MELUHA INTERNATIONAL SCHOOL

HYDERABAD

SR MPC JEE MAINS | **UNIT – III** | **Date: 28-04-2020**
Time: | **ASSIGNMENT – 3** | **Max. Marks:**

MATHS

Syllabus: ***CO-OORDINATE GEOMETRY:– 1. STRAIGHT LINES , 2. PAIR OF STRAIGHT LINES, 3.CIRCLES, 4.SYSTEM OF CIRCLES, 5. PARABOLA, 6. ELLIPSE, 7. HYPERBOLA***

1. The set of real values of k for which the equation $(k+1)x^2+2(k-1)xy+y^2-x+2y+3=0$ represents an ellipse is
   (A) (0, 3) (B) $(-\infty,0)$ (C) $(3,+\infty)$ (D) $(-\infty,\infty)$

2. The latus rectum of the conic section $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ whose eccentricity = e, is
   (A) $\frac{2a^2}{b}$ (B) $\frac{2b}{a^2}$ (C) $2a(1-e^2)$ (D) $2b(1-e^2)$

3. In the ellipse $x^2 + 3y^2 = 9$ the distance between the foci is
   (A) $\sqrt{6}$ (B) 3 (C) $\frac{2}{3}\sqrt{6}$ (D) $2\sqrt{6}$

4. If in an ellipse the minor axis = the distance between the foci and its latus rectum = 10 then the equation of the ellipse in the standard form is
   (A) $\frac{x^2}{(10)^2}+\frac{y^2}{(5\sqrt{2})^2}=1$ (B) $\frac{x^2}{(5\sqrt{2})^2}+\frac{y^2}{(10)^2}=1$ (C) $\frac{x^2}{25}+\frac{y^2}{(5\sqrt{2})^2}=1$ (D) $\frac{x^2}{25}+\frac{y^2}{10}=1$

5. If in an ellipse, a focus is (6, 7), the corresponding directrix is x + y + 2 = 0 and the eccentricity = 1/2 then the equation of the ellipse is
   (A) $7x^2+2xy+7y^2-44x-108y+684=0$ (B) $7x^2-2xy+7y^2-52x-116y+676=0$
   (C) $9x^2-2xy+9y^2-44x-108y+684=0$ (D) $9x^2-5xy+4y^2-12x+89y+676=0$

6. A point P on the ellipse $\frac{x^2}{25}+\frac{y^2}{9}=1$ has the eccentric angle $\frac{\pi}{8}$. The sum of the distance of P from the two foci is
   (A) 5 (B) 6 (C) 10 (D) 3

7. The equation of the tangent to the ellipse $4x^2 + 3y^2 = 12$ at the point whose eccentric angle is $\frac{\pi}{4}$ is
   (A) $\sqrt{3}x+2y=2\sqrt{6}$ (B) $2x+\sqrt{3}y=2\sqrt{6}$
   (C) $2x-\sqrt{3}y=2\sqrt{6}$ (D) $x-\sqrt{7}y=3\sqrt{2}$

8. The number of values of m for which the line $y = mx+\sqrt{m^2-4}$ touches the hyperbola $4(x^2-1)=y^2$ is
   (A) 2 (B) 0 (C) None (D) Infinite

9. The length of the common chord of the parabola $2y^2 = 3(x + 1)$ and the circle $x^2+y^2+2x=0$ is
   (A) 1.732 (B) 3.464 (C) 0.866 (D) 9.898

10. The eccentricity of the ellipse $\frac{x^2}{4}+\frac{y^2}{9}=1$ is

(A) 1.128 (B) 0.666 (C) 0.719 (D) 0.444

11. The ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ passes through the point (– 3, 1) and has the eccentricity $\sqrt{\frac{2}{5}}$. Then the major axis of the ellipse has the length $a\sqrt{\frac{b}{c}}$ such that a + b – c =

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

12. The major axis of the ellipse $9x^2 + 5y^2 = 30y$ is

(A) 6.000 (B) 4.472 (C) 2.449 (D) 2.236

13. An ellipse having foci at (3, 1) and (1, 1) passes through the point (1, 3). Its eccentricity is

(A) 0.414 (B) 0.732 (C) 0.207 (D) 0.369

14. If two foci of an ellipse be (– 2, 0) and (2, 0) and its eccentricity is 2/3 then the ellipse has the equation

(A) $5x^2 + 9y^2 = 45$ (B) $9x^2 + 5y^2 = 45$ (C) $5x^2 + 9y^2 = 90$ (D) $9x^2 + 5y^2 = 90$

15. If for a conic section a focus is (– 1, 1), eccentricity = 3 and the equation of the corresponding directrix is x – y + 3 = 0 then the equation of the conic section is

(A) $7x^2 - 18xy + 7y^2 + 50x - 50y + 77 = 0$ (B) $7x^2 + 18xy + 7y^2 = 1$

(C) $7x^2 + 18xy + 7y^2 - 50x + 50y + 77 = 0$ (D) None of these

16. A point on the ellipse $\frac{x^2}{6}+\frac{y^2}{2}=1$ at a distance 2 from the centre of the ellipse has the eccentric angle

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{3}$ (C) $\frac{\pi}{6}$ (D) $\frac{\pi}{2}$

17. PP' is a diameter of the ellipse $b^2x^2+a^2y^2=a^2b^2$ such that $(PP')^2$ is the AM of the squares of the major and minor axes. Then the slope of PP' is

(A) $\frac{b}{a}$ (B) $\frac{a}{b}$ (C) $\frac{\pi}{4}$ (D) $\frac{\pi}{3}$

18. The line 3x + 5y = k is a tangent to the ellipse $16x^2+25y^2=400$ if k is

(A) $\pm\sqrt{5}$ (B) $\pm\sqrt{15}$ (C) ± 25 (D) $\pm\sqrt{10}$

19. The line px + qy = r touches the hyperbola $b^2x^2-a^2y^2=a^2b^2$ if

(A) $a^2p^2+b^2q^2=r^2$ (B) $a^2p^2-b^2q^2=r^2$

(C) $a^2q^2+b^2p^2=r^2$ (D) $a^2q^2-b^2p^2=r^2$

20. If the tangents from the point $(\lambda, 3)$ to the ellipse $\frac{x^2}{9}+\frac{y^2}{4}=1$ are at right angles then λ is

(A) ± 1 (B) ± 3 (C) ± 2 (D) None of these

21. A point on the ellipse $x^2 + 3y^2 = 9$, where the tangent is parallel to the line y – x = 0 is

(A) $(\sqrt{3}, \sqrt{2})$ (B) $\left(-\frac{3\sqrt{3}}{2}, -\frac{\sqrt{3}}{2}\right)$ (C) $\left(-\frac{3\sqrt{3}}{2}, \frac{\sqrt{3}}{2}\right)$ (D) $(-\sqrt{3}, \sqrt{2})$

22. If the tangent to the ellipse $x^2 + 4y^2 = 16$ at the point 'ϕ' is a normal to the circle $x^2+y^2-8x-4y=0$ then ϕ is equal to

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

23. Find a so that distance between (– 2, 1, – 3) and (a, 3, – 6) be 7 units.

(A) – 4 (B) – 8 (C) 8 (D) 5

24. Determine the point in XY-plane which is equidistant from the points A(1, – 1, 0), B(2, 1, 2) and C(3, 2, – 1).
(A) (3/2, 1, 0) (B) (– 4, 0, 0) (C) (3, – 2, 5) (D) (– 2/5, 1, – 3/7)

25. Find the equation of the common tangent in first quadrant to the circle $x^2+y^2=16$ and the ellipse $\frac{x^2}{25}+\frac{y^2}{4}=1$.
(A) $\frac{x}{2\sqrt{7}}+\frac{y}{4\sqrt{\frac{7}{3}}}=1$ (B) $\frac{x}{7}+\frac{y}{3}=1$ (C) $\frac{x}{3\sqrt{5}}+\frac{y}{7\sqrt{11}}=1$ (D) 3x + 5y = 7

26. Let P be a point on the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1, 0<b<a$. Let the line parallel to y-axis passing through P meet the circle $x^2 + y^2 = a^2$ at the point Q such that P and Q are on the same side of x-axis. For two positive real numbers r and s, find the locus of the point R on PQ such that PR : RQ = r : s as P varies over the ellipse.
(A) $\frac{x^2}{2a^2}+\frac{y^2(r+s)^2}{(a+b)^2}=1$ (B) $\frac{bx^2}{a}+\frac{y^2(rs)^2}{(ar+bs)^2}=1$
(C) $\frac{bx^2}{(r+s)^2}+\frac{y^2a}{(b+1)}=1$ (D) $\frac{x^2}{a^2}+\frac{y^2(r+s)^2}{(ar+bs)^2}=1$

27. Find the equation of the hyperbola whose one directrix is 2x + y = 1 and the corresponding focus is (1, 2) and eccentricity is $\sqrt{3}$.
(A) $9x^2-16y^2-72x+96y-144=0$ (B) $7x^2-2y^2+12xy-2x+14y-22=0$
(C) $3x^2-5y^2-89x-29y-17=0$ (D) $5x^2-9y^2+17xy-x+15y-21=0$

28. If $(a\sec\theta, b\tan\theta)$ and $(a\sec\phi, b\tan\phi)$ are the end points of a focal chord of the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$, then evaluate $\tan\frac{\theta}{2}\tan\frac{\phi}{2}+\left(\frac{e-1}{e+1}\right)$
(A) – 1 (B) 0 (C) 2 (D) 9

29. Let P$(a\sec\theta, \text{b}\tan\theta)$ and Q$(a\sec\phi, \text{b}\tan\phi)$ where $\theta+\phi=\frac{\pi}{2}$, be two points on the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$. If (h, k) is the point of intersection of the normals at P and Q, then k is equal to
(A) $\frac{a^2+b^2}{a}$ (B) $-\frac{a^2+b^2}{a}$ (C) $\frac{a^2+b^2}{b}$ (D) $-\frac{a^2+b^2}{b}$

30. If x = 9 is the chord of contact of the hyperbola $x^2 - y^2 = 9$, then the equation of the corresponding pair of tangents is
(A) $9x^2-8y^2+18x-9=0$ (B) $9x^2-8y^2-18x+9=0$
(C) $9x^2-8y^2-18x-9=0$ (D) $9x^2-8y^2+18x+9=0$

31. A hyperbola, having transverse axis of length $2\sin\theta$, is confocal with the ellipse $3x^2 + 4y^2 = 12$. Then its equation is
(A) $x^2\operatorname{cosec}^2\theta-y^2\sec^2\theta=1$ (B) $x^2\sec^2\theta-y^2\operatorname{cosec}^2\theta=1$
(C) $x^2\sin^2\theta-y^2\cos^2\theta=1$ (D) $x^2\cos^2\theta-y^2\sin^2\theta=1$

32. Consider a branch of the hyperbola $x^2 - 2y^2 - 2\sqrt{2}\,x - 4\sqrt{2}y - 6 = 0$ with vertex at the point A. Let B be one of the end points of the latus rectum. If C is the focus of the hyperbola nearest to the point A, then the area of the triangle ABC is

(A) $1-\sqrt{\frac{2}{3}}$ (B) $\sqrt{\frac{3}{2}}-1$ (C) $1+\sqrt{\frac{2}{3}}$ (D) $\sqrt{\frac{3}{2}}+1$

33. Let a and b be non-zero real numbers. Then the equation $\left(ax^2+by^2+c\right)\left(x^2-5xy+6y^2\right)=0$ represents

(A) Four straight lines when c = 0 and a, b are of same sign
(B) Two straight lines and a circle when a = b and c is of sign opposite to that of a
(C) Two straight lines and a hyperbola when a and b are the same sign and c is of sign opposite to that of a
(D) A circle and an ellipse when a and b are of same sign and c is of sign opposite to that of a.

34. If any point on a hyperbola has the coordinates $\left(5\tan\phi, 4\sec\phi\right)$ then the eccentricity of the hyperbola is

(A) 1.222 (B) 1.280 (C) 1.562 (D) 1.600

35. The foci of the ellipse $\frac{x^2}{16}+\frac{y^2}{b^2}=1$ and the hyperbola $\frac{x^2}{144}-\frac{y^2}{81}=\frac{1}{25}$ coincide. Then the value of b^2 is

(A) 5 (B) 7 (C) 9 (D) 1

36. The area (in sq. units) of the quadrilateral formed by tangents at the end points of latus recta of the ellipse $\frac{x^2}{9}+\frac{y^2}{5}=1$ is

(A) 6.75 (B) 9.00 (C) 13.5 (D) 27

37. If y = x and 3y + 2x = 0 are the equations of a pair of conjugate diameters of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ then its eccentricity is

(A) 0.5 (B) 0.333 (C) 0.577 (D) 0.866

38. Find the distance between the points P(– 3, 7, 2) and Q(2, 4, – 1).

(A) 6.855 (B) 6.557 (C) 6.403 (D) 6.244

39. If the eccentricity of a hyperbola $\frac{x^2}{9}-\frac{y^2}{b^2}=1$, which passes through (k, 2), is $\frac{\sqrt{13}}{3}$, then the value of k^2 is

(A) 18 (B) 8 (C) 1 (D) 2

40. The equation of the hyperbola whose foci are (– 2, 0) and (2, 0) and eccentricity is 2 is given by

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

41. For the hyperbola $\frac{x^2}{\cos^2\alpha}-\frac{y^2}{\sin^2\alpha}=1$, which of the following remains constant when α varies =

(A) Abscissae of vertices (B) Abscissae of foci
(C) Eccentricity (D) Directrix

42. The locus of a point $P\left(\alpha,\beta\right)$ moving under the condition that the line y = $\alpha x+\beta$ is a tangent to the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ is

(A) An ellipse (B) A circle (C) A parabola (D) A hyperbola

43. Find eccentricity of a hyperbola passing through (3, 0) and $\left(3\sqrt{2}, 2\right)$

(A) 4 (B) $\frac{\sqrt{13}}{5}$ (C) 1.5 (D) $\frac{\sqrt{13}}{3}$

44. A common tangent to the conics $x^2 = 6y$ and $2x^2 - 4y^2 = 9$ is

(A) x – y = 3/2 (B) x + y = 1 (C) x + y = 9/2 (D) x – y = 1

45. A tangent to the hyperbola $\frac{x^2}{4} - \frac{y^2}{2} = 1$ meets x-axis at P and y-axis at Q. Lines PR and QR are drawn such that OPRQ is a rectangle (Where O is the origin). Then R lies on

(A) $\frac{4}{x^2} + \frac{2}{y^2} = 1$ (B) $\frac{2}{x^2} - \frac{4}{y^2} = 1$ (C) $\frac{2}{x^2} + \frac{4}{y^2} = 1$ (D) $\frac{4}{x^2} - \frac{2}{y^2} = 1$

46. P, Q and R are three points on the hyperbola xy = c^2. If PQ is parallel to the normal at R, then the angle subtended by PQ at R is

(A) $\pi / 2$ (B) $\pi / 6$ (C) $\cos^{-1}\left(2c/3\right)$ (D) $\tan^{-1}\left(2c/3\right)$

47. A hyperbola whose transverse axis is along the major axis of the conic, $\frac{x^2}{3} + \frac{y^2}{4} = 4$ and has vertices at the foci of this conic. If the eccentricity of the hyperbola is 3/2, then which of the following points does NOT lie on it?

(A) $\left(\sqrt{5}, 2\sqrt{2}\right)$ (B) (0, 2) (C) $\left(5, 2\sqrt{3}\right)$ (D) $\left(\sqrt{10}, 2\sqrt{3}\right)$

48. If P, Q, R and S are the points of intersection of a circle and a rectangular hyperbola and if PQ passes through the centre of hyperbola, then RS passes through the

(A) Centre of hyperbola (B) centre of circle

(C) Circumference of circle (D) None of these

49. A variable straight line of slope 4 intersects the hyperbola xy = 1 at two points. Then the locus of the point which divides the line segment between these two points in the ratio 1 : 2, is

(A) $x^2 + 16y^2 + 10xy + 2 = 0$ (B) $x^2 + 16y^2 + 2xy - 10 = 0$

(C) $x^2 + 16y^2 - 8xy + 19 = 0$ (D) $16x^2 + y^2 + 10xy - 2 = 0$

50. A hyperbola passes through the point $P\left(\sqrt{2}, \sqrt{3}\right)$ and has foci at $\left(\pm 2, 0\right)$. Then the tangent to this hyperbola at P also passes through the point

(A) $\left(-\sqrt{2}, -\sqrt{3}\right)$ (B) $\left(3\sqrt{2}, 2\sqrt{3}\right)$ (C) $\left(2\sqrt{2}, 3\sqrt{3}\right)$ (D) $\left(\sqrt{3}, \sqrt{2}\right)$

51. The locus of the point of intersection of the straight lines, tx – 2y – 3t = 0,
x – 2ty + 3 = 0 $\left(t \in \mathbb{R}\right)$ is:

(A) An ellipse with eccentricity $\frac{2}{\sqrt{5}}$

(B) An ellipse with the length of major axis 6

(C) A hyperbola with eccentricity $\sqrt{5}$

(D) A hyperbola with the length of conjugate axis 3

52. The perpendicular focal chords of a rectangular hyperbola are

(A) In the ratio 1 : 2 (B) In the ratio 2 : 1 (C) Equal (D) None of these

53. PQ is the ordinate of any point on the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$, if QR is perpendicular to $A'P$, where AA' is transverse axis, then AR/RP =

(A) $\sqrt{a/b}$ (B) a/b (C) a^2/b^2 (D) None of these

54. If a tangent to the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ cuts the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ at P and Q, then the locus of mid-point of PQ is

(A) $\left(\frac{x^2}{a^2}+\frac{y^2}{b^2}\right)^2=\frac{x^2}{a^2}-\frac{y^2}{b^2}$ (B) $\frac{x^2}{a^2}+\frac{y^2}{b^2}=\left(\frac{x^2}{a^2}-\frac{y^2}{b^2}\right)^2$

(C) $\left(\frac{x^2}{a^4}+\frac{y^2}{b^4}\right)=\frac{x^2}{a^2}-\frac{y^2}{b^2}$ (D) $\frac{x^2}{a^4}+\frac{y^2}{b^4}=\left(\frac{x^2}{a^2}-\frac{y^2}{b^2}\right)^2$

55. For a hyperbola, if the focal distance of any point and the perpendicular from centre upon the tangent at it meet on a circle whose centre is focus, then its radius is equal to

(A) Semi-conjugate axis (B) Conjugate axis

(C) Semi-transverse axis (D) Transverse axis

56. An ellipse passes through the foci of the hyperbola, $9x^2-4y^2=36$ and its major and minor axes lie along the transverse and conjugate axes of the hyperbola respectively. If the product of eccentricities of the two conics is ½, then which of the following points does not lie on the ellipse?

(A) $\left(\sqrt{\frac{13}{2}},\sqrt{6}\right)$ (B) $\left(\frac{\sqrt{39}}{2},\sqrt{3}\right)$ (C) $\left(\frac{1}{2}\sqrt{13},\frac{\sqrt{3}}{2}\right)$ (D) $\left(\sqrt{13},0\right)$

57. An ellipse intersects the hyperbola $2x^2-2y^2=1$ orthogonally. The eccentricity of the ellipse is reciprocal of that of the hyperbola. If the axes of the ellipse are along the coordinates, then

(A) Equation of the ellipse is $x^2+2y^2=2$ (B) The foci of ellipse are $(\pm 2,0)$

(C) Equation of the ellipse is $x^2+2y^2=4$ (D) The foci of ellipse are $(\pm\sqrt{2},0)$

58. If θ be the angle between the asymptotes of hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ then $(\cos(\theta/2))=$

(A) e (B) 1/e (C) e + $\frac{1}{e}$ – 1 (D) e/2

59. If e_1 and e_2 be the eccentricities of hyperbola and its conjugate. then $(1/e_1^2)+(1/e_2^2)=$

(A) 0.176 (B) 0.25 (C) 1.00 (D) 4.00

60. The eccentricity of the hyperbola whose length of the latus rectum is equal to 8 and the length of its conjugate axis is equal to half to the distance between its foci, is

(A) 1.154 (B) 1.732 (C) 1.333 (D) 2.309

61. Let a and b respectively be the semi-transverse and semi-conjugate axes of a hyperbola whose eccentricity satisfies the equation $9e^2-18e+5=0$. If S(5, 0) is a focus and 5x = 9 is the corresponding directrix of this hyperbola, then a^2-b^2 is equal to

(A) – 7 (B) – 5 (C) 5 (D) 7

62. The tangent at an extremity (in the first quadrant) of latus rectum of the hyperbola $\frac{x^2}{4}-\frac{y^2}{5}=1$, meet x-axis and y-axis at A and B respectively. Then $(OA)^2-(OB)^2$, where O is the origin, equals:

(A) – 2.222 (B) 1.777 (C) 4.00 (D) – 1.333

63. If the foci of the ellipse $\frac{x^2}{16}+\frac{y^2}{b^2}=1$ coincide with the foci of the hyperbola $\frac{x^2}{144}-\frac{y^2}{81}=\frac{1}{25}$, then b^2 is equal to

(A) 8 (B) 10 (C) 7 (D) 9

64. The normal to the rectangular hyperbola $xy = c^2$ at the point 't_1' meets the curve again at the point 't_2'. The value of $t_1^3 . t_2$ is

(A) 1 (B) c (C) – c (D) – 1

65. Number of circles drawn through two points is

(A) One (B) Two (C) Three (D) Infinite

66. Find the equation of the circle passing through (– 2, 14) and concentric with the circle $x^2+y^2-6x-4y-12=0$.

(A) $x^2+y^2-6x-4y-156=0$ (B) $x^2+y^2-6x+4y-156=0$

(C) $x^2+y^2-6x+4y+156=0$ (D) $x^2+y^2+6x+4y+156=0$

67. For the circle $ax^2+y^2+bx+dy+2=0$ centre is (1, 2) then 2b + 3d + 4a =

(A) – 12 (B) 16 (C) 8 (D) – 8

68. If the two circles $x^2+y^2+2gx+c=0$ and $x^2+y^2-2fx-c=0$ have equal radius then locus of (g, f) is

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

69. The diameters of a circle are along 2x + y – 7 = 0 and x + 3y – 11 = 0. Then the equation of this circle which also passes through (5, 7) is

(A) $x^2+y^2-4x-6y-16=0$ (B) $x^2+y^2-4x-6y-20=0$

(C) $x^2+y^2-4x-6y-12=0$ (D) $x^2+y^2+4x+6y-12=0$

70. The shortest distance from (– 2, 14) to the circle $x^2+y^2-6x-4y-12=0$ is

(A) 4 (B) 6 (C) 8 (D) 10

71. The least distance of the line 8x – 4y + 73 = 0 from the circle $16x^2+16y^2+48x-8y-43=0$ is

(A) $\sqrt{5}/2$ (B) $2\sqrt{5}$ (C) $3\sqrt{5}$ (D) $4\sqrt{5}$

72. The equation of the tangents to the circle $x^2+y^2=25$ with slope 2 is

(A) $y=2x\pm\sqrt{5}$ (B) $y=2x\pm2\sqrt{5}$ (D) $y=2x\pm3\sqrt{5}$ (D) $y=2x\pm5\sqrt{5}$

73. If the line $x+y=\lambda$ touch the circle $x^2+y^2=1$ then λ^2 is

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

74. The normal at (1, 1) to the circle $x^2+y^2-4x+6y-4=0$ is

(A) 4x + 3y = 7 (B) 4x + y = 5 (C) x + y = 2 (D) 4x – y = 5

75. The length of the tangent from (1, 1) to the circle $2x^2+2y^2+5x+3y+1=0$ is

(A) $\sqrt{13/2}$ (B) 3 (C) 2 (D) 1

76. A chord of length 24 units is at a distance of 5 units from the centre of a circle then its radius is

(A) 5 (B) 12 (C) 13 (D) 10

77. The equation of the circle with centre at (4, 3) and touching the line 5x – 12y – 10 = 0 is

(A) $x^2+y^2-4x-6y+4=0$ (B) $x^2+y^2+6x-8y+16=0$

(C) $x^2+y^2-8x-6y+21=0$ (D) $x^2+y^2-24x-10y+144=0$

78. The equation of the image of the circle $x^2+y^2-6x-4y+12=0$ by the mirror x + y – 1 = 0 is

(A) $x^2+y^2+2x+4y+4=0$ (B) $x^2+y^2-2x+4y+4=0$

(C) $x^2+y^2+2x+4y-4=0$ (D) $x^2+y^2+2x-4y+4=0$

79. Equation of tangent to circle $x^2+y^2+6x+2y-90=0$ drawn from centre of the circle $x^2+y^2-6x-14y+23=0$ is

(A) 3x + 4y = 37 (B) 4x – 3y = 73 (C) 4x + 3y = 37 (D) 3x – 4y = 37

80. If the tangent at the point P on the circle $x^2+y^2+6x+6y=2$ meets the straight line 5x – 2y + 6 = 0 at a point Q on the y-axis then the length of PQ is

(A) 4 (B) $2\sqrt{5}$ (C) 5 (D) $3\sqrt{5}$

81. Area of circle touching both the lines 3x + 4y = 3 and 3x + 4y = 18 is

(A) $\frac{4\pi}{9}$ (B) $\frac{\pi}{9}$ (C) $\frac{9\pi}{4}$ (D) $\frac{25\pi}{4}$

82. If origin be shifted to point (1, 2) by parallel translation of axis. Then new equation of circle $x^2+y^2-2x-4y-20=0$ is

(A) $(x-1)^2+(y-2)^2=5$ (B) $x^2+y^2=5$

(C) $x^2+y^2=25$ (D) $(x-1)^2+(y-2)^2-2(x-1)-4(y-2)-20=0$

83. If y = 2x is a chord of circle $x^2+y^2-10x=0$. Then the equation of the circle with this chord as a diameter is

(A) $x^2+y^2+2x+4y=0$ (B) $x^2+y^2-2x+4y=0$

(C) $x^2+y^2+2x-4y=0$ (D) $x^2+y^2-2x-4y=0$

PHYSICS

Syllabus: ***HEAT, HYDROSTATICS AND UNITS & MEASUREMENTS:– 1. THERMAL PROPERTIES, 2. THERMODYNAMICS, 3. KINETICTHEORY OF GASES, 4. ELASTICITY, HYDROSTATICS AND DYNAMICS (Including surface tension and viscosity) 5. UNITS,MEASUREMENTS AND ERRORS***.

1. When temperature of a black body increases, it is observed that the wavelength corresponding to maximum energy changes from 0.26 μm to 0.13 μm. The ratio of the emissive powers of the body at the respective temperature is

(A) 16/1 (B) 4/1 (C) 1/4 (D) 1/16

2. A copper block of mass 4 kg is heated in a furnace to a temperature 425°C and then placed on a large ice block. The mass of ice that will melt in this process will be 0.5 x, where x is (specific heat copper = 500 J/kg°C^{-1} and heat of fusion of ice = 336 kJ/kg)

(A) 1 (B) 2 (C) 3 (D) 5

3. If temperature of the sun were to increase from T and 2T and its radius from R to 2R, then how many times the radiant energy will be received on the earth in form of 2^n. Where n is?

(A) 2 (B) 4 (C) 5 (D) 6

4. Total energy emitted by a perfectly black body is directly proportional to T^n (T is temperature), where n is

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

5. An object is cooled from 75°C to 65°C in two minutes in a room temperature at 30°C. Then time taken to cool the same object from 55°C to 45°C in the same room (in minute) is

(A) 7 (B) 6 (C) 5 (D) 4

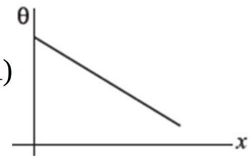
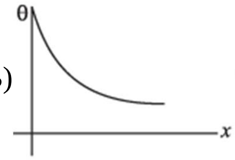
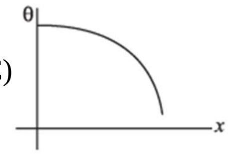
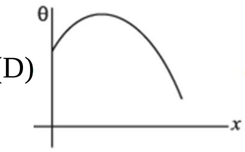
6. The temperature at which centigrade and Fahrenheit scales give same reading is – 10 x, where x is

(A) 4 (B) 5 (C) 3 (D) 2

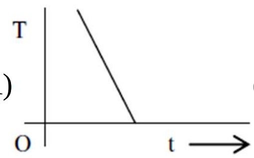
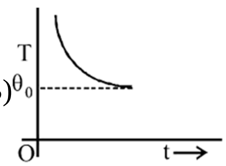
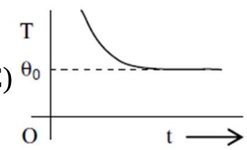
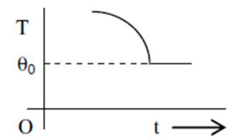
7. Assuming the sun to be a spherical body of radius R at a temperature of T K, evaluate the total radiant power, incident on Earth, at a distance r from the Sun. (earth radius = r_0)

(A) $\frac{R^2\sigma T^4}{r^2}$ (B) $\frac{4\pi r_0^2 R^2\sigma T^4}{r^2}$ (C) $\frac{\pi r_0^2 R^2\sigma T^4}{r^2}$ (D) $\frac{r_0^2 R^2\sigma T^4}{4\pi r^2}$

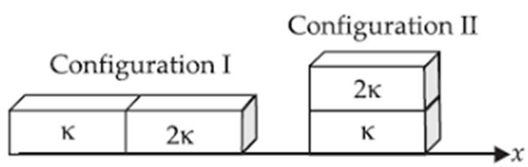
8. A long metallic bar is carrying heat from one of its ends to the other end under steady-state. The variation of temperature θ along the length x of the bar from its hot end is best described by which of the following figures

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

9. If a piece of metal is heated to temperature θ and then allowed to cool in a room which is at temperature θ_0, the graph between the temperature T of the metal and time t will be closest to

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

10. Two rectangular blocks, having identical dimensions, can be arranged either in configuration I or in configuration II as shown in the figure, On of the blocks has thermal conductivity k and the other 2k. The temperature difference between the ends along the x-axis is the same in both the configurations. It takes 9s to transport a certain amount of heat from the hot end to the cold end in the configuration I. The time to transport the same amount of heat in the configuration II is :



(A) 2.0 s (B) 3.0 s (C) 4.5 s (D) 6.0 s

11. The temperature of a body is increased from 27°C to 127°C. The radiation emitted by it increased by a factor of

(A) 256/81 (B) 15/9 (C) 4/5 (D) 12/27

12. On investigation of light from three different stars A , B and C , it was found that in the spectrum of A the intensity of red colour is maximum, in B the intensity of blue colour is maximum and in C the intensity of yellow colour is maximum. From these observations it can be concluded that

(A) The temperature of A is maximum, B is minimum and C is intermediate

(B) The temperature of A is maximum, C is minimum and B is intermediate

(C) The temperature of B is maximum, A is minimum and C is intermediate

(D) The temperature of C is maximum, B is minimum and A is intermediate

13. Certain substances emit only the wavelength $\lambda_1, \lambda_2, \lambda_3, \lambda_4$ when it is a high temperature. When this substance is at a cold temperature it will absorb only the following wavelength

(A) λ_1 (B) λ_2 (C) $\lambda_1 \& \lambda_2$ (D) $\lambda_1, \lambda_2, \lambda_3 \& \lambda_4$

14. Ice starts forming in a lake with water at 0°C when the atmospheric temperature is – 10°C. If the time taken for the first 1 cm of ice to be formed is 7 hrs, then the time taken for the thickness of ice to change from 1 cm to 2 cm is

(A) 7 hours (B) 14 hours (C) 21 hours (D) 3.5 hours

SECTION-II
(Numerical Value Answer Type)

15. A metal rod AB of length 10 x has its one end A in ice at 0ºC and the other end B in water at 100ºC. If a point P on the rod is maintained at 400ºC, then it is found that equal amounts of water and ice evaporate and melt per unit time. The latent heat of evaporation of water is 540 cal/g and latent heat of melting of ice is 80 cal/g. If the point P is at a distance of λx from the ice end A, find the value of λ.
[Neglect any heat loss to the surrounding]
(A) 9 (B) 8 (C) 7 (D) 6

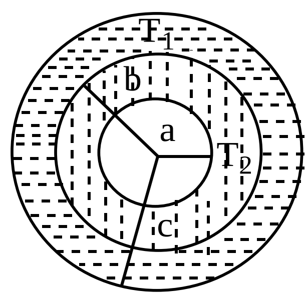
16. Two spherical bodies A (radius 6 cm) and B (radius 18 cm) are at temperature T_1 and T_2 respectively. The maximum intensity in the emission spectrum of A is at 500 nm and in that of B is at 1500 nm. Considering them to be black bodies, what will be the ratio of the rate of total energy radiated by A to that of B ?
(A) 8 (B) 5 (C) 9 (D) 6

17. Two spherical stars A and B emit blackbody radiation. The radius of A is 400 times that of B and A emits 10^4 times the power emitted from B. The ratio $\left(\frac{\lambda_A}{\lambda_B}\right)$ for their wavelengths λ_A and λ_B at which the peaks occur in their respective radiation curves is:
(A) 4 (B) 2 (C) 3 (D) 6

18. A rod of length L is fixed between two rigid supports and supplied heat to raise its temperature T. If γ is the coefficient of volume expansion of the wire and y is young's modulus of the wire then the elastic potential energy density stored in the wire is
(A) $\frac{\gamma^2T^2y}{2}$ (B) $\frac{\gamma^2T^2y^3}{3}$ (C) $\frac{\gamma^2T^2}{18y}$ (D) $\frac{\gamma^2T^2y}{18}$

19. The limbs of a manometer consist of uniform capillary tubes of radii 1.4x 10^{-3} m and 7.2 x10^{-4}m. The liquid in the tubes have density 1000 kg/ m^3 and surface tension 0.072 N/m. The level of liquid in the narrower tube stands 0.2 m above that in the broader tube. If the angle of contact is zero, the pressure difference between them is (g = 9.8 m/s^2)
(A) 1.1 x 10^3 Pa (B)1.863 x10^3 Pa (C) 1.96x 10^3Pa (D) 9.8 x 10^3 Pa

20. Two different liquid films of surface tensions T_1 and T_2 are held between three concentric wires of radii a, b and c as shown in the figure. The outermost and the innermost wires are fixed. Neglecting gravity, the tension in the middle wire is

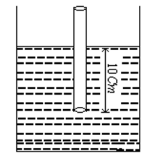


(A) $(T_1 - T_2)b$ (B) $(T_1c - T_2b)\left(\frac{a}{b+c}\right)$
(C) $2(T_1 - T_2)b$ (D) $(T_1c - T_2b)$

21. A soap bubble has a thickness of 100nm and a refractive index of 1.35. What is the wavelength of the colour does the bubble appear to be at the point by reflection on its surface closest to an observer when it is illuminated by the white light?

22. A uniform rope is rotated about an axis perpendicular to length and passing through one of its end. The ratio of stresses at end near the axis of rotation and middle point is (neglect gravity)
(A) 2:1 (B) 3:2 (C) 4:3 (D) 5:4

23. Consider the following diagram in which a capillary tube of radius 1mm is dipped into a fluid whose density $800 kg/m^3$ and surface tension $0.1 N/m$ .The gauge pressure required in the tube to blow a hemisphere bubble at the dipped end is



(A) $800 N/m^2$ (B) $1000 N/m^2$
(C) $1200 N/m^2$ (D) $1600 N/m^2$

24. In a capillary tube of radius 'r', neglecting the meniscus weight, the maximum height up to which a liquid can be filled without any dripping is [density of liquid is ρ, surface tension of fluid is T and contact angle is 90^0]
(A) $\frac{4T}{\rho gr}$ (B) $\frac{2T}{\rho gr}$ (C) $\frac{T}{\rho gr}$ (D) $\frac{T}{2\rho gr}$

25. A ball of mass 'm' and density ρ is being released inside a fluid of density $\frac{\rho}{2}$ and coefficient of viscosity η .Find the net force on the ball when speed achieved by ball is 60% of the terminal speed.
(A) 0.6 mg (2) mg (C) 0.4 mg (D) 0.2 mg

26. A cylindrical container of cross sectional area $100 cm^2$ is containing water upto a height of 2m. Now a cork ball of 5 kg is put into the container and it floats in equilibrium. If a tiny hole is made on vertical walls very close to base then the velocity of efflux will be (in m/s).
(A) $2\sqrt{10}$ (B) 5 (C) $5\sqrt{2}$ (D) 10

27. A body is rotated in a circular path by means of a wire, which fails at angular velocity ω_0. If the wire is cut into two equal pieces and the same body is rotated by means of the two pieces together, then the failure takes place at angular velocity ω. The ratio $\frac{\omega}{\omega_0}$ is (neglect gravity)
(A) 1 (B) $\sqrt{2}$ (C) 2 (D) $2\sqrt{2}$

28. A uniform rope of mass m and length L is hanged freely from stationary ceiling. If the cross sectional area of rope is A and Young's modulus Y, then net elongation in the rope due to its own weight
(A) $\frac{mgL}{AY}$ (B) $\frac{mgL}{2AY}$ (C) $\frac{mgL}{3AY}$ (D) $\frac{mgL}{4AY}$

29. Two square plates of side length 'a' are stick together by putting a thin layer of liquid between them having thickness t. If liquid wets the plates completely and surface tension is S then the force required to pull them apart is
(A) $\frac{Sa^2}{4t}$ (B) $\frac{Sa^2}{2t}$ (C) $\frac{Sa^2}{t}$ (D) $\frac{2Sa^2}{t}$

30. Two wires of the same material and same mass are stretched by same force. Their lengths are in the ratio 2: 3. Then their elongations are in the ratio
(A) 3 : 2 (B) 2 : 3 (C) 4 : 9 (D) 9 : 4

31. The work done in stretching a wire by 0.1 mm is 4 J. The work done in stretching another wire of same material, but with double the radius and half the length by 0.1mm is
(A) 16 J (B) 32 J (C) 64 J (D) 128 J

32. The rubber cord catapult has cross-sectional are $10^{-6} m^2$ and total un stretched length 0.1m. It is stretched to 0.12 m and then released to project a stone of mass $5\times10^{-3} kg$. If young's modular of rubber is 0.5 Gpa, the velocity projection of the stone is
(A) 0.5 m/s (B) 0.1 m/s (C) 2 m/s (D) 20 m/s

33. How much work will be done in increasing the diameter of a soap bubble from 2 cm to 5cm? Surface tension of soap solution is 3×10^{-2} N/m.

(A) 8.96×10^{-4} J (B) 3.96×10^{-4} J (C) 0.96×10^{-4} J (D) 10^{-4} J

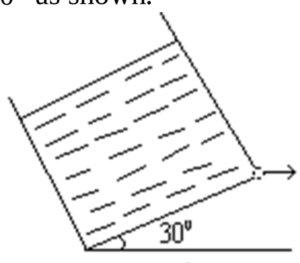
34. The following 4 wires are made of the same material subjected to same force. Arrange them with their elongations in ascending order

(1) l = 50 cm and r = 0.5 mm (2) l = 100 cm and r = 1 mm

(3) l= 200 cm and r = 2 mm (4) l = 300 cm and r = 3 mm

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

35. Liquid is filled in a vessel of square base (2m x 2m) up to a height of 2 m and the vessel is tilted from the horizontal at 30^0 as shown.



Find the velocity of efflux if liquid does not spills out?

(A) 3.2 m/s (B) 4.96 m/s (C) 5.6 m/s (D) 2.68 m/s

36. A tank is filled with a liquid up to a height H. a small hole is made at the bottom of this tank. Let t_1 be the time taken to empty first half of the tank and t_2 the time taken to empty the rest half of the tank. Then find $\frac{t_1}{t_2}$.

(A) 0.414 (B) 0.82 (C) 0.2 (D) 1.6

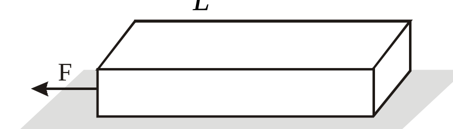
37. In a tank, having a large base area a liquid of density 1200 kg/m^3 is filled up to a height 5m is placed on a platform. The platform is moving up with an acceleration 5 m/s^2. A very small hole is made in the tank at a height of 2 m from the bottom. Find the distance of the point where the liquid falls on the platform w.r.to the edge of the tank. (g = 10 m/s^2)

(A) 4.9 m (B) 9.8 m (C) 19.6 m (4) 29.4 m

38. A wire of length L and cross-section A is made of material of Young's modulus Y. It is stretched by an amount x, the work done is

(A) $\frac{YxA}{2L}$ (B) $\frac{Yx^2A}{2L}$ (C) $\frac{Yx^2A}{L}$ (D) $\frac{2Yx^2A}{L}$

39. A uniform bar of square cross-section is lying along a frictionless horizontal surface. A horizontal force is applied to pull it from one of its ends then



(A) The bar is under same stress throughout its length

(B) The bar is not under any stress because force has been applied only at one end

(C) The bar simply moves without any stress in it

(D) The stress developed reduces to zero at the end of the bar where no force is Applied

40. A steel wire with cross section 3 cm^2 has elastic limit $2.4\times10^8 Pa$. The maximum upward acceleration that can be given to a 1200 kg elevator suppoted by this cable if the stress is not to exceed $1/3^{rd}$ of the elastic limit is $\left(g = 10 m/s^2\right)$

(A) $9ms^{-2}$ (B) $10ms^{-2}$ (C) $11ms^{-2}$ (D) $12ms^{-2}$

41. The length of a metal wire is l_1 when the tension in it is T_1 & l_2 when the tension is T_2. The natural length of the wire is

(A) $\frac{l_1T_2 - l_2T_1}{T_2 - T_1}$ (B) $\frac{l_1T_2 - l_2T_1}{T_1 + T_2}$ (C) $\frac{l_1T_2 - l_2T_1}{T_1 - T_2}$ (D) $\frac{l_1T_1 - l_2T_2}{T_1 + T_2}$

42. A cube with a mass m = 20 g wettable by water floats on the surface of water. Each side of the cube has length l = 3 cm. The angle of contact between water and glass is zero degree and the surface tension of the water is 7.5×10^{-2} N/m. The distance between the lower face of the cube and the surface of the water is

(A) 20/22 cm (B)2.222 cm (C) 2.322 cm (D)2.434 cm

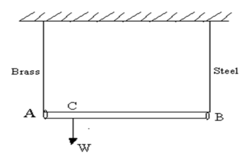
43. Two soap bubbles of same soap solution touch each other and are in equilibrium. One soap bubble has radius twice that of the other. Neglecting the effect of gravity, the angle of contact between them is

(A) 60^0 (B) 90^0 (C) 120^0 (D) can't be determined.

44. In the Searle's experiment of determination of Young's modulus of a wire, the quantity which should be measured with greater precision is

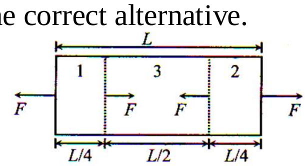
(A) Diameter of the wire (B) length of the wire
(C) Deflection of loaded wire (D) Loading weights

45. A 2m long light metal rod AB is suspended from the ceiling horizontally by means of two vertical wires of equal length tied to its ends. One wire is of brass and has cross section of $0.2\times10^{-4}m^2$ and the other is of steel with $0.1\times10^{-4}m^2$ cross section. In order to have equal stress in the two wires, a weight is hang from the rod. The position of the weight along the rod from end A should be.



(A) 66.6 cm (B) 133 cm (C) 44.4 cm (D)155.6 cm

46. External forces acting on a rod of length L, cross - sectional area A and Young's modulus Y are as shown in the figure. Choose the correct alternative.



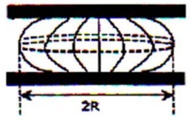
(A) There will be no change in length of rod.

(B) The net change in length of rod is $\frac{2FL}{AY}$

(C) The net change in length of rod is $\frac{FL}{2AY}$

(D) The net change in length of rod is $\frac{FL}{AY}$

47. A liquid drop is sandwiched between two plates as shown. Consider the contact angle to be 180°. The separation between the plates is H (<<R). What is excess pressure in the drop? (Neglect the effect of gravity. the shape of the drop is like a circular tablet. Take surface tension as S.



(A) 2S/H + S/R (B) 2S/R (C) S/H (D) S/H + S/R

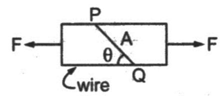
48. A uniform metal wire of cross sectional radius r and Young's modulus Y is in the form of a ring of radius R and it is rotated about a vertical axis through its center at an angular speed of ω. The change in radius (ΔR) of the ring due to ratation would be ?

(A) $\frac{M\omega^2R^2}{\pi^2r^2Y}$ (B) $\frac{M\omega^2R^2}{2\pi^2r^2Y}$ (C) $\frac{M\omega^2r^2}{\pi^2r^2Y}$ (D) $\frac{M\omega^2r^2}{2\pi^2r^2Y}$

49. The change in volume of a cylinder of length 65cm when subjected to a compressive force of 1000N over the end face would be? The Young's modulus and Poisson's ratio of the material of the cylinder are 130×10^9Pa and 0.34 respectively.

(A) 1.0mm^3 (B) 1.6mm^3 (C) 2.5mm^3 (D) 3.2mm^3

50. The shearing stress on the area PQ is.



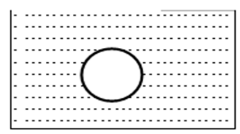
(A) $\frac{F}{A\cos\theta}$ (B) $\frac{F}{A\sin\theta}$ (C) $\frac{F\cos\theta}{A}$ (D) $\frac{F}{A}$

where A = given area of the plane PQ of the wire.

51. Two parallel glass plates separated by a small gap x are dipped in a liquid of surface tension T, density p. if the angle of contact is θ then the height upto which the liquid rises is.

(A) h=0 (B) $\frac{2T\cos\theta}{x\rho g}$ (C) $h=\frac{2T\cos\theta}{x}$ (D) $h=\frac{xT}{\rho gh\cos\theta}$

52. A smooth spherical ball of radius 1 cm and density 4×10^3 kg/m^3 is dropped gently in a large container containing viscous liquid of density 2×10^3 kg/m^3,n=0.1 N-s/m^2. The distance moved by the ball in 1-0.1 sec after it attains terminal velocity is.

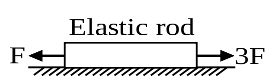


(A) $\frac{4}{5}$ m up (B) $\frac{4}{9}$ m up (C) $\frac{2}{3}$ m down (D) $\frac{4}{9}$ m down

53. A steel wire of length 4 m and diameter 5 mm is stretched by 5 kg-wt. Find the increase in its length, if the Young's modulus of steel of wire is 2.4×10^{12} dyne/cm^2.

(A) 1.0041 cm. (B) 0.0041 cm. (C) 4.1 cm. (D) 1.2 cm.

54. A uniform elastic rod of cross section are A natural length L and Youngs modulus Y is placed on a smooth horizontal ... and 3F) directed along the length of rod ... wn. After the rod has acquired steady stat...



(A) $\frac{2F}{YA}L$ (B) $\frac{4F}{YA}L$ (C) $\frac{F}{YA}L$ (D) $\frac{3F}{2YA}L$

55. A composite wire (uniform cross section of $5.5 \times 10^{-5} m^2$) is made of a steel wire of length 1.5 m and a copper wire of length 2.0 m. The extension produced in this composite wire, when it is loaded with a mass of 200 kg is $\left(Y_{Steel} = 2\times10^{11} N/m^2,\right.$

$\left.Y_{Copper} = 1\times10^{11} N/m^2, g = 10 m/s^2\right)$ (Weight of the composite wire is negligible)

(A) 0.5 mm (B)1mm (C)2 mm (D) 4 mm

56. The work done in stretching a wire by 0.1 mm is 4 J. The work done in stretching another wire of same material, but with double the radius and half the length by 0.1mm is

(A) 16 J (B) 32 J (C) 64 J (D) None

57. A water drop is divided into 8 equal droplets. The pressure difference between the inner and outer side of the big drop will be:

(A) Same as for smaller droplet (B) 1/2 of that for smaller droplet

(C) ¼ of that for smaller droplet (D) Twice that for smaller droplet

58. If the excess pressure inside a soap bubble is balanced by an oil column of height 2 mm, then the surface tension of soap solution will be (r = 1 cm and density of oil = 0.8 gm/cc) (g = 9.8 m/s^2)

(A) 3.9 N/m (B) 3.9×10^{-1} N/m (C) 3.9×10^{-3} N/m (D) 3.9 d/m

59. In a surface tension experiment with a capillary tube water rises 0.1m. If the same experiment is repeated in an artificial satellite, which is revolving around the earth, water will rise in the capillary tube up to a height of :

(A) 0.1 m (B) 0.2 m (C) 0.98 m (D) full length of tube

60. Two glass plates are separated by water. If surface tension of water is 75 dynes per cm and area of each plate wetted by water is 8 cm^2 and the distance between the plates is 0.12 mm, then the force required to separate the two plates is

(A) 10^2 dynes (B) 10^4 dynes (C) 10^5 dynes (D) 10^6 dynes

61. There is a small hole in a hollow sphere. The water enters in it when it is taken to a depth of 40cm under water. The surface tension of water is 0.07 N/m. The diameter of hole is:

(A) 7mm (B) 0.07 mm (C) 0.0007mm (D) 0.7 m

62. A sphere of solid material of relative density 9 has a concentric spherical cavity, just sinks in water. If the radius of the sphere be R, then the radius of the cavity (r) will be related to R as :

(A) $r^3 = \frac{8}{9}R^3$ (B) $r^3 = \frac{2}{3}R^3$ (C) $r^3 = \frac{\sqrt{8}}{3}R^3$ (D) $r^3 = \sqrt{\frac{2}{3}}R^3$

63. If S and V are the change is surface area and volume when two soap babbles coalesce, then (σ is surface tension P_O is atmospheric pressure).

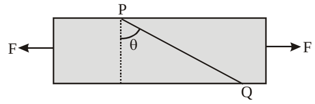
(A) $3P_0V + 4S\sigma = 0$ (B) $4P_0V + 3\sigma S = 0$

(C) $P_0V + 4\sigma S = 0$ (D) $4P_0V + \sigma S = 0$

64. Stress – Strain curve for the wire A and B are shown in figure. Y_A and Y_B are the young's modulii of wire A and B respectively, then

(A) $Y_A > Y_B$ (B) $Y_A < Y_B$ (C) $Y_A = Y_B$ (D) $2Y_A = Y_B$

65. A bar is subjected to equal and opposite forces as shown in the figure, PQ is plane making angle θ with the cross-section of the bar. If the area of cross section be 'a', then what is the tensile stress on PQ?



(A) F/a (B) F cos θ/a (C) $\frac{F\cos^2\theta}{a}$ (D) F/a cos θ

CHEMISTRY

Syllabus: ***FIRST YEAR PHYSICAL CHEMISTRY:– 1.ATOMIC STRUCTURE, 2. STATES OF MATTER, 3. STOICHIOMETERY, 4. THERMODYNAMICS, 5. CHEMICAL EQUILIBRIUM, 6. IONIC EQUILIBRIUM***

1. Assuming that the system is at equilibrium, which of the following reactions goes most nearly to 100% completion

(A) $C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$; $K_c = 6.5\times 10^{-23}$

(B) $CO(g) + 3H_2(g) \rightleftharpoons CH_4(g) + H_2O(g)$; $K_c = 0.176$

(C) $2C(s) + O_2(g) \rightleftharpoons 2CO(g)$; $K_c = 1 \times 10^{16}$

(D) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$; $K_c = 54.5$

2. An equilibrium system for the reaction between hydrogen and iodine to give hydrogen iodide at 765K in a 5 litre volume contains 0.4 mole of hydrogen, 0.4 mole of iodine and 2.4 moles of hydrogen iodide. The equilibrium constant for the reaction is $H_2 + I_2 \rightleftharpoons 2HI$, is

(A) 36.0 (B) 15.0 (C) 0.067 (D) 0.028

3. The equilibrium constant of the reaction

$SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$ is 4×10^{-3} atm$^{-1/2}$. The equilibrium constant of the reaction

$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$ would be

(A) 250 atm (B) 4×10^3 atm (C) 0.25×10^4 atm (D) 6.25×10^4 atm

4. The value of K_P for the reaction.

$2H_2O(g) + 2Cl_2(g) \rightleftharpoons 4HCl(g) + O_2(g)$

is 0.03 atm at 427ºC, when the partial pressure are expressed in atmosphere, then the value of K_C for the same reaction is -

(A) 5.23×10^{-4} (B) 7.34×10^{-4} (C) 3.2×10^{-3} (D) 5.43×10^{-5}

5. For the equilibrium $2NOBr(g) \rightleftharpoons 2NO(g) + Br_2(g)$, calculate the ratio $\frac{K_P}{P}$, where P is the total pressure and $P_{Br_2} = \frac{P}{9}$ at a certain temperature -

(A) $\frac{1}{9}$ (B) $\frac{1}{81}$ (C) $\frac{1}{27}$ (D) $\frac{1}{3}$

6. 28g of N_2 and 6g of H_2 were mixed. At equilibrium 17g NH_3 was produced. The weight of N_2 and H_2 at equilibrium are respectively -

(A) 11g , 0g (B) 1g , 3g (C) 14g , 3g (D) 11g , 3g

7. For the gas phase reaction

$C_2H_4 + H_2 \rightleftharpoons C_2H_6$, $\Delta H = -32.7$ kcal carried out in a vessel, the equilibrium concentration of C_2H_4 can be increased by

(A) increasing the temperature (B) Increasing concentration of H_2

(C) Decreasing temperature (D) Increasing pressure

8. In the system $AB(s) \rightleftharpoons A(g) + B(g)$ doubling the quantity of AB (s) would

(A) increase the amount of A to double its value
(B) increase the amount B to double its value
(C) increase the amount of both A & B to double their values
(D) cause no change in the amounts of A and B

9. Consider the heterogeneous equilibrium in a closed container

$$NH_4HS\ (s) \rightleftharpoons NH_3\ (g) + H_2S(g)$$

If more NH_4HS is added to the equilibrium

(A) Partial pressure of NH_3 increases
(B) Partial pressure of H_2S increases
(C) Total pressure in the container increases
(D) No effect on partial pressure of NH_3 and H_2S

10. For the reaction $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

K_C = 66.9 at 350ºC and K_C = 50.0 at 448ºC. The reaction has

(A) ΔH = + ve
(B) ΔH = – ve
(C) ΔH = zero
(D) ΔH = Not found the signs

11. $N_2 + 3H_2 \rightleftharpoons 2NH_3$

1 mole N_2 and 3 mole H_2 are present at start in 1L flask. At equilibrium NH_3 formed required 100mL of 5M HCl for neutralisation hence K_C is -

(A) $\frac{(0.5)^2}{(0.75)(2.25)^3}$
(B) $\frac{(0.5)^2}{(0.5)(2.5)^3}$
(C) $\frac{(0.5)L}{(0.75)(2.5)^3}$
(D) none of these

12. The decomposition of N_2O_4 to NO_2 was carried out in chloroform at 280^0C. At equilibrium, 0.2 mol of N_2O_4 and 2 x 10^{-3} mole of NO_2 were present in 2L of solution. The equilibrium constant for the reaction $N_2O_4 \rightleftharpoons 2NO_2$ is

(A) 0.01×10^{-3}
(B) 2.0 x$\times 10^{-3}$
(C) 2.0×10^{-5}
(D) $.01 \times 10^{-5}$

13. $N_2 + O_2 \rightleftharpoons 2NO, K_1$

$\left(\frac{1}{2}\right)N_2 + \left(\frac{1}{2}\right)O_2 \rightleftharpoons NO, K_2$

$2NO \rightleftharpoons N_2 + O_2, K_3$

$NO \rightleftharpoons \left(\frac{1}{2}\right)N_2 + \left(\frac{1}{2}\right)O_2, K_4$

Correct relation between K_1, K_2 and K_4 is :

(A) $K_1 \times K_3 = 1$
(B) $\sqrt{K_1} \times K_4 = 1$
(C) $\sqrt{K_3} \times K_2 = 1$
(D) All of these

14. For the decomposition reaction

$NH_2COONH_4\ (s) \rightleftharpoons 2NH_3\ (g) + CO_2\ (g)$ the $K_P = 2.9 \times 10^{-5}$ atm^3. The total pressure of gases at equilibrium when 1 mol of $NH_2COONH_4(s)$ was taken initially could be -

(A) 0.0194 atm
(B) 0.0388 atm
(C) 0.0582 atm
(D) 0.0766 atm

15. A 1 litre container contains 2 moles of PCl_5 initially. If at equilibrium , K_C is found to be 1, degree of dissociation of PCl_5 is -

(A) 4
(B) 3
(C) $\frac{1}{2}$
(D) 50

16. In a vessel containing SO_3, SO_2 and O_2 at equilibrium, some helium gas is introduced so that the total pressure increases while temperature and volume remains constant. According to Le-chatelier principle, the dissociation of SO_3

(A) Increase
(C) decrease
(B) Remain unaltered
(D) changes unpredictable

SECTION-II
(Numerical Value Answer Type)

17. Molar concentration of 96 g of O2 contained in a 2L vessel in mol/L is

18. At a certain temp. $2HI \rightleftharpoons H_2 + I_2$. Only 50% HI is dissociated at equilibrium. The equilibrium constant is

19. The active mass of 64 g of HI in a two litre flask would be

20. On a given condition, the equilibrium concentration of H_2, H_2 and I_2 are 0.80, 0.10 and 0.10 mole/litre. The equilibrium constant for the reaction $H_2 + I_2 \rightleftharpoons 2HI$ will be

21. In a reaction $A + B \rightleftharpoons C + D$, the concentrations of A, B, C and D (in moles/litre) are 0.5, 0.8, 0.4 and 1.0 respectively. The equilibrium constant is

22. Which of the following are Lewis acids?
(A) PH_3 and BCl_3 (B) $AlCl_3$ and $SiCl_4$
(C) PH_3 and $SiCl_4$ (D) BCl_3 and $AlCl_3$

23. 100 ml of 0.2 M H_2SO_4 is added to 100 ml of 0.2 M NaOH. The resulting solution will be
(A) Acidic (B) Basic (C) Neutral (D) Slightly basic

24. In the following reaction $HC_2O_4^-(aq) + PO_4^{3-}(aq) \rightleftharpoons HPO_4^{2-}(aq) + C_2O_4^{2-}(aq)$, which are the two Bronsted bases?
(A) $HC_2O_4^-$ and PO_4^{3-} (B) HPO_4^{2-} and $C_2O_4^{2-}$
(C) $HC_2O_4^-$ and HPO_4^{2-} (D) PO_4^{3-} and $C_2O_4^{2-}$

25. The following equilibrium is established when $HC\ell O_4$ is dissolved in weak acid HF.

$$HF + HC\ell O_4 \rightleftharpoons C\ell O_4^- + H_2F^+$$

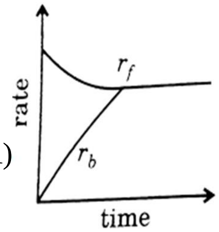
Which of the following is correct set of conjugate acid base pair?
(A) HF and $HC\ell O_4$ (B) HF and $C\ell O_4^-$ (C) HF and H_2F^+ (D) $HC\ell O_4$ and H_2F^+

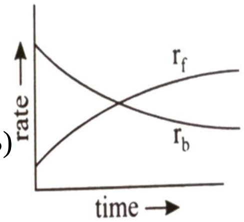
26. 10 ml of 1 M H_2SO_4 will completely neutralise
(A) 10 ml of 1 M NaOH solution (B) 10 ml of 2 M NaOH solution
(C) 5 ml of 2 M KOH solution (D) 5 ml of 1 M Na_2CO_3 solution

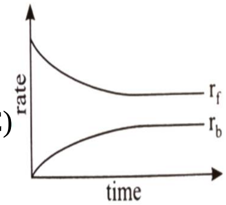
27. The hydrogen ion concentration in weak acid of dissociation constant K_a and concentration c is nearly equal to
(A) $\sqrt{K_a / c}$ (B) c / K_a (C) $K_a c$ (D) $\sqrt{K_a c}$

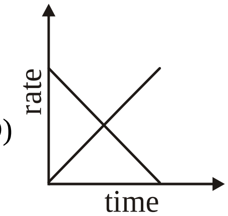
28. The decomposition of N_2O_4 is carried out at 280 K in chloroform. When equilibrium has been established, 0.2 mol of N_2O_4 and 2×10^{-3} mol of NO_2 are present in 2 litre solution. The equilibrium constant for reaction $N_2O_4 \rightleftharpoons 2NO_2$ is
(A) 1×10^{-2} (B) 2×10^{-3} (C) 1×10^{-5} (D) 2×10^{-5}

29. Rate of reaction curve for equilibrium can be like: [r_f = forward rate, r_b = backward rate]

(A) 

(B) 

(C) 

(D) 

SECTION-II

(Numerical Value Answer Type)

30. In a chemical reaction, $A + 2B \rightleftharpoons 2C + D$, the initial concentration of B was 1.5 times of the concentration of A, but the equilibrium concentration of A and B were found to be equal. The equilibrium constant (K) for the aforesaid chemical reaction is

(A) 1.4 (B) 16 (C) 1 (D) 4

31. If in the reaction $N_2O_4 \rightleftharpoons 2NO_2$, α is that part of N_2O_4 which dissociates and value of α is 0.2, then the number of moles at equilibrium will be

(A) 3 (B) 1 (C) 1.2 (D) 1.4

32. Which of the following has a higher value for K_h at 27°C?

(A) NaF (B) $NaC\ell$ (C) NaBr (D) NaI

33. A salt of weak acid and weak base undergoes

(A) Only cationic hydrolysis

(B) Only anionic hydrolysis

(C) Both cationic and anionic hydrolysis

(D) Neither cationic nor anionic hydrolysis

34. The solubility of calcium fluoride in saturated solution, if its solubility product is 3.2×10^{-11}, is

(A) 2.0×10^{-4} M (B) 12.0×10^{-3} M (C) 0.2×10^{-4} M (D) 2.0×10^{-3} M

35. For the electrolyte of type, A_2B, K_{sp} is given then its solubility is calculated by

(A) $K_{sp}/4$ (B) $\sqrt[3]{\frac{K_{sp}}{4}}$ (C) $\sqrt[3]{K_{sp}}$ (D) $\sqrt{\frac{K_{sp}}{4}}$

36. The addition of $KC\ell$ to $AgC\ell$ decreases the solubility of $AgC\ell$, because

(A) K_{sp} of $AgC\ell$ decreases (B) K_{sp} of $AgC\ell$ increases

(C) Solution becomes unsaturated (D) Ionic product exceeds the K_{sp} value

37. Calculate the hydrolysis constant of a salt of weak acid $\left(K_a = 2 \times 10^{-6}\right)$ and of a weak base $\left(K_b = 5 \times 10^{-7}\right)$.

(A) 10^{-4} (B) 10^{-2} (C) 10^{-6} (D) 10^{-8}

38. The pH of an aqueous solution of a slat is 10, the salt is

(A) $KC\ell$ (B) NH_4NO_3 (C) NaCN (D) $(NH_4)_2SO_4$

39. The molar solubility of PbI_2 in 0.2 M $Pb(NO_3)_2$ solution in terms of solubility product, K_{sp}

(A) $\left(K_{sp}/0.2\right)^{1/2}$ (B) $\left(K_{sp}/0.8\right)^{1/3}$ (C) $\left(K_{sp}/0.4\right)^{1/2}$ (D) $\left(K_{sp}/0.8\right)^{1/2}$

40. At 25°C, the K_{sp} value of $Fe(OH)_3$ in aqueous solution is 3.8×10^{-38}. The solubility of Fe^{3+} ions will increase when

(A) p^H is increased (B) p^H is 7 (C) p^H is decreased (D) $p^H = 14$

SECTION-II

(Numerical Value Answer Type)

41. Solubility product constant of a sparingly soluble salt $MC\ell$ is 4×10^{-12} at 25°C. Also, at 25°C, solubility of $MC\ell_2$ in an aqueous solution of $CaC\ell_2$ is 4×10^{-10} times less compared to its solubility in pure water. Hence, concentration (molarity) of $NaC\ell$ solution is

(A) 0.01 (B) 3 (C) 4 (D) 5

42. Ksp of $M(OH)_2$ is 5 × 10^{-16} at 25°C. The pH of its saturated solution at 25°C is

(A) 3 (B) 7 (C) 5 (D) 9

43. For the reaction, $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, the equilibrium constant Kp changes with

(A) total pressure (B) catalyst
(B) the amounts of H_2 and I_2 present (D) temperature

44. The equilibrium constant, K for the reaction $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ at room temperature is 2.85 and that at 698 K, it is 1.4 × 10^{-2}.
This implies that:
(A) HI is exothermic compound (B) HI is very stable at room temperature
(C) HI is relatively less stable than H_2 and I_2 (D) HI is resonance stabilised

45. A and B are gaseous substances which react reversibly to give two gaseous substances C and D, accompanied by the liberation of heat. When the reaction reaches equilibrium, it is observed that $K_p = K_c$. The equilibrium cannot be disturbed by

(A) adding A (B) adding D
(C) raising the temperature (D) increasing the pressure

46. K_1 and K_2 are equilibrium constant for reactions (1) and (2)

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ ......(1)

$NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$ ......(2)

Then

(A) $K_1 = \left(\frac{1}{K_2}\right)^2$ (B) $K_1 = K_2^2$ (C) $K_1 = \frac{1}{K_2}$ (D) $K_1 = (K_2)^0$

47. For the gas phase reaction $2NO \rightleftharpoons N_2 + O_2$, $\Delta H = -43.5\,\text{kcal mol}^{-1}$ which one of the statement below is true for $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

(A) K is independent of T (B) K increases as T decreases
(C) K decreases as T decreases (D) K varies with the addition of NO

48. According to Le-Chatelier's principle, adding heat to a solid and liquid in equilibrium will cause the

(A) temperature to increase (B) temperature to decrease
(C) amount of liquid to decrease (D) amount of solid to decrease

49. The reaction, $SO_2 + Cl_2 \longrightarrow SO_2Cl_2$ is exothermic and reversible. A mixture of $SO_2(g)$, Cl_2 (g) and $SO_2Cl_2(l)$ is at equilibrium in a closed container. Now a certain quantity of extra SO_2 is introduced into the container, the volume remaining the same. Which of the following is/are true?
(A) the pressure inside the container will not change

(B) the temperature will not change

(C) the temperature will increase

(D) the temperature will decrease

50. The equilibrium constant for the reaction, $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ is 4×10^{-4} at 2000 K. In presence of a catalyst, equilibrium is attained ten times faster. Therefore, the equilibrium constant, in presence of the catalyst, at 2000 K is:

(A) 40×10^{-4} (B) 4×10^{-4}
(C) 4×10^{-3} (D) difficult to compute without more data

51. Consider the reaction $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ in a closed container at equilibrium. At a fixed temperature what will be the effect of addition of more PCl_5 on the equilibrium concentration of $Cl_2(g)$?

(A) it decreases (B) it increases
(C) it remains unaffected (D) it cannot be predicted without the value of K_p

52. The standard state Gibb's free energy change for the isomerisation reaction cis-2-pentene $\rightleftharpoons$ trans-2-pentene is –3.67 kJ mol^{-1} at 400 K. If more trans-2-pentene is added to the reaction vessel

(A) more cis-2-pentene is formed (B) Equilibrium shifts in the forward direction
(C) equilibrium remains unaffected (D) more trans-2-pentene is produced

53. The following equilibria are given

$N_2 + 3H_2 \rightleftharpoons 2NH_3, K_1$

$N_2 + O_2 \rightleftharpoons 2NO, K_2$

$H_2 + \frac{1}{2}O_2 \rightleftharpoons H_2O, K_3$

The equilibrium constant of the reaction

$2NH_3 + \frac{5}{2}O_2 \rightleftharpoons 2NO + 3H_2O$ in terms of K_1, K_2 and K_3 is

(A) $K_1K_2K_3$ (B) K_1K_2/K_3 (C) $K_1K_3^2/K_2$ (D) $K_2K_3^3/K_1$

54. At a given temperature, the equilibrium constant for the reaction, $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ is 2.4×10^{-3}. At the same temperature the equilibrium constant for the reaction, $PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$ will be:

(A) 2.4×10^3 (B) 4.2×10^2 (C) -2.4×10^{-3} (D) 4.8×10^{-2}

55. XY_2 dissociates as $XY_2(g) \rightleftharpoons XY(g) + Y(g)$ When the initial pressure of XY_2 is 600 mm Hg, the total equilibrium pressure is 800 mm Hg. Calculate K_p for the reaction assuming that the volume of the system remains unchanged.

(A) 50 (B) 100 (C) 166.6 (D) 400.0

56. A reaction is A + B $\rightleftharpoons$ C + D. Initially we start with equal concentrations of A and B. At equilibrium we find that the moles of C is two times of A. What is the equilibrium constant of the reaction?

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

57. If K_p for a reaction $A(g) + 2B(g) \rightleftharpoons 3C(g) + D(g)$ is 0.05 atm at 1000 K. Its K_c in terms of R will be

(A) 20000 R (B) 0.02 R (C) 5×10^{-5} R (D) $\frac{5\times10^{-5}}{R}$

58. On mixing equal volumes of two buffer solutions of pH value 3 and 4, the pH of the resultant solution will be (approx)

(A) 3.3 (B) 3.5 (C) 4.7 (D) 5.3

59. 0.365g of HCl gas was passed through 100 cm^3 of 0.2 M NaOH solution. The pH of the resulting solution would be

(A) 13 (B) 6 (C) 8 (D) 9

60. 100 mL of a solution contains 0.1 M NH_4OH and 0.1 M M NH_4Cl. The pH of the solution will not change on adding.

(A) 20 mL of 0.1 M NH_4OH solution (B) 20 mL of 0.1 M NH_4Cl solution

(C) 10 mL of 0.1 M NaOH solution (D) 10 mL of distilled water

61. Calculate the molar solubility of $Ni(OH)_2$ in 0.10 M NaOH. The Ksp of $Ni(OH)_2$ is 2.0×10^{-15}

(A) 6.0×10^{-12} M (B) 8.0×10^{-13} M

(C) 2.0×10^{-13} M (D) 5.0×10^{-12} M

62. The change in pH near the end point will be maximum in the titration of

(A) strong acid and strong base (B) strong acid and weak base

(C) weak acid and weak base (D) weak acid and strong base

63. Given that K_a for acetic acid as 1.8×10^{-5} and K_b of NH_4OH as 1.8×10^{-5} at 25°C, predict the nature of aqueous solution of ammonium acetate

(A) Acidic (B) Basic

(C) Slightly acidic or basic (D) Neutral

64. The precipitate of CaF_2 ($K_{sp} = 1.7 \times 10^{-10}$) is obtained when equal volumes of the following are mixed

(A) 10^{-4} M Ca^{2+} +10^{-4} M F^- (B) 10^{-2} M Ca^{2+} +10^{-3} M F^-

(C) 10^{-5} M Ca^{2+} +10^{-3} M F^- (D) 10^{-3} M Ca^{2+} +10^{-5} M F^-

65. The pH of the neutralization point of 0.1 M ammonium hydroxide with 0.1 M HCl is closest to

(A) 1 (B) 6 (C) 7 (D) 9

66. The compound whose 0.1 M solution is basic is

(A) Ammonium acetate (B) Ammonium chloride

(C) Ammonium sulphate (D) Sodium acetate

67. Which of the following salts undergoes anionic hydrolysis?

(A) $CuSO_4$ (B) NH_4Cl (C) $FeCl_3$ (D) Na_2CO_3

68. At 90°C, pure water has $[H_3O^+] = 10^{-6}$ mol L^{-1}. What is the value of K_w at 90°C?

(A) 10^{-6} (B) 10^{-12} (C) 10^{-14} (D) 10^{-8}

69. The solubility product of AgI at 25°C is 1.0×10^{-16} mol^2 L^{-2}. The solubility of AgI in 10^{-4} M solution of KI at 25°C is approximately (in mol L^{-1})

(A) 1.0×10^{-16} (B) 1.0×10^{-12} (C) 1.0×10^{-10} (D) 1.0×10^{-8}

70. The pH of 0.1 M solution of a weak acid is 3. What is the value of the ionization constant for the acid ?

(A) 0.1 (B) 10^{-3} (C) 10^{-5} (D) 10^{-7}

71. The pH of 10^{-8} M aqueous solution of hydrochloric acid is

(A) 8.0 (B) more than 8.0 (C) 7 (D) less than 7.

72. The solubility of calcium phosphate in water is x mol L^{-1} at 25°C. Its solubility product is equal to

(A) 108 x^2 (B) $36x^3$ (C) 36 x^5 (D) 108 x^5

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