PRE-SERIES-OLT-2021-FT-II-KVPY-CLASS-XI
FULL TEST – II

PART – I
MATHEMATICS

1. The three different face diagonals of a cuboid (rectangular parallelepiped) have lengths 39, 40, 41. The length of the main diagonal of the cuboid which joins a pair of opposite corners is

(A) 49 (B) $49\sqrt{2}$

(C) 60 (D) $60\sqrt{2}$

Ans. A

Sol. $\sqrt{a^2+b^2}=39$ ....(i)

$\sqrt{b^2+c^2}=40$ ….(ii)

$\sqrt{c^2+a^2}=41$ ….(iii)

$\sqrt{a^2+b^2+c^2}=?$

Square and add (i), (ii) and (iii)

$2\left(a^2+b^2+c^2\right)=39^2+40^2+41^2=4802$

$a^2+b^2+c^2=2401\Rightarrow\sqrt{a^2+b^2+c^2}=49$

2. 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. $3^{\frac{x}{y}+1}-3^{\frac{x}{y}-1}=24\Rightarrow 3^{\frac{x}{y}}\times 3-\frac{3^{\frac{x}{y}}}{3}=24$

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

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

3. Let a, b, x, y be real numbers such that $a^2+b^2=81,\ x^2+y^2=121$ and $ax+by=99$. Then the set of all possible values of $ay-bx$ is

(A) $\left(0, \frac{9}{11}\right]$ (B) $\left(0, \frac{9}{11}\right)$

(C) {0} (D) $\left[\frac{9}{11}, \infty\right)$

Ans. C

Sol. $a^2+b^2=81$

$x^2+y^2=121$

$ax+by=99$

$\left(a^2+b^2\right)\left(x^2+y^2\right)=(81)(121)$ .....(1)

and $(ax+by)^2=(99)^2$ .....(2)

(1) – (2)

$(ay-bx)^2=0$

$ay-bx=0$

4. Let ABC be a triangle with $\angle B=90^o$. Let AD be the bisector of $\angle A$ with D on BC. Suppose AC = 6 cm and the area of the triangle ADC is 10 cm^2. Then the length of BD in cm is equal to

(A) $\frac{3}{5}$ (B) $\frac{3}{10}$

(C) $\frac{5}{3}$ (D) $\frac{10}{3}$

Ans. D

Sol. From angle bisector theorem

$\frac{r}{6}=\frac{p}{q}$

$qr=6p$

Area of $\Delta ADC=10\ cm^2$

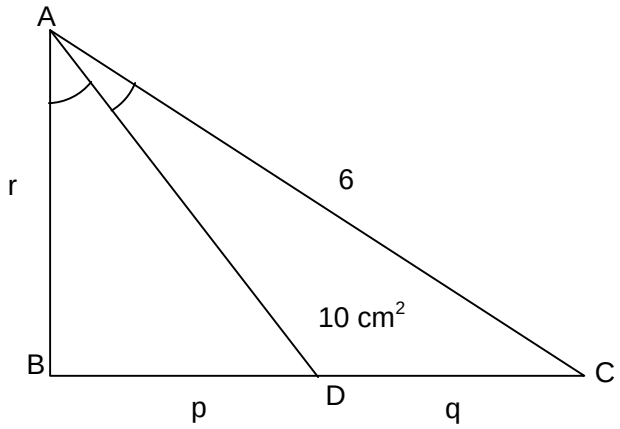
$\frac{1}{2}(DC)(AB)=10,\ \ \frac{1}{2}(q)(r)=10$

$qr=20$

From (1)

$\Rightarrow 20=6\ p$

$p=\frac{20}{6}=\frac{10}{3}$



5. The number of distinct prime divisors of the number $512^3 - 253^3 - 259^3$ is

(A) 4 (B) 5

(C) 6 (D) 7

Ans. C

Sol. $(512)^3 - 253^3 - 259^3$

$= (512)^3 - \left[\left(253^3\right) + (259)^3\right]$

$= (512)^3 - (253 + 259)\left(253^2 + 259^2 - (253)(259)\right)$

$= (512)^3 - (512)\left[(253 + 259)^2 - 2(253)(259) - (253)(259)\right]$

$= 512\left[(512)^2 - \left\{(512)^2 - 3(253)(259)\right\}\right]$

$= (512)\left[3(253)(259)\right]$

$= 2^9.3.(253)(259)$

$= 2^9.3(11)(23)(7)(37)$

6 prime divisors.

6. For $\dfrac{2^2 + 4^2 + 6^2 + ... + (2n)^2}{1^2 + 3^2 + 5^2 + ... + (2n-1)^2}$ to exceed 1.01, the maximum value of n is

(A) 99 (B) 100

(C) 101 (D) 150

Ans. D

Sol. $\dfrac{2^2\left(1^2 + 2^2 + 3^2 + ... + n^2\right)}{\left[1^2 + 2^2 + 3^2 + ... + (2n)^2\right] - 2^2\left(1^2 + 2^2 + 3^2 + ... + n^2\right)}$

$\dfrac{\dfrac{2^2 n(n+1)(2n+1)}{6}}{\dfrac{2n(2n+1)(4n+1)}{6} - \dfrac{2^2 n(n+1)(2n+1)}{6}} > 1.0$

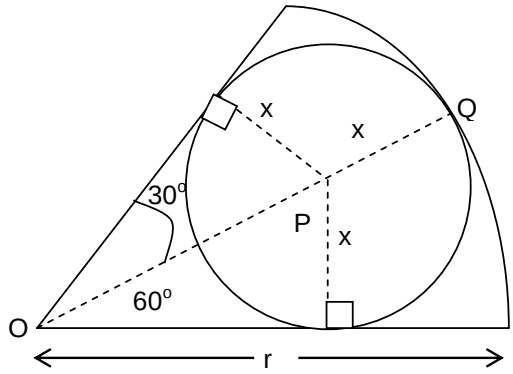
$\dfrac{2n+2}{2n-1} > 1.01$

$1 + \dfrac{3}{2n-1} > 1.01$

$2n - 1 > 300$

$n < 150.5$

7. A circle is drawn in a sector of a larger circle of radius r, as shown in the adjacent figure. The smaller circle is tangent to the two bounding radii and the arc of the sector. The radius of the small circle is



(A) $\frac{r}{2}$

(B) $\frac{r}{3}$

(C) $\frac{2\sqrt{3}r}{5}$

(D) $\frac{r}{\sqrt{2}}$

Ans. B

Sol. Say the radius of smaller circle is x

Here $OP = x\,\text{cosec}\,30^o$

while $OQ = r = x + x\,\text{cosec}\,30^o$

$x = \frac{r}{3}$

8. In a triangle ABC, it is know that AB = AC. Suppose D is the mid point of AC and BD = BC = 2. Then the area of the triangle ABC is

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

(C) $\sqrt{7}$ (D) $2\sqrt{7}$

Ans. C

Sol. We know

$AB^2 + BC^2 = 2\left(CD^2 + BD^2\right)$

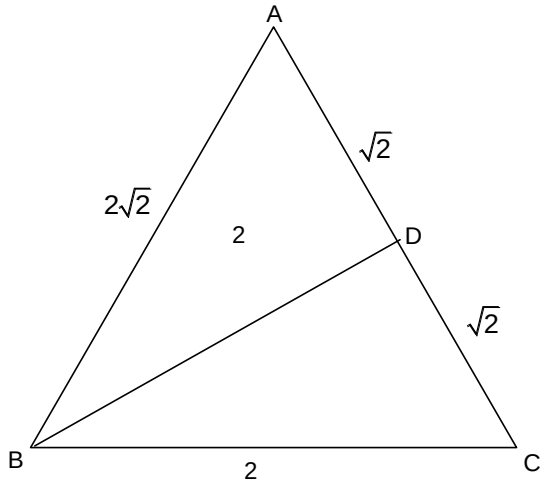
$AB^2 + 4 = 2\left(\frac{AB^2}{4} + 4\right)$

$AB^2 + 4 = \frac{AB^2}{2} + 8$

$\frac{AB^2}{2} = 4$

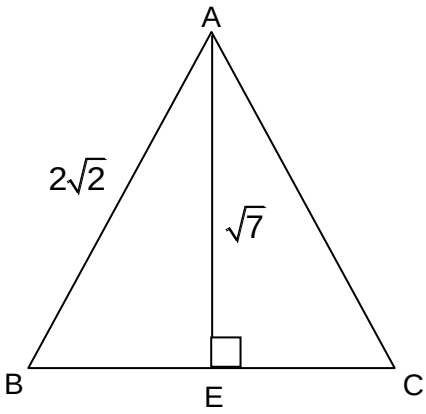
$AB^2 = 8$

$AB = 2\sqrt{2}$



Now

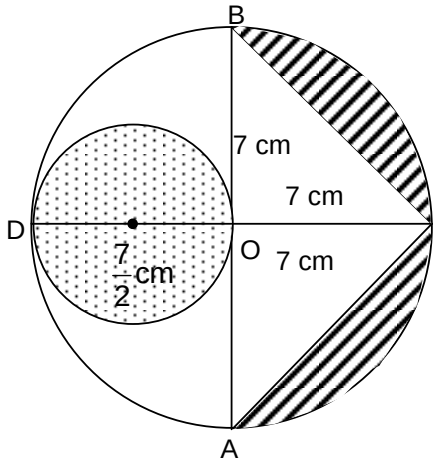
Area $= \frac{1}{2} \times 2 \times \sqrt{7} = \sqrt{7}$ square unit.



9. In figure AB and CD are two diameters of a circle (with centre O) perpendicular to each other and OD is the diameter of the smaller circle. If OA = 7 cm, find the area of the shaded region.

(A) 66.5 (B) 66

(C) 67 (D) 67.5



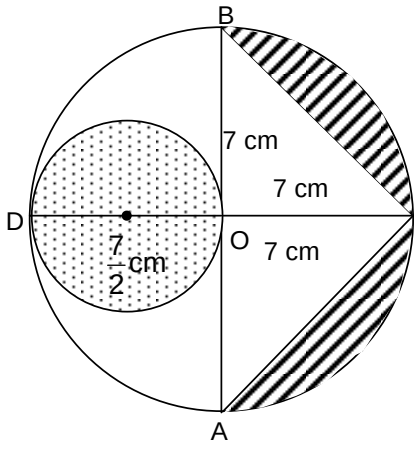
Ans. A

Sol. We have

Area of the shaded region

= (Area of circle with OD (= 7 cm) as diameter)

+ Area of sim – circle with AB as diameter – Area of ΔABC



$$= \pi \times \left(\frac{7}{2}\right)^2 + \frac{1}{2} \times \pi \times (7)^2 - \frac{1}{2} \times AB \times OC$$

$$= \left(\frac{\pi}{4} \times 49 + \frac{\pi}{2} \times 49 - \frac{1}{2} \times 14 \times 7\right) cm^2$$

$$= \left(\frac{3\pi}{4} \times 49 - 49\right) cm^2$$

$$= \left(\frac{3}{4} \times \frac{22}{7} \times 49 - 49\right) cm^2 = \frac{231-98}{2} cm = 66.5\, cm^2$$

10. The angle bisectors BD and CE of a triangle ABC are divided by the incentre I in the ratio 3 : 2 and 2 : 1 respectively. Then the ratio in which I divides the angle bisector through A is

(A) 3 : 1 (B) 11: 4

(C) 6 : 5 (D) 7 : 4

Ans. B

Sol. I divides AF

b + c : a

I divides BD

c + a : b

I divides CE in

a + b : c

$\frac{c+a}{b}=\frac{3}{2};\frac{a+b}{c}=\frac{2}{1}$

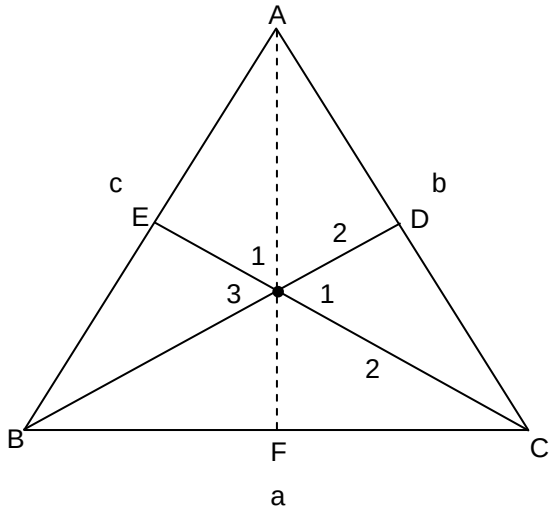
$2c+2a=3b \qquad \Rightarrow a+b=2c$

$\Rightarrow a+b+2a=3b \qquad a+\frac{3a}{2}=2c$

$\Rightarrow 3a=2b \qquad \frac{5}{2}a=2c$

$\Rightarrow b=\frac{3a}{2} \qquad c=\frac{5}{4}a$

Now $\frac{b+c}{a}=\frac{\frac{3a}{2}+\frac{5a}{4}}{a}=\frac{6+5}{4}=\frac{11}{4}$



11. Two distinct polynomials $f(x)$ and $g(x)$ are defined as follows:

$f(x)=x^2+ax+2; g(x)=x^2+2x+a$.

If the equation $f(x)=0$ and $g(x)=0$ have a common root then the sum of roots of the equation $f(x)+g(x)=0$ is

(A) $-\frac{1}{2}$ (B) 0

(C) $\frac{1}{2}$ (D) 1

Ans. C

Sol. Let 'α' is the common root

So, $\alpha^2+a\alpha+2=0$ ……(i)

$\alpha^2+2\alpha+a=0$ ……(ii)

$\Rightarrow (a-2)\alpha+2-a=0$

$\Rightarrow \alpha=1$ is common root.

$\therefore 1^2 + a + 2 = 0 \Rightarrow a = -3$

$f(x) + g(x) = 0$

$\Rightarrow 2x^2 + (a+2)x + (a+2) = 0$

$\Rightarrow 2x^2 - x - 1 = 0$

$\Rightarrow$ Sum of roots $= \frac{1}{2}$.

12. If 100! is divided by 6^n then largest value of $n \in N$ is
(A) 45 (B) 46
(C) 47 (D) 48

Ans. D

Sol. Power of 3 = x

$$x = \left[\frac{100}{3}\right] + \left[\frac{100}{3^2}\right] + \left[\frac{100}{3^3}\right] + \left[\frac{100}{3^4}\right]$$

$= 33 + 11 + 3 + 1$

= 48

$100!$ is divided by 6^{48}

largest value of n = 48

13. Total number of divisors of number 120 which are not multiple of 2 =
(A) 6 (B) 7
(C) 8 (D) 9

Ans. A

Sol. $120 = 2^3 \times 3^2 \times 5^1$

Divisors not multiple of 2

$= 1 \times 3 \times 2 = 6$

14. If $f : R \to R$ be a function such that $2f(x) + f(1-x) = x + 1$ then $f(2) = ?$
(A) 1 (B) 2
(C) –1 (D) 0

Ans. B

Sol. $2 \times (2f(2) + f(-1) = 3)$

$2f(-1) + f(2) = 0$

$4f(2) - f(2) = 6$

$3f(2) = 6$

$f(2) = 2$

15. The rank of the word “MONDAY” in a dictionary formed by using all the letters of word Monday is

(A) 325 (B) 326

(C) 327 (D) 328

Ans. C

Sol. $A = 5! = 120$

D = 120

$MA = 4! = 24$

MD = 24

MN = 24

$MOA = 3! = 6$

MOD = 6

MONA = 2

Monday = 1

327

PHYSICS

16. A disc of radius R rolls with slipping on a horizontal surface with linear velocity $v\hat{i}$ and angular velocity $\omega(-k)$. There is a particle p on the circumference of the disc which has velocity in vertical direction. The height of that particle from the ground will be

(A) $R + \frac{V}{\omega}$ (B) $R - \frac{V}{\omega}$

(C) $R + \frac{V}{2\omega}$ (D) $R - \frac{V}{2\omega}$

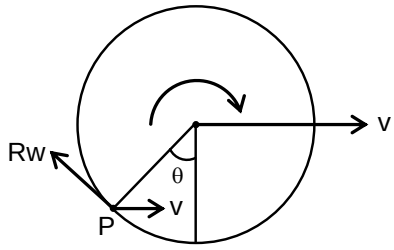
Ans. B

Sol. If velocity of point P in vertical direction, then

$v = Rw \cos\theta$ …(i)

Height of P from ground

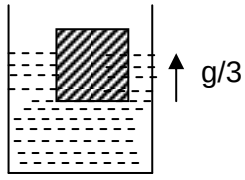
$h = R - R\cos\theta$ …(ii)



17. A cubical block is floating in a liquid with half of its volume immersed in the liquid. When the whole system accelerates upwards with a net acceleration of g/3. The fraction of volume immersed in the liquid will be

(A) 1/2 (B) 3/8

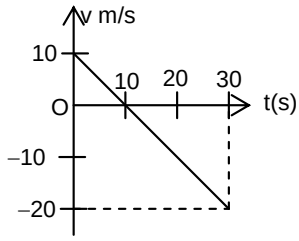
(C) 2/3 (D) 3/4



Ans. A

Sol. The apparent weight of block and apparent weight of fluid are changed by same amount.

18. The velocity-time graph for a particle moving on a straight line is shown in figure then choose the correct option.

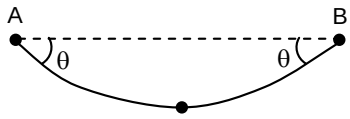


(A) the particle has variable acceleration
(B) the particle has never turned around
(C) the particle has zero displacement
(D) the average speed in the interval 0 to 10 s is the same as the average speed in the interval 10 s to 20 s.

Ans. D

Sol. Area (0 to 10 sec) = area (10 sec to 20 sec)

19. A rope of mass m hangs between two fixed points A and B at the same level, as shown in figure. The tension at the mid point of the chain



(A) mg
(B) mg cot θ
(C) 2mg cot θ
(D) $\frac{mg\cot\theta}{2}$

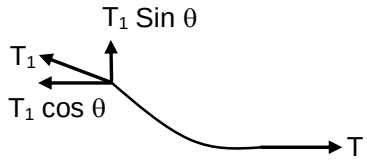
Ans. D

Sol. $T_1 \sin\theta = \frac{m}{2}g$

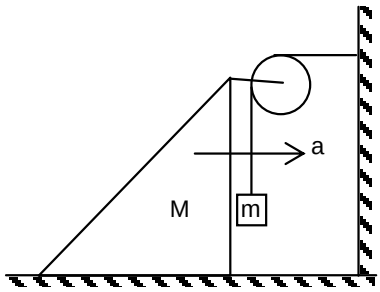
$T_1 \cos\theta = T$

$\Rightarrow \quad \frac{T}{\frac{m}{2}g} = \cot\theta$

$\Rightarrow \quad T = \frac{m}{2}g\cot\theta$



20. If wedge is moving with acceleration a as shown in the figure then value of net force on m is

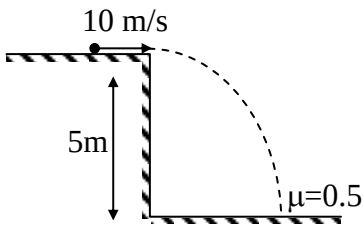


(A) ma
(B) $\sqrt{2}$ ma
(C) mg
(D) zero

Ans. B

Sol. Net force $F = m\,a_{net} = m\sqrt{a^2 + a^2} = ma\sqrt{2}$.

21. A small ball moving with a velocity 10 m/s, horizontally (as shown in figure) strikes a rough horizontal surface having $\mu = 0.5$. If the coefficient of restitution is e = 0.4. Horizontal component of velocity of ball after first impact will be ($g = 10\ m/s^2$)



(A) 10 m/s (B) 8 m/s
(C) 3 m/s (D) 4 m/s

Ans. C

Sol. $\int Ndt = mv_y - mu_y, e = \frac{v_y}{u_y} \Rightarrow v_y = 0.4 \times 10 = 4\ m/s$

$\int Ndt = m \times 4 - (-10m) = 14\ m$

$-\int \mu Ndt = mv_x - mu_x$

$-0.5 \times 14m = mv_x - m \times 10 \Rightarrow v_x = 3\ m/s$

22. A cylinder containing water stands on a table of height H. A small hole is punched in the side of cylinder at its base. The stream of water strikes the ground at a horizontal distance R from the table. Then the depth of water in the cylinder is

(A) H (B) R
(C) $\sqrt{(RH)}$ (D) $R^2/4H$

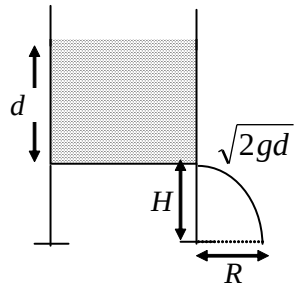
Ans. D

Sol. $t = \sqrt{\frac{2H}{g}}$

$R = \sqrt{2gd}\sqrt{\frac{2H}{g}}$

$R = \sqrt{4dH}$

$d = \frac{R^2}{4H}$



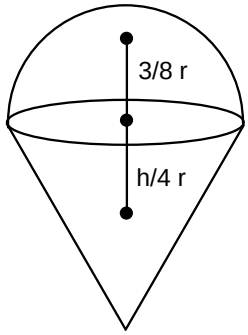
23. A uniform solid hemisphere of radius r is joined to uniform solid right circular cone of base of radius r. Both have same density. The centre of mass of the composite solid lies on the common face. The height (h) of the cone is

(A) 2r (B) $\sqrt{3}\,r$
(C) 3r (D) $r\sqrt{6}$

Ans. B

Sol. $\frac{3}{8}r \cdot \rho \frac{2}{3}\pi r^3 = \frac{h}{4} \cdot \rho \frac{1}{3}\pi r^2 h$

$\Rightarrow \quad h = \sqrt{3}\, r$



24. The error in the measurement of the radius of a sphere is 1%. Then error in the measurement of volume is

(A) 1% (B) 5%

(C) 3% (D) 8%

Ans. C

Sol. $V = \frac{4}{3}\pi r^3 \qquad \ldots(1)$

$\Rightarrow \quad \frac{dV}{dr} = 4\pi r^2$

$\Rightarrow \quad dV = 4\pi r^2 dr \qquad \ldots(2)$

From (1) and (2), we obtain:

$$\frac{dV}{V} = 3\left(\frac{dr}{r}\right)$$

$\Rightarrow$ Error in volume = 3 × (1%) = 3%.

25. A particle is projected on inclined plane of inclination β at angle of projection α to the horizontal. If the particle strikes the plane horizontally then

(A) $\tan\beta = 2\tan\alpha$ (B) $\tan\alpha = \cot\beta$

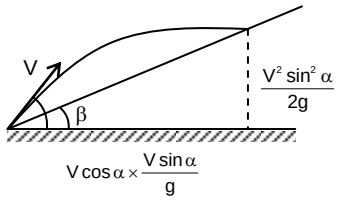
(C) $\tan\alpha = 2\tan\beta$ (D) $\alpha = 2\beta$

Ans. C

Sol. $t = \frac{V\sin\alpha}{g}$

$$\tan\beta = \frac{V^2\sin^2\alpha}{2gV^2\frac{\sin\alpha\cos\alpha}{g}}$$

$\tan\alpha = 2\tan\beta$



26. The speed of a wave on a string is 150 m/s when the tension is 120 N. The percentage increase in the tension in order to raise the wave speed by 20% is:

(A) 44% (B) 40%

(C) 20% (D) 10%

Ans. A

Sol. $v = \sqrt{\frac{T}{\mu}}$; $V' = \frac{6V}{5}$

$V' = \sqrt{\frac{T'}{\mu}}$; $T' = \frac{36}{25}T$

% T = 44%

27. A body cools from 62°C to 50°C in 10 minutes and to 42°C in the next 10 minutes. The temperature of surroundings is

(A) 20°C (B) 26°C

(C) 23°C (D) 25°C

Ans. B

Sol. For the first ten minutes,

$\frac{dT}{dt} = -\left(\frac{62^o - 50^o}{10}\right)$ = –1.2°C/min and

$\Delta T = \left(\frac{62+50}{10}\right) - T_0 = (56 - T_0)^oC$

$\Rightarrow$ –1.2°C/min = –KA (56–T_0)°C …(1)

Similarly for the next ten minutes

$\frac{dT}{dt} = \left[\frac{42^o - 50^o}{10}\right]$ = –0.8 °C/min and

$\Delta T = \left(\frac{42+50}{2}\right) - T_0 = (46 - T_0)^oC$

$\Rightarrow$ –0.8°C/min = –KA (46–T_o)°C …(2)

Dividing (1) by (2)

$\frac{3}{2} = \frac{56 - T_0}{46 - T_0}$

$\Rightarrow T_0 = 26°C$.

Alternate Method:

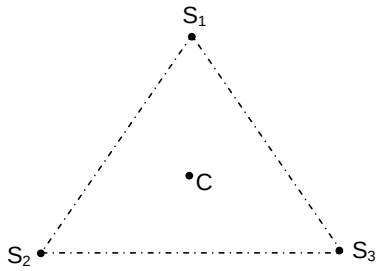
$\frac{dT}{dt} = -k(T - T_o)$

$\Rightarrow \int_{62}^{50} \frac{dT}{T - T_o} = \int_0^{10} -kdt$ ie $\ell n \frac{62 - T_o}{50 - T_o} = 10k$ …(i)

also $\int_{50}^{42} \frac{dT}{T - T_o} = \int_0^{10} -kdt$ i.e. $\ell n \frac{50 - T_o}{42 - T_o} = 10k$ …(ii)

from (i) and (ii) $T_o = 26^oC$

28. Three identical sources S_1, S_2 and S_3 are placed at the vertices of an equilateral triangle. If they have intensity I_0 each at centroid c of triangle. The resulting intensity of sound at c will be

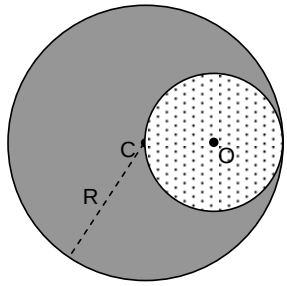


(A) $3I_0$ (B) $6I_0$
(C) zero (D) $9I_0$

Ans. D

Sol. $I_r = \left(\sqrt{I_o} + \sqrt{I_o} + \sqrt{I_o}\right)^2 = 9I_o$

29. A fixed sphere of radius R and uniform mass density d has a cavity of radius R/2 as shown in figure. The centre of the solid sphere was at C while that of the cavity is at O. A liquid of density d/2 is filled in the cavity. Find the gravitational force exerted by the liquid on solid sphere.



(A) $\frac{G\pi^2R^4d^2}{6}$ (B) $\frac{G\pi^2R^4d^2}{12}$
(C) $\frac{G\pi^2R^4d^2}{9}$ (D) $\frac{G\pi^2R^4d^2}{18}$

Ans. D

Sol. 'E' at centre of cavity due to solid.

$\vec{E}_{net} = \vec{E}_{complete} - \vec{E}_{cavity}$

$= \frac{GMr}{R^3} - 0$

Now, F = mE

30. A ball of mass m and density ρ is immersed in a liquid of density 3 ρ at a depth h and released. To what height will the ball jump up above the surface of liquid? (neglect the resistance of water and air, radius of ball << h).

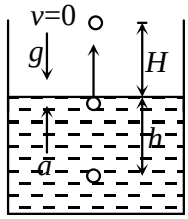
(A) h (B) h/2
(C) 2h (D) 3h

Ans. C

Sol. Volume of ball $V = \frac{m}{\rho}$

Acceleration of ball inside the liquid

$a = \frac{F_{net}}{m} = \frac{\text{upthrust} - \text{weight}}{m}$



or $a = \dfrac{\left(\dfrac{m}{\rho}\right)(3\rho)(g) - mg}{m} = 2g$ (upwards)

$\therefore$ Velocity of ball while reaching at surface

$$v = \sqrt{2ah} = \sqrt{4gh}$$

$\therefore$ The ball will jump to a height

$$H = \frac{v^2}{2g} = \frac{4gh}{2g} = 2h$$

CHEMISTRY

31. Sulphur dioxide may be prepared by the following reaction

$S_8 + 8O_2 \longrightarrow 8SO_2$

How many grams of SO_2 will be produced from 0.25 mol of S_8 with excess of O_2?
(Given S = 32, O = 16)

(A) 64 (B) 128
(C) 256 (D) None of these

Ans. B

Sol. Moles of SO_2 formed = $0.25 \times 8 = 2$ moles

$W_{SO_2} = 2 \times 64$ g

32. How many maximum no. of spectral lines are produced when an electron jumps from 8th orbit to 2nd orbit of a sample of hydrogen atoms?

(A) 28 (B) 21
(C) 22 (D) 18

Ans. B

Sol. The no. of spectral lines = $\dfrac{(n_2 - n_1)(n_2 - n_1 + 1)}{2} = \dfrac{(8-2)(8-2+1)}{2} = 21$

33. Hybridization of each carbon in C_3O_2 is

(A) sp (B) sp^2
(C) sp^3 (D) sp^3d

Ans. A

Sol. $O = \overset{sp}{C} = \overset{sp}{C} = \overset{sp}{C} = O$

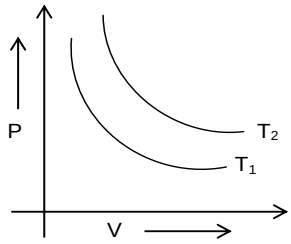
34. Which has the highest value of first ionization energy?

(A) Ba (B) Mg
(C) Be (D) Ca

Ans. C

Sol. The order of $I.E_1$ is Be > Mg > Ca > Ba

35. For a fixed amount of an ideal gas at a particular temperatures, the P-V curves are:
Choose the correct option



(A) $T_1 = T_2$ (B) $T_1 > T_2$
(C) $T_1 < T_2$ (D) $T_1 = 2T_2$

Ans. C

Sol. On increasing temperature, the value of pressure increases for a fixed amount of gas having a particular volume.

36. For which of the following equilibrium, the value of K_P is greater than K_C?
(A) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ (B) $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$
(C) $N_2O_3(\ell) \rightleftharpoons NO(g) + NO_2(g)$ (D) $2NO_2(g) \rightleftharpoons N_2O_4(s)$

Ans. C

Sol. $K_P = K_C(RT)^{\Delta n}$

37. Choose the incorrect statement?
(A) The value of equilibrium constant is independent of initial concentrations of reactants and products.
(B) The equilibrium constant for the reverse reaction is equal to the inverse of the equilibrium constant for the forward reaction.
(C) The numerical values of K_P and K_C are same for the reaction
$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ at a particular temperature.
(D) The value of equilibrium constant is temperature dependent for a given reaction.

Ans. C

Sol. $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$
$K_C = [CO_2]; K_P = p_{CO_2}$

38. Which of the following is correct for an isobaric process?
(A) $\Delta E = 0$ (B) $\Delta V = 0$
(C) $\Delta P = 0$ (D) $\Delta S = 0$

Ans. C

Sol. Isobaric processes are carried out at constant pressure.

39. Which of the following is not a carbonate ore?
(A) Siderite (B) Malachite
(C) Zincite (D) Calamine

Ans. C

Sol. Siderite-$FeCO_3$, Malachite-$CuCO_3.Cu(OH)_2$, Zincite-ZnO, Calamine-$ZnCO_3$.

40. Which of the following compound undergoes decomposition reaction on heating?
(A) Na_2SO_4 (B) $LiNO_3$
(C) K_2CO_3 (D) RbOH

Ans. B

Sol. $4LiNO_3 \longrightarrow 2Li_2O + 4NO_2 + O_2$

41. Syngas is a mixture of
(A) $CO_2(g)$, $H_2(g)$ (B) $CO(g)$, $H_2O(g)$
(C) $CO(g)$, $CO_2(g)$ (D) $CO(g)$, $H_2(g)$

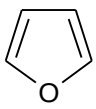
Ans. D

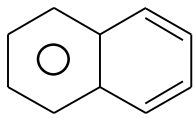
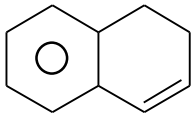
Sol. Mixture of $CO(g)$ and $H_2(g)$ is called syn-gas.

42. Silicate ions contain
(A) Si, C, O (B) Si, O
(C) Si, H, O (D) Si, H

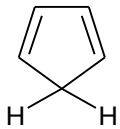
Ans. B

Sol. Silicates contain silicon and oxygen.

43. Which of the following molecules is not aromatic?
(A) 

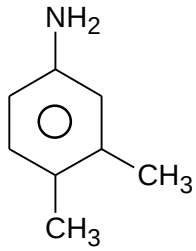
(B) 
(C) 
(D) 

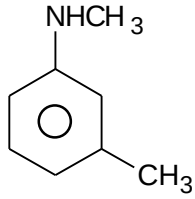
Ans. D

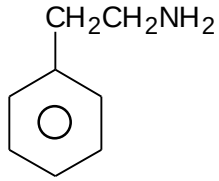
Sol. 

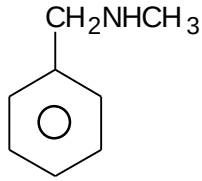
contains sp^3 – carbon and molecule does not obey Huckel's rule.

44. The most basic compound out of the following is

(A) 

(B) 

(C) 

(D) 

Ans. D

Sol. It is secondary amine and the lone pair on nitrogen atom does not undergo resonance.

45. Which of the following reagents can be used to distinguish But-1-yne and But-2-yne?
(A) H_2/Ni
(B) dil.H_2SO_4/$HgSO_4$(aq)
(C) HBr/acetone
(D) $NaNH_2$

Ans. D

Sol. $CH_3 - CH_2 - C \equiv CH \xrightarrow{Na^+ NH_2^-} CH_3 - CH_2 - C \equiv C^- Na^+ + NH_3 \uparrow$

BIOLOGY

46. Ribosomes are granules formed of
(A) rRNA + tRNA
(B) mRNA + tRNA
(C) rRNA + Proteins
(D) sugar, base

Ans. C

Sol. Ribosomes are granules formed of rRNA + Proteins

47. In an undamaged blood vessel, conversion of prothrombin to thrombin is prevented by
(A) fibrinogen
(B) Ca^{2+}
(C) factor VII
(D) heparin

Ans. D

Sol. In an undamaged blood vessel, conversion of prothrombin to thrombin is prevented by heparin

48. Which one of the following features is common in silverfish, scorpion, dragonfly and prawn?
(A) Two pairs of legs and segmented body
(B) Living chitinous cuticle and two pairs of antennae
(C) Jointed appendages and chitinous exoskeleton
(D) Closed blood vascular system

Ans. C

Sol. Silverfish, scorpion, dragonfly and prawn all fall in Phylum Arthropoda which have jointed appendages.

49. The correct sequence of organelles without binding membrane and with single, double and triple binding membranes
I. sphaerosomes (plant lysosomes
II. transosomes (in ovarian follicular cells)
III. ribosomes
IV. mitochondria
(A) IV, I, III, II
(B) II, I, IV, III
(C) III, I, IV, II
(D) I, IV, III, II

Ans. C

Sol. Ribosomes membraneless organelles Sphaerosomes sphaerosomes are single membrane bound cell organelles Mitochondria double membrane bound Transosomes triple membrane bound cell organelle.

50. The type of immunoglobulin present in the colostrum is
(A) IgD
(B) IgA
(C) IgM
(D) IgE

Ans. B

Sol. Colostrum is maternal milk of mammal formed during the first few days after the birth. It contains antibodies (IgA is the major immunoglobulin in it) that provide passive immunity to the new born infant.

51. Choose the correctly matched pair from the following
(A) Gonorrhoea, hepatitis, sexually transmitted diseases
(B) AIDS, gonorrhoeaviral infection
(C) Diphtheria, ringwormfungal infection
(D) Diphtheria, tuberculosisprotozoan infection

Ans. A

Sol. AIDS is caused by HIV virus. Gonorrhoea is caused by bacteria Neisseria gonorrhoeae. Diphtheria is caused by bacteria Corynebacterium diphtheria. Ringworm disease is caused by fungus Trichophyton, Epidermophyton and Microsporum. Tuberculosis is caused by a bacterium called Mycobacterium tuberculosis.

52. An artery is:
(A) thick-walled in which blood flows under low pressure
(B) thin-walled in which blood flows under high pressure
(C) thick-walled in which blood flows under high pressure
(D) thin-walled in which blood flows under low pressure

Ans. C

Sol. An artery is thick-walled in which blood flows under high pressure.

53. 'Ontogeny Recapitulates Phylogeny' is narrated in which of the evidences for organic evolution?
(A) Palaeontological evidence
(B) Physiological evidence
(C) Embryological evidence
(D) Anatomical evidence

Ans. C

Sol. 'Ontogeny Recapitulates Phylogeny' is narrated by Embryological evidence.

54. Exposure to carbon monoxide (from coal gas) is extremely dangerous and can kill a patient because
(A) the compound carboxy-hemoglobin is formed with hemoglobin which can gradually clot the blood resulting in circulatory failure.
(B) carboxy-hemoglobin reduces the ability of blood to transport oxygen by rupturing a vast majority of erythrocyte.
(C) Carboxy-hemoglobin greatly modifies the structure of hemoglobin, thus making it lose its affinity for oxygen.
(D) the compound formed, carboxy-hemoglobin does not allow RBCs to act for their respiratory function.

Ans. D

Sol. Exposure to carbon monoxide (from coal gas) is extremely dangerous and can kill a patient because the compound formed, carboxy-hemoglobin does not allow RBCs to act for their respiratory function.

55. Which ONE of the following statements is true about trypsinogen?
(A) It is activated by enterokinase
(B) It is activated by renin
(C) It is activated by pepsin
(D) It does not need activation

Ans. A

Sol. Trypsinogen is activated by enterokinase inside the duodenum.

56. An example of nastic movement?
(A) Folding up of the leaves of mimosa pudica
(B) Climbing of tendrils
(C) Growth of roots from seeds
(D) Growth of pollen tube towards the ovule

Ans. A

Sol. Folding up of the leaves of mimosa pudica is an example of nastic movement. Nastic movement are non-directional response to stimuli, it is reversible also.

57. The mode of speciation mediated by geographical isolation is referred to as
(A) adaptive radiation (B) allopatric speciation
(C) parapatric speciation (D) sympatric speciation

Ans. B

Sol. **Allopatric speciation**
Allopatric speciation also known as geographical speciation. this speciation occur when biological populations of the same species become isolated due to geographical changes.

58. Which one of the following is a CORRECT statement about primate's evolution?
(A) Chimpanzees and gorillas evolved from macaques
(B) Humans and chimpanzees evolved from gorillas
(C) Humans, chimpanzees and gorillas evolved from a common ancestor
(D) Humans and gorillas evolved from chimpanzees

Ans. C

Sol. Humans, chimpanzees and gorillas evolved from a common ancestor according to evolutionary study. Primatologists know from fossils that humans, chimpanzees, and gorilla shared an ancient ancestor.

59. Microscopic examination of a blood smear reveals an abnormal increase in the number of granular cells with multiple nuclear lobes. Which one of the following cells types has increased in number?
(A) Lymphocytes (B) Monocytes
(C) Neutrophils (D) Thrombocytes

Ans. C

Sol. **Neutrophils**
In this type of granules, granulocytes has very tiny granules and nucleus is multilobed with lobed connected by thin strands of nuclear material.

60. Which one of the following genetic phenomena is represented by the blood group AB?
(A) Codominance (B) Dominance
(C) Overdominance (D) Semidominance

Ans. A

Sol. Co-dominance
Codominance occurs when both alleles show dominance in case of blood group AB type (I^A & I^B) in humans.

PART – II

MATHEMATICS

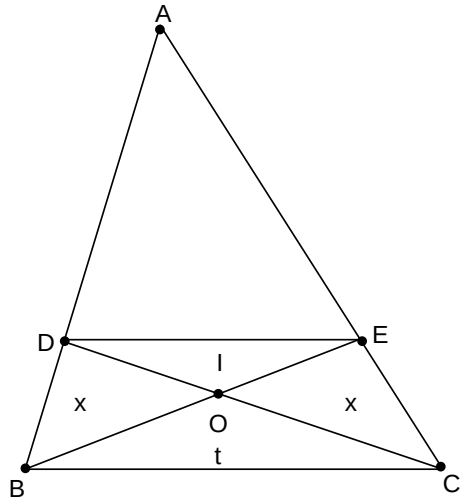
61. In triangle ABC, D and E are points on AB, AC respectively such that DE is parallel to BC. Suppose BE, CD intersect at O. if the area of the triangle ADE and ODE are 3 and 1 respectively, find the area of the triangle ABC, with justification

(A) 10 (B) 11

(C) 12 (D) 13

Ans. C

Sol. We denote the area of triangle PQR by [PQR]. We see that [BOD] and [COE] are equal. Let the common value be x, and let [BOC] = t. Using the fact that the ratio of area of two triangles having equal altitudes is the same as the ratio of their respectively bases, we obtain.



$$\frac{x}{1}=\frac{BO}{OE}=\frac{t}{x}.$$

The gives $t=x^2$. Now ADE and ABC are similar so that

$$\frac{[ADE]}{[ABC]}=\frac{DE^2}{BC^2}=\frac{[ODE]}{[OBC]},$$

since ODE and OCB are also similar. This implies that

$$\frac{3}{4+2x+t}=\frac{1}{t}.$$

Which simplifies to t = 2 + x, using $t=x^2$ we get a quadratic in $x: x^2-x-2=0$. Its solution are x = 2 and x = –1. Since x cannot negative, x = 2 and t = 4. Thus [ABC] = 4 + 2x + t = 4 + 4 + 4 = 12

62. The expression $\frac{2^2+1}{2^2-1}+\frac{3^2+1}{3^2-1}+\frac{4^2+1}{4^2-1}+.....+\frac{(2011)^2+1}{(2011)^2-1}$ lies in the interval

(A) $\left(2010, 2010\frac{1}{2}\right)$ (B) $\left(2011-\frac{1}{2011}, 2011-\frac{1}{2012}\right)$

(C) $\left(2011, 2011\frac{1}{2}\right)$ (D) $\left(2012, 2012\frac{1}{2}\right)$

Ans. C

Sol. $\frac{2^2+1}{2^2-1}+\frac{3^2+1}{3^2-1}+\frac{4^2+1}{4^2-1}+.....+\frac{(2011)^2+1}{(2011)^2-1}$

$$\sum_{r=2}^{2011}\frac{r^2+1}{r^2-1}=\sum_{r=2}^{2011}\left[1+\frac{2}{(r+1)(r-1)}\right]$$

$$=\sum_{r=2}^{2011}\left[1+\frac{1}{r-1}-\frac{1}{r+1}\right]$$

$$=2010+\left[1-\frac{1}{3}+\frac{1}{2}-\frac{1}{4}+\frac{1}{3}-\frac{1}{5}+.....+\frac{1}{2010}-\frac{1}{2012}\right]$$

$$=2010+1+\frac{1}{2}-\frac{1}{2012}-\frac{1}{2011}$$

$$=2011+\frac{1}{2}-\left[\frac{1}{2011}+\frac{1}{2012}\right]\text{ lies between }\left(2011,\ 2011\frac{1}{2}\right)$$

63. The diameter of one of the base of a truncated cone is 100 mm. If the diameter of this base is increased by 21% such that it still remains a truncated cone with the height and the other base unchanged, the volume also increases by 21%. The radius of the other base (in mm) is

(A) 65 (B) 55

(C) 45 (D) 35

Ans. B

Sol. Let initially 2 bases have radii 5 cm and r cm.

Finally base have radii (1.21×5) and r

Ratios of volume $=\frac{V_2}{V_1}=1.21$

$$V_2=\frac{\pi h}{3}\left[(6.05)^2+(6.05)r+r^2\right]$$

$$V_1=\frac{\pi h}{3}\left[5^2+5r+r^2\right]$$

$$\frac{V_2}{V_1}=1.21\Rightarrow\frac{(6.05)^2+(6.05)r+r^2}{5^2+5r+r^2}=1.21$$

$$\Rightarrow r^2=\frac{6.3525}{21}\quad\Rightarrow r=\frac{11}{2}\text{cm}=55\text{ mm}$$

64. Let ABCD be a square of side length 1. Let P, Q, R, S be points in the interior of the sides AD, BC, AB, CD, respectively, such that PQ and RS intersect at right angles. If $PQ=\frac{3\sqrt{3}}{4}$ then RS equals

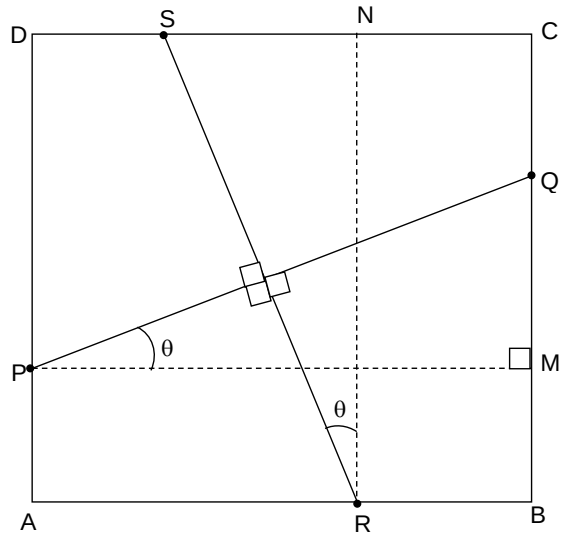
(A) $\frac{2}{\sqrt{3}}$ (B) $\frac{3\sqrt{3}}{4}$

(C) $\frac{\sqrt{2}+1}{2}$ (D) $4-2\sqrt{2}$

Ans. B

Sol. $\Delta PQM \cong \Delta RSN$

So, $RS = PQ = \dfrac{3\sqrt{3}}{4}$



65. The least positive integer n from which $\sqrt[3]{n+1} - \sqrt[3]{n} < \dfrac{1}{12}$ is

(A) 6 (B) 7
(C) 8 (D) 9

Ans. C

Sol. $(n+1)^{1/3} - n^{1/3} < \dfrac{1}{12}$

$(n+1) - n - 3(n+1)^{1/3} n^{1/3}\left((n+1)^{1/3} - n^{1/3}\right) < \left(\dfrac{1}{12}\right)^3$,

$1 - 3n^{1/3}(n+1)^{1/3} \times \dfrac{1}{12} < \dfrac{1}{(12)^3}$

$(12)^3 - 3.(12)^2 n^{1/3}(n+1)^{1/3} < 1$

$(12)^3 - 1 < 3.(12)^2 n^{1/3}(n+1)^{1/3}$

$\dfrac{1727}{3\times 144} < n^{1/3}(n+1)^{1/3}$

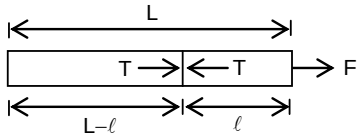
$n(n+1) > \left(\dfrac{1727}{3\times 144}\right)^3$

$n(n+1) > 63.88$

n = 8

PHYSICS

66. A uniform rope of length L, resting on frictionless horizontal surface is pulled at one end by a force F. Find the tension in the rope at distance ℓ from the end where force F is applied.



(A) $\frac{F\ell}{L}$ (B) $\frac{F(L-\ell)}{L}$

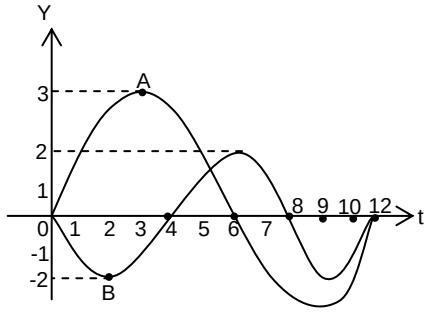
(C) $\frac{F\ell}{L+\ell}$ (D) $\frac{F\ell}{L-1}$

Ans. B

Sol. Let $\frac{M}{L}$ be mass per unit length. Then mass of length (L - ℓ) is $M' = M\frac{(L-\ell)}{L}$.

$$T = M' \times \frac{F}{M} = \frac{M(L-\ell)}{L} \times \frac{F}{M} = \frac{(L-\ell)}{L}F$$

67. The displacement Vs time graph for two waves A and B which travel along the same string are shown in figure. Determine the ratio of their Intensity $\frac{I_A}{I_B}$



(A) 1 (B) 2

(C) 3 (D) 4

Ans. A

Sol. $\frac{I_A}{I_B} = \frac{a_A^{\,2} f_A^{\,2}}{a_B^{\,2} f_B^{\,2}} = 1$

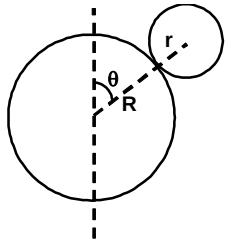
68. A uniform sphere of radius r rolls without slipping down the top of a sphere of radius R. The initial velocity of the sphere is negligible. The angular velocity of the sphere at the moment when it breaks off from the other sphere is

(A) $\sqrt{\frac{10g(R+r)}{17r^2}}$ (B) $\sqrt{\frac{17g(R+r)}{10r^2}}$

(C) $\sqrt{\frac{5g(R+r)}{10r^2}}$ (D) $\sqrt{\frac{5g(R+r)}{11r^2}}$

Ans. A

Sol. When the line joining the centers of the two spheres makes an angle θ with the vertical, then



$$mg\cos\theta - N = \frac{mv^2}{R+r}$$

When the contact breaks off, N= 0

$$mg\cos\theta = \frac{mv^2}{R+r} = \frac{m\omega^2r^2}{R+r} \quad \ldots (1)\ [\because v = \omega r]$$

From COE principle

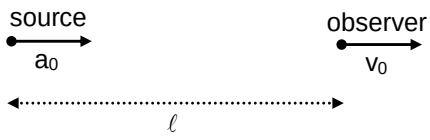
$$mg(R+r) = mg(R+r)\cos\theta + \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$$

$$mg(R+r) = (R+r)\frac{m\omega^2r^2}{R+r} + \frac{m\omega^2r^2}{2} + \frac{1}{2}.\ \frac{2}{5}mr^2\omega^2$$

$$\text{or } g(R+r) = \frac{17}{10}\omega^2r^2$$

$$\therefore\ \omega = \sqrt{\frac{10g(R+r)}{17r^2}}$$

69. At t = 0, source starts accelerating with an acceleration a and observer starts moving with constant velocity v_0 as shown in the figure simultaneously. Source emits a frequency f_0 and velocity of sound in the air is v. The frequency detected by the observer initially is

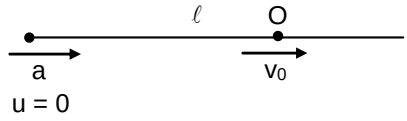


(A) $\frac{(v-v_o)f^2}{(2vf-a)}$ (B) $\frac{2(v-v_o)f^2}{(2vf-a)}$

(C) $\frac{(v-v_o)f^2}{2(2vf-a)}$ (D) $\frac{2(v-v_o)f^2}{(vf-a)}$

Ans. B

Sol. Let first pulse be released at t = 0.



Time when first pulse reaches O = $t_1 = \frac{\ell}{v-v_o}$

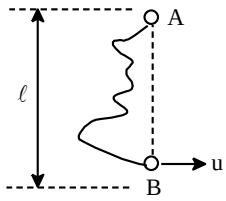
Time when second pulse reaches O =

$$t_2 = T + \frac{\ell + v_oT - \frac{1}{2}aT^2}{v-v_o}$$

$$T' = t_2 - t_1 = \frac{vT}{v-v_o} - \frac{aT^2}{2(v-v_o)}$$

$$\therefore\ f' = \frac{2f^2(v-v_o)}{2fv-a}$$

70. Two balls A & B both of mass m & connected by a light inextensible string of length 2ℓ. Whole system is on a frictionless horizontal table. Ball B is given a velocity u (as shown) $\perp$r to AB. The velocity of ball A just after the string becomes taut is



(A) $\frac{u\sqrt{3}}{4}$ (B) $u\sqrt{3}$

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

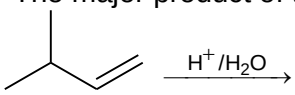
Ans. A

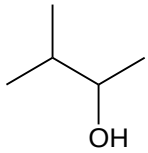
Sol. Applying momentum conservation in the direction of string

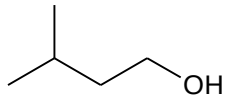
$mu\frac{\sqrt{3}}{2} = 2\,mv \Rightarrow v = \frac{\sqrt{3}}{4}(u)$

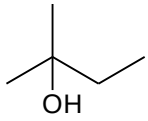
CHEMISTRY

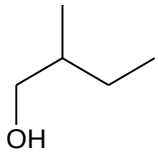
71. The major product of the reaction is



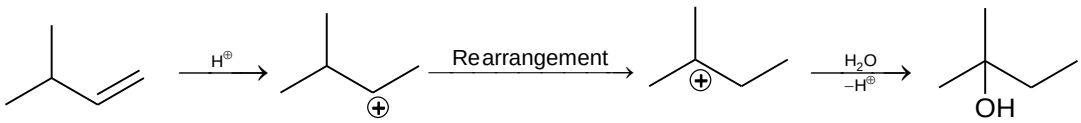
(A) 

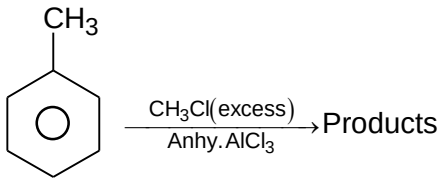
(B) 

(C) 

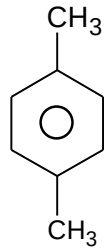
(D) 

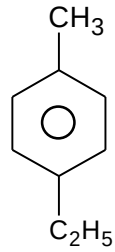
Ans. C

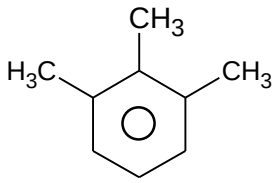
Sol. 

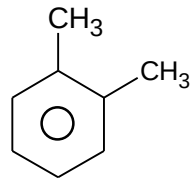
72. 

Which is not a product of above reaction?

(A) 

(B) 

(C) 

(D) 

Ans. B

Sol. $C_2H_5^+$ is not formed in the reaction.

73. Which of the following species is paramagnetic?
(A) BaO_2 (B) KO_2
(C) N_2O (D) Li_2O

Ans. B

Sol. K^+ $1s^2 2s^2 2p^6 3s^2 3p^6$

O_2^- $\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \sigma_{2P_z}^2$ $\pi_{2P_x}^2 \pi_{2P_x}^{*2}$ $\pi_{2P_y}^2 \pi_{2P_y}^{*1}$

KO_2 contains one unpaired electron hence paramagnetic.

74. If the solubility of a salt XY_3 in water is 's' mol L^{-1}, what will be it's solubility product in terms of 's'?
(A) $8s^4$ (B) $3s^4$
(C) $27s^4$ (D) $18s^4$

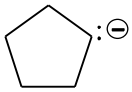
Ans. C

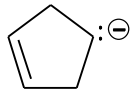
Sol. $XY_3(s) \rightleftharpoons X^{3+}(aq) + 3Y^-(aq)$

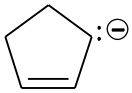
s 3s

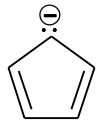
$K_{sp} = s \times (3s)^3 = 27\ s^4$.

75. Which is the most stable carbanion of the following?

(A) 

(B) 

(C) 

(D) 

Ans. D

Sol It is aromatic

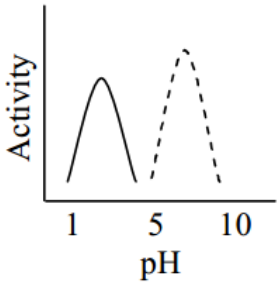
BIOLOGY

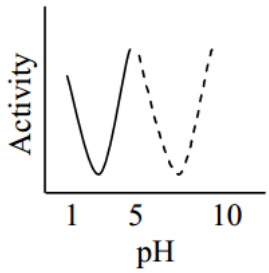
76. Papaya is a dioecious species with XY sexual genotype for male and XX for female. What will be the genotype of the embryos and endosperm nuclei after double fertilization?
(A) 50% ovules would have XXX endosperm and XY embryo, while the other 50% would have XXY endosperm and XX embryo
(B) 100% ovules would have XXX endosperm and XY embryo
(C) 100% ovules would have XXY endosperm and XY embryo
(D) 50% ovules would have XXX endosperm and XX embryo, while the other 50% would have XXY endosperm and XY embryo

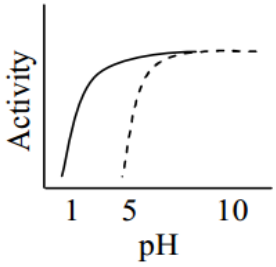
Ans. C

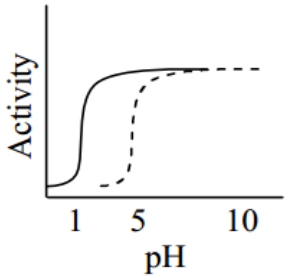
Sol. After double fertilization when male gametes enter in embryo sac and fused with XX of $\overset{+}{O}$ & XY of O, then the genotype of endosperm will be:
XXX and XXY and 50% embryo of XX and 50% embryo of XY

77. Solid and dotted lines represent the activities of pepsin and salivary amylase enzymes of the ……vs pH?

(A) 

(B) 

(C) 

(D) 

Ans. A

Sol. In the graph (A) indicating activity of pepsin at low pH (2.8). It will be highest and similarly activity of salivary amylase will be highest at the pH of 6.8 and in other graphs. (B) is representing minimum activity (C) and (D) graphs. Showing constant activity of both enzyme at increasing pH.

78. If the gene pool of the locus X in the human genome is 4, then what would be the highest possible number of genotypes in a large population?
(A) 6 (B) 8
(C) 10 (D) 16

Ans. C

Sol. For locus 'x' total gene = 4 For example → a, b, c and d Possible genotype

aa	bb	cc	dd
ab	bc	cd	
ac	bd		
ad			

Formula – for given gene alleles Total number = n

Possible genotype = $\frac{n}{2}(n+1)$

= $\frac{4}{2}(4+1)$

= 2(5)

= 2 × 5 = 10

79. If one strand of DNA has the nitrogenous base sequence as ATCTG, what would be the complementary RNA strand sequence?
(A) TTAGU (B) UAGAC
(C) AACTG (D) ATCGU

Ans. B

Sol. RNA lacks thymine instead RNA has Uracil.

80. Match the items in column I with those given in column II.

Column-I		Column-II	
(a)	Hyaluronidase	(1)	Autosomal reaction
(b)	Corpus luteum	(2)	Morphogenetic movements
(c)	Gastrulation	(3)	Progesterone
(d)	Capacitation	(4)	Mammary gland
(e)	Colostrum	(5)	Sperm activation

(A) a → 5; b → 2; c → 4; d → 1; e → 3
(B) a → 1; b → 3; c → 2; d → 5; e → 4
(C) a → 2; b → 3; c → 4; d → 5; e → 1
(D) a → 3; b → 5; c → 2; d → 1; e → 4

Ans. B

Sol.

Column-I		Column-II	
(a)	Hyaluronidase	(1)	Autosomal reaction
(b)	Corpus luteum	(3)	Progesterone
(c)	Gastrulation	(2)	Morphogenetic movements
(d)	Capacitation	(5)	Sperm activation
(e)	Colostrum	(4)	Mammary gland