MELUHA INTERNATIONAL SCHOOL

HYDERABAD

SR MPC JEE MAINS | **UNIT – III** | **Date: 27-04-2020**
Time: | **ASSIGNMENT – 2** | **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. A circle touches the y-axis at (0, 2) and has an intercept of 4 units on the positive side of the x-axis. Then the equation of the circle is

(A) $x^2+y^2-4\left(\sqrt{2}x+y\right)+4=0$ (B) $x^2+y^2-4\left(x+\sqrt{2}y\right)+4=0$

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

2. C_1 is a circle of radius 1 touching the x-axis and the y-axis. C_2 is another circle of radius > 1and touching the axes as well as the circle C_1. Then the radius of C_2 is

(A) $3-2\sqrt{2}$ (B) $3+2\sqrt{2}$ (C) $3+2\sqrt{3}$ (D) None of these

3. The intercept on the line y = x by the circle $x^2+y^2-2x=0$ is AB. The equation of the circle with AB as a diameter is

(A) $x^2+y^2+x+y=0$ (B) $x^2+y^2=x+y$ (C) $x^2+y^2-3x+y=0$ (D) None of these

4. Two circles, each of radius 5, have a common tangent at (1, 1) whose equation is 3x + 4y – 7 = 0. Then their centres are

(A) (4, – 5), (– 2, 3) (B) (4, – 3), (– 2, 5) (C) (4, 5), (– 2, – 3) (D) None of these

5. Two distinct chords drawn from the point (p, q) on the circle $x^2+y^2=px+qy$, where $pq\neq0$, are bisected by the x-axis. Then

(A) $|p|=|q|$ (B) $p^2=8q^2$ (C) $p^2<8q^2$ (D) $p^2>8q^2$

6. The length of the chord of the circle $x^2+y^2=9$ passing through (3, 0) and perpendicular to the line y + x = 0 is

(A) $3/\sqrt{2}$ (B) $3\sqrt{2}$ (C) $2\sqrt{3}$ (D) None of these

7. The equation of the diameter of the circle $3\left(x^2+y^2\right)-2x+6y-9=0$ which is perpendicular to the line 2x + 3y = 12 is

(A) 3x – 2y = 3 (B) 3x – 2y + 1 = 0 (C) 3x – 2y = 9 (D) None of these

8. The range of values of λ for which the circles $x^2+y^2=4$ and $x^2+y^2-4\lambda x+9=0$ have two common tangents, is

(A) $\lambda\in\left[-\frac{13}{8},\frac{13}{8}\right]$ (B) $\lambda>\frac{13}{8}$ or $\lambda<-\frac{13}{8}$ (C) $1<\lambda<\frac{13}{8}$ (D) None of these

9. If the points A(1, 4) and B are symmetrical about the tangent to the circle $x^2+y^2-x+y=0$ at the origin then coordinates of B are

(A) (1, 2) (B) $\left(\sqrt{2},1\right)$ (C) (4, 1) (D) None of these

10. The angle between the pair of tangents from the point (1, 1/2) to the circle $x^2+y^2+4x+2y-4=0$ is

(A) $\cos^{-1}\frac{4}{5}$ (B) $\sin^{-1}\frac{4}{5}$ (C) $\sin^{-1}\frac{3}{5}$ (D) None of these

11. The chords of contact of the pair of tangents to the circle $x^2+y^2=1$ drawn from any point on the line 2x + y = 4 pass through the point

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

12. The line $\lambda x+\mu y=1$ is a normal to the circle $2x^2+2y^2-5x+6y-1=0$ if

(A) $5\lambda-6\mu=2$ (B) $4+5\mu=6\lambda$ (C) $4+6\mu=5\lambda$ (D) None of these

13. The equation of a chord of the circle $x^2+y^2-4x=0$ which is bisected at the point (1, 1) is

(A) x + y = 2 (B) 3x – y = 2 (C) x – 2y + 1 = 0 (D) x – y = 0

14. The equations of two circles are $x^2+y^2+2\lambda x+5=0$ and $x^2+y^2+2\lambda y+5=0$. P is any point on the line x – y = 0. If PA and PB are lengths of the tangents from P to the two circles and PA = 3 then PB is equal to

(A) 1.5 (B) 6 (C) 3 (D) None of these

15. If the common chord of the circles $x^2+(y-\lambda)^2=16$ and $x^2+y^2=16$ subtend a right angle at the origin then λ is equal to

(A) 4 (B) $4\sqrt{2}$ (C) $\pm4\sqrt{2}$ (D) 8

16. The equation of a circle is $x^2+y^2=4$. The centre of the smallest circle touching this circle and the line x + y = $5\sqrt{2}$ has the coordinates

(A) $\left(\frac{7}{2\sqrt{2}},\frac{7}{2\sqrt{2}}\right)$ (B) $\left(\frac{3}{2},\frac{3}{2}\right)$ (C) $\left(-\frac{7}{2\sqrt{2}},-\frac{7}{2\sqrt{2}}\right)$ (D) None of these

17. The members of a family of circles are given by the equation $2(x^2+y^2)+\lambda x-(1+\lambda^2)y-10=0$. The number of circles belonging to the family that are cut orthogonally by the fixed circle $x^2+y^2+4x+6y+3=0$

(A) 2 (B) 1 (C) 0 (D) None of these

18. The locus of the centres of the circles passing through the intersection of the circles $x^2+y^2=1$ and $x^2+y^2-2x+y=0$ is

(A) A line whose equation is x + 2y = 0 (B) A line whose equation is 2x –y = 1
(C) A circle (D) A pair of lines

19. Find slope of radical axis for circles

$S_1: x^2+y^2-3x-4y+5=0$

$S_2: 3x^2+3y^2-7x+8y+11=0$

(A) – 1/10 (B) – 10 (C) 1 (D) 3

20. $S_1: x^2+y^2-12x-16y+64=0$, $S_2: 3x^2+3y^2-36x+81=0$, $S_3: x^2+y^2-16x+81=0$

Find coordinates of a point from which the length of tangents drawn to each circle is equal.

(A) $\left(\frac{7}{2},\frac{-3}{16}\right)$ (B) $\left(14,\frac{-3}{16}\right)$ (D) $\left(\frac{7}{2},14\right)$ (D) $\left(\frac{3}{2},\frac{-14}{3}\right)$

21. The length of the chord of the circle $x^2+y^2+4x-7y+12=0$ along the y-axis is

(A) 1 (B) 2 (C) 1/2 (D) None of these

22. There are two circles whose equations are $x^2+y^2=9$ and $x^2+y^2-8x-6y+n^2=0, n\in$ □. If the two circles have exactly two common tangents then the number of possible values of n is

(A) 2 (B) 8 (C) 9 (D) None of these

23. The number of common tangents to the circles $x^2+y^2=4$ and $x^2+y^2-6x-8y=24$ is

(A) 0 (B) 1 (C) 3 (D) 4

24. The number of common tangents to the circles $x^2+y^2+2x+8y-23=0$ and $x^2+y^2-4x-10y+19=0$ is

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

25. Lines are drawn through the point P(– 2, – 3) to meet the circle $x^2+y^2-2x-10y+1=0$. The length of the line segment PA, A being the point on the circle where the line meets the circle at coincident points, is

(A) 16 (B) $4\sqrt{3}$ (C) 48 (D) None of these

26. The length of the chord of the circle $x^2+y^2+4x-7y+12=0$ along the y-axis is

(A) 1 (B) 2 (C) 1/2 (D) None of these

27. Lines are drawn through the point P (– 2, – 3) to meet the circle $x^2+y^2-2x-10y+1=0$. The length of the line segment PA, A being the point on the circle where the line meets the circle at coincident points, is

(A) 16 (B) $4\sqrt{3}$ (C) 48 (D) None of these

28. The common chord of the circle $x^2+y^2+6x+8y-7=0$ and a circle passing through the origin, and touching the line y = x, always passes through the point

(A) (– 1/2, 1/2) (B) (1, 1) (C) (1/2, 1/2) (D) None of these

29. A ray of light incident at the point (-2,-1) gets reflected from the tangent at (0,-1) to the circle $x^2+y^2=1$. The reflected ray touches the circle. The equation of the line along which the incident ray moved is

(A) $4x - 3y + 11 = 0$ (B) $4x + 3y + 11 = 0$ (C) $3x + 4y + 11 = 0$ (D) None of these

30. The locus of the centres of circle passing through the origin and intersecting the fixed circle $x^2+y^2-5x+3y-1=0$ orthogonally is

(A) A straight line of the slope 3/5
(B) A circle
(C) A pair of straight lines
(D) None of these

31. Equation of the parabola having focus (3, 2) and vertex (–1, 2) is

(A) $(x + 1)^2 = 16(y - 2)$
(B) $(x - 1)^2 = 16(y + 2)$
(C) $(y - 2)^2 = 16(x + 1)$
(D) $(y + 2)^2 = 16(x - 1)$

32. The focus and directrix of a parabola are (1, –1) and x + y + 3 = 0. Its vertex is

(A) $\left(\frac{7}{4}, \frac{1}{4}\right)$ (B) $\left(\frac{1}{2}, \frac{-7}{4}\right)$ (C) $\left(\frac{1}{4}, \frac{-7}{4}\right)$ (D) $\left(\frac{1}{2}, \frac{5}{2}\right)$

33. Focus of the parabola $4x^2 - 12x + 8y + 13 = 0$ is

(A) $\left(\frac{3}{2}, -2\right)$ (B) $\left(\frac{3}{2}, -5\right)$ (C) $\left(\frac{3}{2}, -3\right)$ (D) $\left(\frac{3}{2}, -1\right)$

34. The focus and directrix of a parabola are (1, 2) and 2x – 3y + 1 = 0. Then the equation of the tangent at the vertex is

(A) $4x - 6y + 5 = 0$ (B) $4x - 6y + 9 = 0$ (C) $4x - 6y + 11 = 0$ (D) $4x - 6y + 7 = 0$

35. Area of the triangle formed by the vertex, focus and one end of latus rectum of the parabola $(x + 2)^2 = -12(y - 1)$ is

(A) 18 (B) 36 (C) 12 (D) 9

36. Equation of the tangent to $y^2 = 8x$ inclined at an angle 30° to the axis is

(A) $x+\sqrt{3}y+6=0$ (B) $x-\sqrt{3}y+6=0$ (C) $\sqrt{3}x+y+6=0$ (D) $\sqrt{3}x-y+6=0$

37. Equation of the tangent to $x^2 - 4x - 8y + 12 = 0$ at $\left(4, \frac{3}{2}\right)$ is

(A) $x + 2y - 1 = 0$ (B) $x + 2y + 1 = 0$ (C) $x - 2y + 1 = 0$ (D) $x - 2y - 1 = 0$

38. If P is a point on the parabola $y^2 = 4ax$ in which the abscissa is equal to ordinate then the equation of the normal at P is

(A) $2x + y + 12a = 0$ (B) $2x + y - 12a = 0$
(C) $2x + y - 18a = 0$ (D) $x + 2y - 12a = 0$

39. The length of latusrectum of the parabola $169\left[(x-1)^2 + (y-3)^2\right] = (5x - 12y + 17)^2$ is

(A) 1.076 (B) 0.538 (C) 2.154 (D) 4.308

40. A parabola with vertex (2, 3) and axis parallel to the y-axis passes through (4, 5). Then its length of latusrectum is

(A) 2.000 (B) 4.000 (C) 0.500 (D) 2.500

41. M is the foot of the perpendicular from a point P on the parabola $y^2 = 8(x - 3)$ to its directrix and S is the focus of the parabola, if SPM is an equilateral triangle, the length of each side of the triangle is

(A) 2.000 (B) 3.000 (C) 4.000 (D) 8.000

42. If (x_1, y_1), (x_2, y_2) are the extremities of a focal chord of the parabola $y^2 = 16x$, then $4x_1x_2 + y_1y_2$ =

(A) –48.000 (B) 0.000 (C) –64.000 (D) 16.000

43. If two tangents are drawn from the point (–2, –1) to the parabola $y^2 = 4x$. If α is the angle between these tangents, then $\tan\alpha$

(A) 2.000 (B) 3.000 (C) 4.000 (D) 5.000

44. The equation of parabola whose focus is (3, –4) and directrix is $x - y + 5 = 0$, is

(A) $x^2 + y^2 + 2xy - 22x + 26y + 25 = 0$ (B) $x^2 + y^2 + 2xy + 22x - 26y + 25 = 0$
(C) $x^2 + y^2 + 2xy + 22x + 26y - 25 = 0$ (D) $x^2 + y^2 + 2xy - 22x - 26y - 25 = 0$

45. If the two ends of the latusrectum are given, then the maximum number of parabolas that can be drawn, is

(A) 1 (B) 2 (C) 0 (D) infinite

46. The point on $y^2 = 4ax$ nearest to the focus has its abscissa

(A) $x = -a$ (B) $x = a$ (C) $x = \frac{3}{2}$ (D) $x = 0$

47. The vertex of the parabola $x^2 + 2y = 8x - 7$ is

(A) $\left(4, \frac{7}{2}\right)$ (B) $\left(4, \frac{9}{2}\right)$ (C) $\left(\frac{9}{2}, 4\right)$ (D) (1, 0)

48. If (2, –8) is at an end of a focal chord of the parabola $y^2 = 32x$, then the coordinate of the other end of chord is

(A) (8, –2) (B) (16, 32) (C) (32, 32) (D) (–2, 8)

49. If the line $y = 3x + c$ touches the parabola $y^2 = 12x$ at point P, then the equation of the tangent at point Q, where PQ is a focal chord, is

(A) $x + 3y + 27 = 0$ (B) $3x - y - 27 = 0$ (C) $x + 3y - 27 = 0$ (D) $x - 3y = 3$

50. The equation of tangent to the parabola $y^2 = 8x$ having slope 2, is

(A) $y = 2x + 1$ (B) $y = 2x + 4$ (C) $y = 2x + 3$ (D) $y = 2x + 2$

51. If two equal parabolas having the same vertex and their axes are at right angles. Then, the length of their common tangent is (where 4a is length of latus rectum)

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

52. If y_1, y_2 are the ordinates of two points P and Q on the parabola and y_3 is the ordinate of the point of intersection of tangents at P and Q, then

(A) y_1, y_2, y_3 are in A.P. (B) y_1, y_3, y_2 are in A.P.

(C) y_1, y_2, y_3 are in G.P. (D) y_1, y_3, y_2 are in G.P.

53. The condition that the straight line $\ell x + my + n = 0$ touches the parabola $x^2 = 4ay$ is

(A) $bn = am^2$ (B) $a\ell^2 - mn = 0$ (C) $\ell n = am^2$ (D) $am = \ell n^2$

54. The point $(-2m, m + 1)$ is an interior point of the smaller region bounded by the circle $x^2 + y^2 = 4$ and parabola $y^2 = 4x$. Then, m belongs to the interval

(A) $-5-2\sqrt{6} < m < 1$ (B) $0 < m < 4$ (C) $-1 < m < \frac{3}{5}$ (D) $-1 < m < -5+2\sqrt{6}$

55. The equation of a parabola is $y^2 = 4x$. If P(1, 3) and Q(1, 1) are two points in the XY-plane. Then, for the parabola,

(A) P and Q are exterior points

(B) P is an interior point while Q is an exterior point

(C) P and q are interior points

(D) P is an exterior point while Q is an interior point

56. Locus of trisection point of any double ordinate of $y^2 = 4ax$ is

(A) $3y^2 = 4ax$ (B) $y^2 = 6ax$ (C) $9y^2 = 4ax$ (D) $y^2 = 2ax$

57. If the tangent at P on $y^2 = 4ax$ meets the tangent at the vertex in Q and S is the focus of the parabola, then $\angle SQP$ is equal to

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

58. The locus of a point from which tangents to a parabola are at right angles, is

(A) a straight line (B) a pair of straight lines

(C) a circle (D) a parabola

59. The parabola $y^2 = 4x$ and the circle $(x - 6)^2 + y^2 = r^2$ will have no common tangent, if

(A) $r > \sqrt{20}$ (B) $r < \sqrt{20}$ (C) $r > \sqrt{18}$ (D) $r \in (\sqrt{20}, \sqrt{20})$

60. The locus of the middle points of chords of the parabola $y^2 = 8x$ drawn through the vertex is a parabola whose

(A) focus is (2, 0) (B) latusrectum is 8

(C) focus is (0, 2) (D) latusrectum is 4

61. Tangent and normal drawn to parabola at $A(at^2, 2at)$, $t \neq 0$ meet X-axis at points B and d, respectively. If the rectangle ABCD is complete, then the locus of C is

(A) $y = 2a$ (B) $y + 2a = 0$ (C) $x = 2a$ (D) $x + 2a = 0$

62. The equation of a tangent to the parabola $y^2 = 8x$ is $y = x + 2$. The point on this line from which the other tangent to the parabola is perpendicular to the given tangent, is

(A) (–1, 1) (B) (0, 2) (C) (2, 4) (D) (–2, 0)

63. The value of λ for which the curve $(7x + 5)^2 + (7y + 3)^2 = \lambda^2(4x + 3y - 24)^2$ represents a parabola, is

(A) $\pm\frac{6}{5}$ (B) $\pm\frac{7}{5}$ (C) $\pm\frac{1}{5}$ (D) $\pm\frac{2}{5}$

64. The slope of the line touching both the parabolas $y^2 = 4x$ and $x^2 = -32y$ is

(A) 0.500 (B) 1.500 (C) 0.125 (D) 0.667

65. If the straight lines $y = \pm x$ intersect the parabola $y^2 = 8x$ in points P and Q, then length of PQ is

(A) 4.000 (B) 3.000 (C) 8.000 (D) 16.000

66. The equation $y^2 + 4x + 4y + k = 0$ represents a parabola whose latusrectum is

(A) 1.000 (B) 2.000 (C) 3.000 (D) 4.000

67. The normal chord at a point 't' on the parabola $y^2 = 4ax$ subtends a right angle at the vertex. Then, t^2 is equal to

(A) 4.000 (B) 2.000 (C) 1.000 (D) 3.000

68. The tangents from origin to the parabola $y^2 + 4 = 4x$ are inclined at an angle α (in radian). Then $\frac{\pi}{\alpha}$ is

(A) 6.000 (B) 4.000 (C) 3.000 (D) 2.000

69. The number of distinct normals that can be drawn from (– 2, 1) to the parabola $y^2 - 4x - 2y - 3 = 0$ is

(A) 1 (B) 2 (C) 3 (D) 0

70. The area of the triangle formed by the tangent and the normal to the parabola $y^2 = 4ax$, both drawn at the same end of the latus rectum, and the axis of the parabola is

(A) $2\sqrt{2}a^2$ (B) $2a^2$ (C) $4a^2$ (D) $7a^2$

71. If two of the three feet of normals drawn from a point to the parabola $y^2 = 4x$ be (1, 2) and (1, – 2) then the third foot is

(A) $\left(2, 2\sqrt{2}\right)$ (B) $\left(2, -2\sqrt{2}\right)$ (C) (0, 0) (D) (1, 2)

72. Let P, Q, R be three points on a parabola, normals at which are concurrent. The centroid of the ΔPQR must lies on

(A) A line parallel to the directrix (B) The axis of the parabola

(C) A line of slope 1 passing through the vertex (D) A line perpendicular to directrix

73. The vertex of the parabola $y^2 = 8x$ is at the centre of a circle and the parabola cuts the circle at the ends of its latus rectum. Then the equation of the circle is

(A) $x^2 + y^2 = 4$ (B) $x^2 + y^2 = 20$ (C) $x^2 + y^2 = 80$ (D) $x^2 + y^2 = 1$

74. The circle $x^2 + y^2 + 2\lambda x = 0, \lambda \in \square$, touches the parabola $y^2 = 4x$ externally. Then

(A) $\lambda > 0$ (B) $\lambda < 0$ (C) $\lambda > 1$ (D) $\lambda = 0$

75. The locus of the middle points of chords of a parabola which subtend a right angle at the vertex of the parabola is

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

76. The locus of a point from which tangents to a parabola are at right angles is a

(A) Straight line (B) Pair of straight lines

(C) Circle (D) Parabola

77. P is a point. Two tangents are drawn from it to the parabola $y^2 = 4x$ such that the slope of one tangent is three times the slope of the other. The locus of P is

(A) A straight line (B) A circle (C) A parabola (D) An ellipse

78. The locus of the middle points of parallel chords of a parabola $x^2 = 4ay$ is a

(A) Straight line parallel to the x-axis (B) Straight line parallel to the y-axis

(C) Circle

(D) Straight line parallel to a bisector of the angles between the axes

79. The locus of the middle points of chords of the parabola $y^2 = 8x$ drawn through the vertex is a parabola whose

(A) Focus is (2, 0) (B) Latus rectum = 8 (C) Focus is (0, 2) (D) Latus rectum = 4

80. The equation $2x^2 - 3xy + 5y^2 + 6x - 3y + 5 = 0$ represents

(A) A parabola
(B) An ellipse
(C) A hyperbola
(D) A pair of straight lines

PHYSICS

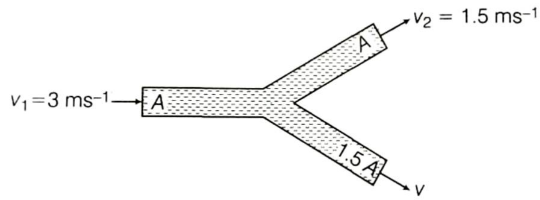
Syllabus: ***HEAT, HYDROSTATICS AND UNITS & MEASUREMENTS:– 1. THERMAL PROPERTIES, 2. THERMODYNAMICS, 3. KINETICTHEORY OF GASES, 4. ELASTICITY, HYDROSTATICS AND DYNAMICS (Including surface tension and viscosity) 5. UNITS,MEASUREMENTS AND ERRORS***.

1. How would the levels change in case (b), if 13.6 cm of water (immiscible with mercury) are poured into the right limb of the manometer? (Ignore the small change in volume of the gas).
(A) 19 cm (B) 20 cm (C) 21 cm (D) 23 cm

2. A plane is in level fligh at constant speed and each of its two wings has an area of 25 m^2. If the speed of the air is 180 kmh^{-1} over the lower wing and 234 kmh^{-1} over the upper wing surface, determine the mass of plane. (Take air density to be 1 kgm^{-3}).
(A) 4000 kg (B) 5400 kg (C) 4400 kg (D) 5000 kg

SECTION-II
(Numerical Value Answer Type)

3. An incompressible liquid flows through a horizontal tube as shown (areas of tubes is marked in diagram) then the velocity v of the fluid is (in ms^{-1})



(A) 3.0 (B) 1.5 (C) 1.0 (D) 2.25

4. A cylinder of height 20 m is completely filled with water. The velocity of efflux of water (in ms^{-1}) through a small hole on the side wall of the cylinder near its bottom is

(A) 10 (B) 20 (C) 25.5 (D) 5

5. An open glass tube is immersed in mercury in such a way that a length of 8 cm extends above the mercury level. The open end of the tube is then closed and sealed and the tube is raised vertically up by additional 46 cm. What will be length of the air column above mercury in the tube now (in cm)?

(Atmospheric pressure = 76 cm of Hg)

(A) 16 (B) 22 (C) 38 (D) 6

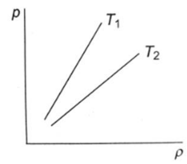
6. A man grows into a giant such that his linear dimensions increase by a factor of 9. Assuming that his density remains same, the stress in the leg will change by a factor of

(A) 81 (B) 0.012 (C) 9 (D) 0.111

7. The temperature at which the r.m.s velocity of oxygen molecules equal that of nitrogen molecules at 100ºC is nearly

(A) 426.3 K (B) 456.3 K (C) 436.3 K (4) 446.3 K

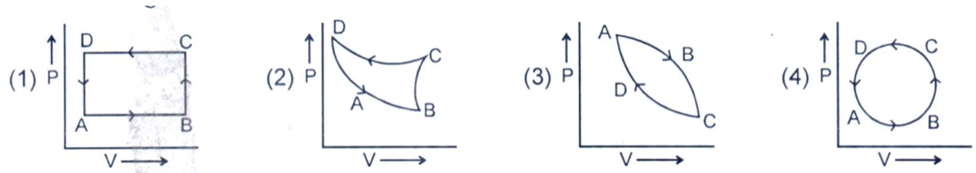
8. Figure shows graphs of pressure vs density for an ideal gas at two temperatures T_1 and T_2



(A) $T_1 > T_2$ (B) $T_1 = T_2$

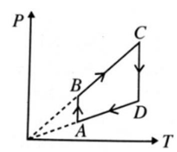
(C) $T_1 < T_2$ (D) any of the three is possible

9. In the following figures (1) to (4), variation of volume by change of pressure is shown. A gas is taken along the path ABCDA. The change in internal energy of the gas will be:



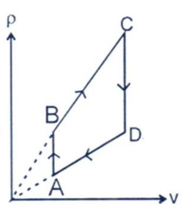
(A) positive in all cases from (1) to (4)
(B) positive in cases (1), (2) and (3) but zero in case (4)
(C) negative in cases (1), (2) and (3) but zero in case (4)
(D) zero in all the four cases

10. Pressure versus temperature graph of an ideal gas is as shown in figure.

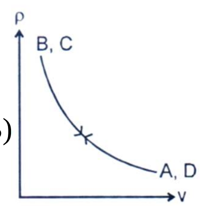


Corresponding density (ρ) versus volume (v) graph will be

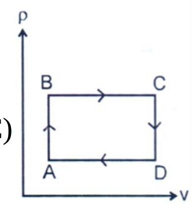
(A)



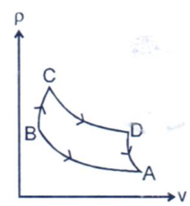
(B)



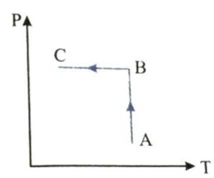
(C)



(D)



11. Ideal gas is taken through process shown in figure:



(A) In process AB, work done by system is positive
(B) In process AB, heat is rejected out of the system
(C) In process AB, internal energy increases
(D) In process AB internal energy decreases and in process BC internal energy increases

12. When an ideal gas undergoes an adiabatic change causing a temparture change ΔT

(i) There is no heat gained or lost by the gas

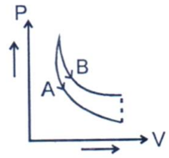
(ii) The work done by the gas is equal to change in internal energy

(iii) The change in internal energy per mole of the gas is $C_v \Delta T$, where C_v is the molar heat capacity at constant volume

(A) (i), (ii), (iii) correct (B) (i), (ii) correct

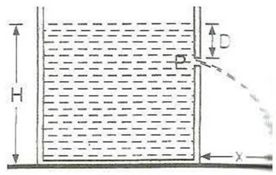
(C) (i), (iii) correct (D) (i) correct

13. In figure, A and B are two adiabatic curves for two different gases. Then A and B corresponds to



(A) Ar and He respectively (B) He and H_2 respectively
(C) O_2 and H_2 respectively (D) H_2 and He respectively

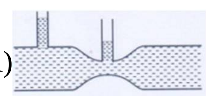
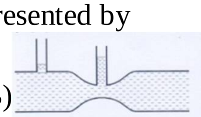
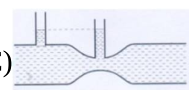
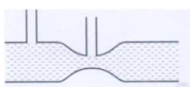
14. A tank is filled with water up to height H. Water is allowed to come out of a hole P in one of the walls at a depth D below the surface of water as shown in the figure. Express the horizontal distance x in terms of H and D



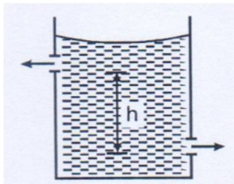
(A) $x=\sqrt{D(H-D)}$ (B) $x=\sqrt{\frac{D(H-D)}{2}}$ (C) $x=2\sqrt{D(H-D)}$ (D) $x=4\sqrt{D(H-D)}$

15. A fixed cylindrical vessel is filled with water up to height H. A hole is bored in the wall at a depth h from the free surface of water. For maximum horizontal range h is equal to
(A) H (B) 3H/4 (C) H/2 (D) H/4

16. For a fluid which is flowing steadily in a horizontal tube as shown in the figure, the level in the vertical tubes is best represented by

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

17. There are two identical small holes on the opposite sides of a tank containing a liquid. The tank is open at the top. The difference in height of the two holes is h as shown in the figure. As the liquid comes out of the two holes, the tank will experience a net horizontal force proportional to



(A) $h^{1/2}$ (B) h (C) $h^{3/2}$ (D) h^2

18. A cylindrical tank of height 0.4 m is open at the top and has a diameter 0.16 m. Water is filled in it up to a height of 0.16 m. How long it will take to empty the tank through a hole of radius 5×10^{-3} m at its bottom?
(A) 46.26 sec (B) 4.6 sec (C) 462.6 sec (D) 0.46 sec

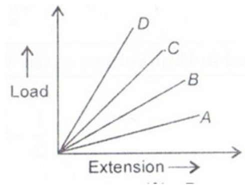
19. A steel wire of diameter 1 mm is stretched horizontally between two clamps located at a distance of 2 m from each other. A load of 0.25 kg is suspended from the mid-point of the wire. What will be the vertical distance in cm through which the mid-point of the wire moves down? Young's modulus of steel = 20×10^{10} N/m^2 and g = 9.8 m/s^2.

(A) 3.5 (B) 1 (C) 2.5 (D) 0

20. Determine the length of the copper wire which breaks under its own weight when suspended vertically from one end. Breaking stress for copper = 2.45×10^8 N/m^2 and density of copper = 8600 kg/m^3.

(A) 2800 (B) 2907 (C) 3027 (D) None of these

21. Figure shows the load of extension curves for four wires A, B, C and D. The dimensions of all the four wires are identical but materials of wires are different. Which wire has highest value of Young's modulus of elasticity?



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

22. Two steel wires, where one has twice the diameter and three times the length of the another, are stretched by the same force. The ratio of the elastic strain energy stored in them is

(A) 2 : 3 (B) 3 : 4 (C) 3 : 2 (D) 6 : 1

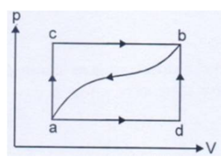
SECTION-II

(Numerical Value Answer Type)

23. The average speed of nitrogen molecules in a gas is v. If the temperature is doubled and the N_2 molecule dissociate into nitrogen atoms, then the average speed will be ηv, where η is

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

24. When a system is taken from state 'a' to state 'b' along the path 'acb', it is found that a quantity of heat Q = 200 J is absorbed by the system and a work W = 80J is done by it. Along the path 'adb', Q = 144J. The work done along the path 'adb' is 6x, where x is



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

25. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its absolute temperature. The ratio Cp/Cv for the gas is $\frac{x}{6}$ where x is

(A) 4 (B) 2 (C) 7 (D) 9

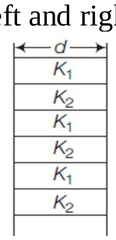
26. A large cylindrical vessel contains water to a height of 10m. It is found that the thrust acting on the curved surface is equal to that at the bottom. If atmospheric pressure can support a water column of 10m, the radius of the vessel is5x, where x is

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

27. A wall has two layers A and B, each made of different material. Both the layers have the same thickness. The thermal conductivity for A is twice that of B. Under steady state, the temperature difference across the whole wall is 36°C. Then the temperature difference across the layer A is

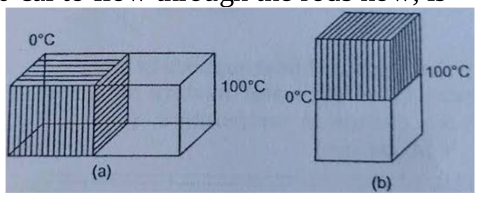
(A) 6°C (B) 12°C (C) 18°C (D) 24°C

28. A wall consists of alternating blocks with length 'd' and coefficient of thermal conductivity k_1 and k_2. The cross sectional area of the blocks are the same. The equivalent coefficient of thermal conductivity of the wall between left and right is



(A) $K_1 + K_2$ (B) $\frac{(K_1 + K_2)}{2}$ (C) $\frac{K_1K_2}{K_1 + K_2}$ (D) $\frac{2K_1K_2}{K_1 + K_2}$

29. Two identical square rods of metal are welded end to end as shown in figure (a). Assume that 10 cal of heat flows through the rods in 2 min. Now the rods are welded as shown in figure, (b). The time it would take for 10 cal to flow through the rods now, is



(A) 0.75 min (B) 0.5 min (C) 1.5 min (D) 1 min

30. A difference of temperature of 25° C is equivalent to a difference of :

(A) 45°F (B) 72°F (C) 32°F (D) 25°F

31. A solid spherical black body of radius r and uniform mass distribution is in free space. It emits power 'P' and its rate of cooling is R then

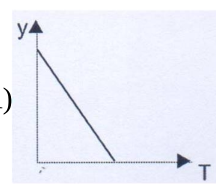
(A) $RP\,\alpha\,r^2$ (B) $RP\,\alpha\,r$ (C) $RP\,\alpha\,1/r^2$ (D) $RP\,\alpha$

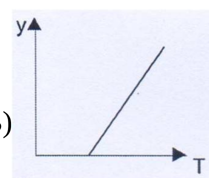
32. Which of the law can be understood in terms of Stefan's law?

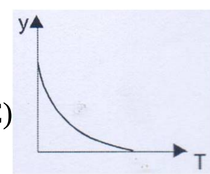
(A) Wien's displacement law (B) Kirchhoff's law

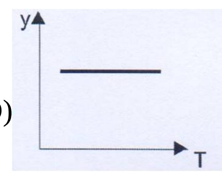
(C) Newton's law of cooling (D) Planck's law

33. A hot liquid is kept in a big room. According to Newton's law of cooling rate of cooling of liquid (represented as y) is plotted against its temperature T. Which of the following curves may represent the plot?

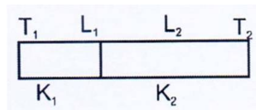
(A) 

(B) 

(C) 

(D) 

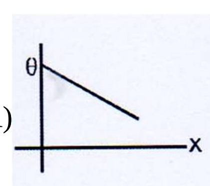
34. One end of a thermally insulated rod is kept at a temperature T_1 and the other at T_2. The rod is composed of two sections of lengths L_1 and L_2 and thermal conductivities k_1 and k_2 respectively. The temperature at the interface of the sections is

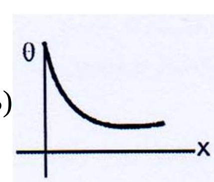


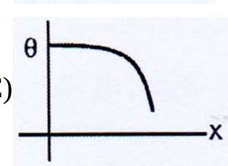
(A) $\frac{(K_2L_2T_1 + K_1L_1T_2)}{(K_1L_1 + K_2L_2)}$ (B) $\frac{(K_2L_1T_1 + K_1L_2T_2)}{(K_2L_1 + K_1L_2)}$

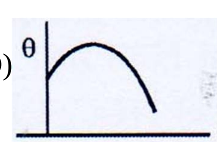
(C) $\frac{(K_1L_2T_1 + K_2L_1T_2)}{(K_1L_2 + K_2L_1)}$ (D) $\frac{(K_1L_1T_1 + K_2L_2T_2)}{(K_1L_1 + K_2L_2)}$

35. 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

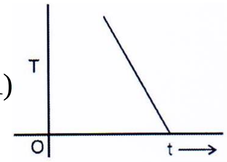
(A) 

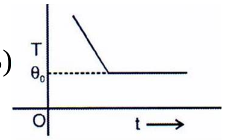
(B) 

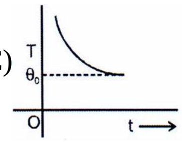
(C) 

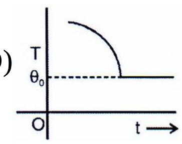
(D) 

36. 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) 

37. Three rods of Copper, brass and steel are welded together to form a Y-shaped structure. Area of cross-section of each rod = 4 cm^2. End of copper rod is maintained at 100°C where as ends of brass and steel are kept at 0°C. Lengths of the copper, brass and steel rods are 46, 13 and 12 cms respectively. The rods are thermally insulated from surroundings except at ends. Thermal conductivities of copper, brass and steel are 0.92, 0.26 and 0.12 CGS units respectively. Rate of heat flow through copper rod is:

(A) 1.2 cal/s (B) 2.4 cal/s (C) 4.8 cal/s (D) 6.0 cal/s

38. A small quantity, mass m, of water at a temperature θ (in ºC) is poured on to a large mass M of ice which is at its melting point. If c is the specific heat capacity of water and L the latent heat of fusion of ice, then the mass of ice melted is given by :

(A) $\frac{ML}{mc\theta}$ (B) $\frac{mc\theta}{ML}$ (C) $\frac{Mc\theta}{L}$ (D) $\frac{mc\theta}{L}$

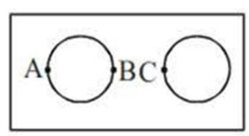
39. 20 gm ice at –10 ºC is mixed with m gm steam at 100 ºC. Minimum value of m so that finally all ice and steam converts into water. (Use s_{ice}=0.5 cal/gmºC,s_{water}=1 cal/gmºC,L (melting)=80 cal/gm and L (vaporization) = 540 cal/gm)

(A) $\frac{85}{32}gm$ (B) $\frac{85}{64}gm$ (C) $\frac{32}{85}gm$ (D) $\frac{64}{85}gm$

40. 2 kg ice at – 20 ºC is mixed with 5 kg water at 20 ºC. Then final amount of water in the mixture will be : [Specific heat of ice = 0.5 cal/gm ºC, Specific heat of water = 1 cal/gm ºC, Latent heat of fusion of ice = 80 cal/gm]

(A) 6 kg (B) 7 kg (C) 3.5 kg (D) 5 kg

41. Two large holes are cut in a metal sheet. If this is heated, distances AB and BC, (as shown)



(A) both will increase (B) both will decrease

(C) AB increases, BC decreases (D) AB decreases, BC increases

42. A steel scale is to be prepared such that the millimetre intervals are to be accurate within 6×10^{-5} mm. The maximum temperature variation from the temperature of calibration during the reading of the millimetre marks is ($\alpha = 12 \times 10^{-6}$ /ºC)

(A) 3.0°C (B) 4.5°C (C) 5.0°C (D) 5.5°C

43. Expansion during heating –

(A) occurs only in a solid
(B) increases the density of the material
(C) decreases the density of the material
(D) occurs at the same rate for all liquids and solids.

44. If a bimetallic strip is heated, it will
(A) bend towards the metal with lower thermal expansion coefficient.
(B) bend towards the metal with higher thermal expansion coefficient.
(C) twist itself into helix
(D) have no bending.

45. Two rods, one of aluminium and the other made of steel, having initial length ℓ_1 and ℓ_2 are connected together to form a single rod of length $\ell_1 + \ell_2$. The coefficients of linear expansion for aluminium and steel are α_a and α_s respectively. If the length of each rod increases by the same amount when their temperature are raised by tºC, then find the ratio $\frac{\ell_1}{(\ell_1+\ell_2)}$

(A) $\frac{\alpha_s}{\alpha_a}$ (B) $\frac{\alpha_a}{\alpha_s}$ (C) $\frac{\alpha_s}{(\alpha_a+\alpha_s)}$ (D) $\frac{\alpha_a}{(\alpha_a+\alpha_s)}$

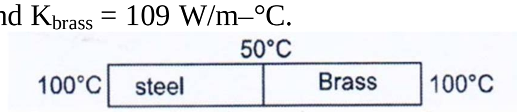
46. A liquid with coefficient of volume expansion γ is filled in a container of a material having the coefficient of linear expansion α. If the liquid overflows on heating, then

(B) $\gamma > 3\alpha$ (B) $\gamma < 3\alpha$ (C) $\gamma = 3\alpha$ (D) None of these

SECTION-II

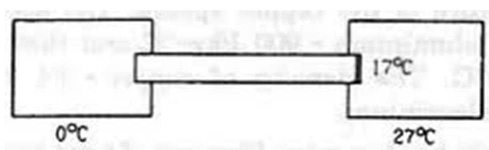
(Numerical Value Answer Type)

47. Figure shows a steel rod joined to a brass rod. Each of the rods has length of 31 cm and area of cross-section 0.20 cm^2. The junction is maintained at a constant temperature 50°C and the two ends are maintained at 100°C. The amount of heat taken out from the cold junction in 10 minutes after the steady state is reached in n × 10^2 J. Find 'n'. The thermal conductivities are K_{steel} = 46 W/m–°C and K_{brass} = 109 W/m–°C.



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

48. A cylindrical rod of length 1 m is fitted between a large ice chamber at 0°C and an evacuated chamber maintained at 27°C as shown in figure. Only small portions of the rod are inside the chambers and the rest is thermally insulated from the surrounding. The cross-section going into the evacuated chamber is blackened so that it completely absorbs any radiation falling on it. The temperature of the blackened end is 17°C when steady state is reached. Stefan constant $\sigma = 6 \times 10^{-8}$ W/m²–K⁴. The thermal conductivity of the material of the rod is 1.2 P (W/m – °C). Find P (29^4 = 707281)



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

49. A lake surface is exposed to an atmosphere where the temperature is < 0°C. If the thickness of the ice layer formed on the surface grows from 2 cm to 4 cm in 1 hour, The atmospheric temperature, Ta will be (– 5x) where x is (Thermal conductivity of ice K = 4 x 10^{-3}cal/cm/s/°C; density of ice = 0.9 gm/cc. Latent heat of fusion of ice = 80 cal/gm. Neglect the change of density during the state change. Assume that the water below the ice has 0º temperature everywhere)

(A) 4 (B) 0 (3) 6 (D) 3

50. How long does a 59 kw water heater take to raise the temperature of 150 L of water from 21°C to 38ºC (in min)?

(A) 3.0 (B) 2.0 (C) 1.0 (D) 4.0

51. 50g of Ice at 0°C is mixed with 200g of water at 0°C. 6 kcal heat is given to system [Ice + water].Find the temperature (in °C) of the system.

(A) 7 (B) 8 (C) 9 (D) 5

52. One kg of ice at 0°C is mixed with 1 kg of water at 10°C. The resulting temperature will be

(A) Between 0°C and 10°C (B) Equal to 0°C
(C) Less than 0°C (D) Greater than 10°C

53. Which one of the following would raise the temperature of 20 gm of water at 30°C most when added to water? (Specific heat of copper = 0.1 cal/gm °C)
(A) 20 gm of water at 40°C
(B) 80 gm of water at 27°C
(C) 1000 gm of copper at 25°C
(D) 4 gm of water at 80°C

54. 10 gm of ice at – 20°C is dropped into a calorimeter containing 10 gm of water at 10°C. The specific heat of water is twice that of ice. When equilibrium is reached, the calorimeter will contain
(A) 10 gm of ice and 10 gm of water
(B) 20 gm of water
(C) 5 gm of ice and 15 gm of water
(D) 20 gm of ice

55. Two liquids, A and B are at 32°C and 24°C respectively. When mixed in equal masses the temperature of the mixture is found to be 28°C. Their specific heats are in the ratio of
(A) 3 : 2 (B) 2 : 3 (C) 1 : 1 (D) 4 : 3

56. Boiling water is changing into steam. Under this condition the specific heat of water is
(A) Zero (B) One (C) Infinite (D) Less than one

57. If there are no heat losses, the heat released by the condensation of x gm of steam at 100°C into water at 100°C can be used to convert y gm of ice at 0°C into water at 100°C. Then the ratio y : x is nearly (S = 1 cal/gK, $L_f = 80\, cal/g; L_v = 540\, cal/g$)
(A) 1 : 1 (B) 2 : 1 (C) 2.5 : 1 (D) 3 : 1

58. A cylinder of radius R made of material of thermal conductivity k_1 is surrounded by a cylindrical shell of inner radius R and outer radius 3R made of a material of thermal conductivity k_2. The two ends of the combined system are maintained at two different temperatures. There is no loss of heat across the cylindrical surface and the system is in steady state. The effective thermal conductivity of the system is
(A) $k_1 + k_2$ (B) $\frac{k_1 + 8k_2}{9}$ (C) $\frac{k_1 k_2}{(k_1 + k_2)}$ (D) $\frac{(8k_1 + k_2)}{9}$

59. Heat is flowing through two cylindrical rods of same material. The diameter of the rod is in the ratio 1 : 2 and the lengths in the ratio of 2 : 1. If the temperature difference between the ends be the same, then the ratio of rate of flow of heat through them will be
(A) 1 : 8 (B) 8 : 1 (C) 1 : 1 (D) 2 : 1

60. Two rods of same length and area of cross-section A_1 and A_2 have their ends at the same temperature. If k_1 and k_2 are their thermal conductivities, C_1 and C_2 are their specific heats and d_1 and d_2 are their densities, then the rate of flow of heat is the same in both ends, if
(A) $\frac{A_1}{A_2} = \frac{k_1}{k_2}$ (B) $\frac{A_1}{A_2} = \frac{k_1 C_1 d_1}{k_2 C_2 d_2}$ (C) $\frac{A_1}{A_2} = \frac{k_1 2 C_1 d_1}{k_2 C_2 d_2}$ (D) $\frac{A_1}{A_2} = \frac{k_2}{k_1}$

61. According to Wien's law
(A) $\lambda_m T$ = Constant
(B) $\frac{\lambda_m}{T}$ = Constant
(C) $\frac{T}{\lambda_m}$ = Constant
(D) $T + \lambda_m$ = Constant

62. A bucket full of hot water is kept in a room and it cools from 75°C to 70°C in T_1 minutes from 70°C to 65°C in T_2 minutes and from 65°C to 60°C in T_3 minutes. Then
(A) $T_1 = T_2 = T_3$ (B) $T_1 < T_2 < T_3$ (C) $T_1 > T_2 > T_3$ (D) $T_1 < T_2 > T_3$

63. Solar radiation emitted by the sun resembles that emitted by black body at a temperature of 6000 K. maximum intensity is emitted at a wavelength of about $4800\overset{0}{A}$. If the sun were to cool down from 6000 K to 3000 K, then the peak intensity would occur at wavelength of

(A) $4800\overset{0}{A}$ (B) $9600\overset{0}{A}$ (C) $2400\overset{0}{A}$ (D) $19200\overset{0}{A}$

64. The power radiated by a black body is P and it radiates maximum energy around the wavelength λ_0. If the temperature of the black body is now changed, so that it radiates maximum energy around the wavelength $\frac{3\lambda_0}{4}$, the power radiated by it will increase by a factor of

(A) $\frac{4}{3}$ (B) $\frac{16}{9}$ (C) $\frac{64}{27}$ (D) $\frac{256}{81}$

65. When water is heated from 0°C to 10°C it volume

(A) Increases (B) Decreases

(C) Does not change (D) First decreases then increases

66. Two rods of lengths ℓ_1 and ℓ_2 are made of materials whose coefficients of linear expansion are α_1 and α_2. If the difference between the two lengths is independent of temperature

(A) $\frac{\ell_1}{\ell_2} = \left(\frac{\alpha_1}{\alpha_2}\right)$ (B) $\frac{\ell_1}{\ell_2} = \left(\frac{\alpha_2}{\alpha_1}\right)$ (C) $\ell_1^2\alpha_1 = \ell_2^2\alpha_2$ (D) $\alpha_1^2\ell_1 = \alpha_2^2\ell_2$

67. A bimetallic strip made of copper $\left(\alpha = 1.8\times10^{-5}K^{-1}\right)$ and steel $\left(\alpha = 1.2\times10^{-5}K^{-1}\right)$ is heated, then

(A) It bends with steel on concave side (B) It bends with copper on concave side

(C) It does not expand (D) Data is insufficient

68. The radiation energy density per unit wavelength at a temperature T has a maximum at a wavelength λ_0. At temperature 2T, it will have a maximum at a wavelength

(A) $4\lambda_0$ (B) $2\lambda_0$ (C) $\lambda_0/2$ (D) $\lambda_0/4$

69. The ratio of coefficient of thermal conductivity of two different materials is 5 : 3. If the thermal resistance of the rods of the same thickness of these materials is same, then the ratio of the length of these rods will be

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

70. In which mode of transmission of heat, does heat travels in form of waves along straight line with the speed of light?

(A) Thermal radiation (B) Forced convection

(C) Natural convection (D) Thermal conduction

71. If gas molecules undergo inelastic collision with the wall of the container?

A) the temperature of the gas will decrease

B) the pressure of the gas will increase

C) neither the temperature nor the pressure will change

D) the temperature of the gas will increase

72. The root mean square velocity of gas molecules at 0^0C will be if at N.T.P its density is 1.43 kg/m^3

A) 461 m/s B) 164 m/s C) 461 cm/s D) 164 cm/s

73. At what temperature does the average translational kinetic energy of a molecule in a gas become equal to kinetic energy of an electron accelerated from rest through a potential difference of 1 volt? $\left(K = 1.38\times10^{-23}J1K\right)$

A) 3770 K B) 7370 K C) 7730 K D) 7330 K

74. The average degrees of freedom per molecule for a gas is 6. The gas performs 25J of work when it expands at constant pressure. The heat absorbed by gas is

A) 75 J B) 100 J C) 150 J D) 125 J

75. A vessel of volume V=5.0 litre contains 1.4 gm of nitrogen of temperature T=1800 K. Find the pressure of the gas if 30% of its molecule are dissociated into atom at this temperature.

A) $0.54\times10^{5}N/m^{2}$ B) $1.94\times10^{5}N/m^{2}$ C) $2.62\times10^{5}N/m^{2}$ D) $3.75\times10^{5}N/m^{2}$

76. Two chambers one containing m_1 gram of a gas at pressure P_1 and other containing m_2 gram of same gas at pressure P_2 are put in communication with each other. If temperature remains constant, the common pressure reached will be

A) $\frac{P_1P_2(m_1+m_2)}{P_1m_2+P_2m_1}$ B) $\frac{m_1m_2(P_1+P_2)}{P_1m_2+P_2m_1}$ C) $\frac{P_1P_2m_1}{P_1m_2+P_2m_1}$ D) $\frac{m_1m_2P_2}{P_1m_2+P_2m_1}$

77. The pressure of an ideal gas varies according to the law $P=P_0-Av^2$ where P_0 and A are positive constant, what is the highest temperature that can be attained by the gas?

A) $\frac{P_0}{nR}\sqrt{\frac{P_0}{A}}$ B) $\frac{P_0}{nR}\sqrt{\frac{P_0}{2A}}$ C) $\frac{2P_0}{nR}\sqrt{\frac{P_0}{2A}}$ D) $\frac{2P_0}{3nR}\sqrt{\frac{P_0}{3A}}$

78. Find the number of degrees of freedom of molecules in a gas whose molar heat capacity at constant pressure is equal to $C_P=29J/(mol.K)$

A) 3 B) 4 C) 5 D) 6

79. An ideal gas undergoes a process in which PV^{-a} = constant where V is the volume occupied by the gas initially at pressure P. At the end of the process, 'rms' speed of gas molecule has become $a^{1/2}$ times of its initial value. What will be the value of C_V so that energy transferred in the form of heat to the gas is 'a' times of the initial energy

A) $\frac{(a^2+1)R}{a^2-1}$ B) $\frac{(a^2+1)R}{(a^2+1)}$ C) $\frac{(a+1)R}{(a-1)}$ D) $\frac{(a-1)R}{(a+1)}$

80. N molecules each of mass 'm' of gas 'A' and '2N' molecules each of mass '2m' of gas 'B' are contained in the same vessel which are maintained at a temperature T. The mean square velocity of molecules of B type is denoted by V^2 and the mean square of the x component of the velocity of A type is denoted by CV^2, then $\frac{W^2}{V^2}$ is

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

81. The r.m.s. speed of oxygen molecule (O_2) at a certain temperature is T is V. If on increasing the temperature of the oxygen gas to 2T, the oxygen molecules dissociate into atomic oxygen, find the speed of the oxygen atom

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

82. Diatomic molecules like hydrogen have energies due to both translational as well as rotational motion from the equation in kinetic theory $PV=\frac{2}{3}E,\ E'$ is

A) the total energy per unit volume
B) only the translational part of energy because rotational energy is very small compared to the translational energy
C) only the translational part of energy because during collision with the wall pressure relates to changes in linear momentum
D) the translational part of the energy because rotational energies of molecules can be of either sign and its average over all the molecules is zero.

83. When an ideal gas is compressed adiabatically, its temperature rises the molecule on the average have more kinetic energy than before. The kinetic energy increase

A) Because of collision with moving parts of the wall only

B) Because of collision with the entire wall

C) Because of molecules gets accelerated in their motion inside the volume

D) Because of redistribution of energy amongst the molecules

84. One mole of an ideal gas undergoes a process $P = \dfrac{P_0}{1+\left(\dfrac{V_0}{V}\right)^2}$. Here, P_0 *and* V_0 are constants.

Change in temperature of the gas when volume is changed from $V = V_0$ *to* $V = 2V_0$ is

A) $\dfrac{-2P_0V_0}{5R}$ B) $\dfrac{11P_0V_0}{10R}$ C) $\dfrac{-5P_0V_0}{4R}$ D) P_0V_0

85. The equation of state of a gas is given by $\left(P+\dfrac{aT^2}{V}\right)V^c = (RT+b)$, where *a*, *b*, *c* and *R* are constants.

The isotherms can be represented by $P = AV^m - BV^n$, where *A* and *B* depend only on temperature and

A) $m = -c$ and $n = -1$ B) $m = c$ and $n = 1$

C) $m = -c$ and $n = 1$ D) $m = c$ and $n = -1$

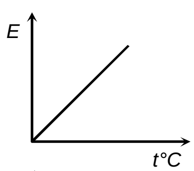
86. Inside a cylinder having insulating walls and closed at ends is a movable piston, which divides the cylinder into two compartments. On one side of the piston is a mass *m* of a gas and on the other side a mass 2 *m* of the same gas. What fraction of volume of the cylinder will be occupied by the larger mass of the gas when the piston is in equilibrium? Consider that the movable piston is conducting so that the temperature is the same throughout

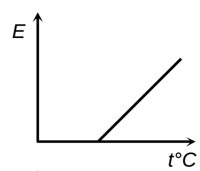
A) $\frac{1}{4}$ B) $\frac{1}{3}$ C) $\frac{1}{2}$ D) $\frac{2}{3}$

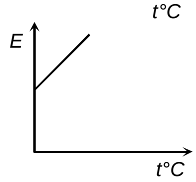
87. The temperature of the mixture of one mole of helium and one mole of hydrogen is increased from $0°C$ to $100°C$ at constant pressure. The amount of heat delivered will be

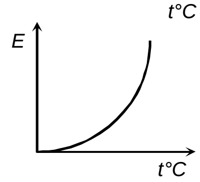
A) 600 *cal* 2) 1200 *cal* 3) 1800 *cal* D) 3600 *cal*

88. The graph which represent the variation of mean kinetic energy of molecules with temperature *t*°*C* is

A)


B)


C)


D)


89. Energy of all molecules of a monatomic gas having a volume V and pressure P is 3/2 PV. The total translational kinetic energy of all molecular of a diatomic gas at the same volume and pressure is

A) 1/2 PV B) 3/2 PV C) 5/2 PV D) 3 PV

90. Internal energy of n_1 mole of hydrogen of temperature T is equal to the internal energy of n_2 mole of helium at temperature 2T. The ratio $\dfrac{n_1}{n_2}$ is

A) $\dfrac{3}{5}$ B) $\dfrac{2}{3}$ C) $\dfrac{6}{5}$ D) $\dfrac{3}{7}$

91. Consider a collection of large number of particles each with speed v. The direction of velocity is randomly distributed in the collection. What is the magnitude of the relative velocity between a pairs in the collection?

A) $2V/\pi$ B) V/π C) $8V/\pi$ D) $4V/\pi$

92. Three closed vessels A,B and C are at the same temperature T and contain gases which obey the Maxwellian distribution of velocities. Vessel A contains only O_2, B only N_2 and C a mixture of equal quantities of O_2 and N_2. If the average speed of the O_2 molecules in vessel A is V_1, that of the N_2 molecules in vessel B is V_2, the average of the O_2 molecules in vessel C is

A) $\frac{V_1+V_2}{2}$ B) V_1 C) $(V_1V_2)^{1/2}$ D) $\sqrt{3kT/M}$

93. A cubic vessel (with face horizontal + vertical) contains, an ideal gas at NTP. The vessel is being carried by a rocket which is moving at a speed of $500ms^{-1}$ in vertical direction. The pressure of the gas inside the vessel as observed by us on the ground

(A) Remains the same because $500\ ms^{-1}$ is very much smaller than V_{rms} of the gas

(B) Remains the same because motion of the vessel as a whole does not affect the relative motion of the gas molecules and the walls

(C) Will increase by a factor equal to $\frac{v_{rms}^2+(500)^2}{v_{rms}^2}$ where v_{rms} was the original mean square velocity of the gas

(D) Will be different on the top wall and bottom wall of the vessel

94. From the following statements, concerning ideal gas at any given temperature T, select the incorrect one (s)

(A) The coefficient of volume expansion at constant pressure is same for all ideal gas

(B) The average translational kinetic energy per molecule of oxygen gas is 3KT (K being Boltzmann constant)

(C) In a gaseous mixture, the average translation kinetic energy of the molecules of each component is same

(D) The mean free path of molecules increases with decrease in pressure

95. How is the mean free path (λ) in a gas related to the interatomic distance?

(A) λ is 10 times the interatomic distance

(B) λ is 100 times the interatomic distance

(C) λ is 1000 times the interatomic distance

(D) λ is $\frac{1}{10}$ times of the interatomic distance

CHEMISTRY

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

1. A and B are two identical vessels. A contains 75 g of ethane at 298 K and 1 atm. The vessel B contains 75 g gas X_2 at the same temperature and pressure. The vapour density of X_2 is

(A) 75 (B) 150 (C) 37.5 (D) 300

2. The behavior of real gas is usually depicted by plotting compressibility factor Z versus P at constant temperature. At high temperature and high pressure, Z is usually more than one. This fact can be explained by van der Waals' equation when:

(A) The constant a is negligible and not b (B) The constant b is negligible and not a
(C) Both constant a and b are negligible (D) Both constant a and b are not negligible

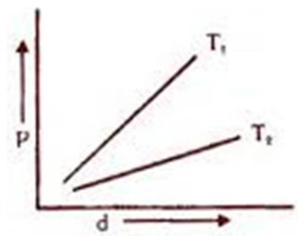
3. When gases are heated from 20°C to 40°C at constant pressure, the volumes:

(A) Increase by the same magnitude (B) Become double
(C) Increase in the ratio of their molecular masses
(D) Increase but to different extent

4. A V dm^3 flask contains gas A and another flask of 2V dm^3 contains gas B at the same temperature. If density of gas A is 3.0 g dm^{-3} and gas of B is 1.5 g dm^{-3} and molar mass of $A = \frac{1}{2}$ molar mass of B. then the ratio of pressure exerted by gases is

(A) $P_A / P_B = 2$ (B) $P_A / P_B = 1$ (C) $P_A / P_B = 4$ (D) $P_A / P_B = 3$

5. Figure shows graphs of pressure versus density for an ideal gas at two temperatures T_1 and T_2. Which is correct?



(A) $T_1 > T_2$ (B) $T_1 = T_2$ (C) $T_1 < T_2$ (D) None of these

6. The ratio of average speed of an oxygen molecule to the RMS speed of a nitrogen molecule at the same temperature is

(A) $\left(\frac{3\pi}{7}\right)^{1/2}$ (B) $\left(\frac{7}{3\pi}\right)^{1/2}$ (C) $\left(\frac{3}{7\pi}\right)^{1/2}$ (D) $\left(\frac{7\pi}{3}\right)^{1/2}$

7. Volume occupied by molecules of one mole of gas at NTP, having radius 10^{-8} cm is approximately:

(A) 22.4 litre (B) $\frac{22.4}{\text{Av.No}}$ litre (C) 2.4 mL (D) 10.09 mL

8. Gases deviate from ideal gas behavior because their molecule

(A) Posses negligible volume (B) Have forces of attraction between them

(C) Are polyatomic (D) All of the above

9. A balloon filled with ethyne is pricked with a sharp point and quickly dropped in a tank of H_2 gas under identical conditions. After a while the balloon will have

(A) Shrunk (B) Enlarged

(C) Completely collapsed (D) Remained unchanged in size

10. The van der Waal's equation is $\left(P + \frac{n^2a}{V}\right)(V - b) = nRT$ for n moles where a and b are van der Waals' constants. Which of the following statements are true about a and b when the temperature of the gas is too low?

(A) Both remains same (B) a remains same, b varies

(C) a varies, b remains same (D) Both varies

11. A vessel has nitrogen gas and water vapour at a total pressure of 1 atm. The partial pressure of water vapour is 0.3 atm. When the contents of this vessel are transformed to another vessel having one third of the capacity of original vessel, completely at the same temperature, the total pressure of the system in the new vessel is

(A) 3.0 atm (B) 1 atm (C) 3.33 atm (D) 2.4 atm

12.

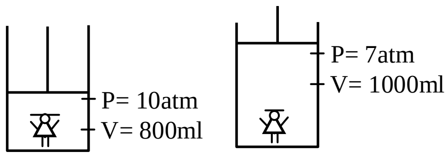
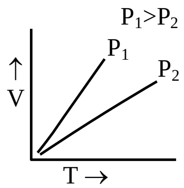


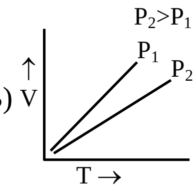
Fig I Fig II

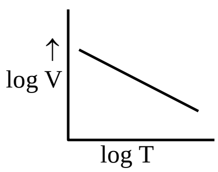
In the above figures a doll is entrapped within a piston and cylinder containing gas. Initial and final conditions are shown Figure-I and Figure-II respectively. The volume of doll is -

(A) 1000 ml (B) $\frac{15000}{17}$ ml (C) $\frac{1000}{3}$ ml (D) $\frac{1000}{15}$ ml

13. Which of the following graph is/are correct as per Charles law ?

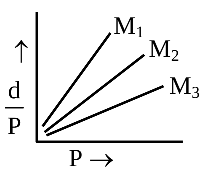
(A) 

(B) 

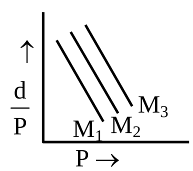
(B) 

(D) Both (2) and (3) are correct

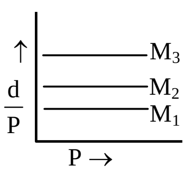
14. For the different ideal gases $\left(\frac{d}{P}\right)$ versus P variations at definite temperature is -

(A) 

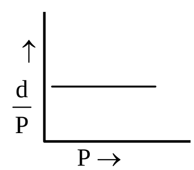
$M_3 > M_2 > M_1$

(B) 

$M_1 > M_2 > M_3$

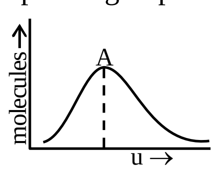
(C) 

$M_3 > M_2 > M_1$

(D) 

15. Distribution of molecules with velocity is represented by the curve :

Velocity corresponding to point A is -



(A) $\sqrt{\frac{3RT}{M}}$ (B) $\sqrt{\frac{2RT}{M}}$ (C) $\sqrt{\frac{8RT}{\pi M}}$ (D) $\sqrt{\frac{RT}{M}}$

16. Regarding compressibility factor, Z which of the following is/are correct ?

(A) For most of the real gases Z decreases with P at the lower pressure

(B) For most of the real gases Z increases with P at the higher pressure

(C) For $H_2(g)$ and He(g) Z increases with P at all the pressure & at room temperature

(D) All of the above are correct

17. Which of the following is most suitable for liquefication ?

(A) $T > T_C$ & $P > P_C$ (B) $T < T_C$ & $P < P_C$

(C) $T < T_C$ & $P > P_C$ (D) $T < T_C$ & $P = 0$

18. Critical temperature and critical pressure values of four gases are given -

Gas	C.Temp (K)	C. Pressure (atm.)
P	5.1	2.2
Q	33	13
R	126	34
S	135	40

Which of the gas/gases cannot be liquefied at a temperature 100 K and pressure 50 atmospheres ?

(A) S only (B) P only (C) R and S (D) P and Q

19. Under critical states of a gas for one mole of a gas, compressibility factor is -

(A) $\frac{3}{8}$ (B) $\frac{8}{3}$ (C) 1 (D) $\frac{1}{4}$

20. A gas at a pressure of 5.0 atm is heated from 0° to 546 °C and simultaneously compressed to one-third of its original volume. Hence final pressure is -

(A) 10.0 atm (2) 30.0 atm (C) 45.0 atm (D) 5.0 atm

21. An open vessel containing air is heated from 300 K to 400 K. The fraction of air originally present which goes out of it is at 400 K -

(A) 3/4 (B) 1/3 (C) 2/3 (D) 1/8

22. What weight of hydrogen at STP could be contained in a vessel that holds 4.8 g oxygen at STP?

(A) 4.8 g (B) 3.0 g (C) 0.6 g (D) 0.3 g

23. $N_2 + 3H_2 \longrightarrow 2NH_3$. 1 mol N_2 and 4 mol H_2 are taken in 15 L flask at 27 °C. After complete conversion of N_2 into NH_3, 5 L of H_2O is added. Pressure set up in the flask is -

(A) $\frac{3\times 0.0821\times 300}{15}$ atm (B) $\frac{2\times 0.0821\times 300}{10}$ atm

(C) $\frac{1\times 0.0821\times 300}{15}$ atm (D) $\frac{1\times 0.0821\times 300}{10}$ atm

24. A sample of air contains only N_2, O_2 and H_2O. It is saturated with water vapours and total pressure is 640 torr. The vapour pressure of water is 40 torr and the molar ratio of $N_2 : O_2$ is 3 : 1. The partial pressure of N_2 in the sample is -

(A) 540 torr (B) 900 torr (C) 1080 torr (D) 450 torr

25. A vessel is filled with mixture of oxygen and nitrogen. At what ratio of partial pressure will the mass of gases be identical -

(A) $p(O_2) = 0.785\, p(N_2)$ (B) $p(O_2) = 8.75\, p(N_2)$

(C) $p(O_2) = 11.4\, p(N_2)$ (D) $p(O_2) = 0.875\, p(N_2)$

26. A cylinder of compressed gas bears no label is supposed to contain either ethylene (C_2H_4) or propylene (C_3H_6). Combustion of the gaseous sample shows that 12 mL of gas required 54 mL of oxygen for complete combustion. This indicates that the gas is -

(A) only ethylene (B) only propylene

(C) 1 : 1 mixture of two gases (D) some unknown mixture of two gases

27. In an effusion experiment, it required 40 s for a certain number of moles of a gas of unknown molar mass to pass through a small orifice into a vacuum. Under the same conditions, 16 s were required for the same number of moles of O_2 to effuse. What is the molar mass of the unknown gas

(A) 5.1 g/mol (B) 12.8 g/mol (C) 80 g/mol (D) 200 g/mol

28. Two glass bulb A and B are connected by a very small tube (of negligible volume) having stop cock. Bulb A has a volume of 100 cm^3 and contains certain gas while bulb B is empty. On opening the stop cock, the pressure in 'A' fell down by 60%. The volume of bulb B must be -

(A) 200 mL (B) 150 mL (C) 250 mL (D) 100 mL

29. A certain gas effuses out of two different vessels A and B. A has a circular orifice while B has a square orifice of length equal to the radius of the orifice of vessel A. The ratio of rate of diffusion of the gas from vessel A to that from vessel B is -

(A) $\pi : 1$ (B) $1 : \pi$ (C) 1 : 1 (D) 3 : 2

30. A balloon with volume 4200 m^3 is filled with helium gas at 27ºC, 1 bar pressure and is found to weigh 700 kg. if density of air is 1.2 kg m^{-3}, the pay load of balloon is -

(A) 5040 kg (B) 4340 kg (C) 3500 Kg (D) 5740 kg

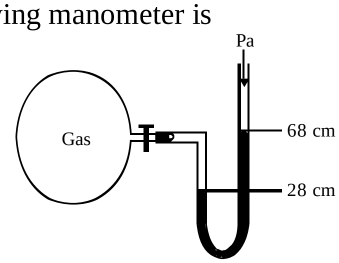
31. A gas with formula C_nH_{2n+2} diffuses through the porous plug at a rate one sixth of the rate of diffusion of hydrogen gas under similar condition. The formula of gas is -

(A) C_2H_6 (B) $C_{10}H_{22}$ (C) C_5H_{12} (D) C_9H_{14}

32. A gaseous mixture of three gases A, B and C has a pressure of 10 atm. The total number of moles of all the gases is 10. If the partial pressure of A and B are 3.0 and 1.0 atm respectively and if C has mol. wt. of 2.0, what is the weight of C in g present in the mixture ?

(A) 6 (B) 8 (C) 12 (D) 3

33. The pressure of gas in the following manometer is



(A) Pa + 40 (B) Pa –h (C) Pa – 40 (D) none of these

34. Calculate the percentage change in volume when the temperature of one mole of an ideal gas increases from 260 K to 320 K at constant pressure.

(A) 20 % (B) 30 % (C) 40 % (D) 23%

35. 0.1 mole of a gas at 0^oC and 0.99 atm pressure occupies a volume of 2.264 L. Select the correct statement.

(A) The gas is ideal
(B) The gas is real with intermolecular attractions.
(C) The gas is real without intermolecular repulsion
(D) The gas is real with intermolecular repulsion greater than intermolecular attraction

36. A real gas obeying van der Waal,s equation will resemble ideal gas if the

(A) constant a and b are small (B) a is large and b is small
(C) a is small and b is large (D) constant a and b are large

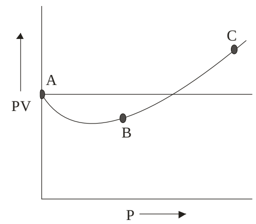
37. Which of the following is correct statement?

(A) the excluded volume of one molecule at low pressure is very high.
(B) excluded volume of one molecule is four time of the actual volume of the gas molecule.
(C) excluded volume of one molecule equal to total volume of vessel.
(D) excluded volume of one molecule is equal to the actual volume of gas molecule.

38. Which of the following has highest value of van der Waal's constant a

(A) Ar (B) CCl_4 (C) NH_3 (D) H_2

39. Select the correct statement for the following figure.



(A) At point B intermolecular repulsive forces are dominates

(B) At point C volume occupied by one molecule can be negligible

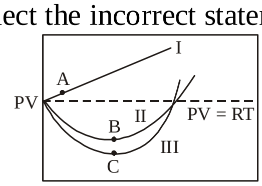
(C) At point A the value of van der Waal,s constants is very high

(D) At point C the gas is less compressible than ideal gas

40. Hydrogen is behaving as a real gas at low pressure. It's compressibility factor at the same pressure is

(A) $\frac{PV}{RT}=1$ (B) $(1+bV)$ (C) $\left(1+\frac{b}{V}\right)$ (D) $\left(1-\frac{a}{V^2}\right)$

41. Consider isotherms, I, II and III. Select the incorrect statement.



(A) For He gas isotherm I is obtained.
(B) When force of attraction is negligible, isotherms II and III are followed after point B or C
(C) When covolume is neglected isotherms II and III are followed A to B or A to C.
(D) For hydrogen isotherm II is obtained

42. Compressibility factor for a gas X at 286 K and 650 atm pressure is 0.85. Calculate the number of moles of X required to fill a gas cylinder of 100 mL capacity under the given conditions.

(A) 3.26 (B) 4.86 (C) 6.82 (D) 1.84

43. A correction using the term $\frac{an^2}{V^2}$ is made in the ideal gas equation to account for

(A) volume occupied by one molecule
(B) restricted movement of gas molecules
(C) inward pull experienced by the molecule at the surface
(D) pressure exerted by one molecule of gas

44. The value of $(PV_m)_{P\to 0}$ of a real gas is independent of the nature of gas because

(A) As $P\to 0$, there is no molecular attractions and volume occupied by one molecule is negligible in compression to the total volume of gas.

(B) As $P\to 0$, there is molecular attractions and volume occupied by one molecule is negligible in compression to the total volume of gas.

(C) As $P\to 0$, there is no molecular attractions and volume occupied by one molecule can not be negligible in compression to the total volume of gas.

(D) As $P\to 0$, gaseous molecule are free to move all the possible directions and volume occupied by one molecule is not negligible in compression to the total volume of gas.

45. `a' and `b' are van der Waals' constants for gases. Chlorine is more easily liquefied than ethane because

(A) a and b for Cl_2 < a and b for C_2H_6
(B) a for Cl_2 < a for C_2H_6 but b for Cl_2 > b for C_2H_6
(C) a for Cl_2 > a for C_2H_6 but b for Cl_2 < b for C_2H_6
(D) a and b for Cl_2 > a and b for C_2H_6

46. The critical temperature of gases A and B are 10 and 30 ^oC respectively. The correct statement is

(A) Gas A can be easily liquefied than gas B
(B) At room temperature gas B can be liquefied more easily than gas A
(C) Both gas can be liquefied only by compression at room temperature
(D) Gas A can be liquefied more easily then B at room temperature

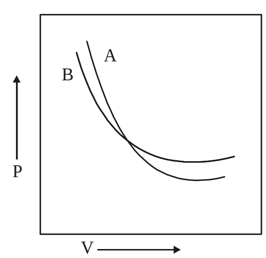
47. Bottle of dry ammonia and a bottle of dry hydrogen chloride connected through a long tube are opened simultaneously at both ends, the white ammonium chloride ring first formed will be

(A) at the center of the tube
(B) near the hydrogen chloride bottle
(C) near the ammonia bottle
(D) throughout the length of the tube

48. The rate of diffusion of two gases 'X' and 'Y' under same conditions of temperature and pressure are in the ratio of 2 : 1. What is the ratio of rms velocity of these gases if temperature of the gases is in the ratio of 3 : 1 ?

(A) 12 : 1
(B) 1 : 1
(C) 3 : 2
(D) $\sqrt{12}:1$

49. Consider the following figure and select the correct statement



(A) Curve A and B reprsents real and ideal gas respectively

(B) Curve A and B reprsents ideal gas

(C) Curve B and A reprsents real and ideal gas respectively

(D) Curve A and B reprsents real gas

50. In kinetic theory of gases, only translational motion of molecules is considered because:

(A) There is no intermolecular forces

(B) The molecules are considered rigid spheres of negligible volume

(C) Different molecules may travel at different speeds

(D) In normal conditions, rotational and vibrational motion is not observed in gas molecules

51. 6×10^{22} gas molecules each of mass 10^{-24} kg are taken in a vessel of 10 litre. What is the pressure exerted by gas molecules? The average velocity of the gas molecules is 92.62 m/sec.

(A) 2×10^5 Pa
(B) 20 Pa
(C) 2×10^6 Pa
(D) 2×10^4 Pa

52. One mole of an ideal gas is subjected to adiabatic expansion in vacuum from initial state of 16 atm, 200 K to final state of 1 atm. Select the incorrect option if $\gamma = \frac{4}{3}$ for the gas

(A) $\Delta U = 0$
(B) $\Delta S = 1 \times R\, \ell n16$
(C) $\Delta S_{surrounding} = 0$
(D) $V_{final} = 8.21$ litre

53. The Gibbs free energy of formation of MO and CO at temperature 1000°C and 1900°C are given below:

$2M + O_2 \longrightarrow 2MO \qquad \Delta G_{1000°C} = -921\,kJ/mol$

$\qquad\qquad\qquad\qquad\qquad \Delta G_{1900°C} = -300\,kJ/mol$

$2C + O_2 \longrightarrow 2CO \qquad \Delta G_{1000°C} = -432\,kJ/mol$

$\qquad\qquad\qquad\qquad\qquad \Delta G_{1900°C} = -624\,kJ/mol$

$MO + C \xrightarrow{\Delta} M + CO\uparrow$

This reaction is feasible at temperature:

(A) 1900°C (2) 1000°C (C) 900°C (D) 1200°C

54. Which of the reaction is expected to be spontaneous at low temperatures and non-spontaneous at high temperatures?

(A) Dissociation of $PC\ell_5$ to give $PC\ell_3$ and $C\ell_2$ (B) Formation of H_2O from $H_2(g)$ and $O_2(g)$

(C) Melting of ice (D) Vaporisation of any volatile liquid

55. Calculate $\Delta G(kH/mol)$ for the reaction at 300 K.

$N_2(g) + O_2(g) \longrightarrow 2NO(g)$ at an instant where partial pressure of N_2, O_2 and NO are 10^{-1} bar, 10^{-3} bar, 10^{-3} bar. If $\Delta H_f^{\circ} NO(g)$ at 300 K = 90.5 kJ/mol and $\Delta S_f^{\circ} NO(g)$ at 300 K = 12.5 J/Kmole: [2.303 × R × 300 = 5750 J/mole]

(A) 173.5 kJ/mole (B) 185 kJ/mole (C) 162 kJ/mole (D) 84.25 kJ/mole

56. For a reaction: $3A(g) + B(g) \longrightarrow 2C(g) + 4D(\ell)$

$\Delta U° =$ 50 kcal/mole and $\Delta S° =$ – 400 cal/mol-K. Calculate $\Delta G°$ at 200 K.

(A) 129.2 kcal (B) 130 kcal (C) 130.8 kcal (D) – 30 kcal

57. Calculate C – H Bond energy from the following data:

$\Delta H_f \quad [C(g)] = 716.68\,kJ/mole$

$\Delta H_f \quad [H(g)] = 217.97\,kJ/mole$

$\Delta H_f \quad [CH_4(g)] = -74.81\,kJ/mole$

(A) 1663.37 kJ (B) 415.84 kJ (C) 179.17 kJ (D) 74.81 kJ

58. Calculate $\Delta H^{\circ}_{combustion}$ of $C_{(graphite)}$ if ΔH_f° of acetone = – 250 kJ, $\Delta H^{\circ}_{combustion}$ of acetone = – 1760 kJ, $\Delta H^{\circ}_{combustion}$ of $H_2(g)$ = – 280 kJ

(A) – 390 kJ (B) – 120 kJ (C) – 500 kJ (D) – 200 kJ

59. $C_2H_6(g) + 3.5O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$

$\Delta S_{vap}(H_2O, \ell) = x_1\,cal\,K^{-1}$ (boiling pint = T_1)

$\Delta H_f(H_2O, \ell) = x_2$

$\Delta H_f(CO_2) = x_3$

$\Delta H_f(C_2H_6) = x_4$

Hence, ΔH for the reaction is

(A) $2x_3 + 3x_2 - x_4$ (B) $2x_3 + 3x_2 - x_4 + 3x_1T_1$

(C) $2x_3 + 3x_2 - x_4 - 3x_1T_1$ (D) $x_1T_1 + x_2 + x_3 - x_4$

60. An ideal gas is allowed to expand both reversibly and irreversibly in an isolated system. If Ti is the initial temperature and Tf is the final temperature, which of the following statements is correct?

(A) $T_f > T_i$ for reversible process but $T_f = T_i$ for irreversible process

(B) $(T_f)_{rev} = (T_f)_{irrev}$

(C) $T_f = T_i$ for both reversible and irreversible processes

(D) $(T_f)_{irrev} > (T_f)_{rev}$

61. One mole of an ideal gas is subjected to adiabatic expansion form initial state of (10atm, 300K) to final pressure of 1 atm against constant external pressure. Which of the following option contain **correct** change in thermodynamic parameters for the above process? (Given: $\gamma = 4/3$)

(A) $\Delta U = 270R$ (B) $\Delta S = R\,\ell n10$ (C) $\Delta H = 230R$ (D) $w = -202.5R$

62. $C(s)+O_2(g)\rightarrow CO_2(g);\quad \Delta H = -94.3\,kcal/mol$

$CO(g)+\frac{1}{2}O_2(g)\rightarrow CO_2(g);\quad \Delta H = -67.4\,kcal/mol$

$O_2(g)\rightarrow 2O(g);\quad \Delta H = 117.4\,kcal/mol$

$CO(g)\rightarrow C(g)+O(g);\quad \Delta H = 230.6\,kcal/mol$

Calculate ΔH for $C(s)\rightarrow C(g)$ in kcal/mol.

(A) 171 (B) 154 (C) 117 (D) 145

63. The bond dissociation energy of gaseous $H_2, C\ell_2$ and $HC\ell$ are 104, 58 and 103 kcal/mol respectively. The enthalpy of formation for $HC\ell$ gas will be

(A) – 44.0 kcal (B) – 22.0 kcal (C) 22.0 kcal (D) 44.0 kcal

64. Which of the reaction defines molar ΔH_f°?

(A) $CaO(s)+CO_2(g)\rightarrow CaCO_3(s)$ (B) $\frac{1}{2}Br_2(g)+\frac{1}{2}H_2(g)\rightarrow HBr(g)$

(C) $N_2(g)+2H_2(g)+\frac{3}{2}O_2(g)\rightarrow NH_4NO_3(s)$ (D) $I_2(s)+H_2(g)\rightarrow 2HI(g)$

65. Heat of neutralization of NH_4OH and HCl is

(A) 13.7 kcal/mole (B) < 13.7 kcal/mole

(C) > 13.7 kcal/mole (D) zero

66. Enthalpy of a reaction at 27°C is 15 kJ mol^{-1}. The reaction will be feasible if entropy is

(A) 15 J mol^{-1} K^{-1} (B) – 50 J mol^{-1} K^{-1}

(C) greater than 50 J mol^{-1} K^{-1} (D) less than 50 J mol^{-1} K^{-1}

67. Which of the following statements/relationships is not correct?

(A) in an exothermic reaction, the enthalpy of products is less than that of reactants

(B) $\Delta H_{fusion} = \Delta H_{sublimation} - \Delta H_{vaporisation}$

(C) A reaction for which $\Delta H^o < 0$ and $\Delta S^o > 0$ is always spontaneous.

(D) ΔH is less than ΔE for the reaction $C(s)+\frac{1}{2}O_2(g)\longrightarrow CO(g)$

68. For a reaction $2NH_3(g)\longrightarrow N_2(g)+3H_2(g)$ which of the following statements is correct?

(A) $\Delta H = \Delta U$ (B) $\Delta H < \Delta U$ (C) $\Delta H > \Delta U$ (D) $\Delta H = 0$

69. Equal volumes of molar hydrochloric acid and sulphuric acid are neutralized by dil. NaOH solution and x kcal and y kcal of heat are liberated respectively. Which of the following is true?

(A) x = y (B) $x = \frac{1}{2}y$ (C) $x = 2y$ (D) none of these

70. During isothermal expansion of an ideal gas, its

(A) internal energy increases (B) enthalpy decreases

(C) enthalpy remains unaffected (D) enthalpy reduces to zero

71. The amount of heat measured for a reaction in a bomb calorimeter is

(A) ΔG (B) ΔH (C) ΔE (D) $P\Delta V$

72. Given that $C+O_2\rightarrow CO_2,\ \Delta H^0 = -xkJ$ & $2CO+O_2\rightarrow 2CO_2,\ \Delta H^0 = -ykJ$, the enthalpy of formation of carbon monoxide will be

(A) $\frac{2x-y}{2}$ (B) $\frac{y-2x}{2}$ (C) $2x-y$ (A) $y = 2x$

73. The standard molar heat of formation of ethane, CO_2 and water (*l*) are respectively –21.1, –94.1 and –68.3 kcal. The standard molar heat of combustion of ethane will be

(A) –372 kcal (B) 162 kcal (C) –240 kcal (D) 183.5 kcal

74. When Zn dust is added to sufficiently large volume of aqueous solution of copper sulphate. 3.175 g of copper metal and 20 J of heat is evolved. The ΔH for the reaction

$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$ is (at wt of Zn = 65.3, at wt of Cu = 63.5)

(A) 20 J (B) 200J (C) 400J (D) 65.3 J

75. The bond energy of an O–H bond is 109 kcal mol^{-1}. When a mole of water is formed

(A) 218 kcal is released (B) 109 kcal is released

(B) 218 kcal is absorbed (D) 109 kcal is absorbed

76. A gas can expand from 100 ml to 250 ml under a constant pressure of 2 atm. The work done by the gas is

(A) 30.38 Joule (B) 25 Joule (C) 5 k/Juole (D) 16 Joule

77. One mole of a non-ideal gas under goes a change of state (2.0 atm, 3.0 L, 95 K) $\rightarrow$ (4.0 atm, 5.0 L, 245 K) with a change in internal energy, $\Delta U = 30.0$ L atm,. The change in enthalpy (ΔH) of the process in L atm is

(A) 40.0 (B) 42.3 (B) 44.0

(D) not defined, because pressure is not constant

78. When a sample of an ideal gas is allowed to expand reversible by isothermically in vacuum:

(A) $w = 0, \Delta E = q > 0$ (B) $\Delta E = 0, q = w < 0$

(B) $\Delta E = 0, q = -P\Delta V$ (D) $\Delta E = q = w = 0$

79. If the dissociation energy of methane and ethane are 360 K.Cal/mole and 620 K.Cal./mole respectively the C-C bond energy in K. Cal. Is:

(A) 80 (B) 260 (C) 180 (D) 130

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