TEST CODE : 114008

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IIT-JEE

Batch – Growth (July) | Minor Test-08

Time: 3 Hours **Test Date: 1st December 2024** **Maximum Marks: 300**

Name of the Candidate: ____Roll No.____________

Centre of Examination (in Capitals):____

Candidate's Signature: ____________________________Invigilator's Signature:___________________________

READ THE INSTRUCTIONS CAREFULLY

1. The candidates should not write their Roll Number anywhere else (except in the specified space) on the Test Booklet/Answer Sheet.
2. This Test Booklet consists of 75 questions.
3. This question paper is divided into three parts **PART A - MATHEMATICS, PART B - PHYSICS** and **PART C - CHEMISTRY** having 25 questions each and every **PART** has two sections.
   (i) **Section-I** contains 20 multiple choice questions with only one correct option. Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.
   (ii) **Section-II** contains 5 questions, is an INTEGERAL VALUE.
   Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.
4. No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electronic device etc., except the Identity Card inside the examination hall/room.
5. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
6. On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Room/Hall. However, the candidate is allowed to take away this Test Booklet with them.
7. **For integer-based questions, the answer should be in decimals only not in fraction.**
8. **If learners fill the OMR with incorrect syntax (say 24.5. instead of 24.5), their answer will be marked wrong**.

TEST SYLLABUS

Batch – Growth (July) | Minor Test-08

1st December 2024

Mathematics: Circle

Physics: Rotational Motion

Chemistry: Chemical Equations

Useful Data Chemistry:

Gas Constant	R	$= 8.314\ JK^{-1}mol^{-1}$
		$= 0.0821\ Lit\ atm\ K^{-1}mol^{-1}$
		$= 1.987 \approx 2\ Cal\ K^{-1}mol^{-1}$
Avogadro's Number	N_a	$= 6.023 \times 10^{23}$
Planck's Constant	h	$= 6.626 \times 10^{-34}\ Js$
		$= 6.25 \times 10^{-27}\ erg.s$
1 Faraday		= 96500 Coulomb
1 calorie		= 4.2 Joule
1 amu		$= 1.66 \times 10^{-27}\ kg$
1 eV		$= 1.6 \times 10^{-19}\ J$

Atomic No:
H = 1, D = 1, Li = 3, Na = 11, K = 19, Rb = 37, Cs = 55, F = 9, Ca = 20, He = 2, O = 8, Au = 79.

Atomic Masses:
He = 4, Mg = 24, C = 12, O = 16, N = 14, P = 31, Br = 80, Cu = 63.5, Fe = 56, Mn = 55, Pb = 207, Au = 197, Ag = 108, F = 19, H = 2, Cl = 35.5, Sn = 118.6

Useful Data Physics:
Acceleration due to gravity $g = 10\ m/s^2$

PART-A: MATHEMATICS

SECTION-A

1. Equation of the pair of tangents drawn from the origin to the circle $x^2+y^2+2gx+2fy+c=0$ is

(A) $gx+fy+c(x^2+y^2)$ (B) $(gx+fy)^2=x^2+y^2$ (C) $(gx+fy)^2=c^2(x^2+y^2)$ (D) $(gx+fy)^2=c(x^2+y^2)$

Ans. (D)

Sol. Equation of pair of tangents is $SS_1=T^2$,

where $T=xx_1+yy_1+g(x+x_1)+f(y+y_1)+c$

$\Rightarrow c(x^2+y^2+2gx+2fy+c)=(gx+fy+c)^2$

$\Rightarrow c(x^2+y^2)=(gx+fy)^2$.

2. Position of the point (1, 1) with respect to the circle $x^2+y^2-x+y-1=0$ is

(A) Outside the circle (B) on the circle (C) Inside the circle (D) None of these

Ans. (A)

Sol. $S_1>0$, hence point lies outside.

3. Circle $x^2+y^2-4x-8y-5=0$ will intersect the line $3x-4y=m$ in two distinct points, if

(A) $-10<m<5$ (B) $9<m<20$ (C) $-35<m<15$ (D) None of these

Ans. (C)

Sol. Radius of given circle > Perpendicular distance from the centre of circle to the given line.

$\Rightarrow \sqrt{4+16+5}>\frac{|3(2)-4(4)-m|}{\sqrt{9+16}}$

$\Rightarrow 25>|-10-m| \Rightarrow -35<m<15$.

4. A pair of tangents are drawn from the origin to the circle $x^2+y^2+20(x+y)+20=0$. The equation of the pair of tangents is

(A) $x^2+y^2+10xy=0$ (B) $x^2+y^2+5xy=0$ (C) $2x^2+2y^2+5xy=0$ (D) $2x^2+2y^2-5xy=0$

Ans. (C)

Sol. Equation of pair of tangents is given by $SS_1=T^2$.

Here $S=x^2+y^2+20(x+y)+20$, $S_1=20$, $T=10(x+y)+20$

$\therefore SS_1=T^2$

$\Rightarrow 20\{x^2+y^2+20(x+y)+20\}=10^2(x+y+2)^2$

$\Rightarrow 4x^2+4y^2+10xy=0 \Rightarrow 2x^2+2y^2+5xy=0$.

5. The equation of the chord of contact, if the tangents are drawn from the point (5, –3) to the circle $x^2+y^2=10$, is

(A) $5x-3y=10$ (B) $5x+3y=10$ (C) $3x+5y=10$ (D) $3x-5y=10$

Ans. (A)

Sol. equation of the chord of contact, $T=0 \Rightarrow xx_1+yy_1=a^2$ *i.e.,* $5x-3y=10$.

6. The equation of director circle of the circle $x^2+y^2=a^2$, is

(A) $x^2+y^2=4a^2$ (B) $x^2+y^2=\sqrt{2}a^2$ (C) $x^2+y^2-2a^2=0$ (D) None of these

Ans. (C)

Sol. Director circle has its radius $\sqrt{2}$ times that of radius of the given circle.

Hence equation is $x^2+y^2=2a^2$.

7. The number of common tangents to the circles $x^2+y^2=1$ and $x^2+y^2-4x+3=0$ is

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

Ans. (C)

Sol. Here $C_1=(0,0), r_1=1$

$C_2 = (2,0), r_2 = 1$

Clearly $C_1C_2 = r_1 + r_2 = 1 + 1 = 2$

Thus two circles touch externally,

Hence the number of common tangents is 3.

8. If a line passing through origin touches the circle $(x-4)^2 + (y+5)^2 = 25$, then its slope should be

(A) $\pm\frac{3}{4}$ (B) 0 (C) ± 3 (D) ± 1

Ans. (B)

Sol. Let equation of line be $y = mx$ or $y - mx = 0$

Then applying condition for tangency,

$$\left|\frac{-5-4m}{\sqrt{1+m^2}}\right| = 5 \Rightarrow 25 + 16m^2 + 40m = 25 + 25m^2$$

$$\Rightarrow 9m^2 - 40m = 0 \Rightarrow m = 0 \text{ or } m = \frac{40}{9}.$$

9. The equation of the chord of the circle $x^2 + y^2 = a^2$ having (x_1, y_1) as its mid-point is

(A) $xy_1 + yx_1 = a^2$ (B) $x_1 + y_1 = a$ (C) $xx_1 + yy_1 = x_1^2 + y_1^2$ (D) $xx_1 + yy_1 = a^2$

Ans. (C)

Sol. $T = S_1$ is the equation of desired chord, hence

$$xx_1 + yy_1 - a^2 = x_1^2 + y_1^2 - a^2 \Rightarrow xx_1 + yy_1 = x_1^2 + y_1^2.$$

10. If the circles of same radius *a* and centers at (2, 3) and (5, 6) cut orthogonally, then *a* =

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

Ans. (C)

Sol. $(C_1C_2)^2 = r_1^2 + r_2^2 \Rightarrow 2a^2 = 18 \Rightarrow a = 3$.

11. The equation of line passing through the points of intersection of the circles $3x^2 + 3y^2 - 2x + 12y - 9 = 0$ and $x^2 + y^2 + 6x + 2y - 15 = 0$, is

(A) $10x - 3y - 18 = 0$ (B) $10x + 3y - 18 = 0$ (C) $10x + 3y + 18 = 0$ (D) None of these

Ans. (A)

Sol. Equation of Common chord is, $S_1 - S_2 = 0$

$\Rightarrow 10x - 3y - 18 = 0$.

12. The equation of the circle through the point of intersection of the circles $x^2 + y^2 - 8x - 2y + 7 = 0$, $x^2 + y^2 - 4x + 10y + 8 = 0$ and (3, –3) is

(A) $23x^2 + 23y^2 - 156x + 38y + 168 = 0$ (B) $23x^2 + 23y^2 + 156x + 38y + 168 = 0$

(C) $x^2 + y^2 + 156x + 38y + 168 = 0$ (D) None of these

Ans. (A)

Sol. Equation of circle is

$$(x^2 + y^2 - 8x - 2y + 7) + \lambda(x^2 + y^2 - 4x + 10y + 8) = 0$$

Also point $(3, -3)$ lies on the above equation.

$$\Rightarrow \lambda = \frac{7}{16}$$

Hence required equation is

$$23x^2 + 23y^2 - 156x + 38y + 168 = 0.$$

13. The radical axis of the pair of circle $x^2 + y^2 = 144$ and $x^2 + y^2 - 15x + 12y = 0$ is

(A) $15x - 12y = 0$ (B) $3x - 2y = 12$ (C) $5x - 4y = 48$ (D) None of these

Ans. (C)

Sol. The radical axis of the circle $S_1 = 0$ and $S_2 = 0$ is $S_1 - S_2 = 0$

$\therefore (x^2 + y^2 - 144) - (x^2 + y^2 - 15x + 12y) = 0$

$\Rightarrow 15x - 12y - 144 = 0 \Rightarrow 5x - 4y = 48$.

14. Locus of the point given by the equations, $x = \dfrac{2at}{1+t^2}, y = \dfrac{a(1-t^2)}{1+t^2}; (-1 \le t \le 1)$ is a

(A) Straight line (B) Circle (C) Ellipse (D) Hyperbola

Ans. (B)

Sol. Here $x = \dfrac{2at}{1+t^2}$ and $y = \dfrac{a(1-t^2)}{1+t^2}$

Squaring and adding both, we get $x^2 + y^2 = a^2$.

15. The length of intercept, the circle $x^2 + y^2 + 10x - 6y + 9 = 0$ makes on the *x*-axis is

(A) 2 (B) 4 (C) 6 (D) 8

Ans. (D)

Sol. Comparing the given equation with $x^2 + y^2 + 2gx + 2fy + c = 0$, we get $g = 5$

$\therefore$ Length of intercept on *x*-axis = $2\sqrt{g^2 - c}$

= $2\sqrt{(5)^2 - 9}$ = 8

16. A circle which passes through origin and cuts intercepts on axes *a* and *b*, the equation of circle is

(A) $x^2 + y^2 - ax - by = 0$ (B) $x^2 + y^2 + ax + by = 0$ (C) $x^2 + y^2 - ax + by = 0$ (D) $x^2 + y^2 + ax - by = 0$

Ans. (A)

Sol. points (a,0) and (0,b) are the diametric end points of the circle.

Then equation of circle be, (x-0)(x-a) + (y-0)(y-b) = 0

$\Rightarrow x^2 + y^2 - ax - by = 0$

17. The value of *c*, for which the line $y = 2x + c$ is a tangent to the circle $x^2 + y^2 = 16$, is

(A) $-16\sqrt{5}$ (B) 20 (C) $4\sqrt{5}$ (D) $16\sqrt{5}$

Ans. (C)

Sol. From $c = \pm a\sqrt{1+m^2}$,

Here, $a = 4, m = 2$

$\therefore c = \pm 4\sqrt{1+4} = \pm 4\sqrt{5}$.

18. The equation of the normal to the circle $x^2 + y^2 = 9$ at the point $\left(\dfrac{3}{\sqrt{2}}, \dfrac{3}{\sqrt{2}}\right)$ is

(A) $x + y = 0$ (B) $x - y = \dfrac{\sqrt{2}}{3}$ (C) $x - y = 0$ (D) None of these

Ans. (C)

Sol. We know that the equation of normal to the circle $x^2 + y^2 = a^2$ at the point (x_1, y_1) is $\dfrac{x}{x_1} - \dfrac{y}{y_1} = 0$.

Therefore, $\dfrac{x}{3/\sqrt{2}} - \dfrac{y}{3/\sqrt{2}} = 0 \Rightarrow x - y = 0$.

19. The equation of the chord of contact, if the tangents are drawn from the point (5, 5) to the circle $x^2 + y^2 = 10$, is

(A) $5x - 3y = 10$ (B) $x + y = 2$ (C) $3x + 5y = 10$ (D) $3x - 5y = 10$

Ans. (B)

Sol. equation of the chord of contact, $T = 0 \Rightarrow xx_1 + yy_1 = a^2$ *i.e.,* $5x + 5y = 10 \Rightarrow x + y = 2$.

20. The number of common tangents to the circles $x^2 + y^2 - 4x - 6y - 12 = 0$ and $x^2 + y^2 + 6x + 18y + 26 = 0$ is

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

Ans. (C)

Sol. Centers of circles are $C_1(2, 3)$ and $C_2(-3, -9)$ and their radii are $r_1 = 5$ and $r_2 = 8$.

Obviously $r_1 + r_2 = C_1C_2$ *i.e.,* circles touch each other externally. Hence there are three common tangents.

SECTION-B

21. If $x^2 + y^2 + px + 3y - 5 = 0$ and $x^2 + y^2 + 5x \; + py + 7 = 0$ cut orthogonally, then 8*p* is ...

Ans. (4)

Sol. $2g_1g_2 + 2f_1f_2 = c_1 + c_2$ for orthogonal cut.

$\Rightarrow p\left(\frac{5}{2}\right) + p\left(\frac{3}{2}\right) = -5 + 7 \Rightarrow p = \frac{1}{2} \Rightarrow 8p = 4$.

22. From the origin chords are drawn to the circle $(x-1)^2 + y^2 = 1$. The equation of the locus of the middle points of these chords is $x^2 + y^2 - kx = 0$, then k is

Ans. (1)

Sol. The given circle is $x^2 + y^2 - 2x = 0$. Let (x_1, y_1) be the middle point of any chord of this circle, than its equation is $S_1 = T$.

or $x_1^2 + y_1^2 - 2x_1 = xx_1 + yy_1 - (x + x_1)$

If it passes through (0, 0), then

$x_1^2 + y_1^2 - 2x_1 = -x_1 \Rightarrow x_1^2 + y_1^2 - x_1 = 0$

Hence the required locus of the given point (x_1, y_1) is $x^2 + y^2 - x = 0$.

23. The equation of the circle touching $x = 0, y = 0$ and $x = 4$ is $x^2 + y^2 - 4x - 4y + k = 0$, then k is.........

Ans. (4)

Sol. $(x-2)^2 + (y-2)^2 = 4$

$x^2 + 4 - 4x + y^2 + 4 - 4y = 4$

$x^2 + y^2 - 4x - 4y + 4 = 0$.

24. The number of values of k for which the point (k, k) lies inside the circle $x^2 + y^2 + 3x - 3y + 2 = 0$ is...

Ans. (0)

Sol. since $S_1 < 0 \Rightarrow k^2 + k^2 + 3k - 3k + 2 < 0$

$\Rightarrow 2k^2 + 2 < 0 \Rightarrow k^2 + 1 < 0$, Which is not possible.

25. The radius of director circle of the circle $x^2 + y^2 = 8$, is ...

Ans. (4)

Sol. The radius of director circle = $\sqrt{2}$ × radius of corresponding circle = $\sqrt{2}$ × $2\sqrt{2}$ = 4

PART-B: PHYSICS

SECTION-A

26. At t = 0 a flywheel is rotating with angular velocity ω_0. If then undergoes uniform angular acceleration for a time t_1, at the end of which the angular velocity is ω_1. How many revolutions did the flywheel make during this time interval?

(A) $\frac{1}{2}(\omega_0 + \omega_1)t$

(B) $\frac{\omega_0 t}{2\pi}$

(C) $\frac{\omega_1 t}{2\pi}$

(D) $\frac{(\omega_0 + \omega_1)t}{4\pi}$

Ans. (D)

Sol. Since the acceleration is uniform, the average velocity is the average of the initial and final angular velocities, so $\omega_{av} = (\omega_0 + \omega_1)/2$. Then $\theta = \omega_{av}\, t$, and the number of revolution is $\theta / 2\pi$.

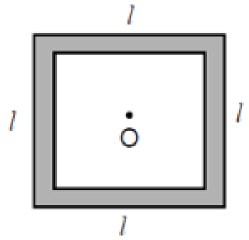
Alternative-

$$\omega_1 = \omega_0 + \alpha t \quad \Rightarrow \alpha = \frac{\omega_1 - \omega_0}{t}$$

$$w_1^2 = w_0^2 = 2\alpha\theta \ \Rightarrow \theta = \frac{(\omega_1 + \omega_0)t}{4\pi}$$

$\therefore$ no. of revolution is $\dfrac{(\omega_0 + \omega_1)t}{4\pi}$

27. Four thin rods of same mass M and same length l, form a square as shown in figure. Moment of inertia of this system about an axis through centre O and perpendicular to its plane is.



(A) $\frac{4}{3}Ml^2$

(B) $\frac{Ml^2}{3}$

(C) $\frac{Ml^2}{6}$

(D) $\frac{2}{3}Ml^2$

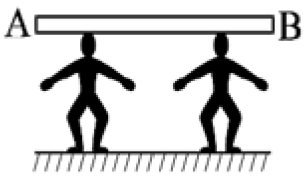
Ans. (A)

Sol. $$I_{axis} = \left[\frac{ml^2}{12} + m\left(\frac{\ell}{2}\right)^2\right] \times 4$$

$$= \frac{4ml^2}{12} \times 4$$

$$= \frac{4ml^2}{3}$$

28. Two persons of equal height are carrying a long uniform wooden beam of length l. They are at distance l/4 and l/6 from nearest end of the rod. The ratio of normal reaction at their heads is



(A) 2 : 3

(B) 1 : 3

(C) 4 : 3

(D) 1 : 2

Ans. (C)

Sol. $$\frac{N_A}{N_B} = \frac{\dfrac{Mg\left(\frac{l}{2}-\frac{l}{6}\right)}{\left(l-\frac{l}{4}-\frac{l}{6}\right)}}{\dfrac{Mg\left(\frac{l}{2}-\frac{l}{4}\right)}{\left(l-\frac{l}{4}-\frac{l}{6}\right)}} = \frac{4}{12}\times\frac{8}{2} = \frac{4}{3}$$

29. A uniform disc of radius R lies in the x-y plane with its center at origin. Its moment of inertia about z-axis is equal to its moment of inertia about line $y = x + c$. The value of c can be

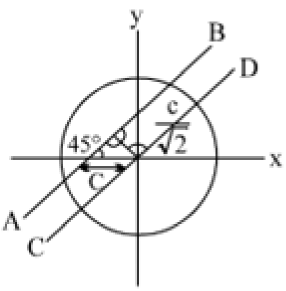
(A) −R/2

(B) $R/\sqrt{2}$

(C) R/4

(D) None

Ans. (B)



Sol.

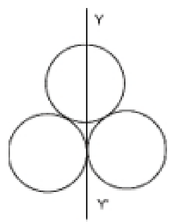
$$I_{CD} = \frac{MR^2}{4}$$

$$I_{AB} = \frac{MR^2}{4} + M\left(\frac{c}{\sqrt{2}}\right)^2$$

$$I_{AB} = \frac{MR^2}{2}$$

$$\frac{MR^2}{4} + \frac{Mc^2}{2} = \frac{MR^2}{2} \quad \Rightarrow c = \frac{R}{\sqrt{2}}$$

30. Three rings each of mass M and radius R are arranged as shown in the figure. The moment of inertia of the system about YY' will be



(A) $3MR^2$

(B) $\frac{3}{2}MR^2$

(C) $5MR^2$

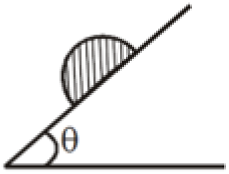
(D) $\frac{7}{2}MR^2$

Ans. (D)

Sol. $\frac{MR^2}{2}+\left[\frac{MR^2}{2}+MR^2\right]\times 2$

$\Rightarrow \frac{MR^2}{2}+3MR^2=\frac{7MR^2}{2}$

31. An uniform hemi-solid sphere is placed with flat surface on rough inclined plane as shown in figure. If friction is large for no sliding, then the minimum angle θ at which toppling occur is



(A) $\tan^{-1}\left(\frac{1}{2}\right)$

(B) $45°$

(C) $\tan^{-1}\left(\frac{8}{3}\right)$

(D) $\tan^{-1}\left(\frac{4}{3}\right)$

Ans. (C)

Sol. For toppling $mg\sin\theta\frac{3R}{8}\geq mg\cos\theta R$

$\tan\theta\geq\frac{8}{3}$

32. A student is standing on the edge of a stationary turntable, made from a uniform disc of mass M and radius R on a frictionless bearing at its center. She starts to run with speed v around the perimeter of the table. (This is her speed relative to the ground – not the turntable). If her mass is m, what is the magnitude of the angular velocity of the turntable (relative to the ground)?

(A) $2mv/(MR)$

(B) $Mv/(mR)$

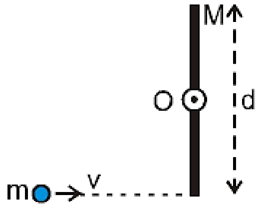
(C) $mv/(MR)$

(D) $2Mv/(mR)$

Ans. (A)

Sol. $mR^2\omega+I_t\omega_t=0\Rightarrow\omega_t=-\frac{mR^2\omega}{I_t}=-\frac{2m}{M}\frac{v}{R}$

33. A particle of mass m is moving horizontally at speed v perpendicular to a uniform rod of length d and mass M = 6m. The rod is hinged at centre O and can freely rotate in horizontal plane about a fixed vertical axis passing through its centre O. The hinge is frictionless. The particle strikes and sticks to the end of the rod. The angular speed of the system just after the collision:



(A) 2v/3d

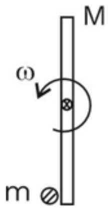
(B) 3v/2d

(C) v/3d

(D) 2v/d

Ans. (B)

Sol.



$L_i = L_f$

$$mv\frac{d}{2} = \left[\frac{Md^2}{12} + m\left(\frac{d}{2}\right)^2\right]\omega$$

$$\Rightarrow \frac{v}{2} = \left[\frac{d}{12} + \frac{d}{4}\right]\omega$$

$$\Rightarrow \frac{v}{2} = \left[\frac{3d}{4}\right]\omega$$

$$w = \frac{2v}{3d}$$

34. Velocity of the centre of smaller cylinder is 2 m/s. There is no slipping anywhere. The velocity of the centre of larger cylinder is

(A) 1 m/s

(B) 2 m/s

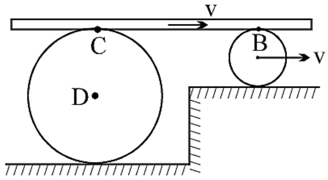
(C) 4 m/s

(D) 1/2 m/s

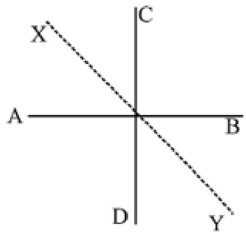
Ans. (B)

Sol. $v_B = 2v = v_C$

$$v_0 = \frac{v_C}{2} = v$$



35. AB and CD are two identical rods each length L and mass M joined to form a cross. Find the M.I. (Moment of Inertia) of the system about a bisector of the angle between the rods (XY).



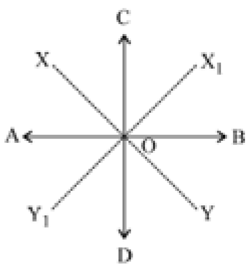
(A) $\frac{ML^2}{12}$

(B) $\frac{ML^2}{6}$

(C) $\frac{ML^2}{3}$

(D) $\frac{4ML^2}{3}$

Ans. (A)



Sol.

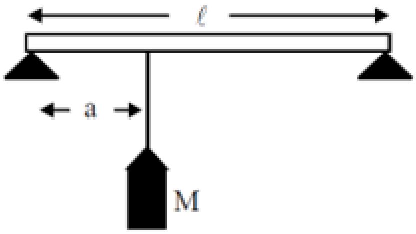
$I_0 = I_{AB} + I_{CD} = \frac{ML^2}{6}$

$\perp$r Axis Theorem

$I_0 = I_{XY} + I_{X'Y'} (I_{XY} + I_{X'Y'})$

$I_{XY} = \frac{I_0}{2} = \frac{ML^2}{12}$

36. A horizontal bar of length ℓ and negligible mass is supported at its two ends. A mass M is hung from the bar at a distance 'a' from the left end, as shown. What is the magnitude of the force that the support on the right applies to the bar?



(A) $Mg\frac{a}{\ell}$

(B) $Mg\frac{\ell}{a}$

(C) $Mg\frac{a}{\ell+a}$

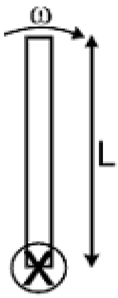
(D) $Mg\frac{\ell}{\ell+a}$

Ans. (A)

Sol. Torque balance about left end

$F\ell = Mg(a),\ \ F = Mg\frac{a}{\ell}$

37. A uniform rod hinged at its one end is allowed to rotate in vertical plane. Rod is given an angular velocity ω in its vertical position as shown in figure. The value of ω for which the force exerted by the hinge on rod is zero in this position is:



(A) $\sqrt{\frac{g}{L}}$

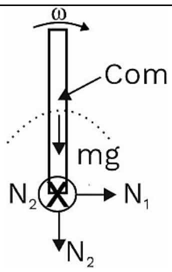
(B) $\sqrt{\frac{2g}{L}}$

(C) $\sqrt{\frac{g}{2L}}$

(D) $\sqrt{\frac{3g}{L}}$

Ans. (B)

Sol.



At this instant

$\tau_{Hinge} = I\alpha$

$\Rightarrow \alpha = 0$

$F_t = ma_t$ [in tangential direction]

$\Rightarrow N_1 = ma_t \quad [\because \alpha = 0]$

$N_1 = 0$

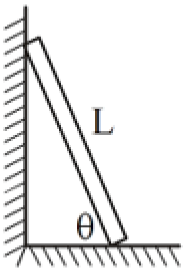
For N_2

$F_c = ma_{c.m}$

$mg + N_2 = m\omega^2 \frac{L}{2}$

$\Rightarrow \omega = \sqrt{\frac{2g}{L}}$

38. A uniform ladder of length L rests against a smooth frictionless wall. The floor is rough and the coefficient of static friction between the floor and ladder is μ. When the ladder is positioned at angle θ, as shown in the accompanying diagram, it is just about to slip. What is θ?



(A) $\cos\theta = \mu$

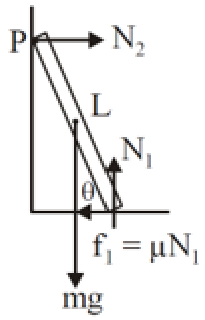
(B) $\tan\theta = 2\mu$

(C) $\tan\theta = \frac{1}{2\mu}$

(D) $\sin\theta = \frac{1}{\mu}$

Ans. (C)

Sol. $\Sigma\tau_P = 0$



At equilibrium $\Sigma F = 0$

$\Rightarrow$ $N_1 = mg$

$\Sigma\tau_p = 0$

$$Mg\,\frac{L}{2}\cos\theta + f_1 L\sin\theta = N_1 L\cos\theta$$

$$\frac{Mg\cos\theta}{2}L + \mu Mg\ L\ \sin\theta = MgL\cos\theta$$

$$\tan\theta = \frac{1}{2\mu}$$

39. A force $\vec{F} = \alpha\hat{i} + 3\hat{j} + 6\hat{k}$ is acting at a point $\vec{r} = 2\hat{i} - 6j - 12\hat{k}$. The value of α for which angular momentum about origin is conserved is:

(A) -1

(B) 2

(C) -2

(D) 1

Ans. (A)

Sol. $$\vec{\tau} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -6 & -12 \\ \alpha & 3 & 6 \end{vmatrix} = i[-36 + 36] - j[12 + 12\alpha] + \hat{k}[6 + 6\alpha]$$

$$= i(0) - \hat{j}[12 + 12\alpha] + \hat{k}[6 + 6\alpha]$$

$12 + 12\alpha = 0$ & $6 + 6\alpha = 0$

$\alpha = -1$ $\qquad$ $\alpha = -1$

40. If the radius of the earth is suddenly contracts to half of its present value, then the duration of day will be of

(A) 6 hours

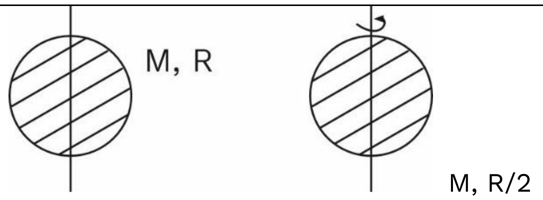
(B) 12 hours

(C) 18 hours

(D) 24 hours

Ans. (A)

Sol.



$I = \frac{2}{5} MR^2$ $\qquad I_f = \frac{2}{5}\frac{MR^2}{4} = \frac{MR^2}{10} = \frac{I}{4}$

$I\omega_i = I_f\,\omega_f$ $\qquad \Rightarrow I(\omega) = \left(\frac{I}{4}\right)\omega_f = \omega_f = 4\omega$

$T = \frac{2\pi}{\omega} \Rightarrow T \alpha \frac{1}{\omega}$ $\qquad \frac{Ti}{T_f} = \frac{\omega_f}{\omega_i} \Rightarrow \frac{T_i}{T_f} = 4$

$T_f = \frac{T_i}{4} = 6\text{hr.}$ $\qquad [\because\ T = 24\text{ hr}]$

41. The moment of inertia of hollow sphere having mass M of inner radius R/2 and outer radius R, having material of uniform density, about a diametral axis is

(A) $31\ MR^2 / 70$

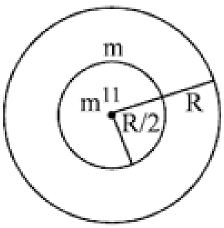
(B) $43\ MR^2 / 90$

(C) $19\ MR^2 / 80$

(D) None

Ans. (A)

Sol.

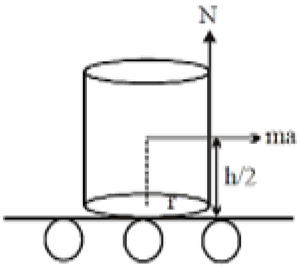


$I = \frac{2}{5}(m^{11} + m)R^2 - \frac{2}{5}m^{11}\left(\frac{R}{2}\right)^2$

$m^{11} = \frac{m}{7}$

$I = \frac{31\ mR^2}{70}$

42. A solid homogenous cylinder of height ‘h’ and base radius ‘r’ is kept vertically on conveyer belt moving horizontally with an increasing velocity $v = a + bt^2$. If the cylinder in not allowed to slip then time when the cylinder is about to topple, will be



(A) $\frac{2rg}{bh}$

(B) $\frac{rg}{bh}$

(C) $\frac{2bg}{rh}$

(D) $\frac{rg}{2bh}$

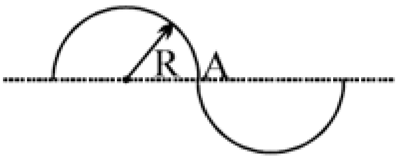
Ans. (B)

Sol. $N(r) = ma(h/2)$

$mgr = \frac{mh}{2}(2bt)$

$t = \frac{rg}{bh}$

43. The S-shaped uniform wire shown in figure has a mass M, and the radius of curvature of each half is R. The moment of inertia about an axis through A and perpendicular to the plane of the paper is:



(A) $\frac{3}{4}MR^2$

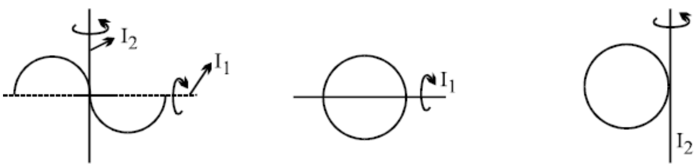
(B) MR^2

(C) $\frac{3}{2}MR^2$

(D) $2MR^2$

Ans. (D)

Sol. In the plane



Required $I = I_1 + I_2$

$\therefore I_1 = \frac{MR^2}{2}$ & $I_2 = \frac{MR^2}{2} + MR^2$

$\therefore I = 2MR^2$

44. A disc of clay is rotating with angular velocity ω. A particle of clay is now stuck to the outer rim of the disc and it has a mass $\frac{1}{10}$ of that of the disc. If the particle detaches and files off tangentially to the outer rim of the disc, what is the angular velocity of the disc after the particle separates?

(A) $\frac{5}{6}\omega$

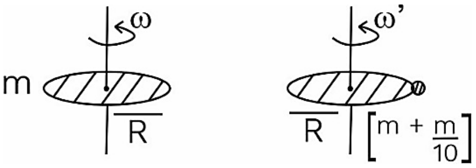
(B) $\frac{10}{11}\omega$

(C) $\frac{6}{5}\omega$

(D) ω

Ans. (A)

Sol.



$$\left[\frac{mR^2}{2}\right]\omega = \left[\frac{mR^2}{2} + \left(\frac{m}{10}\right)R^2\right]\omega'$$

$$\frac{\omega}{2} = \left[\frac{1}{2} + \frac{1}{10}\right]\omega'$$

$$\omega' = \frac{5}{6}\omega$$

45. A mass m hangs with the help of a string wrapped around a pulley on a frictionless bearing. The pulley has mass m and radius R. Assuming pulley to be a perfect uniform circular disc, the acceleration of the mass m, if the string does not slip on the pulley, is:

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

(B) g

(C) $\frac{2}{3}g$

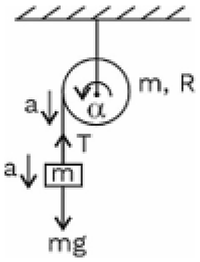
(D) $\frac{g}{3}E$

Ans. (C)

Sol. $a = \alpha R \rightarrow$ (i)

$\tau = I\,\alpha$

$T.R = \left[\frac{mR^2}{2}\right]\alpha$



$\Rightarrow T = \left(\frac{mR}{2}\right)\alpha$

$T = \left(\frac{mR}{2}\right)\left(\frac{a}{R}\right)$

$T = \frac{ma}{2}$

$mg - T = ma$

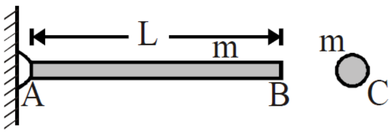
$\Rightarrow mg - \frac{ma}{2} = ma$

$\Rightarrow mg = \frac{3}{2}ma$

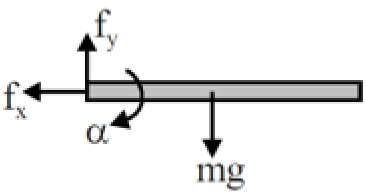
$\Rightarrow \boxed{a = \frac{2g}{3}}$

SECTION-B

46. A uniform bar AB of mass 2kg, Length 30 cm and a ball of the same mass are released from rest from the same horizontal position. The bar is hinged at end A. There is gravity downwards. What is the distance (in cm) of the point from point B that has the same acceleration as the ball, immediately after release?



Ans. 10



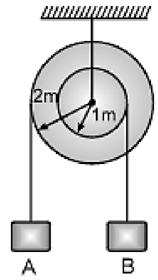
Sol.

$mg\frac{L}{2} = \frac{1}{3}mL^2\alpha$

$\therefore\ \alpha = \frac{3g}{2L}$ and $\alpha x = g$ $\Rightarrow \frac{3g}{2L}x = g$ $\therefore x = \frac{2L}{3}$

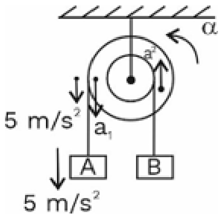
$\therefore$ distance from $B = \frac{L}{3}$

47. In the pulley system (stick to each other) shown, if radii of the bigger and smaller pulley are 2 m and 1 m respectively and the acceleration of block A is 5 m/s² in the downward direction, if the acceleration of block B is $\frac{\alpha}{\beta}$ then $\alpha+\beta$ is:



Ans. 7

Sol.



$a_1 = 5\ m/s^2$

$\alpha[2] = 5$

$\alpha = 5/2$

$a_2 = \frac{5}{2}(1)$

$a_2 = 5/2\ m/s^2$

$\alpha = 5, \beta = 2$

$\alpha + \beta = 7$

48. A solid sphere and a solid cylinder having the same mass and radius roll down the same incline. If the ratio of of their acceleration is P/Q then find P + Q

Ans. 29

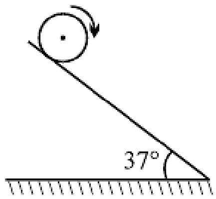
Sol. $a_{s.s} = \frac{mg\sin\theta}{m + \frac{2}{5}\frac{mR^2}{R^2}} = \frac{5}{7}g\sin\theta,\ a_{s.c} = \frac{mg\sin\theta}{m + \left[\frac{mR^2}{2\times R^2}\right]} = \frac{2}{3}g\sin\theta$

$\frac{a_{s.s}}{a_{s.c}} = \frac{15}{14}$

$P = 15, Q = 14$

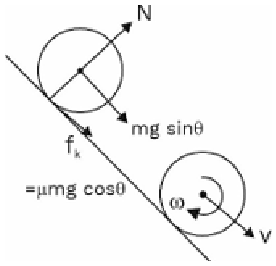
$P + Q = 29$

49. A cylinder having radius 0.4 m, initially rotating (at t = 0) with $\omega_0 = 54\ \text{rad/sec}$ is placed on a rough inclined plane with $\theta = 37^\circ$ having friction coefficient $\mu = 0.5$. The time taken by the cylinder to start pure rolling is x. then find the value of 10x.



Ans. 12

Sol. $\tau = I\alpha$



$$[\mu mg\cos\theta]R = \left[\frac{mR^2}{2}\right]\alpha$$

$$0.5\times 10\times\frac{4}{5} = \left[\frac{0.4}{2}\right]\alpha$$

$$\alpha = \frac{80}{0.4} = 20\ \text{rad/s}^2$$

$$v = \omega r$$

$$v = u + at$$

$$v = 0 + [g\sin\theta + \mu g\cos\theta]t$$

$$= 10\left[\frac{3}{5} + (0.5)\frac{4}{5}\right]t$$

$$= [6+4]t$$

$$v = 10t$$

$$\omega = \frac{v}{r} = \frac{10t}{r} = \frac{10.t}{0.4} = 25t$$

$$\omega_f = \omega_i + \alpha t$$

$$\omega = 54 - 20t$$

$$25t = 54 - 20t$$

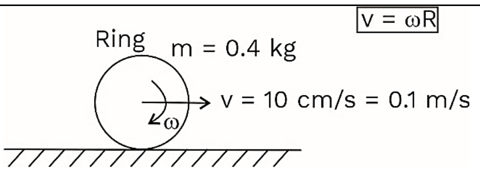
$$45t = 54$$

$$t = \frac{54}{45} = \frac{6}{5} = 1.2\ \text{sec}$$

50. A uniform thin ring of mass 0.4 kg rolls without slipping on a horizontal surface with a linear velocity of 10 cm/s. The kinetic energy of the ring is [in mJ]

Ans. 4

Sol.



$$K.E = \frac{1}{2}I\omega^2 + \frac{1}{2}mv^2$$

$$= \frac{1}{2}[mR^2]\omega^2 + \frac{1}{2}$$

$$= \frac{1}{2}[mR^2]\left[\frac{v}{R}\right]^2 + \frac{1}{2}mv^2$$

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

$$K.E = (0.4)\left(\frac{1}{10}\right)^2 = \frac{4}{1000}\text{Joules}$$

$$K.E = 4\times10^{-3}J$$

$$K.E = 4\,mJ$$

PART-C: CHEMISTRY

SECTION-A

51. For the system $3A+2B \rightleftharpoons C$, the expression for equilibrium constant is

(a) $\frac{[3A][2B]}{C}$ (b) $\frac{[C]}{[3A][2B]}$

(c) $\frac{[A]^3[B]^2}{[C]}$ (d) $\frac{[C]}{[A]^3[B]^2}$

Ans. (d)

Sol. Equilibrium constant for the reaction, $3A + 2B \rightleftharpoons C$ is

$$K = \frac{[C]}{[A]^3[B]^2}.$$

52. In the reversible reaction $A+B \rightleftharpoons C+D$, the concentration of each C and D at equilibrium was 0.8 mole/litre, then the equilibrium constant K_c will be (initial moles of reactant = 1)

(a) 6.4 (b) 0.64

(c) 1.6 (d) 16.0

Ans. (D)

Sol. Suppose 1 mole of A and B each taken then 0.8 *mole/litre* of C and D each formed remaining concentration of A and B will be $(1 - 0.8) = 0.2$ *mole/litre* each.

$$Kc = \frac{[C]\,[D]}{[A]\,[B]} = \frac{0.8\times0.8}{0.2\times0.2} = 16.0$$

53. 4 moles of A are mixed with 4 moles of B. At equilibrium for the reaction $A+B \rightleftharpoons C+D$, 2 moles of C and D are formed. The equilibrium constant for the reaction will be

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$

(c) 1 (d) 4

Ans. (C)

Sol. $A + B \rightleftharpoons C + D$

Initial conc. 4, 4 0 0

After T time conc. (4-2) (4-2) 2 2

Equilibrium constant = $\frac{[C]\,[D]}{[A]\,[B]} = \frac{2 \times 2}{2 \times 2} = 1$

54. A reversible chemical reaction having two reactants in equilibrium. If the concentrations of the reactants are doubled, then the equilibrium constant will

(a) Also be doubled

(b) Be halved

(c) Become one-fourth

(d) Remain the same

Ans. (D)

Sol. K_c is a characteristic constant for the given reaction.

55. Partial pressures of *A, B, C* and *D* on the basis of gaseous system $A + 2B \rightleftharpoons C + 3D$ are A = 0.20; B = 0.10; C = 0.30 and D = 0.50 atm. The numerical value of equilibrium constant is

(a) 11.25 (b) 18.75

(c) 5 (d) 3.75

Ans. (b)

Sol. *A* + 2*B* ⇌ *C* + 3*D*

$$K = \frac{[pC]\,[pD]^3}{[pA]\,[pB]^2} = \frac{0.30 \times 0.50 \times 0.50 \times 0.50}{0.20 \times 0.10 \times 0.10} = 18.75$$

56. 2 moles of PCl_5 were heated in a closed vessel of 2 litre capacity. At equilibrium, 40% of PCl_5 is dissociated into PCl_3 and Cl_2. The value of equilibrium constant is

(a) 0.266 (b) 0.53

(c) 2.66 (d) 5.3

Ans. (A)

Sol. $\underset{2}{PCl_5} \rightleftharpoons \underset{0}{PCl_3} + \underset{0}{Cl_2}$

$\frac{2 \times 60}{100} \quad \frac{2 \times 40}{100} \quad \frac{2 \times 40}{100}$

Volume of container = 2 *litre*.

$$K_c = \frac{\frac{2 \times 40}{100 \times 2} \times \frac{2 \times 40}{100 \times 2}}{\frac{2 \times 60}{100 \times 2}} = 0.266\,.$$

57. For the reaction $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$, the correct expression of equilibrium constant *K* is

(a) $K = \frac{[NH_3]^2}{[N_2][H_2]^3}$ (b) $K = \frac{[N_2][H_2]^3}{[NH_3]^2}$

(c) $K = \frac{2[NH_3]}{[N_2] \times 3[H_2]}$ (d) $K = \frac{[N_2] \times 3[H_2]}{2[NH_3]}$

Ans. (a)

Sol. $K = \frac{[NH_3]^2}{[N_2]\,[H_2]^3}$

58. In the gas phase reaction, $C_2H_4 + H_2 \rightleftharpoons C_2H_6$, the equilibrium constant can be expressed in units of

(a) $litre^{-1}\,mole^{-1}$ (b) $litremole^{-1}$

(c) $mole^2\ litre^{-2}$ (d) $mole\ litre^{-1}$

Ans. (B)

Sol. $K = \dfrac{[C_2H_6]}{[C_2H_4]\,[H_2]} = \dfrac{[mole\ /\ litre]}{[mole\ /\ litre]\,[mole\ /\ litre]}$

= *litre/mole*. or litre mole^{-1}.

59. For the equilibrium $N_2 + 3H_2 \rightleftharpoons 2NH_3, K_c$ at 1000*K* is 2.37×10^{-3}. If at equilibrium $[N_2] = 2M, [H_2] = 3M$, the concentration of NH_3 is

(a) 0.00358 M (b) 0.0358 M

(c) 0.358 M (d) 3.58 M

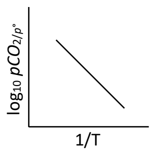
Ans. (C)

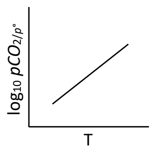
Sol. $K_c = \dfrac{[NH_3]^2}{[N_2]\,[H_2]^3}$

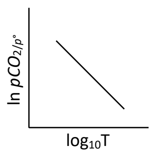
$$2.37 \times 10^{-3} = \frac{x^2}{[2]\,[3]^3} = x^2 = 0.12798$$

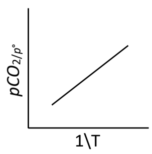
$x = 0.358\ M$.

60. For the chemical equilibrium, $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g), \Delta H_r^\circ$ can be determined from which one of the following plots

(a) 

(b) 

(c) 

(d) 

Ans. (A)

Sol. For the reaction,

$CaCO_{3(g)} \rightleftharpoons CaO_{(s)} + CO_{2(g)}$

$K_p = P_{CO_2}$ *and* $K_C = [CO_2]$

($\because$ [*CaCO*$_3$] = 1 and [*CaO*] = 1 for solids)

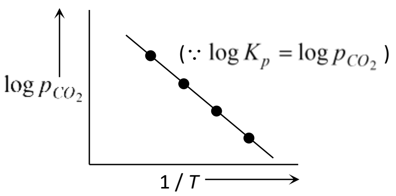
According to Arrhenius equation we have

$K = Ae^{-\Delta H^\circ_r / RT}$

Taking logarithm, we have

$$\log K_p = \log A - \frac{\Delta H_r^o}{RT(2.303)}$$

This is an equation of straight line. When log K_p is plotted against 1 / *T*. we get a straight line.



The intercept of this line = log *A*, slope = $-\Delta H^\circ_r$ / 2.303 *R*

Knowing the value of slope from the plot and universal gas constant *R*, ΔH_r° can be calculated.

(Equation of straight line : *Y* = *mx* + *C*. Here,

$$\log K_p = -\frac{\Delta H_r^o}{2.303\,R}\left(\frac{1}{T}\right) + \log A$$

Y=mx+C

61. In which of the following equilibria, the value of K_p is less than K_c

(a) $H_2 + I_2 \rightleftharpoons 2HI$

(b) $N_2 + 3H_2 \rightleftharpoons 2NH_3$

(c) $N_2 + O_2 \rightleftharpoons 2NO$

(d) $CO + H_2O \rightleftharpoons CO_2 + H_2$

Ans. (B)

Sol. $K_p = K_c(RT)^{\Delta n}$; When $\Delta n = 2-(2+1) = -1$, *i.e.* negative, $K_p < K_c$.

62. Two gaseous equilibria $SO_{2(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons SO_{3(g)}$ and $2SO_{3(g)} \rightleftharpoons 2SO_{2(g)} + O_{2(g)}$ have equilibrium constants K_1 and K_2 respectively at $298\,K$. Which of the following relationships between K_1 and K_2 is correct

(a) $K_1 = K_2$ (b) $K_2 = K_1^2$

(c) $K_2 = \frac{1}{K_1^2}$ (d) $K_2 = \frac{1}{K_1}$

Ans.(C)

Sol. $K_1 = \frac{[SO_3]}{[SO_2]\,[O_2]^{1/2}}$ and $K_2 = \frac{[SO_2]^2[O_2]}{[SO_3]^2}$; $K_2 = \frac{1}{K_1^2}$

63. For the gaseous phase reaction

$2NO \rightleftharpoons N_2 + O_2 \quad \Delta H^\circ = +43.5\ kcal\,mol^{-1}$

Which statement is correct

(a) *K* varies with addition of *NO*

(b) *K* decrease as temperature decreases

(c) *K* Increases as temperature decreases

(d) *K* is independent of temperature

Ans. (B)

Sol. 2.303 log $\frac{K_2}{K_1} = \frac{\Delta H}{R}\frac{[T_2 - T_1]}{T_1 \times T_2}$

ΔH = +ve for the reaction

64. In the reaction, $A_2(g) + 4B_2(g) \rightleftharpoons 2AB_4(g)$

$\Delta H < 0$ the formation of AB_4 is will be favoured at

(a) Low temperature, high pressure

(b) High temperature, low pressure

(c) Low temperature, low pressure

(d) High temperature, high pressure

Ans. (A)

Sol. According to Le-Chatelier principle exothermic reaction is forwarded by low temperature, in forward direction number of moles is less, hence pressure is high.

65. For which of the following reactions $K_p = K_c$

(a) $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$

(b) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

(c) $H_2(g) + Cl_2(g) \rightleftharpoons 2HCl(g)$

(d) $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

Ans. (c)

Sol. $K_p = K_c(RT)^{\Delta n}$; $\Delta n = 2-2=0$

66. The formation of SO_3 takes place according to the following reaction, $2SO_2 + O_2 \rightleftharpoons 2SO_3$; $\Delta H = -45.2\ kcal$

The formation of SO_3 is favoured by

(a) Increasing in temperature

(b) Removal of oxygen

(c) Increase of volume

(d) Increasing of pressure

Ans. (D)

Sol. In this reaction ΔH is negative so reaction move forward by decrease in temperature while value of $\Delta n = 2-3=-1$ *i.e.*, negative so the reaction move forward by increase in pressure.

67. What is the effect of increasing pressure on the dissociation of PCl_5 according to the equation

$PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)} - x\ cal$

(a) Dissociation decreases

(b) Dissociation increases

(c) Dissociation does not change

(d) None of these

Ans. (A)

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

For this reaction $\Delta n = 2-1=1$

Value of Δn is positive so the dissociation of PCl_5 take forward by decrease in pressure & by increase in pressure the dissociation of PCl_5 decrease.

68. $\Delta G^0(HI, g) \cong +1.7\,kJ$. What is the equilibrium constant at $25^o C$ for $2HI(g) \leftrightarrows H_2(g) + I_2(g)$

(a) 24.0　　(b) 3.9

(c) 2.0　　(d) 0.5

Ans. (D)

Sol. $\Delta G^o = -2.303 \times 8.314 \times 10^{-3} \times 298\ \log K_p$

$1.7 = -2.303 \times 8.314 \times 10^{-3} \times 298 \times \log K_p$

$K_p = 0.5$

69. When the pressure is applied over system *ice* $\rightleftharpoons$ *water* what will happen ?

(a) More water will form

(b) More ice will form

(c) There will be no effect over equilibrium

(d) Water will decompose in H_2 and O_2

Ans. (a)

Sol. $\underset{\text{more volume}}{\text{Ice}} \rightleftharpoons \underset{\text{less volume}}{\text{Water}}$

On increasing pressure, equilibrium shifts forward.

70. Reaction in which yield of product will increase with increase in pressure is

(a) $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$

(b) $H_2O_{(g)} + CO_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$

(c) $H_2O_{(g)} + C_{(s)} \rightleftharpoons CO_{(g)} + H_{2(g)}$

(d) $CO_{(g)} + 3H_{2(g)} \rightleftharpoons CH_{4(g)} + H_2O_{(g)}$

Ans.(D)

Sol. In reaction $CO + 3H_2 \rightleftharpoons CH_4 + H_2O$

Volume is decreasing in forward direction so on increasing pressure the yield of product will increase.

SECTION-B

71. For the system $A(g)+2B(g) \rightleftharpoons C(g)$, the equilibrium concentrations are (A) 0.06 *mole/litre* (B) 0.12 *mole/litre* (C) 0.216 *mole/litre*. The K_{eq} for the reaction is..........

Ans. (250)

Sol. For reaction $A + 2B \rightleftharpoons C$

$$K = \frac{[C]}{[A]\,[B]^2} = \frac{0.216}{0.06 \times 0.12 \times 0.12} = 250$$

72. 15 moles of H_2 and 5.2 moles of I_2 are mixed and allowed to attain equilibrium at 500°C. At equilibrium, the concentration of *HI* is found to be 10 moles. The equilbrium constant for the formation of HI is.........

Ans. (50)

Sol. H_2 + I_2 $\rightleftharpoons$ $2HI$

15 5.2 0

(15–5) (5.2–5) 0

$$K_C = \frac{[HI]^2}{[H_2][I_2]} = \frac{10 \times 10}{10 \times 0.2} = 50$$

73. In the reaction, $A + B \rightleftharpoons 2C$, at equilibrium, the concentration of *A* and *B* is 0.20mol l^{-1} each and that of *C* was found to be 0.60 mol l^{-1}. The equilibrium constant of the reaction is ....

Ans. (9)

Sol.

$A + B \rightleftharpoons 2C$

$$K_c = \frac{[C]^2}{[A]\,[B]} = \frac{[0.6]^2}{[0.2]\,[0.2]} = 9$$

74. Equilibrium concentration of HI, I_2 and H_2 is 0.7, 0.1 and 0.1M respectively. The equilibrium constant for the reaction

$I_2 + H_2 \rightleftharpoons 2HI$

Ans. (49)

Sol. $K_c = \frac{[HI]^2}{[H_2]\,[I_2]} = \frac{[0.7]^2}{[0.1]\,[0.1]} = 49$

75. In a chemical equilibrium A+B $\rightleftharpoons$ C+D, when one mole each of the two reactants are mixed, 0.6 mole each of the products are formed. The equilibrium constant calculated is....... (Multiply with 100).

Ans. (225)

$A+ B \rightleftharpoons C+ D$

Initial 1 1 0 0

remaining at equilibrium 0.4 0.4 0.6 0.6

$$K = \frac{[C]\,[D]}{[A]\,[B]} = \frac{0.6 \times 0.6}{0.4 \times 0.4} = \frac{36}{16} = 2.25$$

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