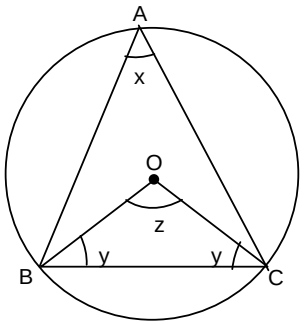
KVPY – CLASS-XI
PART TEST – 4
(OLTS-1819-T4-PT-4-KVPY-XI)

PART – I

MATHEMATICS

1. In the given figure, the $\angle BAC + \angle OBC$ is equal to

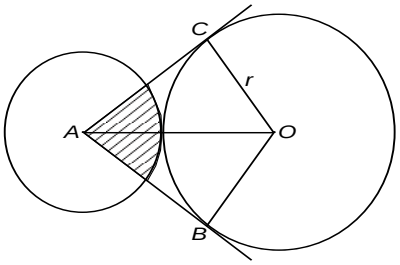


(A) 45^o
(B) 60^o
(C) 90^o
(D) cannot determined

Ans. C

Sol. $z = 2x$
also, $z = 180 - 2y$
$\therefore 2x = 180^o - 2y$
$\Rightarrow x + y = 90^o$
$\therefore \angle BAC + \angle OBC = 90^o$

2. In the figure, assume that the circle are mutually tangent and that the circle with centre at *A* has radius 1. The lines *AB* and *AC* are tangent to the circle with centre at *O* in the points *B* and *C* respectively. If the area of the shaded region is $\pi/4$, the radius of the circle centered at *O*, is :

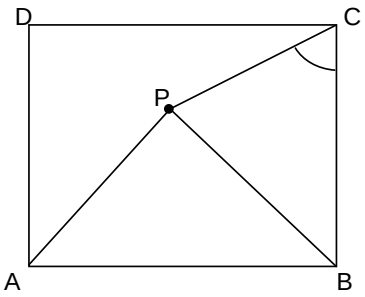


(A) $r = \sqrt{2} - 1$ (B) $r = 2 - \sqrt{2}$
(C) $r = 1 + \sqrt{2}$ (D) $r = 2 + \sqrt{2}$

Ans. C

Sol. Let $\angle CAB = \theta$
$\Rightarrow \pi(1)^2 . \frac{\theta}{2\pi} = \frac{\pi}{4} \Rightarrow \theta = \frac{\pi}{2}$
$\Rightarrow \angle CAO = 45^o$
$\Rightarrow OC = CA = r$
Also $(AO)^2 = (OC)^2 + (AC)^2$
$(r+1)^2 = 2r^2$
$r^2 - 2r - 1 = 0$
$\Rightarrow r = \frac{2 \pm \sqrt{8}}{2} = 1 + \sqrt{2} (r > 0)$

3. In the given figure, ABCD is a square and PAB is an equilateral triangle. Find $\angle BCP$

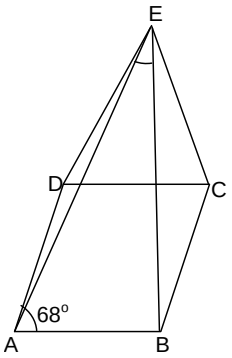


(A) 50^o (B) 75^o
(C) 60^o (D) 30^o

Ans. B

Sol. ΔPAB is equilateral
$\Rightarrow PA = AB = BP = BC \Rightarrow \angle BPC = \angle BCP$
$\Rightarrow \angle PBA = 60^o \Rightarrow \angle PBC = 30^o$
$\Rightarrow \angle BPC + \angle BCP + 30^o = 180^o$
$\Rightarrow \angle BPC = 75^o$

4. In the given figure, ABCD is a rhombus and CDE is an equilateral triangle. If $\angle A = 68^o$, then find $\angle AEB$.

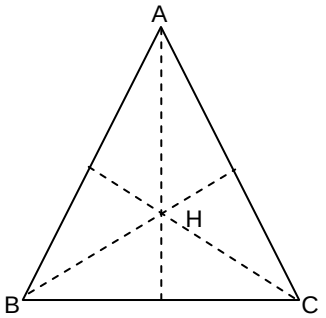


(A) 24^o (B) 20^o
(C) 30^o (D) 36^o

Ans. C

Sol. $AB = BC = CD = AD = CE = ED$
$\angle CDA = 112^o$
Also $\angle DEA = \angle DAE = x$
$\Rightarrow 2x + 112^o + 60^o = 180^o$
$\Rightarrow x = 4^o$
Similarly
$\angle CEB = \angle CBE = y$
$\Rightarrow 2y + 60^o + 68^o = 180^o$
$\Rightarrow y = 26^o$
$\Rightarrow \angle AEB + \angle DEA + \angle CEB = 60^o$
$\Rightarrow \angle AEB = 30^o$

5. The ΔABC, H is the orthocentre (as shown).
Let H_1 : Orthocentre of ΔHBC, H_2 : Orthocentre of ΔHAC,
H_3 : Orthocentre of ΔHAB
Let Δ_1 : area of ΔABC, Δ_2 : area of $\Delta H_1H_2,H_3$ then the value of $\frac{\Delta_1}{\Delta_2}$



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

Ans. C

Sol. H_1 is point A_1, H_2 is point B, H_3 is point C

$\Rightarrow \Delta ABC$ is same as $\Delta H_1H_2H_3$

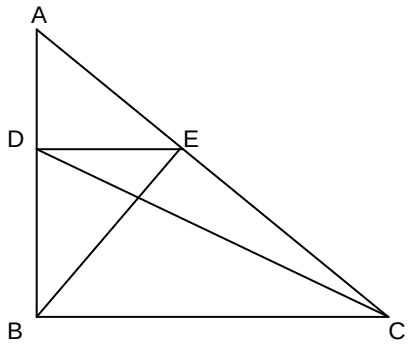
6. In the figure, triangle ABC is right angled at B. Given that AB = 9 cm, AC = 15 cm and D, E are the mid points of the sides AB and AC respectively, then the area of ΔADE is equal to

(A) $12.5\ cm^2$

(B) $13.5 cm^2$

(C) $14.5 cm^2$

(D) $15.5 cm$



Ans. B

Sol. Area of $\Delta ADE = \frac{1}{2}(DE \times AD)$

$= \frac{1}{2}\left\{\frac{1}{2}BC \times \frac{1}{2}AB\right\}$

$= \frac{1}{2}\{6 \times 4.5\} cm^2 = 13.5 cm^2$

7. The sides of a right triangle are 9, 12 and 15 cm long. Then the sum of the squares of the median is

(A) 337.5 cm (B) 331.5 cm

(C) 330.5 cm (D) none of these

Ans. A

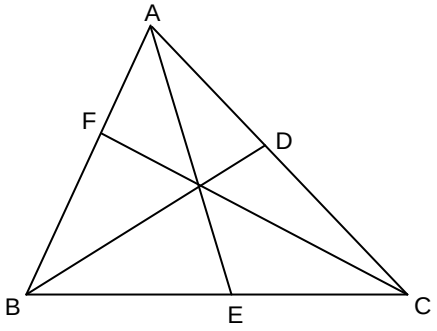
Sol. ΔABC is right angled at $\angle B$. The median drawn are AE, BD and CF.

Now $AB = 12, BC = 9, AC = 15$

$BD = \frac{1}{2}AC \Rightarrow BD^2 = \frac{1}{4}AC^2$

$BD^2 + AE^2 + CP^2$

$= \left(\frac{1}{4} + \frac{5}{4}\right).AC^2 = \frac{6}{4}AC^2 = \frac{6}{4} \times 225 = 337.5$



8. A, B and C are three points on a circle such that the angles subtended by the chords AB and AC at the centre O are 90^o and 110^o, respectively $\angle BAC =$

(A) 45^o (B) 55^o

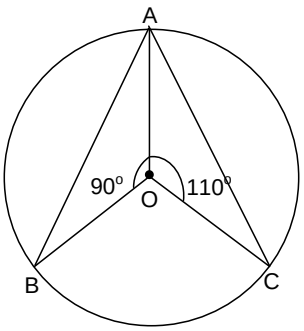
(C) 100^o (D) none of these

Ans. D

Sol. $\angle BOC = 360^o - \left(90^o + 110^o\right) = 160^o$

now $\angle BAC = \frac{1}{2}\angle BOC$

$\therefore \angle BAC = \frac{1}{2} \times 160^o = 80^o$



9. Two circles of unit radius touch each other and each of them touches internally a circle of radius two. Then the radius of the circle which touches all the three circles is

(A) $\frac{2}{3}$ (B) $\frac{3}{2}$

(C) $\frac{1}{2}$ (D) none of these

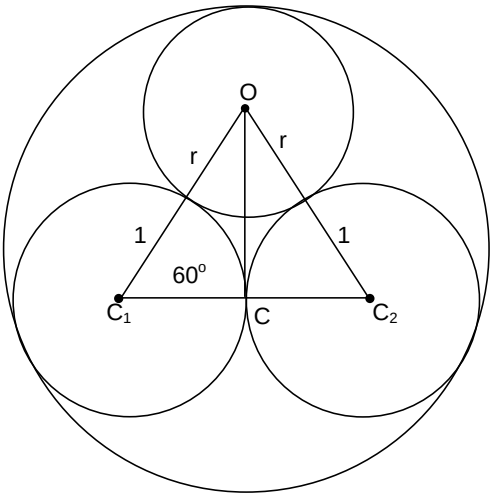
Ans. A

Sol. Since the radius of the third circle is equal to the sum of the radii of the two circles which touch it internally. Therefore the centres of all the three circles line in a straight line. Let r be the radius of the circle which touches all the three circles, then $OC_1 = OC_2 = (1 + r)$

$C_1C = CC_2 = 1$

$\therefore CO = (2 - r)$, in right triangle OCC_1

$(1 + r)^2 = 1^2 + (2 - r)^2$ So that $r = \frac{2}{3}$



10. In the figure, area of circle is 50 sq. cm and area of triangle is 15 cm, find the value of $\sin\theta + \sin\alpha + \sin\beta$

(A) $\frac{\pi}{30}$ (B) $\frac{3\pi}{5}$

(C) $\frac{2\pi}{15}$ (D) $\frac{11\pi}{7}$

Ans. B

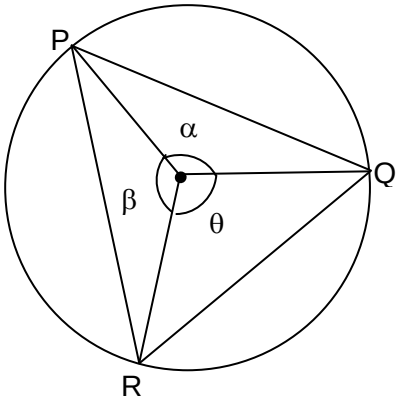
Sol. $Ar(\Delta PQR) = ar(\Delta OPQ) + ar(\Delta OQR) + ar(\Delta OPR)$

$15 = \frac{1}{2}r^2 \sin\alpha + \frac{1}{2}r^2 \sin\theta + \frac{1}{2}r^2 \sin\beta$

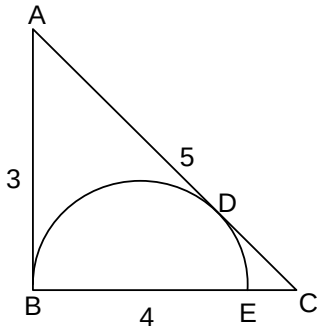
$\Rightarrow (\sin\alpha + \sin\beta + \sin\theta)\frac{1}{2}r^2 = 15$

$\Rightarrow \sin\alpha + \sin\beta + \sin\theta = \frac{30}{r^2}$

but given $\pi r^2 = 50 \Rightarrow \frac{1}{r^2} = \frac{\pi}{50}$



11. What is the radius of the inscribed semi – circle?



(A) $\frac{5}{8}$ (B) $\frac{3}{2}$

(C) $\frac{11}{8}$ (D) $\frac{5}{3}$

Ans. B

Sol. $CD^2 = CE \times CB,$ Let $CE = x$

Now $CD = AC - AD = AC - AB = 2$

$\Rightarrow z^2 = 4 \times CE$

CE = 1

$\therefore$ radius of semicircle $= \frac{3}{2}$

12. A train leaves Pune at 7:30 am and reaches Mumbai at 11:30 am. Another train leaves Mumbai at 9:30 am and reaches Pune at 1:00 pm. Assuming that the two trains travel at constant speeds, at what time do the two trains cross each other?

(A) 10 : 20 am (B) 11 : 30 am

(C) 10 : 26 am (D) data not sufficient

Ans. C

Sol. Let distance between pune and Mumbai be ℓ speed of 1st train $= \frac{\ell}{4}$

2nd train $= \frac{2\ell}{7}$

Distance covered by 1st train in 2 hours $= \frac{\ell}{4} \times = \frac{\ell}{2}$ at 9 : 30 relative distance to be covered

$= \frac{\ell}{2}$

Let they meet at time t $\frac{\ell}{2} = \left(\frac{\ell}{4} \times t\right) + \frac{2\ell}{7} t$

$\frac{\ell}{2} = \ell\left(\frac{7+8}{28}\right) \Rightarrow t = \frac{14}{15}$ hours of 56

$\therefore$ $9:30 + 56$ min = 10 : 26

13. If x, y are real numbers such that $3^{\frac{x}{y}+1} - 3^{\frac{x}{y}-1} = 24,$ then the value of $\frac{(x+y)}{(x-y)}$ is

(A) 0 (B) 1

(C) 2 (D) 3

Ans. D

Sol. $3^{\frac{x}{y}+1} - 3^{\frac{x}{y}-1} = 24 \Rightarrow 3^{\frac{x}{y}} \times 3 - \frac{3^{\frac{x}{y}}}{3} = 24$

$$\frac{8}{3}\left(3^{x/y}\right)=24 \Rightarrow \frac{x}{y}=2$$

$$\frac{x+y}{x-y}=3$$

14. In ΔABC, $A=\frac{\pi}{3}$ and $b:c=2:3$. If $\tan\theta=\frac{\sqrt{3}}{5}$, $0<\theta<\frac{\pi}{2}$, then

(A) $B=60^o+\theta$ (B) $C=60^o+\theta$

(C) $B=60^o-\theta$ (D) $C=60^o-\theta$

Ans. B

Sol. $A=\frac{\pi}{3}$

$$\tan\frac{C-B}{2}=\frac{c-b}{c+b}\cot\frac{A}{2}$$

$$\tan\left(\frac{C-B}{2}\right)=\frac{1}{5}\cot 30^o=\frac{\sqrt{3}}{5}=\tan\theta$$

$\therefore$ $C-B=2\theta$

$C+B=180^o-A=120^o$

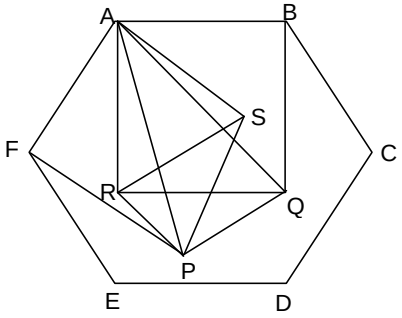
$\therefore$ $2C=120^o+2\theta$

$\therefore$ $C=60^o+\theta$

15. In the figure given below, ABCDEF is a regular hexagon of side length 1, AFPS and ABQR are squares. Then the ratio Area (APQ)/Area (SRP) equals

(A) $\frac{\sqrt{2}+1}{2}$ (B) $\sqrt{2}$

(C) $\frac{3\sqrt{3}}{4}$ (D) 2



Ans. D

Sol. In ΔAPQ

$AP=AQ=\sqrt{2}$, $\angle APQ=30^o$

In ΔSRP

$SR=SP=1$, $\angle RSP=30^o$

$\angle FAB=120^o$

$\angle BAS=\angle FAB-\angle FAS=120^o-90^o=30^o$

$\angle SAR=\angle BAR-\angle BAS=60^o$

$\cos 60^o=\frac{1+1-SR^2}{2.1.1}\left[\because AR=AS=1\right]$

$\Rightarrow SR=1$

Now, $\angle RSP=\angle ASP-\angle ASR$

$=90^o-60^o=30^o\left[\because \text{ ASR is equilateral}\right]$

Now, from $\Delta SRP=\frac{\sqrt{3}-1}{2\sqrt{2}}$

In ΔAPR

$$\cos\angle RAP = \frac{\left(\sqrt{2}\right)^2 + 1^2 - PR^2}{2\sqrt{2}}$$

$$\Rightarrow \cos\angle RAP = 15^o$$

$$\angle PAQ = \angle RAQ - \angle RAP = 45^o - 15^o = 30^o$$

$$\text{Now, } \frac{ar(\Delta APQ)}{ar(\Delta SRP)} = \frac{\frac{1}{2}\times\sqrt{2}\times\sqrt{2}\sin 30^o}{\frac{1}{2}\times 1\times 1\times\sin 30^o} = 2$$

PHYSICS

16. A prism of angle 6 degree made from a crown glass of refractive index 1.5 is placed in contact with another prism, made of flint glass of refractive index 1.6. A ray of light falling normally passes through the two prisms without deviation. The angle of flint glass prism is
(A) 2.0 degree (B) 5.0 degree
(C) 6.6 degree (D) 7.2 degree

Ans. B

Sol. Deviation from one prism is $\delta = (\mu\text{-}1)\,A$. For no deviation $(1.5-1)\times 6^\circ = (1.6-1)A \Rightarrow A = 5^\circ$

17. A circular loop of radius R carries a current i. Another circular loop of radius r (r <<R) carries a current i and is placed at the centre of the larger loop. The planes of the two loops are at right angles to each other. Find the torque acting on the loop.
(A) $\frac{\mu_o i^2\pi r^2}{4R}$ (B) $\frac{\mu_o i^2\pi r^2}{R}$
(C) $\frac{2\mu_o i^2\pi r^2}{R}$ (D) $\frac{\mu_o i^2\pi r^2}{2R}$

Ans. D

Sol. Magnetic field at the centre of larger loop:

$B = \frac{\mu_o i}{2R}$

Magnetic moment of smaller loop

$M = i\pi r^2$

Angle between $\vec{M}$ and $\vec{B}$

$\theta = 90^o$

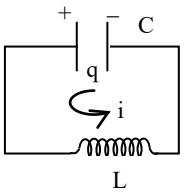
$\therefore$ Torque on smaller loop:

$\tau = MB\sin\theta$

$= i\pi r^2 \times \frac{\mu_o i}{2R}\times\sin\left(90^o\right)$

$\tau = \frac{\mu_o i^2\pi r^2}{2R}$

18. A capacitor of capacitance C farad is charged by a battery of emf V_0 volt. The battery is then disconnected and a pure inductor of L henry is connected across it so that LC oscillations are set up. Then the frequency of oscillation of magnetic energy



(A) $\pi\sqrt{(LC)}$ (B) $\dfrac{1}{\pi\sqrt{(LC)}}$

(C) $\dfrac{1}{\pi}\sqrt{\left(\dfrac{L}{C}\right)}$ (D) $\dfrac{1}{\pi}\sqrt{\left(\dfrac{C}{L}\right)}$

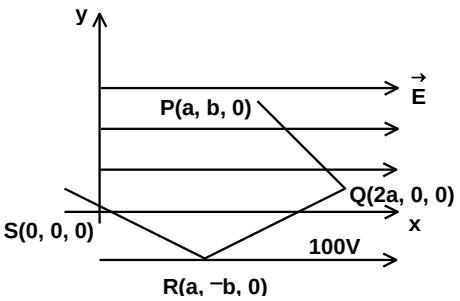
Ans. B

Sol. $i = Q_o\omega \sin\omega t$

$U_B = \dfrac{1}{2}L\, i^2 \propto \sin^2 \omega t$

$\therefore$ Required frequency = $\dfrac{2\omega}{2\pi} = \dfrac{\omega}{\pi} = \dfrac{1}{\pi\sqrt{(LC)}}$

19. A point charge q moves from point P to S along the path PQRS in a uniform electric field $\vec{E}$ pointing parallel to the positive direction of the x-axis. The coordinate of the point P, Q, R and S are (a, b, 0), (2a, 0, 0), (a, –b, 0) and (0, 0, 0) respectively. The work done by the field in the above process is given by the expression



(A) qaE

(B) – qaE

(C) $q\sqrt{\left(a^2 + b^2\right)}\,E$

(D) $3qE\sqrt{\left(a^2 + b^2\right)}$

Ans. B

Sol. The work done is independent of the path followed and is equal to $\left(q\vec{E}\right)\ .\ \vec{r}$,

where $\vec{r}$ = displacement from P to S

Here, $\vec{r} = a\hat{i} - b\hat{j}$, while $\vec{E} = E\hat{i}$

$\therefore$ work = $-(qE\hat{i}).\left(a\hat{i} + b\hat{j}\right) = -qaE$

20. Two positively charged spheres of masses m_1 and m_2 are suspended from a common point at the ceiling by identical insulating massless strings of length ℓ. Charges on the two spheres are q_1 and q_2, respectively. At equilibrium both strings make the same angle θ with the vertical. Then

(A) $q_1m_1 = q_2m_2$ (B) $m_1 = m_2$

(C) $m_1 = m_2\sin\theta$ (D) $q_2m_1 = q_1m_2$

Ans. B

Sol. $\tan\theta = \dfrac{k\,q_1\,q_2}{\ell^2\sin^2\theta\, m_1 g} = \dfrac{k\,q_1\,q_2}{\ell^2\sin^2\theta\, m_2 g}$

$\therefore$ $m_1 = m_2$

21. A non-conducting disc of radius R rotates with an angular velocity of ω about its centre. It is charged uniformly on one side with surface density σ. Find magnetic induction at the centre of the disc.

(A) $\mu_0\sigma\omega r$ (B) $2\mu_0\sigma\omega r$

(C) $4\mu_0\sigma\omega r$ (D) $\frac{\mu_o\sigma\omega r}{2}$

Ans. D

Sol. Radius R: Angular velocity = ω
Surface charge density = σ
Take a ring of radius r and width dr. With centre at '0'.
Charge on this ring dq = $2\pi r\, dr\, \sigma$.
When the disc rotates with angular velocity ω.

This is equivalent to a current of = $\frac{\omega}{2\pi} \times 2\pi r\, dr\, \sigma = \sigma r\omega dr$.

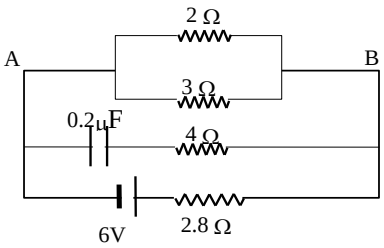
dB due to this as the centre of the disc

$$dB = \frac{\mu_0}{4\pi} \times \frac{2\pi i}{r} = \frac{\mu_0 \sigma\, \omega}{2} dr$$

$$\int dB = B = \int_0^r \frac{\mu_0\, \sigma\omega}{2} dr = \frac{\mu_0\, \sigma\omega\, r}{2}$$

22. The steady-state current in the 2Ω resistor shown. The internal resistance of the battery is negligible and the capacitance of the capacitor is 0.2 μF.

(A) 0.6 A
(B) 0.9 A
(C) 1.2 A
(D) 1.5 A



Ans. B

Sol. The resistance of the parallel combination of 2Ω and 3Ω resistors is given by

$$\frac{1}{R} = \frac{1}{2} + \frac{1}{3} = \frac{5}{6} \Rightarrow \quad R = 1.2\ \Omega$$

This resistance is in series with 2.8 Ω giving a total effective resistance = 1.2 + 2.8 Ω = 4 Ω.
In the steady state, charge on the capacitor C has stabilised and hence no current passes through 4Ω resistor which is in series with the capacitor.
Thus the current through the circuit = 6/4 = 1.5 A,
V_{AB} = 1.5 × 1.2 = 1.8 V, I through 2Ω resistor = 1.8/2 = 0.9 A.

23. The mass of the three wires of copper are in the ratio 1 : 3 : 5 and their lengths are in ratio 5 : 3 : 1 . The ratio of their electrical resistance is

(A) 1 : 3 : 5 (B) 5 : 3 : 1
(C) 1 : 15 : 125 (D) 125 : 15 : 1

Ans. D

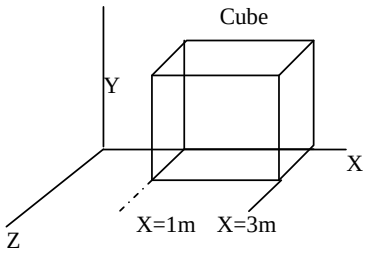
Sol. $$R = \frac{\rho\ell}{A} = \frac{\rho\ell^2}{A\ell} = \frac{\rho\ell^2}{V} = \frac{\rho\ell^2}{m/d}$$

$$R = \frac{\rho d\ell^2}{m} \qquad \text{or } R \propto \frac{\ell^2}{m}$$

$R_1 : R_2 : R_3 = \frac{\ell_1^2}{m_1} : \frac{\ell_2^2}{m_2} : \frac{\ell_3^2}{m_3}$

$= \frac{25}{1} : \frac{9}{3} : \frac{1}{5} = 125 : 15 : 1$

24. A non – uniform electric field given by $\vec{E} = 3x\hat{i} + 4\hat{j}$ (N/C) pierces the Gaussian cube shown in figure. What is the electric flux through the right face



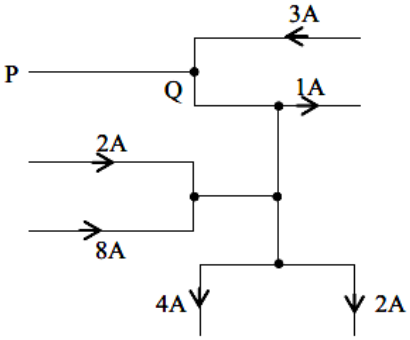
(A) 12 Nm^2/c
(B) 36 Nm^2/c
(C) 6 Nm^2/c
(D) zero

Ans. B

Sol: Electric field at right face $\vec{E} = 3 \times 3\hat{i} + 4\hat{j}$

$\phi = \vec{E}.\vec{A} = (9\ i + 4j)\ .\ (4\ i) = 36\ Nm^2/C$

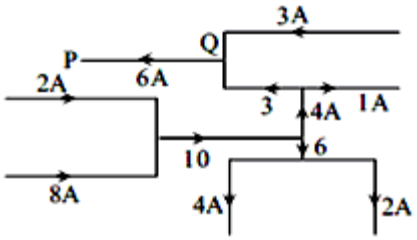
25. Figure below shows a portion of an electric circuit with the currents in amperes and their directions. The magnitude and direction of the current in the portion PQ is



(A) 0A
(B) 3A from P to Q
(C) 4A from Q to P
(D) 6A from Q to P

Ans. D

Sol.



26. 12 positive charges of magnitude q are placed on a circle of radius R in a manner that they are equally spaced. A charge Q is placed at the centre. If one of the charges q is removed, then the force on Q is

(A) zero

(B) $\frac{qQ}{4\pi\varepsilon_0 R^2}$ away from the position of the removed charge.

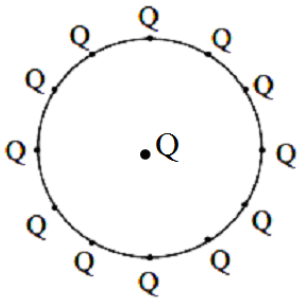
(C) $\frac{11qQ}{4\pi\varepsilon_0 R^2}$ away from the position of the removed charge.

(D) $\frac{qQ}{4\pi\varepsilon_0 R^2}$ towards the position of the removed charge.

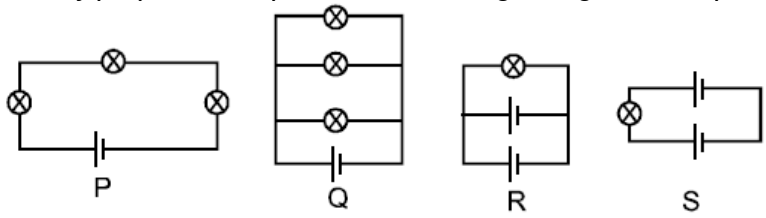
Ans. D

Sol. If one charge is removed then net force on Q is $\frac{q \times Q}{4\pi\varepsilon_0 R^2}$

Towards the position of removed charge.



27. Following figures show different combinations of identical bulb(s) connected to identical battery(ies). Which option is correct regarding the total power dissipated in the circuit?



(A) P < Q < R < S
(B) R < Q < P < S
(C) P < Q < R = S
(D) P < R < Q < S

Ans. D

Sol. In $P = \frac{v^2}{3R}$

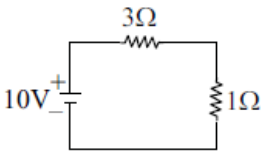
In $Q = \frac{3v^2}{R}$

In $R = \frac{v^2}{R}$

In $S = \frac{4v^2}{R}$

So, P < R < Q < S

28. In the following circuit, the 1Ω resistor dissipates power P. If the resistor is replaced by 9Ω, the power dissipated in it is



(A) P
(B) 3P
(C) 9P
(D) P/3

Ans. A

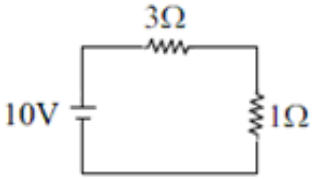
Sol. 10 = 4i

$i = \frac{5}{2}$

$P_i = i^2R = \left(\frac{5}{2}\right)^2 \times 1 = \frac{25}{4}$

$P_f = \left(\frac{10}{12}\right)^2 \times 9 = \frac{100}{12 \times 12} \times 9$

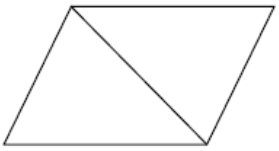
$P_f = P_i$



29. White light is split into a spectrum by a prism and it is seen on a screen. If we put another identical inverted prism behind it in contact, what will be seen on the screen?
(A) Violet will appear where red was.
(B) The spectrum will remain the same.
(C) There will be no spectrum, but only the original light with no deviation.
(D) There will be no spectrum, but the original light will be laterally displaced.

Ans. C

Sol. This system will behave as slab.
$\therefore$ No dispersion.
No deviation



30. Which of the following statements is true about the flow of electrons in an electric circuit?
(A) Electrons always flow from lower to higher potential
(B) Electron always flow from higher to lower potential
(C) Electrons flow from lower to higher potential except through power sources
(D) Electrons flow from higher to lower potential, except through power sources

Ans. C

Sol. Flow of electron is opposite to the conventional current.

CHEMISTRY

31. The correct stability order of the following resonance structure is

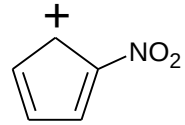
(I) (II) (III) (IV)

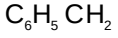
(A) (I) > (II) > (IV) > (III)
(B) (I) > (III) > (II) > (IV)
(C) (II) > (I) > (III) > (IV)
(D) (III) > (I) > (IV) > (II)

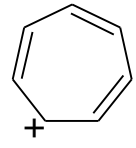
Ans. B

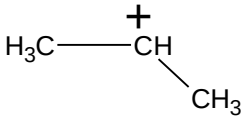
Sol. Negative charge is more stable on more electronegative atom and structure in which all atoms have complete octet are more stable.

32. Which among the following carbocation is most stable?

(A) 

(B) 

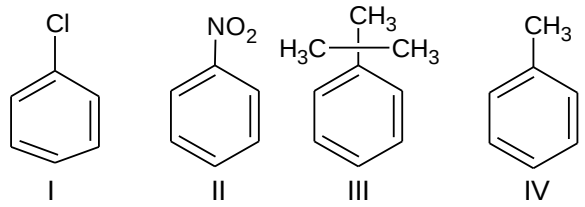
(C) 

(D) 

Ans. C

Sol. Due to aromatic character.

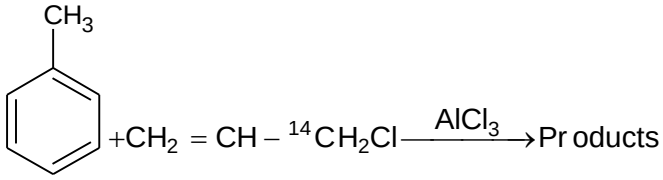
33. Arrange the following in the increasing order of their reactivity towards Electrophilic substitution reaction



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

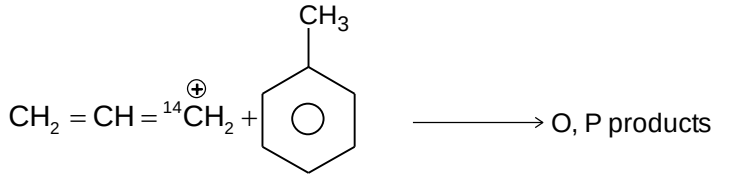
Ans. D

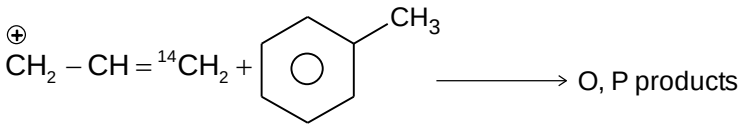
Sol. Due to hyperconjugation of CH_3

34. 

How many maximum number of organic products can be formed in the above reaction by using excess of reactants?
(A) 8
(B) 6
(C) 2
(D) 4

Ans. D

Sol. 



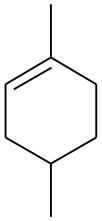
Total 4

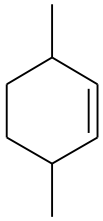
35. A mixture of conc.H_2SO_4 and conc.HNO_3 does NOT contain
(A) NO_2^+
(B) NO_3^-
(C) HSO_4^-
(D) H_2O

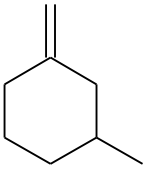
Ans. B

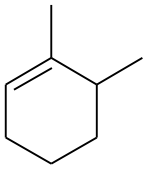
Sol. $H_2SO_4 \rightleftharpoons HSO_4^- + H^+$
$HNO_3 + H^+ \longrightarrow NO_2^+ + H_2O$
$\therefore NO_3^-$ is not present

36. Which of the following compounds will liberate maximum amount of heat energy upon hydrogenation?

(A) 

(B) 

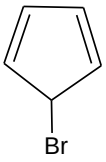
(C) 

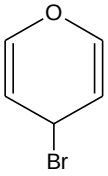
(D) 

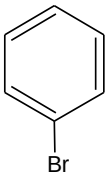
Ans. B

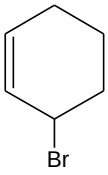
Sol. Most unstable alkene will release more energy.

37. Ease of ionization to produce carbocation and Br^- will be maximum in which of the following compounds?

(A) 

(B) 

(C) 

(D) 

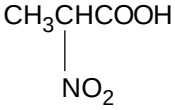
Ans. B

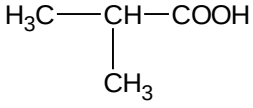
Sol. Aromatic character will develop in (B).

38. Which of the following is the strongest acid ?

(A) CH_3CH_2COOH

(B) $NO_2CH_2CH_2COOH$

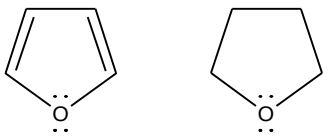
(C) 

(D) 

Ans. C

Sol. $-NO_2$ can withdraw electron which makes conjugate base more stable.

39. Which is correct about hybridization of oxygen in given molecules?



I II

(A) in 1st sp^2 and in 2nd sp^3

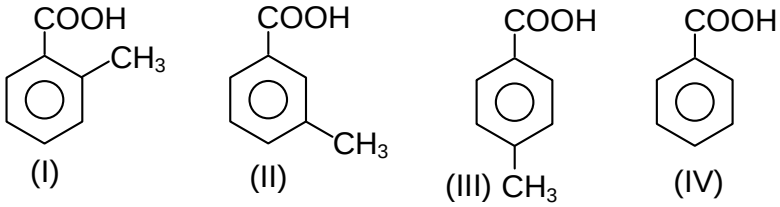
(B) in 1st sp^3 and in 2nd sp^2

(C) in both sp^2

(D) in both sp^3

Ans. A

Sol. Lone pair & oxygen can resonate. So hybridization is sp^2 in 1st molecule. 2nd molecule will not show resonance hence sp^3.

40. 

Correct order of acidic strength in the above compounds will be

(A) (IV) > (II) > (III) > (I)
(B) (I) > (IV) > (II) > (III)
(C) (II) > (I) > (IV) > (III)
(D) (I) > (II) > (III) > (IV)

Ans. B

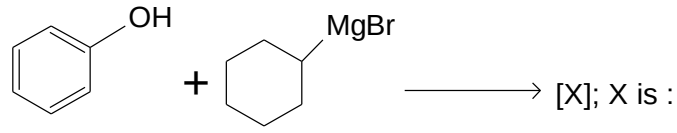
Sol. Due to ortho effect.

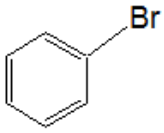
41. Hyperconjugation involves overlapping of following orbitals.

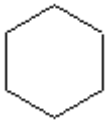
(A) $\sigma - \sigma$
(B) $\sigma - p$
(C) $p - p$
(D) $\pi - \pi$

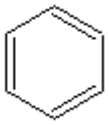
Ans. B

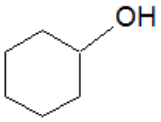
Sol. C – H σ orbitals overlapping with p orbitals.

42. 

(A) 

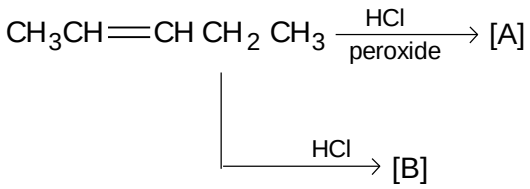
(B) 

(C) 

(D) 

Ans. B

Sol. Grignard reagent are also very strong base.

43. 

Which of the following is true for [A] and [B]:

(A) [A] and [B] are same
(B) [A] and [B] are functional group isomer
(C) [A] and [B] are positional isomers
(D) none

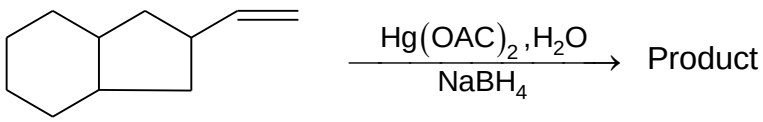
Ans. A

Sol. Peroxide effect is only seen in HBr.

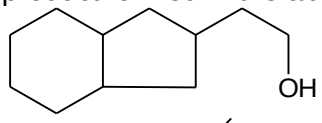
44. Trans-2-Butene on reaction with Br_2 in CCl_4 forms
(A) (±)–2, 3-dibromobutane (B) meso–2, 3-dibromobutane
(C) an equimolar mixture of (A) and (B) (D) 1, 4-dibromo-2-butene

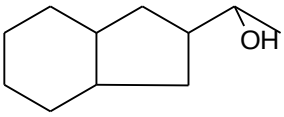
Ans. B

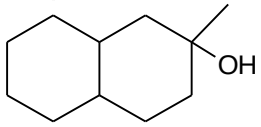
Sol. Br_2/CCl_4 is anti addition. Anti addition on trans compounds results in meso compound.

45. 

The product formed in the above reaction is

(A) 

(B) 

(C) 

(D) Both A and B

Ans. B

Sol. No carbocation rearrangement takes place in oxymercuration demercuration.

BIOLOGY

46. Who first observed *Plasmodium* in the red blood cells of a malarial patient?
(A) Edward Jenner (B) Ronald Ross
(C) Charles Laveran (D) Louis Pasteur

Ans. C

Sol. Charles Laveran observed *Plasmodium* in red blood cells of malarial patient.

47. The 'Blue baby' syndrome results from
(A) Excess of chloride (B) Methemoglobin
(C) Excess of TDS (Total dissolved solids) (D) Excess of dissolved oxygen

Ans. B

Sol. The Blue baby syndrome results from Methemoglobin.

48. A drunken person should not drive vehicle because alcohol
(A) Increases reaction time
(B) Affects co – ordination of body parts, alertness and judgement
(C) Causes rashness and carelessness
(D) All of the above

Ans. D

Sol. A drunken person has increased reaction time, affects co-ordination of body parts, alertness and judgements, causes rashness and carelessness.

49. Humoral immunity system is mediated by
(A) B – cells (B) T – cells
(C) NK – cells (D) Plasma cells

Ans. A

Sol. Humoral immunity is mediated by B-cells.

50. Fatty liver syndrome is due to
(A) Infection by a virus (B) Intake of excessive fat
(C) Intake of excessive alcohol (D) Intake to tobacco through chewing

Ans. C

Sol. Fatty liver syndrome is due to intake of excessive alcohol.

51. Most appropriate term for the life cycle of *Obelia* is
(A) Metagenesis (B) Metamorphosis
(C) Neoteny (D) Alternation of generations

Ans. A

Sol. The appropriate term for the life cycle of obelia is metagenesis.

52. Pearl is produced in the bivalves belonging to the genus
(A) *Pecten* (B) *Mytilus*
(C) *Ostricea* (D) *Pinctada*

Ans. D

Sol. Pearl oyster belongs to the genus *Pinctada*.

53. Scorpion belongs to a class to which one of the following also belongs ?
(A) Cockroach (B) Crab
(C) Ticks (D) Barnacles

Ans. C

Sol. Scorpion and Ticks belongs to the class Arachnid.

54. Nervous system is first formed in
(A) Platyhelminthes (B) Cnidaria
(C) Annelida (D) Sponges

Ans. B

Sol. Nervous system is first formed in Cnidaria.

55. The young ones of cockroach is called
(A) Maggot (B) Fingerling
(C) Nymph (D) Caterpillar

Ans. C

Sol. The young ones of cockroach is called Nymph.

56. Heart lacks sinus venosus in
(A) Mammals (B) Reptiles
(C) Amphibians (D) Fishes

Ans. A

Sol. Heart lacks sinus venosus in mammals.

57. In a fish, the swim bladder is an organ for
(A) Digestion (B) Buoyancy
(C) Respiration (D) Food storage

Ans. B

Sol. In a fish, the swim bladder is an organ for Buoyancy.

58. A bird with teeth is
(A) Ostrich (B) *Archaeopteryx*
(C) Fowl (D) Pelican

Ans. B

Sol. A bird with teeth is *Archaeopteryx* (connecting link between bird and reptiles).

59. Which of the following is not a vertebrate?
(A) Shark (B) Platypus
(C) Lancelet (D) Lamprey

Ans. C

Sol. Lancelet is not a vertebrate.

60. Pigeon produces milk from its
(A) Salivary glands (B) Crop glands
(C) Preen glands (D) Intestinal glands

Ans. B

Sol. Pigeon produces milk from its crop glands.

PART – II

MATHEMATICS

61. Let $z = a\left(\cos\frac{\pi}{5} + i\sin\frac{\pi}{5}\right)$, $a \in R$, $|a| < 1$, then $S = z^{2015} + z^{2016} + z^{2017} + ...$ equals
(A) $\frac{a^{2015}}{z-1}$ (B) $\frac{a^{2015}}{1-z}$
(C) $\frac{z^{2015}}{1-a}$ (D) $\frac{z^{2015}}{a-1}$

Ans. A

Sol. We have $|z| = |a| < 1$, thus

$S = \dfrac{z^{2015}}{1-z}$

But $z^{2015} = a^{2015}\left[\cos(403\pi) + i\sin(403\pi)\right] = -a^{2015}$

$\therefore \quad S = \dfrac{a^{2015}}{z-1}$

62. A man takes 5 hours 45 min. in walking to a certain place and riding back. He would have gained 2 hours by riding both ways. The time he would take to walk both ways, is:
(A) 3 hrs 45 min (B) 7 hrs 30 min
(C) 7 hrs 45 min (D) 11 hrs 45 min

Ans. C

Sol. Let the distance be x km. Then,

(Time taken to walk x km) + (Time taken to rid x km) $= \dfrac{23}{4}$hrs.

$\Rightarrow$ (Time taken to walk 2x km) + (Time taken to ride 2x km) $= \dfrac{23}{2}$hrs.

But, time taken to ride 2x km $= \dfrac{15}{4}$ hrs.

$\therefore$ Time taken to walk 2x km $= \left(\dfrac{23}{2} - \dfrac{15}{4}\right)$hrs $= \dfrac{31}{4}$hrs = 7 hrs 45 min.

63. In a group of persons traveling in a bus 6 can speak Tamil, 15 can speak Hindi and 6 can speak Gujarati. If 2 person in the group can speak exactly two languages and one person can speak all three language, then how many persons are there in the group?
(A) 21 (B) 22
(C) 23 (D) 24

Ans. C

Sol. $d + e + f = 2,\ g = 1$

$a + d + g + f = 6$

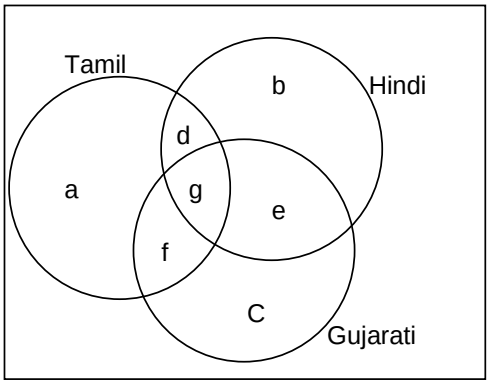
$b + d + g + e = 15$

$c + e + g + f = 6$

$a + b + c + 2(d + e + f) + 3g = 27$

$a + b + c = 20$

Total persons $= a + b + c + d + e + f + g = 23$



64. I started on my bicycle at 7 a.m. to reach a certain place. After going a certain distance, my bicycle went out of order. Consequently, I rested for 35 minutes and came back to my house walking all the way. I reached my house at 1 p.m. If my cycling speed is 10 kmph and my walking speed is 1 kmph, then on my bicycle I covered a distance of:
(A) $4\dfrac{61}{66}$km (B) $13\dfrac{4}{9}$km
(C) $14\dfrac{3}{8}$km (D) $15\dfrac{10}{21}$km

Ans. A

Sol. Time taken = 5 hrs 25 minute $= \frac{65}{12}$ hrs.

Let the required distance be x km.

Then, $\frac{x}{10} + \frac{x}{1} = \frac{65}{12} \Leftrightarrow 11x = \frac{650}{12} \Leftrightarrow x = \frac{325}{66} = 4\frac{61}{66}$ km

65. A dishonest milkman professes to sell his milk at cost price but he mixes it with water and thereby gain 25%. The percentage of water in the mixture is:

(A) 4% (B) $6\frac{1}{4}\%$

(C) 20% (D) 25%

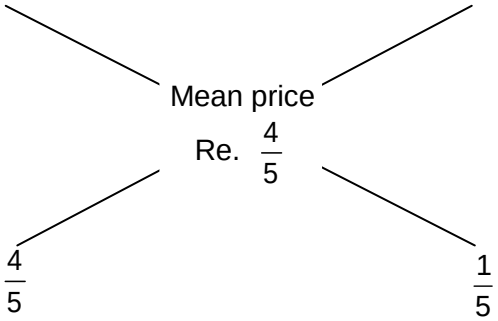
Ans. C

Sol. Let C.P. of 1 litre milk be Rs. 1

Then, SP of 1 litre of mixture = Re. 1, Gain = 25%

C.P. of 1 litre mixture = Re. $\left(\frac{100}{125} \times 1\right) = \text{Re.}\frac{4}{5}$.

C.P. of 1 litre milk Re. 1 C.P. of 1 litre of water 0



$\therefore$ Ratio of milk of water $= \frac{4}{5} : \frac{1}{5} = 4:1$.

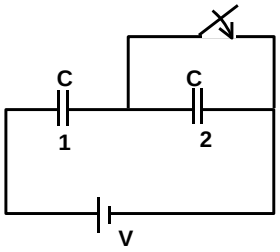
Hence percentage of water in the mixture $= \left(\frac{1}{5} \times 100\right)\% = 20\%$

PHYSICS

66. The charge flowing across the cell on closing the key k is equal to

(A) CV (B) CV/2

(C) 2CV (D) zero



Ans. B

Sol. When the key is kept open, the charge drawn from the source is

$Q = C_{eq}V = \frac{C}{2}V$

When the key is closed the capacitor 2 gets short circuited

And $C'_{eq} = C$

$\therefore$ $Q' = CV$

charge flown through cell $Q' - Q = \frac{C}{2}V$

67. A conducting liquid bubble of radius a and thickness $t(t << a)$ is charged to potential V. If the bubble collapses to a droplet, find the potential on the droplet.

(A) $V\left(\frac{a}{3t}\right)^{1/3}$ (B) $Va^{1/3}$

(C) $V\left(\frac{a^2}{t^{2/3}}\right)$ (D) $\frac{Va^{1/3}}{3g^3}$

Ans. A

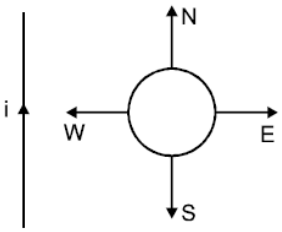
Sol. $V = \frac{1}{4\pi\varepsilon_o}\frac{q}{a}$ (for bubble)

For droplet :- $\frac{4}{3}\pi r^3 = \frac{4}{3}\pi(a+t)^3 - \frac{4}{3}\pi a^3$

$\Rightarrow r^3 = 3a^2t \Rightarrow r = \left(3a^2t\right)^{1/3}$

$V_{droplet} = \frac{1}{4\pi\varepsilon_o}\frac{q}{r} = V\left[\frac{a}{3t}\right]^{1/3}$

68. A circular loop of wire is in the same plane as an infinitely long wire carrying a constant current i. Four possible motions of the loop are marked by N, E, W and S as shown:
A clockwise current is induced in the loop when loop is pulled towards:



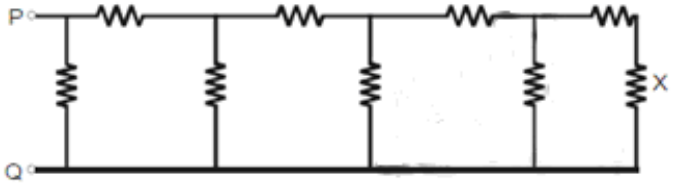
(A) N (B) E

(C) W (D) S

Ans. B

Sol. Magnetic field due to wire is inwards when loop moves towards E current is clockwise.

69. Consider the circuit shown below where all resistors are of 1 kΩ.



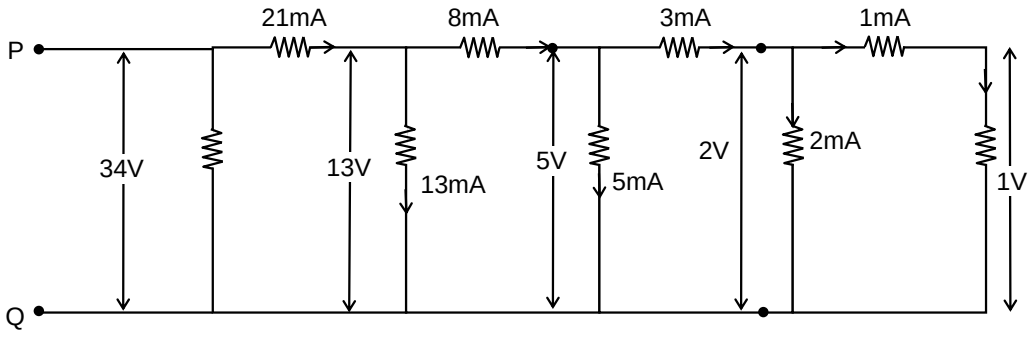
If a current of magnitude 1 mA flows through the resistor marked X, what is the potential difference measured between point P and Q?

(A) 21V (B) 68V

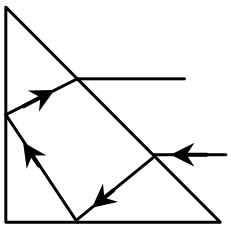
(C) 55V (D) 34V

Ans. D

Sol.



70. A ray of light incident parallel to the base PQ of an isosceles right-angled triangular prism PQR suffers two successive total internal reflections at the faces PQ and QR before emerging reversed in direction as shown. If the refractive index of the material of the prism is μ, then

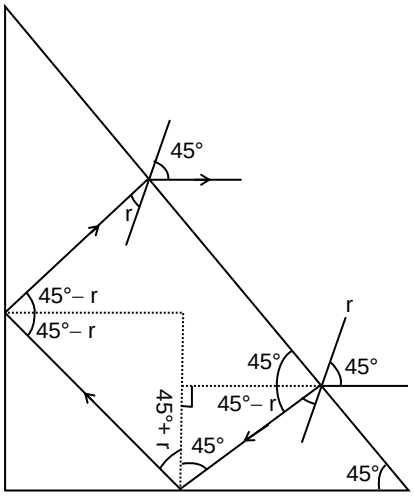


(A) $\mu > \sqrt{5}$ (B) $\sqrt{3} < \mu < \sqrt{5}$

(C) $\sqrt{2} < \mu < \sqrt{3}$ (D) $\mu < \sqrt{2}$

Ans. A

Sol. $\sin(45° - r) > \frac{1}{\mu}$ and



$\mu \sin r = 1 \sin 45° = \frac{1}{\sqrt{2}}$

$\sin r = \frac{1}{\mu\sqrt{2}}$

$\therefore \quad \frac{1}{\sqrt{2}}\cos r - \frac{1}{\sqrt{2}}\sin r > \frac{1}{\mu}$

$\Rightarrow \quad \sqrt{1-\sin^2 r} - \sin r > \frac{\sqrt{2}}{\mu}$

$\Rightarrow \quad 1 - \sin^2 r > \left(\frac{\sqrt{2}}{\mu} + \frac{1}{\mu\sqrt{2}}\right)^2$

$\Rightarrow \quad \sin^2 r < 1 - \left(\frac{2+1}{\mu\sqrt{2}}\right)^2$

$\Rightarrow \quad \frac{1}{\mu^2 2} < 1 - \frac{9}{\mu^2 2}$

$\Rightarrow \quad \mu^2 > 5 \quad ; \quad \mu > \sqrt{5}$

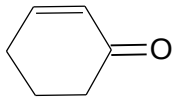
CHEMISTRY

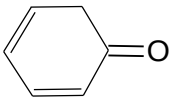
71. A meso compound
(A) is an achiral molecule that contains chirality centers.
(B) contains a plane of symmetry or a center of symmetry.
(C) is optically inactive.
(D) is characterized by all of the above statements.

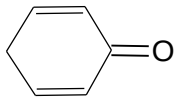
Ans. D

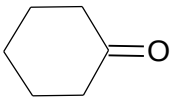
Sol. All are correct statements.

72. Which of the following shows maximum enol content?

(A) 

(B) 

(C) 

(D) 

Ans. B

Sol. Enol form has aromatic nature.

73. Equanil is …….
(A) artificial sweetener
(B) tranquilizer
(C) antihistamine
(D) antifertility drug

Ans. B

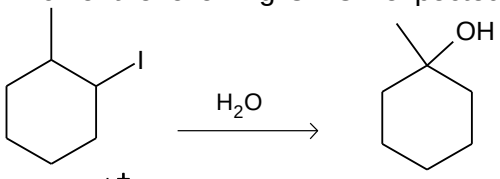
Sol. It is a fact.

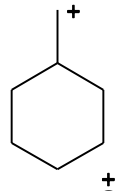
74. A narrow spectrum antibiotic is active against …….
(A) gram positive or gram negative bacteria
(B) gram negative bacteria only
(C) single organism or one disease
(D) both gram positive and gram negative bacteria

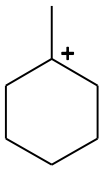
Ans. A

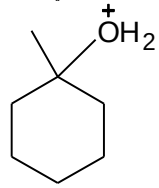
Sol. It is a fact.

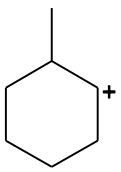
75. Which of the following is NOT expected to be intermediate of the following reaction?



(A) 

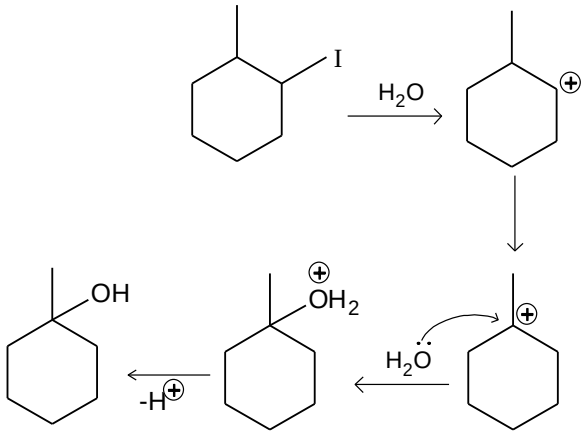
(B) 

(C) 

(D) 

Ans. A

Sol.



BIOLOGY

76. Sound – producing organ of bird is
(A) Larynx (B) Syrinx
(C) Pygostyle (D) Synosacrum

Ans. B

Sol. Sound producing organ of bird is syrinx.

77. Neoteny is found in
(A) *Hyla* (B) Axolotl
(C) Salamander (D) Tadpole

Ans. B

Sol. Neoteny is found in Axolotl.

78. Blubber is a term for
(A) Subcutaneous fat of whale (B) Irregular heart beat
(C) Artificial rubber (D) None of these

Ans. A

Sol. The subcutaneous fat layer of whale is known as blubber.

79. The closest relative of modern man is
(A) Prosimians (B) Monkey
(C) Orangutan (D) Chimpanzee

Ans. D

Sol. The closest relative of modern man is chimpanzee.

80. RBCs are nucleated in
(A) Frog (B) Rat
(C) Cat (D) Rabbit

Ans. A

Sol. RBCs are nucleated in Frog.