q}}$

$\frac{1}{B}\sqrt{\frac{2mV}{q}} > w$

$\frac{2mV}{q} > w^2B^2$

$q < \frac{2mV}{w^2B^2}$

37. Force F applied on a body is written as $F = (\hat{n}.F)\hat{n} + G$, where $\hat{n}$ is a unit vector . The vector G is equal to **[2017]**

(A) $\hat{n} \times F$ (B) $\hat{n}$ ($\hat{n}$ F)

(C) ($\hat{n}$ F) F / | F | (D) ($\hat{n}$ F) $\hat{n}$

Sol. **[D]**

($\hat{n}$ F) $\hat{n}$ = –[$\hat{n}$ ($\hat{n}$ F)]

= –[$\hat{n}$($\hat{n}$.F) F($\hat{n}$.$\hat{n}$)]

= F $\hat{n}$($\hat{n}$ .F)]

= G

38. A particle of mass m moves around the origin in a potential $\frac{1}{2}m^2r^2$, where r is the distance from the origin. Applying the Bohr model in this case, the radius of the particle in its n^{th} orbit in terms of $a = \sqrt{h/(2m)}$ is **[2017]**

(A) $a\sqrt{n}$ (B) an

(C) an^2 (D) $an\sqrt{n}$

Sol. **[A]**

$mvr = n\frac{h}{2}$

v = r

$mr^2 = n\frac{h}{}$

$r = \sqrt{\frac{nh}{2m}}$

$r = \sqrt{n}\sqrt{\frac{h}{2m}}$

$r = \sqrt{n}.a$

39. Two bottles A and B have radii R_A and R_B and heights h_A and h_B respectively with $R_B = 2R_A$ and $h_B = 2h_A$. These are filled with hot water at 60°C. Consider that heat loss for the bottles takes place only from side surfaces. If the time the water to cool down to 50°C is t_A and t_B for the bottles A and B, respectively, then t_A and t_B are best related as **[2017]**

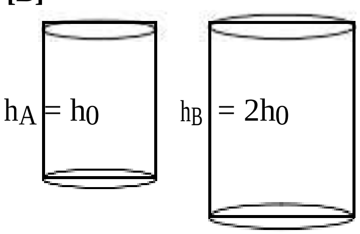
(A) $t_A = t_B$

(B) $t_B = 2t_A$

(C) $t_B = 4t_A$

(D) $t_A = t_A/2$

Sol. **[B]**



$t \quad \frac{m}{A}$

$t = k.\frac{V}{A} = k.\ h$

$t \quad h$

$\frac{t_A}{t_B} = \frac{h_A}{h_B} = \frac{h_0}{2h_0}$ $\quad t_B = 2t_A$

40. The number of gas molecules striking per second per square meter of the top surface of a table placed in a room at 20°C and 1 atmospheric pressure is of the order of ($k_B = 1.4 \times 10^{-23}$ J/K, and the average mass of an air molecules is 5×10^{-27} kg) **[2017]**

(A) 10^{27} (B) 10^{23}

(C) 10^{25} (D) 10^{29}

Sol. **[A]**

$V_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3kT}{M_0}}$

$P = \dot{N} \times 2mV_{rms}$

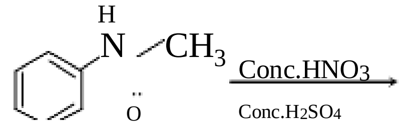
$1.01 \times 10^5 = \dot{N} \times 2 \times 5 \times 10^{-27} \times V_{rms}$

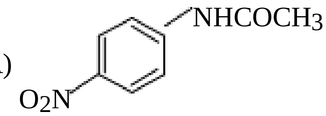
$\dot{N} = \frac{1.01\ 10^5\ \sqrt{5\ 10^{-27}}}{2\ 5\ 10^{-27}\ \sqrt{3\ 1.4\ 10^{-23}\ 293}}$

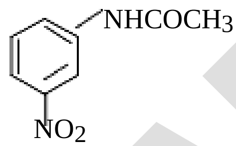
$= 6.43 \times 10^{27}$

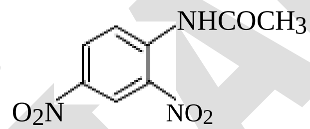
Section 3-Part A Chemistry

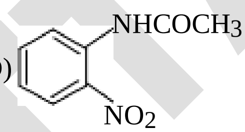
41. The major product formed in the following reaction is **[2017]**



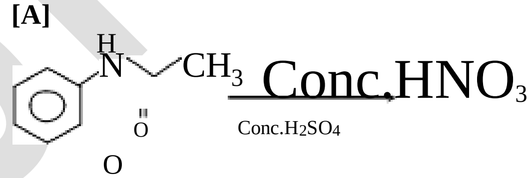
(A) 

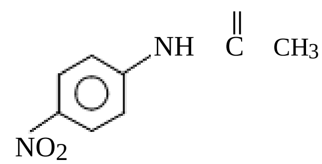
(B) 

(C) 

(D) 

Sol. **[A]**





42. Among the -amino acids - threonine, tyrosine, methionine, arginine and tryptophan, those which contain an aromatic group in their side chain are **[2017]**

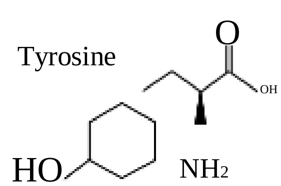
(A) threonine and arginine

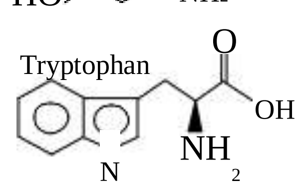
(B) tyrosine and tryptophan

(C) methionine and tyrosine

(D) arginine and tryptophan

Sol. **[B]**





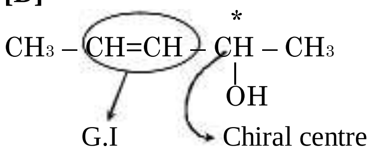
43. The number of stereoisomers possible for the following compound is

CH_3-CH=CH-CH(OH)-CH_3 **[2017]**

(A) 1 (B) 2

(C) 3 (D) 4

Sol. **[D]**



No. of S. I = $2^n = 2^2 = 4$

Cis	R
Trans	R
Cis	S
Trans	S

44. In electrophilic aromatic substitution reactions of chlorobenzene, the ortho/para-directing ability of chlorine is due to its **[2017]**

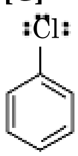
(A) positive inductive effects (+I)

(B) negative inductive effect (–I)

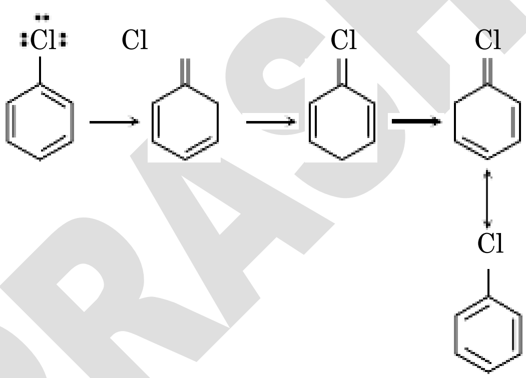
(C) positive resonance effect (+R)

(D) negative resonance effect (–R)

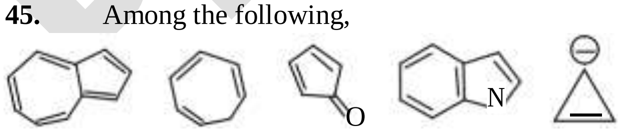
Sol. **[C]**



it shows +R effect that is why it act as o, p directing group.



45. Among the following,



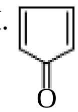
I II III IV V

the antiaromatic compounds are **[2017]**

(A) I and IV (B) III and V

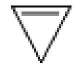
(C) II and V (D) I and III

Sol. **[B]**

III. 

4 e^-

All C, sp^2 hybrid anti aromatic

V.  4 e^-

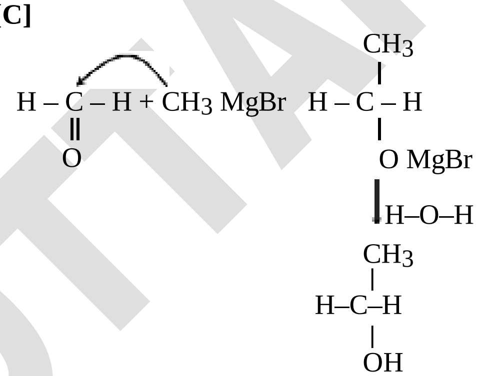
All C, sp^2 hybrid anti aromatic

46. Upon reaction with CH_3MgBr followed by protonation, the compound that produces ethanol is **[2017]**

(A) CH_3CHO (B) HCOOH

(C) HCHO (D) $(CHO)_2$

Sol. **[C]**



Ethanol

47. Which of the following is **NOT** an oxidation-reduction reaction ? **[2017]**

(A) $H_2 + Br_2$ 2HBr

(B) NaCl + $AgNO_3$ $NaNO_3$ + AgCl

(C) 2 $Na_2S_2O_3 + I_2$ $Na_2S_4O_6$ + 2NaI

(D) $Cl_2 + H_2O$ HCl + HOCl

Sol. **[B]**

NaCl + $AgNO_3$ — $NaNO_3$ + AgCl is not a oxidation-reduction reaction because there is no change in oxidation state of any element.

48. The thermal stability of alkaline earth metal carbonates–$MgCO_3$, $CaCO_3$, $SrCO_3$ and $BaCO_3$, follows the order **[2017]**

(A) $BaCO_3 > SrCO_3 > CaCO_3 > MgCO_3$

(B) $CaCO_3 > SrCO_3 > BaCO_3 > MgCO_3$

(C) $MgCO_3 > CaCO_3 > SrCO_3 > BaCO_3$

(D) $SrCO_3 > CaCO_3 > MgCO_3 > BaCO_3$

Sol. **[A]**

Thermal stability of polyvalent anion salt like CO_3^{2-} increase down the group due to increase in ionic character

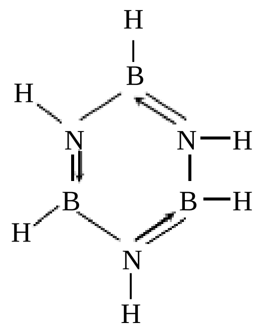
49. When a mixture of diborane and ammonia is heated, the final product is **[2017]**

(A) BH_3 (B) NH_4BH_4

(C) NH_2NH_2 (D) $B_3N_3H_6$

Sol. **[D]**

$B_2H_6 + 2NH_3$



Borazole or Inorganic benzene

50. Among the following metals, the strongest reducing agent is **[2017]**

(A) Ni (B) Cu

(C) Zn (D) Fe

Sol. **[C]**

According to their SRP value.

51. The molecule which is **NOT** hydrolysed by water at 25°C is **[2017]**

(A) $AlCl_3$ (B) $SiCl_4$

(C) BF_3 (D) SF_6

Sol. **[D]**

Due to steric hinderance SF_6 is not hydrolysed by H_2O at 25ºC

52. Among the following compounds, the one which does **NOT** produce nitrogen gas upon heating is **[2017]**

(A) $(NH_4)_2\,Cr_2O_7$ (B) NaN_3

(C) NH_4NO_2 (D) $(NH_4)_2\,(C_2O_4)$

Sol. **[D]**

$(NH_4)_2\,Cr_2O_7\;N_2 + Cr_2O_3 + H_2O$

$2NaN_3\;2Na + 3N_2\;NH_4NO_2\;N_2 +$ H_2O

$(NH_4)_2C_2O_4 \quad 2NH_3 + H_2C_2O_4$

53. Chlorine has two naturally occurring isotopes, ^{35}Cl and ^{37}Cl. If the atomic mass of Cl is 35.45, the ratio of natural abundance of ^{35}Cl and ^{37}Cl is closest to **[2017]**

(A) 3.5 : 1 (B) 3 :1

(C) 2.5 : 1 (D)4:1

Sol. **[B]**

$$Mav = \frac{M_1 n_1 \quad M_2 n_2}{n_1 \quad n_2}$$

$$35.45 = \frac{35n_1 \quad 37n_2}{n_1 \quad n_2}$$

$n_1 : n_2 = 3 : 1$

54. The reaction $C_2H_6\,(g) \rightleftharpoons C_2H_4\,(g) + H_2\,(g)$ is at equilibrium in a closed vessel at 1000 K. The enthalpy change (H) for the reaction is 137.0 kJ mol^{-1}. Which one of the following actions would shift the equilibrium to the right ? **[2017]**

(A) Decreasing the volume of the closed reaction vessel

(B) Decreasing the temperature at which the reaction is performed

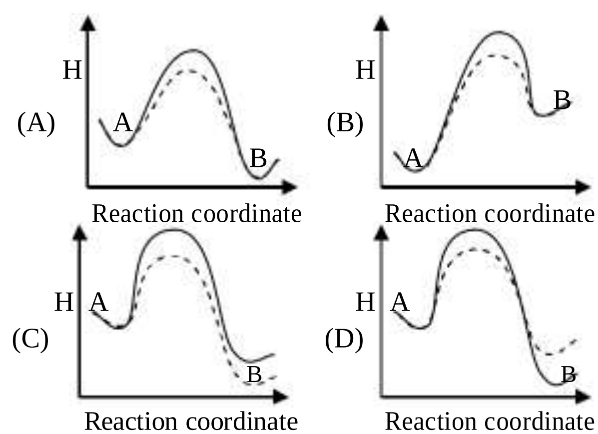
(C) Adding an inert gas to the closed reaction vessel

(D) Increasing the volume of the closed reaction vessel

Sol. **[D]**

According to Lechatelier principal on increasing volume of closed vessel equilibrium will shift towards right.

55. The enthalpy (H) of an elementary exothermic reaction A $\rightleftharpoons$ B is schematically plotted against the reaction coordinate. The plots in the presence and absence of a catalyst are shown in dashed and solid lines, respectively. Identify the correct plot for the reaction. **[2017]**



Sol. **[A]**

For exothermic reaction

$H = E_P – E_R < 0$

$E_B – E_A < 0$

$\mathbf{E_B < E_A}$

Catalyst does not changes the initial and final position of the reaction so correct answer is (A)

56. $Mg(OH)_2$ is precipitated when NaOH is added to a solution of Mg^{2+}. If the final concentration of Mg^{2+} is 10^{-10} M, the concentration of OH^- (M) in the solution is

[Solubility product for Mg $(OH)_2 = 5.6 \times 10^{-12}$]

[2017]

(A) 0.056 (B) 0.12

(C) 0.24 (D) 0.025

Sol. **[C]**

K_{sp} $Mg(OH)_2 = [Mg^{+2}]\,[OH^{-2}]$

$[OH^-] = \sqrt{5.6\ \ 10^{2}} = 0.24$ M

57. A constant current (0.5 amp) is passed for 1 hour through (i) aqueous $AgNO_3$, (ii) aqueous $CuSO_4$ and (iii) molten AlF_3, separately. The ratio of the mass of the metals deposited on the cathode is

[M_{Ag}, M_{Cu}, M_{Al} are molar masses of the respective metals] **[2017]**

(A) $M_{Ag} : 2\,M_{Cu} : 3\,M_{A1}$

(B) $M_{Ag} : M_{Cu} : M_{A1}$

(C) $6\,M_{Ag} : 3\,M_{Cu} : 2\,M_{A1}$

(D) $3\,M_{Ag} : 2\,M_{Cu} : M_{A1}$

Sol. **[C]**

	Ag^+	Cu^{+2}	Al^{+3}
no. of eq. deposit	x	x	x
no. of mol deposit	$\frac{x}{1}$	$\frac{x}{2}$	$\frac{x}{3}$
	6x	3x	2x
no. of mole deposit	6	3	2
mass deposit	$6\,M_{Ag}$	$3M_{Cu}$	$2M_{Al}$

58. A reaction has an activation energy of 209 kJ mol^{-1}. The rate increases 10–fold when the temperature is increased from 27°C to X °C. The temperature X is closest to

[Gas constant, R = 8.314 J mol^{-1} K^{-1}] **[2017]**

(A) 35 (B) 40

(C) 30 (D) 45

Sol. **[A]**

$$\log_{10} = \frac{209\ 10^3}{2.303\ 8.314}\ \frac{1}{300}\ \frac{1}{T}$$

$9.16 \times 10^{-5} = 3.33 \times 10^{-3} - \frac{1}{T}$

T = 308.4 K

or 35º C = X

59. A mineral consists of a cubic close-packed structure formed by O^{2-} ions where half the octahedral voids are occupied by Al^{3+} and one-eighth of the tetrahedral voids are occupied by Mn^{2+}. The chemical formula of the mineral is **[2017]**

(A) $Mn_3Al_2O_6$ (B) $MnAl_2O_4$

(C) $MnAl_4O_7$ (D) $Mn_2Al_2O_5$

Sol. **[B]**

No of O^{-2} per unit cell $= 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$

No of Al^{+3} per unit cell $= 4 \times \frac{1}{2} = 2$

No of Mn^{+2} per unit cell $= 8 \times \frac{1}{8} = 1$

$MnAl_2O_4$

60. For a 4p orbital, the number of radial and angular nodes, respectively, are **[2017]**

(A) 3,2 (B) 1,2

(C) 2, 4 (D) 2,1

Sol. **[D]**

no. of radial node = n – – 1 = 4 – 1 – 1 = 2

no. of angular node = = 1

Section 4-PartA-Biology

61. Interferons combat viral infection by **[2017]**

(A) inhibiting viral packaging directly.

(B) increasing the binding of antibodies to viruses.

(C) binding to the virus and agglutinating them.

(D) restricting viral spread to the neighboring cells.

Sol. **[D]**

In a typical scenario, a virus defected cell will release interferons causing near by cells to heighten their anti-viral defense

62. Leydig cells synthesize **[2017]**

(A) insulin

(B) growth hormone

(C) testosterone

(D) estrogen

Sol. **[C]**

Also know as interstitial cells present in testis between somniferous tubule.

63. Glucagon increases the blood glucose concentration by **[2017]**

(A) promoting glycogenolysis.

(B) increasing the concentration of fructose 2,–6-bisphosphate.

(C) increasing the concentration of pyruvate kinase.

(D) inhibiting gluconeogenesis.

Sol. **[A]**

Promote breakdown of Glycogen in liver.

64. Which ONE of the following is NOT essential for Polymerase Chain Reaction (PCR) ? **[2017]**

(A) Restriction enzyme

(B) Denaturation of DNA

(C) Primers

(D) DNA polymerase

Sol. **[A]**

RE is not required in PCR

65. CO_2 acts as a greenhouse gas because **[2017]**

(A) it is transparent to heat but traps sunlight.

(B) it is transparent to sunlight but traps heat.

(C) it is transparent to both sunlight and heat.

(D) it traps both sunlight and heat.

Sol. **[B]**

Green house effect increases earth's temperature by trapping heat.

66. A graph of species richness *s* area on log-log axes is **[2017]**

(A) linear (B) sigmoidal

(C) oscillatory (D) parabolic

Sol. **[A]**

log S = log c + z log A

67. Concentration of Na^+ ions outside a nerve cell is 100 times more than inside. The concentration of K^+ ions is more inside the cells. The levels of Na^+ ions and K^+ ions are maintained by **[2017]**

(A) free diffusion of Na^+ ions and pumping of K^+ ions across the membrane.

(B) Na^+ and K^+ pumps in the membrane.

(C) free diffusion of K^+ ions and pumping of Na^+ ions across the membrane.

(D) water channels formed by lipids in the membrane.

Sol. **[B]**

Energy derived pumps are present in plasma membrane.

68. In a chemical reaction, enzymes catalyze the reaction by **[2017]**

(A) lowering the activation energy.

(B) increasing the activation energy.

(C) decreasing the free energy change between reactants and products.

(D) increasing the free energy change between reactants and products.

Sol. **[A]**

Enzyme decreases activation energy in reaction.

69. The rigidity of cellulose is due to **[2017]**

(A) coiled structure of glucose polymer

(B) (1 4) glycosidic linkage

(C) hydrogen bonding with adjacent glucose polymer

(D) cross-linking between glucose and peptides

Sol. **[C]**

Bundle of cellulose fibre are rigid to H-bonds.

70. Antigen-angtibody reactions **[2017]**

(A) always result in precipitation of the complex

(B) depend only on covalent interactions.

(C) are irreversible.

(D) depend on ionic and hydrophobic interactions.

Sol. **[D]**

Antibody- antigen interaction is essentially Non-Covalent, Electrostatic interaction, Hydrogen Bonds, Vander walls forces and Hydrophobic interactions are all known to be involved depending on the interaction sites.

71. Which ONE of the following combinations of molecular masses of polypeptides are obtained from purified human IgM when analysed on sodium dodecyl suplhate polyacrylamide gel electrophoresis (SDS-PAGE) under reducing conditions? **[2017]**

(A) 55 kDa, 15 kDa
(B) 70 kDa, 25 kDa, 15 kDa
(C) 55 kDa, 25 kDa
(D) 155 kDa

Sol. **[B]**

72. For a particular gene that determines the coat color in a diploid organism, there are three different alleles that are codominant. How many different skin colors are possible in such an organism? **[2017]**

(A) 9 (B) 6
(C) 4 (D) 3

Sol. **[B]**

$$\frac{n(n-1)}{2} = \frac{3(3-1)}{2} = 6$$

73. Two genetic loci controlling two different traits are linked. During the inheritance of these traits, the Mendelian laws that would be affected is/are **[2017]**

(A) Law of dominance, law of segregation and law of independent assortment
(B) Law of segregation and Law of independent assortment
(C) Only Law of independent assortment
(D) Only Law of segregation

Sol. **[C]**

Linkage in exception of law of independent assortment

74. Which ONE of the following statements is INCORRECT? **[2017]**

(A) Alleles are different forms of the same gene.
(B) Alleles are present at the same locus.
(C) Alleles code for different isoforms of a protein.
(D) Alleles are non-heritable.

Sol. **[D]**

Alleles are alternate form of gives of one character present on same locus.

75. Which ONE of the following statements is INCORRECT about restriction endonucleases? **[2017]**

(A) They serve as primitive form of immune system in bacteria.
(B) They digest the DNA non-randomly.
(C) They digest the DNA at specific location.
(D) They digest the DNA from free ends.

Sol. **[D]**

Endonucleases do not cut from free ends.

76. The number of net ATP molecules produced from 1 glucose molecule during glycolysis is **[2017]**

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

Sol. **[B]**

In glycolysis net ATP produced
=4–2=2ATP

77. Which ONE of the following coenzymes is required for the conversion of L-alanine to a racemic mixture of D-and L-alanine ? **[2017]**

(A) Pyridoxal-6-phosphate
(B) Thiamine pyrophosphate
(C) Coenzyme A
(D) Flavin adenine dinucleotide

Sol. **[A]**

Information based question

78. The cyclic electron flow during photosynthesis generates **[2017]**

(A) NADPH alone.
(B) ATP and NADPH.
(C) ATP alone.
(D) ATP, NADPH and O_2.

Sol. **[C]**

In cyclic photophosphorylation only ATP is formed.

79. Match the type of cells given in Column I with organisms given in Column II. Choose the appropriate combination from the options below. **[2017]**

Column I	Column II
(P) Flame cells	(i) Sponges
(Q) Collar cells	(ii) Hydra
(R) Stinging cells	(iii) Planaria

(A) P-iii, Q-i, R-ii (B) P-iii, Q-ii, R-i
(C) P-i, Q-ii, R-iii (D) P-ii, Q-iii, R-i

Sol. **[A]**
Flame cells are for secretion and osmoregulation in flatworms.
Collar cells line spongocoel and cavars in sponges and creat water amount.
Cnidocytes are stringing cells and help in defense, affiance and capture of prey these cells also help in attachment with substrate

80. Compared to the atmospheric air, the alveolar air has **[2017]**
(A) more pO_2 and less pCO_2
(B) less pO_2 and pCO_2
(C) more pO_2 and more pCO_2
(D) less pO_2 and less pCO_2

Sol. **[B]**
Pressure gradient is essential for movement of gases in and out of the body.

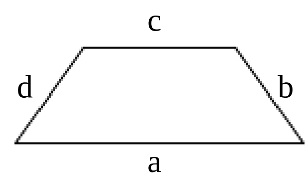
Section 5 part B Mathematics

81. Let x,y,z be positive integers such that HCF (x,y,z) = 1 and $x^2 + y^2 = 2z^2$. Which of the following statements are true?
I. 4 divides x or 4 divides y.
II. 3 divides x + y or 3 divides x – y.
III. 5 divides $z(x^2 – y^2)$ **[2017]**
(A) I and II only (B) II and III only
(C) II only (D) III only

Sol. **[B]**
Take combination such as x = 1, y = 7, z = 5
Now, check options
(ii) & (iii) statement are correct.

82. How many different (mutually noncongruent) trapeziums can be constructed using four distinct side lengths from the set {1,3,4,5,6}? **[2017]**
(A) 5 (B) 11 (C) 15 (D) 30

Sol. **[B]**



$|a – c| < b + d < a + c$
(a, c) (b, d) (1, 3) (5, 6)
(1, 3) (4, 5)
and (1, 3) (4, 6)
Now make different combination. Total of 11 combination are possible.

83. A solid hemisphere is mounted on a solid cylinder, both having equal radii. If the whole solid is to have a fixed surface area and the maximum possible volume, then the ratio of the height of the cylinder to the common radius is **[2017]**
(A) 1:1 (B) 1:2
(C) 2:1 (D) $\sqrt{2}$:1

Sol. **[A]**
$S = 2 R^2 + 2 Rh + R^2$
(R = radius of hemisphere & cylinder)

$V = \frac{2}{3} R^3 + R^2 h$

$V = \frac{2}{3} R^3 + R^2 \times \frac{S - 3R^2}{2R}$

$\frac{dV}{dR} = 2 R^2 + \frac{5}{2} - \frac{9}{2} R^2$

for maximum & minimum $\frac{dV}{dR} = 0$

$5 R^2 = S$
$5 R^2 = 3 R^2 + 2 Rh$

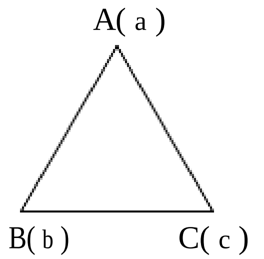
h : R = 1 : 1

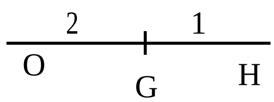
84. Let ABC be an acute scalene triangle, and O and H be its circumcentre and orthocenter respectively. Further let N be the midpoint of OH. The value of the vector sum

NA NB NC is **[2017]**
(A) 0 (zero vector) (B) $\overrightarrow{HO}$
(C) $\frac{1}{2}\overrightarrow{HO}$ (D) $\frac{1}{2}\overrightarrow{OH}$

Sol. **[C]**

Circumcenter (origin O)





$(O) = \frac{a\ b\ c}{3}$; $H = \frac{a\ b\ c}{2}$

$N \ \frac{1}{4}(a\ \ b\ \ c)$

85. The quotient when $1\ x^2\ x^4\ x^6 \ldots\ldots x^{34}$ is divided by $1\ x\ x^2\ x^3 \ldots\ldots x^{17}$ is **[2017]**

(A) $x^{17} - x^{15}\ \ x^{13} - x^{11} \ldots\ldots\ x$

(B) $x^{17}\ \ x^{15}\ \ x^{13}\ \ x^{11}\ \ \ldots\ldots\ x$

(C) $x^{17}\ \ x^{16}\ \ x^{15}\ \ x^{14}\ \ \ldots\ldots\ 1$

(D) $x^{17} - x^{16}\ \ x^{15} - x^{14}\ \ \ldots\ldots -1$

Sol. **[D]**

$$x^{17} - x^{16} + \ldots$$

$$x^{17}+x^{16}+x^{15} + x^{14} + \ldots x^2 + 1 \overline{\big)\ x^{34} + x^{32} + x^{30} + \ldots\ x^2\ + 1}$$

$$x^{34} + x^{33} + x^{32} + x^{31} + 1 \ldots x^{17}$$

$$-x^{33} - x^{31} - x^{29} + \ldots x^{17} + 1$$

$$-x^{33} - x^{32} - x^{31} + \ldots$$

$$x^{32} - x^{31}\ \ + \ldots$$

Do in this way option (D)

86. Let R be the region of the disc $x^2+y^2\ \ 1$ in the first quadrant. Then the area of the largest possible circle contained in R is **[2017]**

(A) $(3\ \ 2\ \ \sqrt{2}\ )$ (B) $(4\ \ 3\ \ \sqrt{2}\ )$

(C) $\frac{}{6}$ (D) $(2\ \sqrt{2}\ \ \ 2)$

Sol. **[A]**

Required equation of circle

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

Both circle touch internally

$\sqrt{h^2\ \ h^2} = |h - 1|$

Solve this $h = \sqrt{2} - 1$

Area $(\sqrt{2} - 1)^2 = \ (3 - 2\sqrt{2}\ )$

87. Let R be the set of real numbers and f : R R be given by $f(x)\ \sqrt{|x|} \log(1\ x\ )$. We now make the following assertions:

I. There exists a real number A such that f(x) A for all x.

II. There exists a real number B such that f(x) B for all x. **[2017]**

(A) I is true and II is false

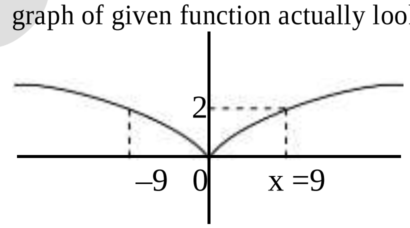
(B) I is false and II is true

(C) I and II both are true

(D) I and II both are false

Sol. **[B]**

graph of given function actually look like this



Clear from graph option (B) is right.

88. Define $g(x)\ \ \int_{-3}^{3} f(x\ \ y) f(y) dy$, for all real x,

where $f(t) \begin{cases} 1, & 0\ \ t\ \ 1, \\ 0, & \text{elsewhere.} \end{cases}$

Then **[2017]**

(A) g(x) is not continuous everywhere

(B) g(x) is continuous everywhere but differentiable nowhere

(C) g(x) is continuous everywhere and differentiable everywhere except at x = 0,1

(D) g(x) is continuous everywhere and differentiable everywhere except at x = 0,1,2

Sol. **[D]**

Definition can be break as

$g(x) = \int_0^1 f(x \quad y)\, dy$

$x - y = t$; $-dy . dt$

$g(x) = \int_{x1}^{x} f(t)\, dt$

$$g(x) = \begin{cases} 0 & x \quad 0 \\ x & 0 \quad x \quad 1 \\ 2 \quad x & 1 \quad x \quad 2 \\ 0 & x \quad 2 \end{cases}$$

Now, check yourself

89. The integer part of the number

$\sum_{k \; 0}^{44} \frac{1}{\cos k \cos(k \quad 1)}$ is **[2017]**

(A) 50 (B) 52

(C) 57 (D) 59

Sol. **[C]**

$\frac{1}{\cos 0^o \cos 1^o} + \frac{1}{\cos 1^o \cos 2^o} + \frac{1}{\cos 2^o \cos 3^o} + ...$

$... \frac{1}{\cos 44^o \cos 45^o}$

multiply & divided by sin 1º

$\frac{1}{\sin 1^o} \frac{\sin 1^o}{\cos 0^o \cos 1^o} \quad \frac{\sin 1^o}{\cos 1^o \cos 2^o} ... \frac{\sin 1^o}{\cos 44^o \cos 45^o}$

$\frac{1}{\sin 1^o} \frac{\sin(1^o \quad 0^o)}{\cos 0^o \cos 1^o} \quad \frac{\sin(2 \quad 1)^o}{\cos 1^o \cos 2^o} ... \frac{\sin(45^o \quad 44^o)}{\cos 44^o \cos 45^o}$

$\frac{1}{\sin 1^o}$ [tan1º – tan0º + tan2º – tan1º + ... tan45º – tan44º]

$= \frac{1}{\sin 1^o}$ [tan 45º]

$= \frac{1}{0.0174524} = 57.2987$

Integral part = 57

90. The number of continuous functions f:[0,1] R that satisfy **[2017]**

(A) 0 (B) 1

(C) 2 (D) infinity

Sol. **[B]**

Given equation can be written as

$\frac{1}{ } = \int_0^1 \frac{f(x)}{ } \quad x \quad ^2 dx \quad \int_0^1 x \quad ^2 dx$

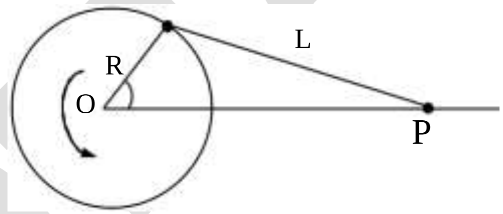
$\int_0^1 x \quad ^2 dx \quad \frac{1}{3} = \int_0^1 \frac{f(x)}{2} \quad x \quad ^2 dx$

$0 = \int_0^1 \frac{f(x)}{2} \quad x \quad ^2 dx$

So, no of continuous function is 1.

Section 6 part B Physics

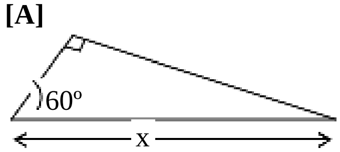
91. One end of a rod of length L=1 m is fixed to a point on the circumference of a wheel of radius $R \; 1/\sqrt{3}$ m. The other end is sliding freely along a straight channel passing through the center O of the wheel as shown in the figure below. The wheel is rotating with a constant angular velocity about O. **[2017]**



The speed of the sliding end P when = 60° is

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

Sol. **[A]**



$\tan 60^o = \frac{L}{R} = \frac{1}{1/\sqrt{3}} = \sqrt{3} = \tan$

$x = 1 \sqrt{\quad \frac{1}{3}} = \frac{2}{\sqrt{3}}$

$\cos = \frac{R^2 \quad x^2 \quad L^2}{2Rx}$

$R^2 + x^2 - L^2 = 2Rx \cos$

$2x \frac{dx}{dt} = 2R\, x(\sin) \quad \cos \quad \frac{dx}{dt}$

$\frac{dx}{dt}[x - R\cos] = -Rx \sin \frac{d}{dt}$

$\frac{dx}{dt} = v \; \& \; \frac{d}{dt} = \frac{ }{ }$

$v = \frac{Rx \sin}{x \quad R\cos}$

$$= \frac{\frac{1}{\sqrt{3}} \cdot \frac{2}{\sqrt{3}} \cdot \frac{\sqrt{3}}{2}}{\frac{2}{\sqrt{3}} \cdot \frac{1}{\sqrt{3}} \cdot \frac{1}{2}} = \frac{\sqrt{3}}{\frac{1}{\sqrt{3}} \cdot \frac{3}{2}} = \frac{2}{3}$$

$v = \frac{2}{\;}$

92. One mole of an ideal monatomic gas undergoes the following four reversible processes :

Step1 : It is first compressed adiabatically from volume V_1 to $1m^3$.

Step 2 : then expanded isothermally to volume $10\ m^3$.

Step 3 : then expanded adiabatically to volume V_3.

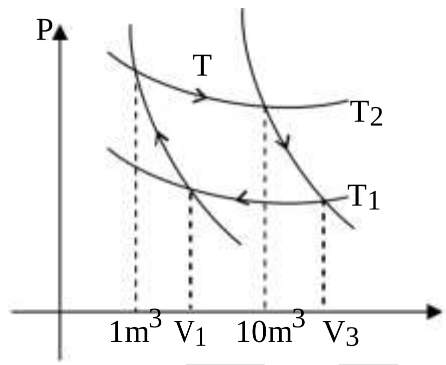
Step 4 : then compressed isothermally to volume V_1.

If the efficiency of the above cycle is 3/4 then V_1 is, **[2017]**

(A) $2m^3$ (B) $4m^3$

(C) $6\ m^3$ (D) $8\ m^3$

Sol. [D]



$\eta = 1 - \frac{T_1}{T_2} = 1 - \left(\frac{V_2}{V_1}\right)^{2/3}$

$-\frac{1}{4} = -\left(\frac{1}{V_1}\right)^{2/3}$ $V_1 = 8m^3$

93. A neutron star with magnetic moment of magnitude m is spinning with angular velocity ω about its magnetic axis. The electromagnetic power P radiated by it is given by $\mu_0^x m^y \omega^z c^u$ where μ_0 and c are the permeability and speed of light in free space, respectively. Then **[2017]**

(A) x = 1, y = 2, z = 4 and u = –3

(B) x = 1, y = 2, z = 4 and u = 3

(C) x = –1, y = 2, z = 4 and u = –3

(D) x = –1, y = 2, z = 4 and u = 3

Sol. [A]

$P = [M L^2 T^{-3}]$

$\mu_0 = [M L T^{-2} I^{-2}]$

$m = [I\ L^2]$

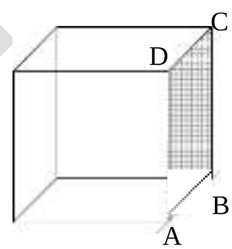
$\omega = [T^{-1}]$ C

$= [L T^{-1}]$

$[M L^2 T^{-3}] = [M L T^{-2} I^{-2}]^x [I L^2]^y [T^{-1}]^z [LT^{-1}]^u$

x = 1, y = 2, z = 4, u = –3

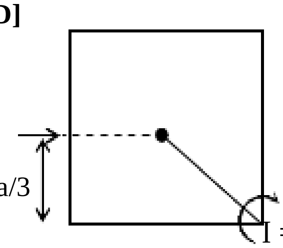
94. A solid cube of wood of side 2a and mass M is resting on a horizontal surface as shown in the figure. The cube is free to rotate about a fixed axis AB. A bullet of mass m (<<M) and speed v is shot horizontally at the face opposite to ABCD at a height 4a/3 from the surface to impart the cube an angular speed ω_c. It strike the face and embeds in the cube. Then ω_c is close to (note : the moment of inertia of the cube about an axis perpendicular to the face and passing through the center of mass is $2Ma^2/3$) **[2017]**



(A) Mv/ma (B) Mv/2ma

(C) mv/Ma (D) mv/2Ma

Sol. [D]



$I = I_{cm} + M(a\sqrt{2})^2 = \frac{8}{3}Ma^2$

$mvr = I\omega$

$\omega = \frac{mv\frac{4a}{3}}{\frac{8}{3}Ma^2}$

$= \frac{mv}{2Ma}$

95. A gas obeying the equation of state PV = RT undergoes a hypothetical reversible process described by the equation, $PV^{5/3} \exp\left(-\frac{PV}{E_0}\right) = c_1$

where c_1 and E_0 are dimensioned constants. Then, for this process, the thermal compressibility at high temperature **[2017]**

(A) approaches a constant value.

(B) is proportional to T.

(C) is proportional to $T^{1/2}$

(D) is proportional to T^2.

Sol. **[A]**

$$PV^{5/3} = c_1 e^{\frac{PV}{E_0}}$$

$$n P + \frac{5}{3} n V = n c_1 + \frac{PV}{E_0}$$

$$\frac{dP}{P} + \frac{5}{3}\frac{dV}{V} = 0 + \frac{PdV \;\; VdP}{E_0}$$

$$dP\left(\frac{1}{P} - \frac{V}{E_0}\right) = dV\left(P - \frac{5}{3V}\right)$$

$$\frac{dV}{dP} = \frac{\frac{1}{P} - \frac{V}{E_0}}{P - \frac{5}{3V}}$$

$$c = -\frac{1}{V}\frac{dV}{dP} = \frac{\frac{1}{E_0} - \frac{1}{PV}}{P - \frac{5}{3V}}$$

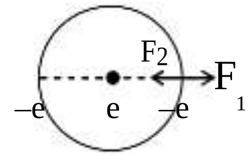
At very high temperature $c = \frac{1}{E_0}$

96. To calculate the size of a hydrogen anion using the Bohr model, we assume that its two electrons move in an orbit such that they are always on diametrically opposite sides of the nucleus. With each electron having the angular momentum = h/2 , and taking electron interaction into account the radius of the orbit in terms of the Bohr radius of hydrogen atom

$a_B = \frac{4 \;\; _0h^2}{me \;\; ^2}$ is **[2017]**

(A) a_B (B) $\frac{4}{3}a_B$ (C) $\frac{2}{3}a_B$ (D) $\frac{3}{2}a_B$

Sol. **[B]**



$$mvr = n\frac{h}{2} \quad ...(1)$$

$$\& \quad \frac{mv^2}{r} = \frac{ke^2}{r^2} - \frac{ke^2}{(2r)^2}$$

$$\frac{mv^2}{r} = \frac{3}{4}\frac{ke^2}{r^2}$$

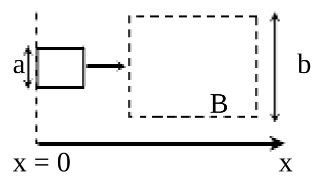
$$mv^2r = \frac{3}{4}ke^2 \quad ...(2)$$

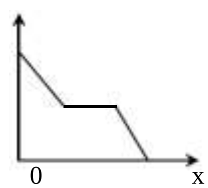
Solving (1) + (2)

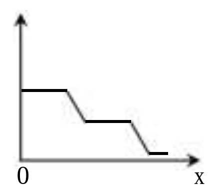
$$r = \frac{4 \;\; _0h^2}{me \;\; ^2} \times \frac{4}{3}$$

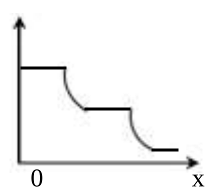
$$r = \frac{}{} a_B$$

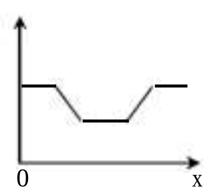
97. A square-shaped conducting wire loop of dimension *a* moving parallel to the x-axis approaches a square region of size *b* (*a* < *b*) where a uniform magnetic field B exists pointing into the plane of the paper (see figure). As the loop passes through this region, the plot correctly depicting its speed ( ) as a function of x is **[2017]**



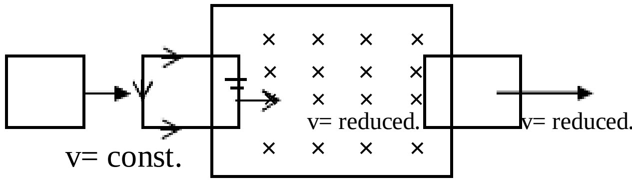
(A)


(B)


(C)


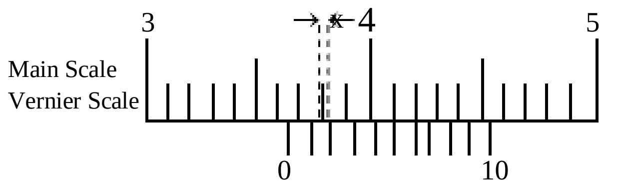
(D)


Sol. **[B]**



inside B speed will be constant therefore B option is correct, representation of speed

98. The figure of a centimeter scale below shows a particular position of the vernier calipers. In this position the value of x shown in the figure is (figure is not to scale) **[2017]**



(A) 0.02 cm (B) 3.65 cm
(C) 4.15 cm (D) 0.03 cm

Sol. **[D]**

x = 0.3 cm – 3 × scale division of vernier calipers

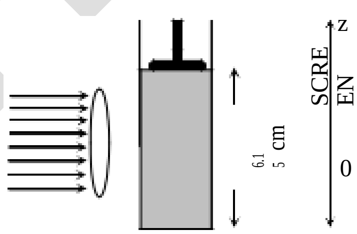
$= 0.3 \text{ cm} - 3 \times \frac{9}{100}$

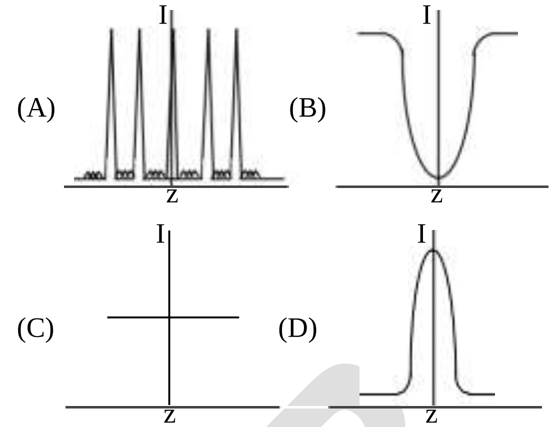
$= \frac{30 \ \ 27}{100}$

$= \frac{3}{100}$

= 0.03 cm

99. A parallel beam of light is incident on a tank filled with water up to a height of 61.5 mm as shown in the figure below. Ultrasonic waves of frequency 0.5 MHz are sent along the length of the water column using a transducer placed at the top, and they form longitudinal standing waves in the water. Which of the schematic plots below best describes the intensity distribution of the light as seen on the screen ? Take the speed of sound in water to be 1,500 m/s. **[2017]**



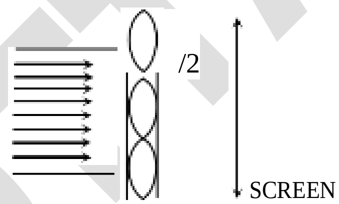


Sol. **[A]**

v =

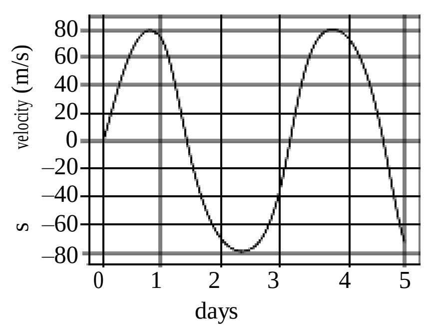
$= \frac{1500}{0.5 \ \ 10^6} = 3000 \times 10^{-6}$

= 3mm



intensity vary according to graph 'A'

100. A star of mass M (equal to the solar mass) with a planet (much smaller than the star) revolves around the star in a circular orbit. The velocity of the star with respect to the center of mass of the star-planet system is shown below : **[2017]**



The radius of the planet's orbit is closest to (1 A. U. = Earth-Sun distance)

(A) 0.004 A. U.
(B) 0.008 A.U.
(C) 0.004 A.U.
(D) 0.12 A.U.

Sol. **[C]**

$T^2 = \frac{4\ ^2 a^2}{GM}$

$\frac{4^2}{GM} = 1$

T = in year

a = radius in A.U.

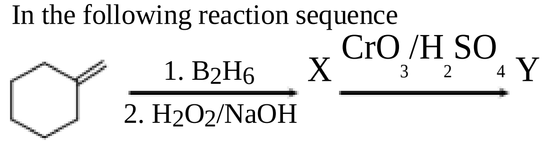
$T = 3 \text{ days} = \frac{3}{\quad}$ year

$a = \left(\frac{3}{365}\right)^{2/3}$

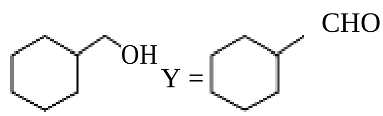
a = 0.04 A.U.

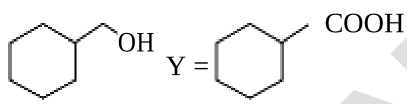
Section 7 Part B-Chemistry

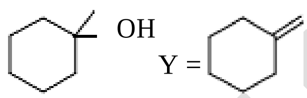
101. In the following reaction sequence

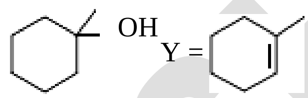


X and Y are **[2017]**

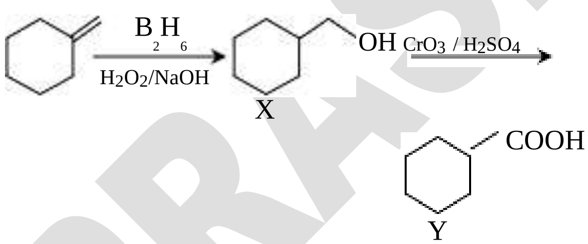
(A) X= 

(B) X= 

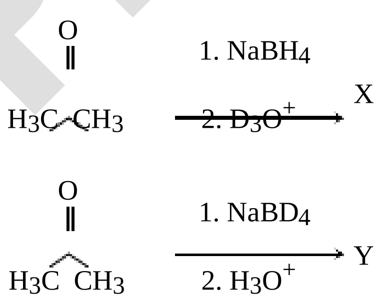
(C) X= 

(D) X= 

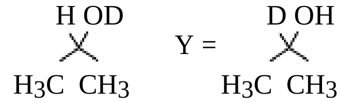
Sol. **[B]**

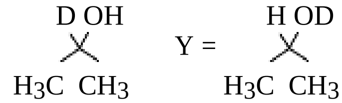


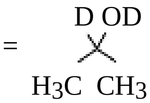
102. In the following reactions

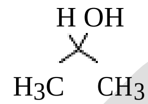


X and Y are **[2017]**

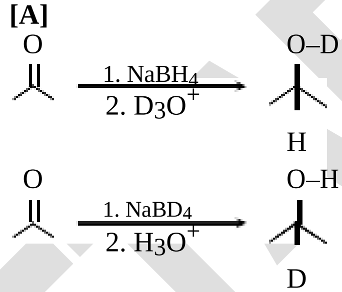
(A) X= 

(B) X= 

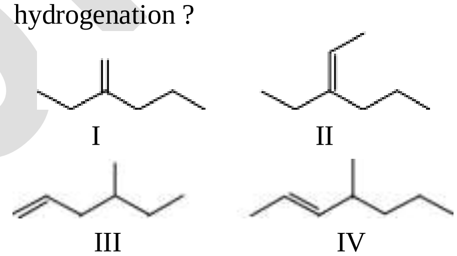
(C) X= Y = 

(D) X= Y = 

Sol. **[A]**



103. Which of the following alkenes can generate opticallyactivecompoundsupon hydrogenation ? **[2017]**



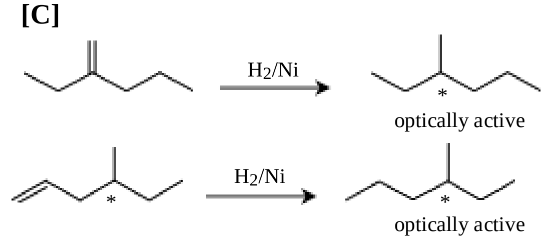
(A) I, III and IV

(B) II and III

(C) I and III

(D) II and IV

Sol. **[C]**



104. When heated in air, brown copper powder turns black. This black powder would turn brown again when heated with **[2017]**

(A) CO (B) O_2

(C) H_2 (D) NH_3

Sol. **[C]**

H_2 is reducing agent

105. The geometry and magnetic property of $[NiCl_4]^{2-}$, respectively, are **[2017]**

(A) tetrahedral, paramagnetic
(B) tetrahedral, diamagnetic
(C) square planar, paramagnetic
(D) square planar, diamagnetic

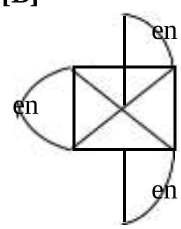
Sol. **[A]**

$[NiCl_4]^2$ sp^3 hybrid, Tetrahedral

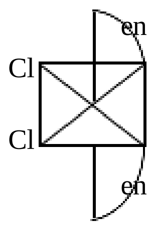
106. Among (i) $[Cr(en)_3]^{3+}$, (ii) trans-$[Cr(en)_2\ Cl_2]^+$, (iii) Cis-$[Cr(en)_2\ Cl_2]^+$ (iv) $[Co(NH_3)_4Cl_2]^+$ the optically active complexes are **[2017]**

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

Sol. **[B]**



optically active

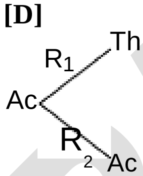


optically active

107. ^{227}Ac has a half-life of 22 years with respect to radioactive decay . The decay follows two parallel paths : ^{227}Ac ^{227}Th and ^{227}Ac ^{223}Fr. If the percentage of the two daughter nuclides are 2.0 and 98.0, respectively, the decay constant (in $year^{-1}$) for ^{227}Ac ^{227}Th path is closest to **[2017]**

(A) 6.3×10^{-2} (B) 6.3×10^{-3}
(C) 6.3×10^{-1} (D) 6.3×10^{-4}

Sol. **[D]**



$$\%Th = \frac{R_1}{R_T} = \frac{2}{100}$$

$$\%Ac = \frac{R_2}{R_T} = \frac{98}{100}$$

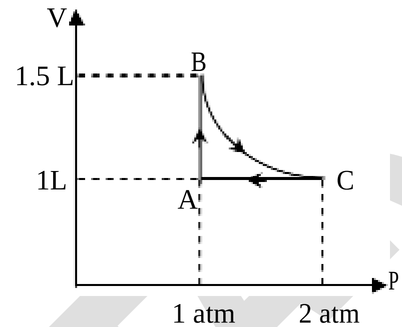
$$\frac{R_1}{R_2} = \frac{2}{98}$$

$R_T = R_1 + R_2$

$$\frac{0.693}{22} = R_1 + \frac{98}{2} R_1$$

$\mathbf{R_1 = 6.3 \times 10^{-4}}$

108. A system consisting of 1 mol of an ideal gas undergoes a reversible process, A B C A (schematically indicated in the figure below). If the temperature at the starting point A is 300 K and the work done in the process B C is 1 L atm, the heat exchanged in the entire process in L atm is **[2017]**



(A) 1.0 (B) 0.0
(C) 1.5 (D) 0.5

Sol. **[C]**

For process A C, W = 0, E = 0, q = 0

For process A B

W = –1 (1.5 – 1) = –0.5 lit. atm

E = q + W

0 = q + W

q = –W = – (– 0.5) = 0.5 lit. atm For process B C, W = 1 atm E = q + W

0 = q – W

–q = W = –1 atm

Total heat exchanged = 1.5

109. A mixture of toluene and benzene boils at 100°C. Assuming ideal behaviour, the mole fraction of toluene in the mixture is closest to [Vapour pressures of pure toluene and pure benzene at 100°C are 0.742 and 1.800 bar respectively. 1 atm = 1.013 bar] **[2017]**

(A) 0.824 (B) 0.744
(C) 0.544 (D) 0.624

Sol. **[B]**

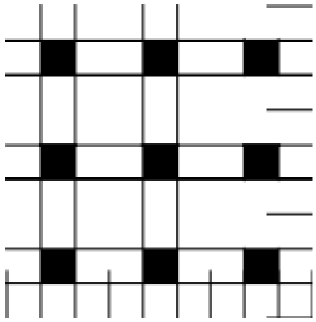
$1.013 = 0.742\ X_t + 1.8\ X_b$

$1.013 = 0.742(1 - X_b) + 1.8\ X_b$

$X_b = 0.256$

$X_t = 1 - X_b = 0.744$

110. A two-dimensional solid pattern formed by two different atoms X and Y is shown below. The black and white squares represent atoms X and Y, respectively. The simplest formula for the compound based on the unit cell from the pattern is **[2017]**



(A) XY_8 (B) X_4Y_9
(C) XY_2 (D) XY_4

Sol. [A]
The unit cell of the above pattern will consist of 8 white square and 1 black square i.e. it will form centre unit cell.
No. of white square Y = 8
No. of black square X = 1
Formula XY_8

Section 8 Part B Biology

111. The genetic distance between genes A and B is 10 cm. An organism with Ab combination of the alleles is crossed with the organism with aB combination of alleles. What will be the percentage of the gametes with AB allele combination by an F1 individual ? **[2017]**
(A) 1 (B) 5
(C) 10 (D) 50

Sol. [B]

Recombinants formed = 10% (AB 5% & ab 5%)

112.

Proteins P, Q, and R are associated with intact organellar membrane in a cell. If the intact organellel is treated with a high ionic strength buffer, only protein R remained associated with the membrane fraction. Based on this, one could conclude that **[2017]**
(A) P and Q are peripheral membrane proteins.
(B) R is a peripheral membrane protein.
(C) P and Q are integral membrane bound proteins.
(D) P is peripheral and Q is integral membrane protein.

Sol. [A]
Peripheral proteins can be detached earily

113. In photosynthesis, oxygen is produced by **[2017]**
(A) photosystem I from carbon dioxide.
(B) photosystem II from carbon dioxide.
(C) photosystem I from water.
(D) photosystem II from water.

Sol. [B]
photosynthesis at Ps II in lumen of thylakoid

114. How many different proteins consisting of 100 amino acids can be formed from 20 different amino acids ? **[2017]**
(A) 20^{100} (B) 100^{20}
(C) 2^{20} (D) 20×100

Sol. [A]
20^{100}

115. Molecular weight of *E. Coli* DNA is 3.1×10^9 g/mol. Average molecular weight of nucleotide pair is 660 g/mol and each nucleotide pair contributes to 0.34 nm to the length of DNA. The length of *E. coli* DNA molecule will be approximately **[2017]**
(A) 0.8 nm (B) 1.6 nm
(C) 1.6 m (D) 1.6 mm

Sol. [C]
$$\frac{3.1\ 10^9}{660} \times 0.34$$

116. Which ONE of the following options is TRUE with respect to Emigration ? **[2017]**
(A) It is the difference between the births and deaths in a population.
(B) It is the difference between individuals who have come to a habitat and who have left the habitat.
(C) It involves individuals of different species coming to a habitat from elsewhere during the period under consideration
(D) It involves individuals of a population leaving a habitat during the time period under consideration.

Sol. [D]
Emigration going out from one population

117. Choose the CORRECT combination of statements given below related to cysteine residue in proteins. **[2017]**

i. Cysteine can be linked to tyrosine by S-O bond.

ii. Cysteine can be linked to another cysteine by S-S bond.

iii. Cysteine can complex with Zn.

iv Cysteine can be linked to methionine by S-S bond

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

Sol. **[B]**

Fact base answer

118. The minimum number of plants to be screened to obtain a plant of the genotype AabbCcDd from a cross beteen plants of genotypes AaBbCcDd and AABbCCDd is **[2017]**

(A) 8 (B) 16
(C) 32 (D) 64

Sol. **[C]**

AaBbCcDd × AaBbCCDd

AabbCcDd

$\frac{1}{2}\times\frac{1}{4}\times\frac{1}{2}\times\frac{1}{2}=\frac{1}{32}$

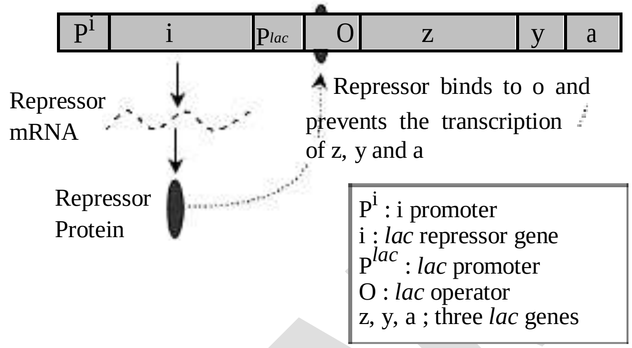
119. When a pure bred, red flower-producing plant of genotype *RR* is crossed with a pure bred, white flower-producing plant of genotype *rr*, all the F_1 plants produced pink flowers If all the plants in each generation from F_1 to F_6 are selfed, what will be the percentage of plants with red and white flowers in the final population consisting of a large number of individuals ? (Consider that flower colour has no effect on reproduction and survival.) **[2017]**

(A)3–4 (B) 12 –13
(C) 49 – 51 (D) 97 – 100

Sol. **[D]**

After selfing homozygous indivisiual produces All white & red offspring and heterozygous also produces 50%. Red & White flower.

120. The schematic below describes the status of *lac* operon in the absence of lactose. Which ONE of the following happens when lactose is present in the cell ? **[2017]**



(A) Lactose binds to P^i and stops the transcription of *i.*

(B) Lactose is converted to allolactose, which binds to P^{lac} and results in the displacements of the repressor from *O*.

(C) Lactose is converted to allolactose, which binds to the repressor protein and prevents its interaction with *O*.

(D) Lactose has no effect on the status of the *lac* operon.

Sol. **[C]**

Lac operon is inducible operon here.