ASAT PREPARATION ASSIGNMENT (NURTURE COURSE)

1. A force of constant magnitude F acts on a particle moving in a plane such that it is perpendicular to the velocity $\vec{v}$ ($|\vec{v}| = v$) of the body, and the force is always directed towards a fixed point. Then the angle turned by the velocity vector of the particle as it covers a distance S is :(take mass of the particle as m)

(A) $\frac{FS}{2mv^2}$ (B) $\frac{2FS}{mv^2}$ (C) $\frac{FS^2}{mv}$ (D) $\frac{FS}{mv^2}$

2. If $v = x^2 - 5x + 4$, find the acceleration of the particle when velocity of the particle is zero.

(A) 0 (B) 2 (C) 3 (D) none of these

3. A man moves on his motorbike with 54 km/h and then takes a U turn (180°) and continues to move with same speed. The time of U turn is 10 s. Find the average acceleration during u turn.

(A) 0 (B) 3 ms^{-2} (C) $1.5\sqrt{2}$ ms^{-2} (D) none of these

4. A body is moving with velocity 30 m/s towards east. After 10 seconds its velocity becomes 40 m/s towards north. The average acceleration of the body is :

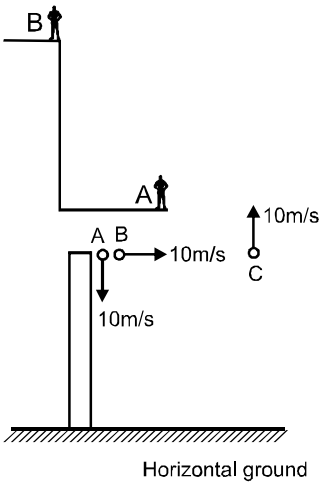
(A) 1 m/s^2 (B) 7 m/s^2 (C) $\sqrt{7}$ m/s^2 (D) 5 m/s^2

5. A projectile is fired at an angle of 45º with the horizontal. Elevation angle of the projectile at its highest point as seen from the point of projection is :

(A) 60º (B) $\tan^{-1}\frac{1}{2}$ (C) $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (D) 45º

6. Two men A and B, A standing on the extended floor nearby a building and B is standing on the roof of the building. Both throw a stone towards each other. Then which of the following will be correct.

(A) stone will hit A, but not B
(B) stone will hit B, but not A
(C) stone will not hit either of them, but will collide with each other
(D) none of these.

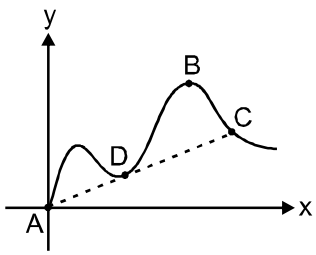


7. Three particles are projected from a tower as shown in figure :

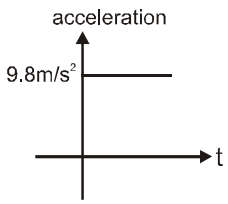
(A) time taken by A to reach the ground is minimum
(B) velocity of all three particle are same just before striking the ground
(C) distance travelled by ball B must be largest
(D) all of the above

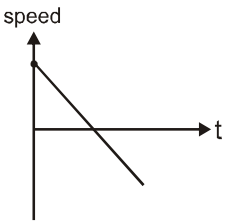
8. A particle is moving in a horizontal plane xy with constant speed on the path shown such that A,D,C are collinear and AC is tangent to the path at point D :

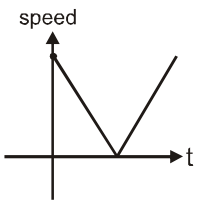
(A) direction of average velocity from A to C is same as direction of instantaneous velocity at D
(B) velocity of particle equal to velocity at D is achieved 4 times in whole path
(C) average speed from A to C is lesser than magnitude of average velocity from A to C
(D) acceleration is zero at every instant



9. A particle is thrown from ground with some initial speed in vertically upward direction, then the graphs representing this motion are : (taking upward direction as positive direction and $g = 9.8\ m/s^2$)

(A) 

(B) 

(C) 

(D) None of these

10. **STATEMENT–1 :** For a particle moving along a circular path with increasing speed, the magnitude of acceleration of particle may decrease with time.
STATEMENT–2 : The centripetal acceleration of a particle of mass m moving along a circle of radius R is $\frac{v^2}{R}$ where v is speed of the particle.
(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1
(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True.

11. A particle moves rectilinearly with a constant acceleration 1 m/s^2. Its speed after 10 seconds is 5 m/s. The distance covered by the particle in this duration is (Initial & final velocities are in opposite directio)
(A) 20 m (B) 25 m (C) 30 m (D) 50 m

12. A particle is moving along x axis with constant acceleration. At t = 0 sec. the particle is at x = 3 m and $\frac{dx}{dt}$ = + 4 m/s. The maximum value of x coordinate of the particle is observed 2 sec. later. Starting from t = 0 sec after what time particle reaches its initial position again -
(A) 4 sec. (B) 6 sec. (C) 8 sec. (D) 12 sec.

13. The displacement of a body at any time t after starting is given by $s = 10t - \frac{1}{2}(0.2)t^2$. The velocity of the body is zero after :
(A) 50 s (B) 100 s (C) 80 s (D) 40 s

14. A ball is thrown vertically upwards from the ground. It crosses a point at the height of 25 m twice at an interval of 4 secs. The ball was thrown with the velocity of
(A) 20 m/sec. (B) 25 m/sec. (C) 30 m/sec. (D) 35 m/sec.

15. A person throws a ball vertically up in air.The ball rises to maximum height and then falls back down such that the person catches it. Neglect the friction between ball and air. While the ball was in air, three statements are given below. (g = 9.8 m/s^2)
Statement 1: Just after the ball leaves the persons hand, the direction of its acceleration is upwards.
Statement 2: The acceleration of ball is zero when it reaches maximum height.
Statement 3: The acceleration of ball is g = 9.8 m/s^2 downwards while the ball is falling down.
Then which of the above statement or statements are correct in the options below.
(A) Statement 1 only (B) Statement 2 only
(C) Statement 3 only (D) Both statement 2 and statement 3

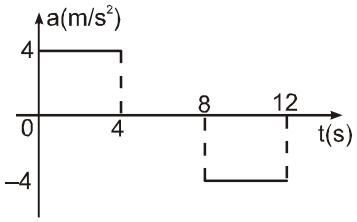
16. Two particles A and B move in x-y plane with constant acceleration $\vec{a}_A = -4\hat{i}$ m/s^2 and $\vec{a}_B = -3\hat{j}$ m/s^2 respectively. At time t = 0, the velocity of both the particles are $\vec{u}_A = 2\hat{i}$ m/s and $\vec{u}_B = (-6\hat{i} + 6\hat{j})$ m/s respectively. Then the instant of time at which velocity of A and B are mutually perpendicular is :
(A) t = 0.5 s (B) t = 2s
(C) t = 3s (D) velocity of A and B are never mutually perpendicular.

17. Drops of water fall at regular intervals from the roof of a building of height H = 5 m, the first drop strikes the ground at the same moment when the fifth drop detaches itself from the roof. Then ratio of distances between the consecutive drops in air as the first drop reaches the ground are :
(A) 1 : 5 : 7 : 3 (B) 1 : 3 : 5 : 7 (C) 1 : 3 : 7 : 5 (D) 1 : 2 : 3 : 4

18. A stone is released at rest from a height of 45 m above the horizontal level ground. There is horizontal wind blowing due to which stone acquires an additional (in addition to acceleration due to gravity) horizontal acceleration of magnitude 10 m/s^2 . Then the net distance travelled by stone before reaching ground is: (Take g = 10m/s^2 and neglect air resistance)
(A) 45 m. (B) $45\sqrt{2}$ m (C) $45\sqrt{3}$ m (D) cannot be determined

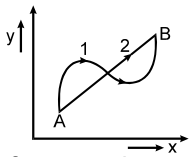
19. On a displacement/time graph, two straight lines make angles at 30º & 60º with the time axis. The ratio of the velocities represented by them is:
(A) 1 : 2 (B) 1 : 3 (C) 2 : 1 (D) 3 : 1

20. A lift starts from rest. Its acceleration is plotted against time in the following graph. When it comes to rest its height above its starting point is:



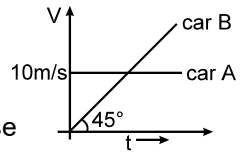
(A) 20 m (B) 64 m (C) 32 m (D) 128 m

21. A particle can travel from point A to B from two different paths 1 and 2, as shown, in same interval of time. Then which of the following is incorrect?



(A) Average velocity along the two paths A to B are equal
(B) The particle may travel along both the paths unaccelerated
(C) The direction of instantaneous velocity along the path 1 & 2 can be same for a maximum of two point on the paths.
(D) Along path 1 the average and instantaneous velocity can have same direction at some instant

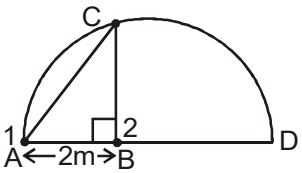
22. Initially car A is 10.5 m ahead of car B. Both start moving at time t = 0 in the same direction along a straight line. The velocity time graph of two cars is shown in figure. The time when the car B will catch the car A, will be



(A) t = 21 sec (B) t = $2\sqrt{5}$ sec (C) 20 sec. (D) None of these

23. A car covers a distance of 2 km in 2.5 minutes. If it covers half of the distance with speed 40 km/hr, the rest distance it shall cover with a speed of:
(A) 56 km/hr (B) 60 km/hr (C) 48 km/hr (D) 50 km/hr

24. A semicircle of radius R = 5m with diameter AD is shown in figure. Two particles 1 and 2 are at points A and B on shown diameter at t = 0 and move along segments AC and BC with constant speeds u_1 and u_2 respectively. Then the value of $\frac{u_1}{u_2}$ for both particles to reach point C simultaneously will be :



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

25. A moving car possess average velocities of 5 m/s, 10 m/s and 15 m/s in the first,second and the third seconds respectively. What is the total distance covered by the car in these 3 sec.
(A) 30 m (B) 55 m (C) 15 m (D) 40 m

26. The displacement of a particle moving in a straight line is given by $x = 16t - 2t^2$ (where, x is in metres and t is in second). Find the distance travelled by the particle in 8 seconds [starting from t = 0] is :
(A) 24 m (B) 40 m (C) 64 m (D) 80 m

27. A particle moves in x-y plane according to equations, $x = 4t^2 + 5t + 16$ & $y = 5t$. The acceleration of the particle will be:
(A) 8 m/sec^2 (B) 13 m/sec^2 (C) 14 m/sec^2 (D) none of these

28. If $v = x^2 - 5x + 4$, find the acceleration of the particle when velocity of the particle is zero.
(A) 0 (B) 2 (C) 3 (D) none of these

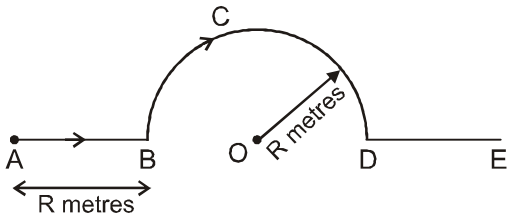
29. A car of mass *m*, travelling at speed *v,* stops in time *t* when maximum braking force is applied. Assuming the braking force is same for both cases, what time would be required to stop a car of mass *2m* travelling at speed *v* ?

(A) $\frac{1}{2}t$ (B) t (C) $\sqrt{2}\,t$ (D) $2t$

30. A particle has an initial velocity (i.e., at t = 0) of $3\hat{i} + 4\hat{j}$ (m/s) and an acceleration of $0.4\hat{i} + 0.3\hat{j}$ (m/s^2). The speed of particle at t = 10 sec is :

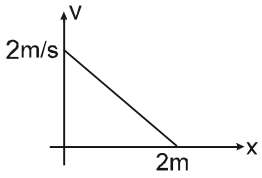
(A) 7 m/s (B) $7/\sqrt{2}$ m/s (C) $7\sqrt{2}$ m/s (D) $14\sqrt{2}$ m/s

31. A particle at t = 0 second is at point A and moves along the shown path (ABCDE) with uniform speed v = $\left(1+\frac{\pi}{3}\right)$ m/s. Both the straight segments AB and DE are along the diameter BD of semicircle BCD of radius R = 1 metre. Then the instant of time at which the instantaneous velocity of the particle is along the direction of average velocity from t = 0 second to that instant is also

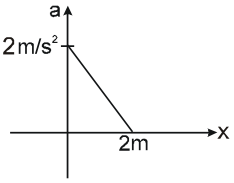


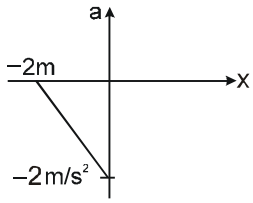
(A) $\frac{1}{2}$ sec. (B) 1 sec (C) $\left(1+\frac{\pi}{6}\right)$sec (D) 1.5 sec.

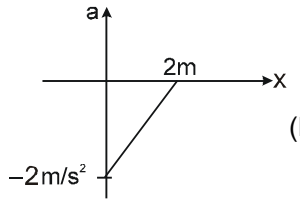
32. The velocity displacement graph of a particle moving along a straight line is shown in figure.

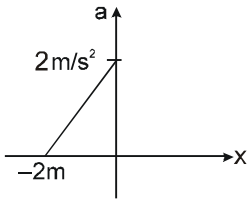


Then the acceleration displacement graph is.

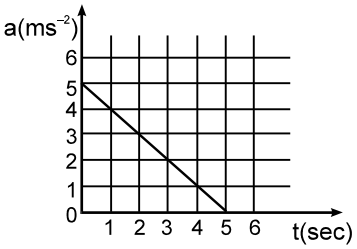
(A) 

(B) 

(C) 

(D) 

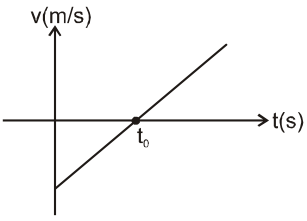
33. Starting from rest at t = 0, a car moves in a straight line with an acceleration given by the accompanying graph. The speed of the car at t = 3 s is :



(A) 1 m s^{-1} (B) 2 m s^{-1}

(C) 6.0 m s^{-1} (D) 10.5 m s^{-1}

34. The velocity time graph of a particle moving along a straight line in a given time interval is as shown in figure. Then the particle (with increase in time starting from t = 0 sec.)



(A) speeds up
(B) speeds down
(C) first speeds up and then speeds down
(D) first speeds down and then speeds up

35. Instantaneous position vector of a particle is given by

$\vec{r} = 3t^2\hat{i} + 4t^2\hat{i} + 7\hat{k}$, where t is in seconds $\vec{r}$ is in meters

Find distance travelled in first 10 sec

(A) 600 m (B) 650 m (C) 550 m (D) 500 m

36. The distance covered by a moving particle is directly proportional to $t^{1/2}$ where t is time elasped. What type of motion the object is performing :
(A) always retarded
(B) always accelerated
(C) first retarded and then accelerated
(D) first accelerated and then retardation

37. A particle moves in a straight line so that its displacement 'x' at time 't' is given by $x = (1 + t^2)^{1/2}$. It's acceleration at time t is :

(A) $\frac{1}{x^3}$ (B) $-\frac{t}{x^3}$ (C) $\frac{1}{x}-\frac{t^2}{x^3}$ (D) $\frac{1}{x}-\frac{1}{x^2}$

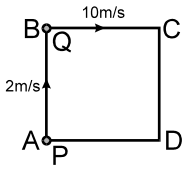
38. A train is standing on a platform , a man inside a compartment of a train drops a stone . At the same instant train starts to move with constant acceleration . The path of the particle as seen by the person who drops the stone is :
(A) parabola
(B) straight line for sometime & parabola for the remaining time
(C) straight line
(D) variable path that cannot be defined

39. Two persons A and B running on a straght track in the same direction observe a car. A says that the car is moving in east direction and B says that the car is moving in north direction. They contradict the direction but say that magnitude is same. If the speed of B is double that of the speed of A, then the true direction of the car will be:

(A) $\theta = \tan^{-1}\left(\frac{1}{2}\right)$ North of East (B) $\theta = \tan^{-1}\left(\frac{1}{2}\right)$ South of East

(C) $\theta = \tan^{-1}(2)$ North of East (D) none of these

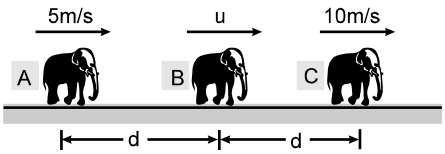
40. Two men P & Q are standing at corners A & B of square ABCD of side 8 m. They start moving along the track with constant speed 2 m/s and 10 m/s respectively. Find the time when they will meet for the first time.



(A) 2 sec (B) 3 sec (C) 1 sec (D) 6 sec

41. A flag on a bus is fluttering in north direction & wind is blowing in east direction. Then which of the following will be true -
(A) bus is moving in south direction.
(B) bus is moving in north east direction.
(C) bus may be moving in any direction between south & east.
(D) bus may be moving in any direction between south & west.

42. Three elephants A, B and C are moving along a straight line with constant speed in same direction as shown in figure. Speed of A is 5 m/s and speed of C is 10 m/s. Initially separation between A & B is 'd' and between B & C is also d. When 'B' catches 'C' separation between A & C becomes 3d. Then the speed of B will be -



(A) 7.5 m/s (B) 15 m/s (C) 20 m/s (D) 5 m/s

43. Hailstones falling vertically with a speed of 10 m/s, hit the wind screen (wind screen makes an angle 30° with the horizontal) of a moving car and rebound elastically. The velocity of the car if the driver finds the hailstones rebound vertically after striking is :

(A) $10\sqrt{3}$ m/s (B) $20\sqrt{3}$ m/s (C) 10 m/sec (D) $\frac{10}{\sqrt{3}}$ m/sec

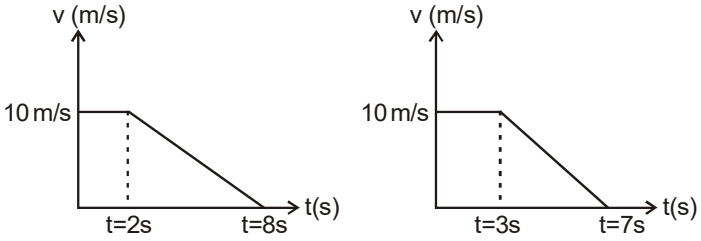
44. Two observers A and B are moving opposite to each other on a parallel track, separated by a distance d, with same speed. When they are at the shortest distance, a particle is thrown horizontally from some height from ground by A towards B with respect to itself. The path of the particle observed by B is –

(A) Horizontal straight line.
(B) Vertical straight line.
(C) Straight line at some angle with the horizontal.
(D) Parabolic.

45. When a man started from rest with constant acceleration a along an incline plane of angle 37º and he found rain to be falling vertically. After t seconds, he finds rain to strike him horizontally. Assume that actual velocity of rain is constant with magnitude 4 m/s. Choose the correct option :

(A) man is moving up the incline with acceleration of 1 m/s^2 if t = 5 sec.
(B) man is moving down the incline and if a = 1 m/s^2 then t = 5 sec.
(C) man is moving down the incline and if t = $\frac{20}{3}$ s then a = 1 m/s^2
(D) man is moving up the incline and if a = 1 m/s^2 then t = $\frac{20}{3}$ s.

46. Car A and car B move on a straight road and their velocity versus time graphs are as shown in figure. Comparing the motion of car A in between t = 0 to t = 8 sec. and motion of car B in between t = 0 to t = 7 sec., pick up the correct statement.



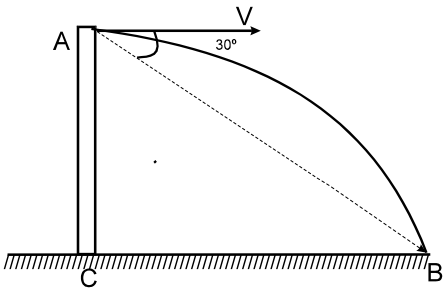
Car A Car B

(A) Distance travelled by car A is less than distance travelled by car B.
(B) Distance travelled by car A is greater than distance travelled by car B.
(C) Average speed of both cars are equal.
(D) Average speed of car A is less than average speed of car B.

47. A man can swim certain distance in still water up and down in time t_1. If he swims to some distance down stream the river and returns back to same point he takes time t_2. Then :

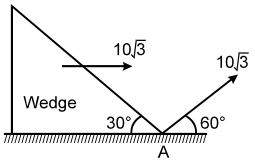
(A) $t_1 = t_2$ (B) $t_1 < t_2$
(C) $t_1 < t_2$ (D) t_1 & t_2 can't be compared

48. An object is thrown from a point 'A' horizontally from a tower and hits the ground 3s later at B. The line from 'A' to 'B' makes an angle of 30º with the horizontal. The initial velocity of the object is : (take g = 10 m/s^2)



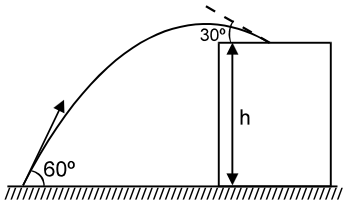
(A) $15\sqrt{3}$ m/s (B) 15 m/s (C) $10\sqrt{3}$ m/s (D) $25/\sqrt{3}$ m/s

49. A particle is projected at angle 60° with speed $10\sqrt{3}$, from the point 'A' as shown in the fig. At the same time the wedge is made to move with speed $10\sqrt{3}$ towards right as shown in the figure. Then the time after which particle will strike with wedge is (g = 10 m/sec^2) :



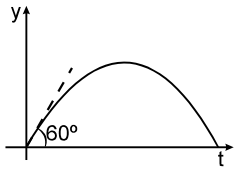
(A) 2 sec (B) $2\sqrt{3}$ sec (C) $\frac{4}{\sqrt{3}}$ sec (D) none of these

50. A stone projected at an angle of 60° from the ground level strikes at an angle of 30° on the roof of a building of height 'h'. Then the speed of projection of the stone is :



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

51. A particle is projected from the horizontal x-z plane, in vertical x-y plane where x-axis is horizontal and positive y-axis vertically upwards. The graph of 'y' coordinate of the particle v/s time is as shown. The range of the particle is $\sqrt{3}$ m. Then the speed of the projected particle is :



(A) $\sqrt{3}$ m/s (B) $\sqrt{\frac{403}{4}}$ m/s (C) $2\sqrt{5}$ m/s (D) $\sqrt{28}$ m/s

52. A particle is moving with initial velocity $\vec{u} = (\hat{i} - 2\hat{j})$ m/sec. Now two forces start acting on it, one of them is $\vec{F}_1 = (3\hat{i} + \hat{j})$N. Which of the following can be the other force $\vec{F}_2$, so that the particle still moves along the same straight line.

(A) $(6\hat{i} - 17\hat{j})$N (B) $(-4\hat{i} - \hat{j})$N (C) $(4\hat{i} - 9\hat{j})$N (D) $(-5\hat{i} + 3\hat{j})$N

53. A particle starts from the origin at t = 0 and moves in the x-y plane with constant acceleration a in the y direction. Its equation of motion is $y = bx^2$. The x component of its velocity is :

(A) variable (B) $\sqrt{\frac{2a}{b}}$ (C) $\frac{a}{2b}$ (D) $\sqrt{\frac{a}{2b}}$

54. A particle is projected with a velocity $10\sqrt{2}$ m/s making an angle 45° with the horizontal. Neglect the effect of air friction. Then after 1 seconds of projection. Take g=10 m/s^2
(A) the height of the particle above the point of projection is 5 m.
(B) the height of the particle above the point of projection is 10 m.
(C) the horizontal distance of the particle from the point of projection is 5 m.
(D) the horizontal distance of the particle from the point of projection is 15 m.

55. If a missile is detected at its half-way point, how much warning time will you have ? Take $g = 10\ ms^{-2}$, u = 1000 m/sec., $\theta = 45°$ and assume earth to be flat.

(A) 100 sec (B) $\frac{100}{\sqrt{2}}$ sec (C) $100 \times \sqrt{\frac{3}{2}}$ sec (D) 200 sec

56. A body is projected with kinetic energy K at an angle of 60º with the horizontal. Its kinetic energy at the highest point of its trajectory will be

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

57. The maximum height attained by a projectile and its horizontal range are equal to each other if the projectile is projected at an angle θ given by

(A) $\theta = \tan^{-1}(2)$ (B) $\theta = \tan^{-1}(3)$ (C) $\theta = \tan^{-1}(4)$ (D) $\theta = \tan^{-1}(5)$

58. A bomb is dropped from an aeroplane when it is at a height h directly above the target. If the aeroplane is moving horizontally with a speed v, the distance by which the bomb will miss the target is given by

(A) $2v\sqrt{\frac{h}{g}}$ (B) $v\sqrt{\frac{h}{g}}$ (C) $v\sqrt{\frac{2h}{g}}$ (D) $v\sqrt{\frac{h}{2g}}$

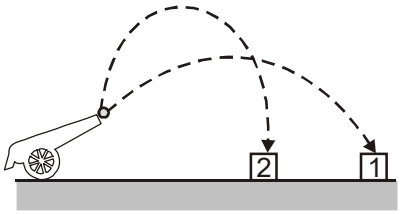
59. The equation of motion of a projectile is $y = 12x - 3/4\ x^2$. Given that $g = 10\ ms^{-2}$. What is the range of the projectile?

(A) 36m (B) 30.6 m (C) 16 m (D) 12.4 m

60. A stone is projected horizontally with speed v from a height h above ground. A horizontal wind is blowing in direction opposite to velocity of projection and gives the stone a constant horizontal acceleration f (in direction opposite to initial velocity). As a result the stone falls on ground at a point vertically below the point of projection. Then the value of height h in terms of f, g, v is (g is acceleration due to gravity)

(A) $\frac{gv^2}{2f^2}$ (B) $\frac{gv^2}{f^2}$ (C) $\frac{\sqrt{2}gv^2}{f^2}$ (D) $\frac{2gv^2}{f^2}$

61. Neglect air resistance in this problem. A cannon simultaneously fires two identical cannonballs at targets 1 and 2 as shown below. If the cannonballs have identical initial speeds, which of the following statements is true ? Assume the point of projection and targets to be at same horizontal level.

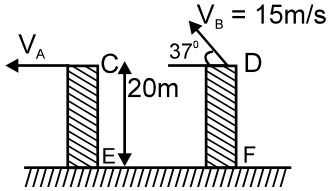


(A) Target 1 is hit before target 2. (B) Target 2 is hit before target 1.
(C) Both are hit at the same time. (D) Data insufficient for inference

62. Distance between a frog and an insect on a horizontal plane is 10 m. Frog can jump with a maximum speed of $\sqrt{10}$ m/s. g =10 m/s^2. Minimum number of jumps required by the frog to catch the insect is :

(A) 5 (B) 10 (C) 100 (D) 50

63. CE and DF are two walls of equal height (20 meter) from which two particles A and B of same mass are projected as shown in the figure. A is projected horizontally towards left while B is projected at an angle 37^0 (with horizontal towards left) with velocity 15 m/sec. If A always sees B to be moving perpendicular to EF, then the range of A on ground is :

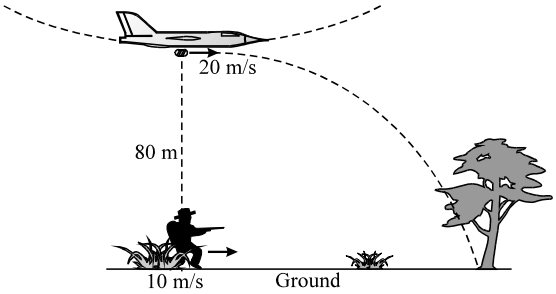


(A) 24 m (B) 30 m (C) 26 m (D) 28 m

64. In a closed room, a ball is projected vertically upward from ground with 20 m/s and height of ceiling is 10 m. It strikes the ground vertically with a velocity of $10\sqrt{3}$ m/s. The coefficient of restitution for the collision between ball & ceiling is :

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

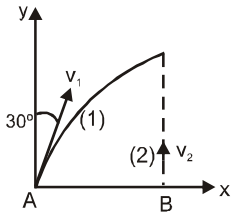
65. A bomber plane moving at a horizontal speed of 20 m/s releases a bomb at a height of 80 m above ground as shown. At the same instant a Hunter starts running from a point below it, to catch the bomb at 10 m/s. After two seconds he realized that he cannot make it, he stops running and immediately holds his gun and fires in such direction so that just before bomb hits the ground, bullet will hit it. What should be the firing speed of bullet. (Take g = 10 m/s^2)



(A) 10 m/s (B) $20\sqrt{10}$ m/s

(C) $10\sqrt{10}$ m/s (D) None of these

66. A particle–1 is projected with speed v_1 from a point A making an angle of 30º with the vertical. At the same instant, a second particle–2 is thrown vertically upwards from point B. Both the particles reach height H, simultaneously. The ratio of $\frac{v_1}{v_2}$ is :

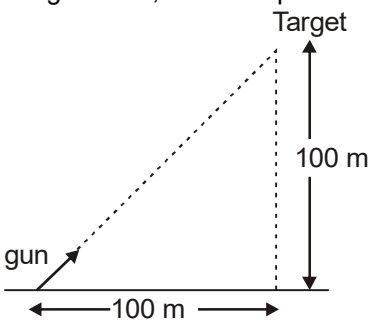


(A) $\frac{2}{\sqrt{3}}$ (B) $\frac{1}{\sqrt{3}}$ (C) $\frac{\sqrt{3}}{2}$ (D) $\sqrt{3}$

67. Two persons X and Y are playing with two different balls of masses m and 2m. If X throws his ball vertically up and Y at an angle θ with vertical, both of them stay in air for the same time. The maximum heights attained by the two are in the ratio :

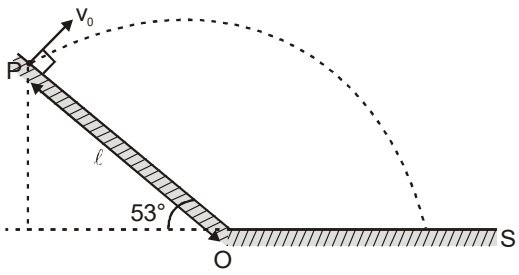
(A) 2 : 1 (B) 1 : cos θ (C) 1 : 1 (D) 1 : sec θ

68. A gun is pointed towards a 100 m high target as shown in figure. Target is released at the same time when the gun is shot. To hit the target in air, muzzle speed should not less than (g = 9.8 m/s^2)



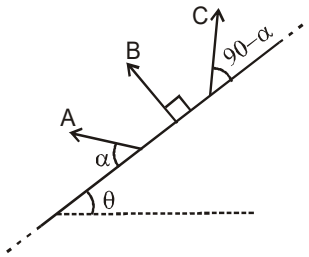
(A) $7\sqrt{2}$ m/s (B) $14\sqrt{5}$ m/s (C) 10 m/s (D) $10\sqrt{10}$ m/s

69. A stone is projected from point P on the inclined plane with velocity v_0 = 5m/sec directed perpendicular to the plane. The time taken by the stone to strike the horizontal ground S is (Given PO = ℓ = 10 meter)



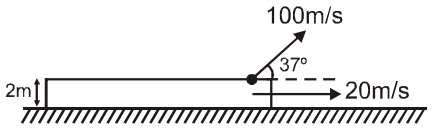
(A) 4 sec (B) 1.4 sec (C) 2 sec (D) None of these

70. Three stones A, B, C are projected from surface of very long inclined plane with equal speeds and different angles of projection as shown in figure. The incline makes an angle θ with horizontal.If H_A, H_B and H_C are maximum height attained by A, B and C respectively above inclined plane then : (Neglect air friction)



(A) $H_A + H_C = H_B$ (B) $H_A^2 + H_C^2 = H_B^2$ (C) $H_A + H_C = 2H_B$ (D) $H_A^2 + H_C^2 = 2H_B^2$

71. A particle is projected with speed 100 m/s (w.r.t platform) from a moving platfrom as shown in the figure. Platform is moving on smooth floor with velocity 20 m/s. Ratio of horizontal range of particle with respect to ground and with respect to platform is : (height of platform is 2 m) **[g = 10 m/s²]**

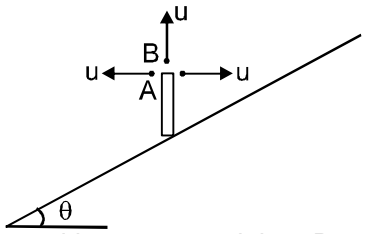


(A) $\frac{5}{4}$ (B) $\frac{6}{5}$ (C) $\frac{3}{2}$ (D) none of these

72. The height y (in m) and the horizontal distance x (in m) of a projectile on a certain planet (with uniform gravity and no atmosphere) are given by $y = (8t - 5t^2)$ and $x = 6t$. where 't' is time in seconds. The speed of projection of projectile at t = 0 is :

(A) 8 m/s (B) 10 m/s (C) 6 m/s (D) Not obtainedable from the data

73. Three particles are projected from a tower on inclined plane with same speed u as shown in figure. Mark the correct option :

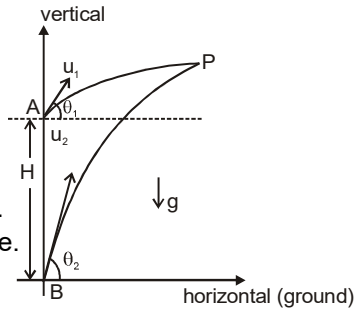


(A) A will collide the inclined plane with more speed than B and C
(B) A will collide the inclined plane with more speed than A and C
(C) C will collide the inclined plane with more sped than A and B
(D) All will collide the inclined plane with same speed

74. A stone is projected from level ground such that its horizontal and vertical components of initial velocity are u_x = 10 m/s and u_y = 20 m/s respectively. Then the angle between velocity vector of stone one second before and one second after it attains maximum height is :

(A) 30° (B) 45° (C) 60° (D) 90°

75. Two particles 1 and 2 are projected in the same vertical plane simultaneously from A & B as shown with velocities u_1 & u_2 respectively and pass through each other at point P at same time such that particle 1 is at maximum height of its path at P :



(Neglect the collision between particles 1 and 2 at point P and assume that H ≠ 0)

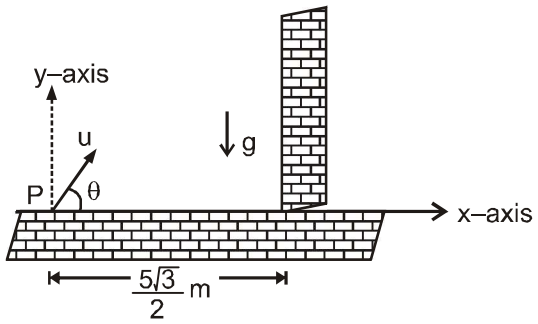
(A) Relative velocity of particle 1 with respect to 2 will be zero at point P.

(B) Relative acceleration between 1 and 2 keeps on decreasing with time.

(C) Relative velocity (along vertical direction) between two particles will be a non–zero constant (while both particles are in air).

(D) Horizontal range of both particles from starting point will be same when they strike the ground.

76. A particle is projected from point 'P' on ground with speed u = 10m/sec at an angle $\theta = 60^\circ$ (with horizontal as shown). A vertical rigid wall is present at distance S = $\frac{5\sqrt{3}}{2}$ m from 'P' as shown in figure. Assuming that the collision with the wall is perfectly elastic and particle lands back on ground. Pick the correct statements: ($g = 10 m/s^2$)



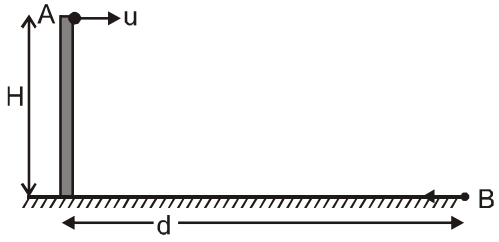
(A) The particle strikes back the ground (after collision with wall) at the same point from which it was projected.

(B) Total displacement of particle for complete ground to ground motion is negative along x-axis.

(C) Initial velocity of particle (at time of projection) and final velocity of particle (just before landing) are equal.

(D) None of the above statements is correct.

77. Two particles A and B are placed as shown in figure. The particle A on the top of a tower of heigh H, is projected horizontally with a velocity u and the particle B is projected along the horizontal surface towards the foot of the tower, simultaneously. When particle A reaches at ground, it simultaneously hits particle B. Then the speed of projection of particle B is : (Neglect any type of friction)



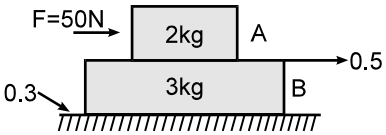
(A) $d\sqrt{\frac{g}{2H}}$ (B) $d\sqrt{\frac{g}{2H}} - u$ (C) $d\sqrt{\frac{g}{2H}} + u$ (D) u

SECTION (B) : NEWTON'S LAWS OF MOTION , FRICTION

78. A block of mass 5 kg and surface area 2 m^2 just begins to slide down an inclined plane when the angle of inclination is 30°. Keeping mass same, the surface area of the block is doubled. The angle at which this starts sliding down is:

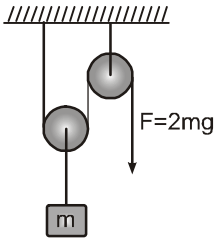
(A) 30° (B) 60° (C) 15° (D) none

79. From the figure shown, find out acceleration of 3 kg block.



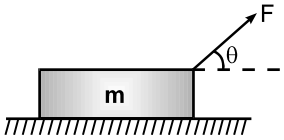
(A) 7 m/s^2 (B) 10 m/s^2 (C) 10/3 m/s^2 (D) none of these

80. In the shown mass pulley system, pulleys and string are massless. The one end of the string is pulled by the force F = 2mg. The acceleration of the block will be



(A) g/2 (B) 0 (C) g (D) 3g

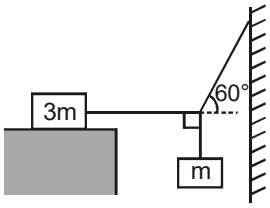
81. A wooden block of mass m resting on a rough horizontal table (coefficient of friction = μ) is pulled by a force F as shown in figure. The acceleration of the block moving horizontally is:



(A) $\frac{F\cos\theta}{m}$ (B) $\frac{\mu F\sin\theta}{M}$

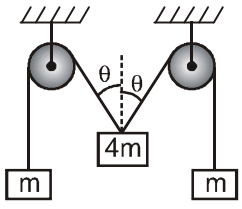
(C) $\frac{F}{m}(\cos\theta + \mu\sin\theta) - \mu g$ (D) none of these

82. A mass *m* is supported as shown in the figure by ideal strings connected to a rigid wall and to a mass 3*m* at rest on a fixed horizontal surface. The string connected to larger mass is horizontal, that connected to smaller mass is vertical and the one connected to wall makes an angle 60° with horizontal.Then the minimum coefficient of static friction between the larger mass and the horizontal surface that permits the system to remain in equilibrium in the situation shown is:



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

83. In the figure shown, the pulleys and strings are massless. The acceleration of the block of mass 4m just after the system is released from rest is ($\theta = \sin^{-1}\frac{3}{5}$)

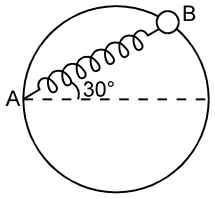


(A) $\frac{2g}{5}$ downward (B) $\frac{2g}{5}$ upwards

(C) $\frac{5g}{11}$ upwards (D) $\frac{5g}{11}$ downwards

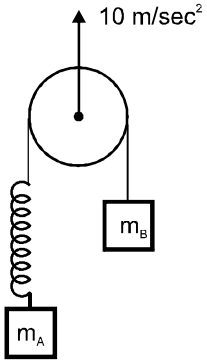
84. **STATEMENT-1 :** A cyclist is cycling on a rough horizontal circular track with increasing speed. Then the net frictional force on cycle is always directed towards centre of the circular track.
STATEMENT-2 : For a particle moving in a circle, component of its acceleration towards centre, that is, centripetal acceleration should exist (except when speed is zero instantaneously).
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

85. A bead of mass m is attached to one end of a spring of natural length R and spring constant k = $\frac{(\sqrt{3}+1)mg}{R}$. The other end of the spring is fixed at point A on a smooth vertical ring of radius R as shown in figure. The normal reaction at B just after it is released to move is



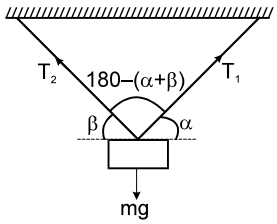
(A) $\frac{mg}{2}$ (B) $\sqrt{3}mg$ (C) $3\sqrt{3}mg$ (D) $\frac{3\sqrt{3}mg}{2}$

86. In the system shown in figure at some instant acceleration of pully was 10 m/sec^2 in upward direction. At that instant spring was in its natural length. If acceleration of block A and B are a_A and a_B at that instant then :
(Given m_A = 10 kg , m_B = 20 kg , g = 10 m/sec^2, pulley is light and smooth)



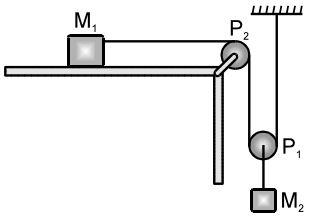
(A) $a_A = \frac{10}{3}$ m/sec^2 upward $a_B = \frac{10}{3}$ m/sec^2 downward
(B) $a_A = a_B$ = 5 m/sec^2 upward
(C) $a_A = a_B$ = 10 m/sec^2 downward
(D) None of these

87. A body of mass m is suspended by two strings making angle α and β with the horizontal as shown in figure. Find the tension in the strings.



(A) $T_1 = \frac{mg\cos\beta}{\sin(\alpha+\beta)} = T_2$ (B) $T_1 = T_2 = \frac{mg\sin\beta}{\sin(\alpha+\beta)}$
(C) $T_1 = \frac{mg\cos\beta}{\sin(\alpha+\beta)}$, $T_2 = \frac{mg\cos\alpha}{\sin(\alpha+\beta)}$ (D) none of these

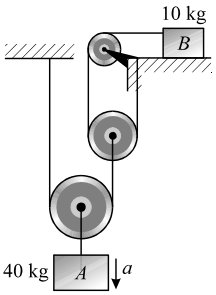
88. Blocks of mass M_1 and M_2 are connected by a cord which passes over the pulleys P_1 and P_2 as shown in the figure. If there is no friction, the acceleration of the block of mass M_2 will be:



(A) $\frac{M_2 g}{(4M_1+M_2)}$ (B) $\frac{2M_2 g}{(4M_1+M_2)}$

(C) $\frac{2M_1 g}{(M_1+4M_2)}$ (D) $\frac{2M_1 g}{(M_1+M_2)}$

89. Figure shows two blocks A and B connected to an ideal pulley string system. In this system when bodies are released then : (neglect friction and take g = 10 m/s^2)



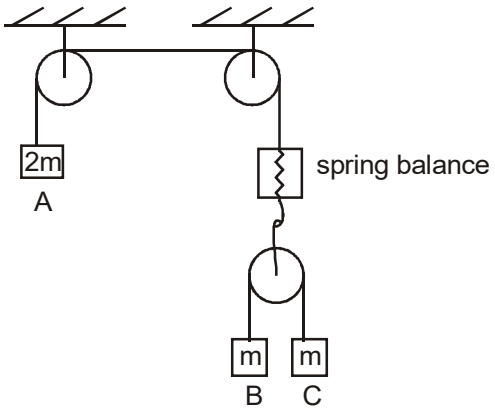
(A) Acceleration of block A is 1 m/s^2

(B) Acceleration of block A is 3 m/s^2

(C) Tension in string connected to block B is 40 N

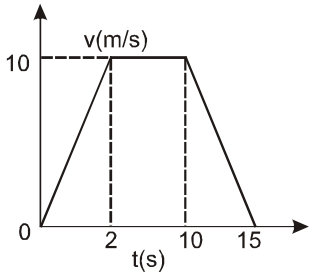
(D) Tension in string connected to block B is 80 N

90. Block A of mass 2m; B and C each of mass m are in equilibrium at rest as shown in figure. Assume the spring balance, pulley and string to be ideal. Now, an additional force mg is applied on block C in downward direction. Find the new reading of the spring balance.



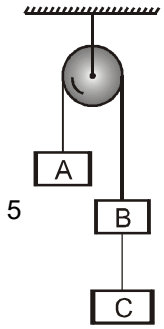
(A) $\frac{5}{2}$mg (B) $\frac{5}{3}$mg (C) $\frac{5}{4}$mg (D) None of these

91. A lift of mass 1000 kg is going up. The variation in the speed of lift is shown in figure. Then the minimum tension in the rope will be (g = 10 m/s^2) :



(A) Zero (B) 10000 N (C) 12000 N (D) 8000 N

92. Three blocks A, B and C of mass 10 kg each are hanging on a string passing over a fixed frictionless pulley as shown in figure. The tension in the string connecting blocks B and C is ($g = 10\ m/s^2$)



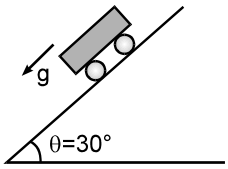
(A) $\frac{2000}{3}$N (B) $\frac{400}{3}$N (C) 100 N (D) $\frac{200}{3}$N

93. As shown to the right, two blocks with masses m and M (M > m) are pushed by a force F in both Case I and Case II. The surface on which blocks lie, is horizontal and frictionless. Let R_I be the force that m exerts on M in case I and R_{II} be the force that m exerts on M in case II. Which of the following statements is true?

(A) $R_I = R_{II}$ and is not equal to zero or F.
(B) $R_I = R_{II} = F$
(C) $R_I < R_{II}$
(D) $R_I > R_{II}$

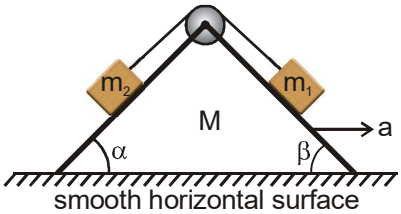
94. Ten one rupee coins are put on top of each other on a table. Each coin has a mass m kg. Then [Coins are counted from the top]
(A) the reaction of the 6th coin on the 7th coin is 4 mg
(B) the force on the 7th coin (counted from the bottom) due to all the coins on its top is 3 mg
(C) the force on the 7th coin by the eighth coin is 3mg
(D) none of these

95. In the figure shown the car moves down with a constant acceleration g. A bob of mass m is attached to a string whose other end is tied to the ceiling of the car. If the bob remains stationary relative to the car. Then tension in the string is:



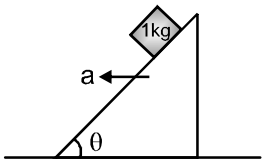
(A) m g/2 (B) m g (C) 2 m g (D) none of these

96. Two blocks of mass m_1 and m_2 are connected by a light string passing over a smooth light pulley fixed with wedge of mass M. Both the blocks are in contact with wedge. Consider all surfaces to be smooth. Now an external force is applied on wedge such that it moves with horizontal acceleration 'a' ($0 < a < g\cot\alpha$) as shown. Then the value of $\frac{\cos\alpha}{\cos\beta}$ such that the tension in string is independent of acceleration of wedge a, will be :



(A) $\frac{m_1}{m_2}$ (B) $\frac{m_2}{m_1}$ (C) $\frac{m_1+m_2}{M}$ (D) 1

97. A block of mass 1 kg is at rest relative to a smooth wedge being moved leftwards with constant acceleration $5m/s^2$. Let N be the normal reaction between the block and the wedge. Then N and $\tan\theta$ are :



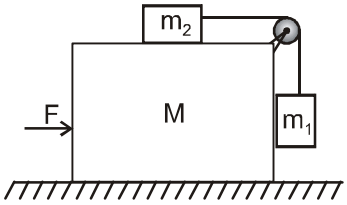
(A) N = $5\sqrt{5}$ N and $\tan\theta = \frac{1}{2}$

(B) N = 15 N and $\tan\theta = \frac{1}{2}$

(C) N = $5\sqrt{5}$ N and $\tan\theta = 2$

(D) N = 15 N and $\tan\theta = 2$

98. A large cubical shaped block of mass M rests on a fixed horizontal surface. Two blocks of mass m_1 and m_2 are connected by a light inextensible string passing over a light pulley as shown. Neglect friction everywhere. Then the constant horizontal force of magnitude F that should be applied to M so that m_1 and m_2 do not move relative to M is :



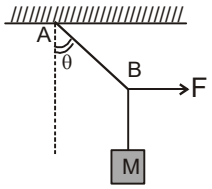
(A) $F = \frac{m_2}{m_1}(m_1 + m_2 + M)g$

(B) $F = \frac{m_1}{m_2}(m_1 + m_2 + M)g$

(C) $F = \frac{m_1}{m_2}(m_1 + M)g$

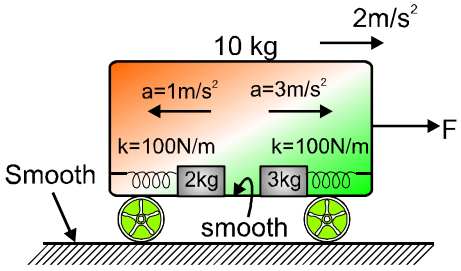
(D) $F = \frac{m_2}{m_1}(m_1 + M)g$

99. A mass M is suspended by a rope from a rigid support at A as shown in figure. Another rope is tied at the end B, and it is pulled horizontally with a force F. If the rope AB makes an angle θ with the vertical in equilibrium, then the tension in the string AB is :



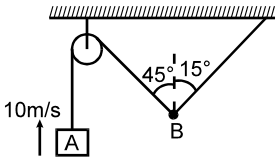
(A) F sin θ (B) F/sin θ (C) Mg cos θ (D) Mg/sin θ

100. Two blocks of mass 2 kg and 3 kg are placed in a cart. A variable force F is acting on the Cart. At an instant acceleration of different blocks and cart are as shown. Find value of F at this instant (mass of cart is 10 kg) All accelerations are horizontal.



(A) 27 N (B) 81 N (C) 30 N (D) 90 N

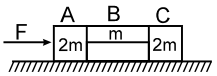
101. A system is shown in the figure. Block A moves with velocity 10 m/s.



The speed of the mass B will be: ($\sin 15^\circ = \frac{\sqrt{3}-1}{2\sqrt{2}}$)

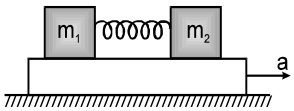
(A) $10\sqrt{2}$ m/s (B) $5\sqrt{3}$ m/s (C) $\frac{20}{\sqrt{3}}$ m/s (D) 10 m/s

102. The system is pushed by a force F as shown in figure. All surfaces are smooth except between B and C. Friction coefficient between B and C is μ. Minimum value of F to prevent block B from downward slipping is



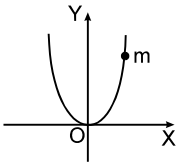
(A) $\left(\frac{3}{2\mu}\right)$mg (B) $\left(\frac{5}{2\mu}\right)$mg (C) $\left(\frac{5}{2}\right)\mu$mg (D) $\left(\frac{3}{2}\right)\mu$mg

103. Two blocks of masses m_1 and m_2 are connected with a massless unstretched spring and placed over a plank moving with an acceleration 'a' as shown in figure. The coefficient of friction between the blocks and platform is μ.



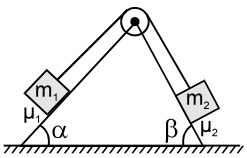
(A) spring will be stretched if $a > \mu g$
(B) spring will be compressed if $a \leq \mu g$
(C) spring will neither be compressed nor be stretched for $a \leq \mu g$
(D) spring will be in its natural length under all conditions

104. A bead of mass m is located on a parabolic wire with its axis vertical and vertex directed towards downward as in figure and whose equation is $x^2 = ay$. If the coefficient of friction is μ, the highest distance above the x-axis at which the particle will be in equilibrium is



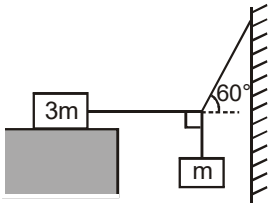
(A) μa (B) $\mu^2 a$ (C) $\frac{1}{4}\mu^2 a$ (D) $\frac{1}{2}\mu a$

105. Two blocks of masses m_1 and m_2 connected by a string are placed gently over a fixed inclined plane, such that the tension in the connecting string is initially zero. The coefficient of friction between m_1 and inclined plane is μ_1 ; between m_2 and the inclined plane is μ_2. The tension in the string shall continue to remain zero if



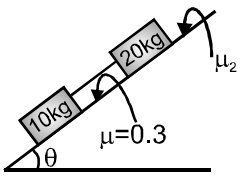
(A) $\mu_1 > \tan\alpha$ and $\mu_2 < \tan\beta$ (B) $\mu_1 < \tan\alpha$ and $\mu_2 > \tan\beta$
(C) $\mu_1 > \tan\alpha$ and $\mu_2 > \tan\beta$ (D) $\mu_1 < \tan\alpha$ and $\mu_2 < \tan\beta$

106. A mass *m* is supported as shown in the figure by ideal strings connected to a rigid wall and to a mass 3*m* at rest on a fixed horizontal surface. The string connected to larger mass is horizontal, that connected to smaller mass is vertical and the one connected to wall makes an angle 60° with horizontal.Then the minimum coefficient of static friction between the larger mass and the horizontal surface that permits the system to remain in equilibrium in the situation shown is:



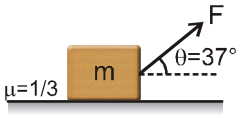
(A) $\frac{1}{\sqrt{3}}$ (B) $\frac{1}{3\sqrt{3}}$ (C) $\frac{\sqrt{3}}{2}$ (D) $\sqrt{\frac{3}{2}}$

107. Value of θ is increased gradually from $\theta = 0$. At $\theta = \tan^{-1}\left(\frac{1}{2}\right)$ both the blocks just start slipping. Than value of μ_2 is: ($g = 10\ m/s^2$)

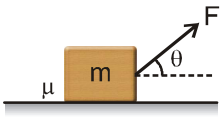


(A) 0.5 (B) 0.4
(C) 0.6 (D) 0.3

108. **STATEMENT-1 :** A block of mass m is placed at rest on rough horizontal surface. The coefficient of friction between the block and horizontal surface is $\mu = \frac{1}{3}$. The minimum force F applied at angle $\theta = 37°$ (as shown in figure) to pull the block horizontally is not equal to μmg. (Take $\sin 37° = \frac{3}{5}$, $\cos 37° = \frac{4}{5}$)



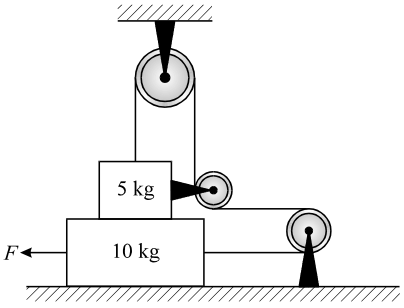
STATEMENT-2 : For a block of mass m placed on rough horizontal surface, the minimum horizontal force required to pull the block is μmg. The minimum force F applied at angle θ (as shown in figure) to pull the block horizontally may be less than μmg. (Where μ is co-efficient of friction).



(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

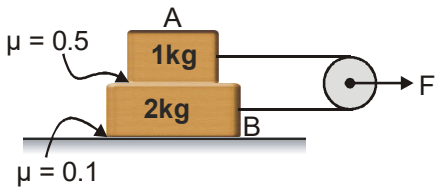
109. **STATEMENT-1 :** A body is lying at rest on a rough horizontal surface. A person accelerating with acceleration $a\hat{i}$ (where a is positive constant and $\hat{i}$ is a unit vector in horizontal direction) observes the body. With respect to him, the block experiences a kinetic friction.
STATEMENT-2 : Whenever there is relative motion between two rough contact surfaces then kinetic friction acts.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

110. Figure shows a system of two blocks of 10 kg and 5 kg mass, connected by ideal strings and pulleys. Here ground is smooth and friction coefficient between the two blocks is $\mu = 0.5$. A horizontal force *F* is applied on lower block as shown. The minimum value of *F* required to start sliding between the blocks is : (Take $g = 10\ m/s^2$)]



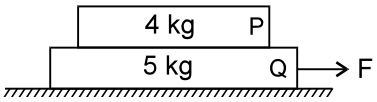
(A) 12.5 N (B) 25 N (C) 50 N (D) 100 N

111. Find the maximum horizontal force F which can be applied such that sliding does not occur between A and B.



(A) 20 N (B) 24 N (C) 30 N (D) 332 N

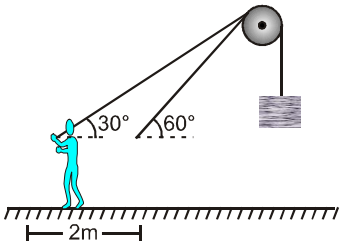
112. If the lower block is held fixed & force is applied to P, minimum force required to slide P on Q is 12 N. Now if Q is free to move on frictionless surface and force is applied to Q then the minimum force F required to slide P on Q is _____.



(A) 12 N (B) 27 N (C) 24 N (D) None of these

SECTION (C) : WORK POWER, ENERGY, CIRCULAR MOTION

113. A person lifts a 25 kg block hanging over a fixed light frictionless small pulley by walking horizontally, as shown in figure. As the person walks 2 metres, the angle of the rope to the horizontal changes from 60° to 30°. If the block rises at constant speed, the work done by rope on the person as the person moves by 2 metres is : [consider the rope to be light and inextensible] (Take g = 10m/s^2)



(A) $500(\sqrt{3}-1)$J (B) $500(1-\sqrt{3})$ J (C) $500(\sqrt{3})$J (D) None of these

114. The potential energy of spring when stretched by a distance x is E. The energy of the spring when stretched by x/2 is -

(A) E (B) E/2 (C) E/4 (D) E/6

115. The potential energy of a body is given by $U = A - Bx^2$ (where x is the displacement). The magnitude of force acting on the particle is

(A) constant (B) proportional to x (C) proportional to x^2 (D) proportional to 1/x

116. If a spring of stiffness 'k' is cut into two parts 'A' and 'B' of length $\ell_A : \ell_B = 2 : 3$, then the stiffness of spring 'A' is given by :

(A) $\frac{3k}{5}$ (B) $\frac{2k}{5}$ (C) k (D) . $\frac{5k}{2}$

117. A mass of 20 kg moving with a speed of 10 m/s collides with another stationary mass of 5 kg. As a result of the collision both masses stick together. The kinetic energy of the composite mass will be :

(A) 600 J (B) 800 J (C) 1000 J (D) 1200 J

118. A mass of M kg is suspended by a weightless string. The minimum horizontal force that is required to displace it slowly until the string makes an angle of 45° with the initial vertical direction is

(A) Mg ($\sqrt{2}$ +1) (B) Mg $\sqrt{2}$ (C) $\frac{Mg}{\sqrt{2}}$ (D) Mg ($\sqrt{2}$ – 1)

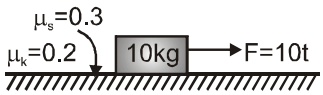
119. An engineer is designing a spring to be placed at the bottom of an elevator shaft in vertical position. If the elevator cable breaks at a height *h* above the upper end of the spring, calculate the required value of the spring constant so that the passenger undergo an acceleration of not more than 5*g* when elevator is brought to rest. Let *M* be the mass of the elevator & passengers.

(A) $\frac{12Mg}{h}$ (B) $\frac{15Mg}{2h}$ (C) $\frac{20Mg}{h}$ (D) $\frac{25Mg}{4h}$

120. Which of the following bodies has the largest kinetic energy ?
(A) Mass 3M and speed V (B) Mass 3M and speed 2V
(C) Mass 2M and speed 3V (D) Mass M and speed 4V

121. A particle has a constant kinetic energy. Which of the following quantities must also be constant.
(A) Position (B) Speed (C) velocity (D) momentum

122. A block is kept on a rough horizontal surface. A variable horizontal force is acting on the block as shown in the figure. At t = 0, block is at rest. Kinetic energy of block at t = 5 sec. will be : (g = 10 m/s^2)



(A) 60 J (B) 160 J (C) 80 J (D) zero

123. Kinetic energy of a particle moving in a straight line varies with time as K = 4t^2. The force acting on the particle.
(A) is constant (B) is increasing
(C) is decreasing (D) first increases and then decreases

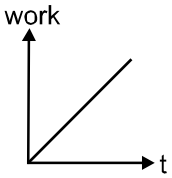
124. Assume that force required to tow a boat at constant velocity is proportional to the speed. If a speed of 4km/hr requires 10 kw, how much power does a speed of 12 km/h require.

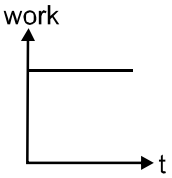
(A) 30 kw (B) $\frac{10}{3}$ kw (C) 60 kw (D) x = 90 kw

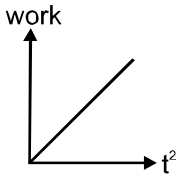
125. An object of mass m is located on the rough horizontal plane. The body is given horizontal velocity v. The mean power developed by the frictional force during the whole time of motion is (μ is coefficient of friction).

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

126. Which of the following graph represents constant non–zero power ?

(A) 

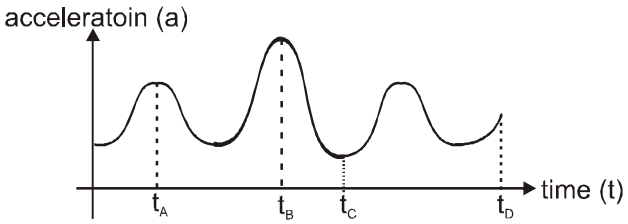
(B) 

(C) 

(D) None of these

127. A conveyor belt carrying coal in Kota thermal power plant gets coal poured on it at the rate of 5kg/s. What is power delivered by motor drawing the belt if it moves with velocity 3 m/s.
(A) 15 watt (B) 25 watt (C) 30 watt (D) 45 watt

128. Acceleration time graph of a particle moving in a straight line is shown in figure. (Assume that at t = 0 particle was at rest)



It is also given that during the entire motion only a single force F acts on the particle. Choose the ***correct*** Statement.
(A) Power developed by force is maximum at time t = t_A .
(B) Power developed by force is maximum at time t = t_B .
(C) Power developed by force is minimum at time t = t_C .
(D) Power developed by force may be maximum at time t = t_D .

129. A force of 5N acts on a 15 kg particle initially at rest. What will be instantaneous power due to the force at the end of 6th second.

(A) 10 watt (B) 5 watt (C) 20 watt (D) 25 watt

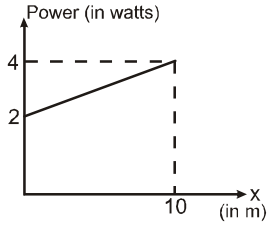
130. A particle of mass m moves from rest under the action of a constant force F which acts for two seconds. The maximum power attained is:

(A) 2 Fm (B) $\frac{F^2}{m}$ (C) $\frac{2F}{m}$ (D) $\frac{2F^2}{m}$

131. A particle of mass m moves in circular path of radius r with centripetal acceleration at any time t is given as $a_C = k\,t$, then power of resultant force is:

(A) $\frac{m\,k\,r}{2}$ (B) $\frac{m\sqrt{k\,r}}{2}$ (C) $\frac{m\,(k\,r)^{3/2}}{2}$ (D) $\frac{k\,r}{2}$

132. A particle A of mass $\frac{10}{7}$ kg is moving in the positive direction of x. Its initial position is x = 0 & initial velocity is 1 m/s. The velocity at x = 10 is: (use the graph given)

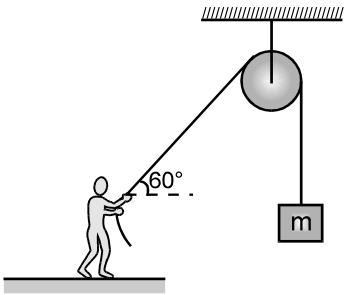


(A) 4 m/s (B) 2 m/s (C) $3\sqrt{2}$ m/s (D) 100/3 m/s

133. Power supplied to a particle of mass 2 kg varies with time as P = $\frac{3t^2}{2}$ watt. Here t is time in second. If velocity of particle at t = 0 s is v = 0 m/s. The velocity of particle at time t = 2 s will be

(A) 1 m/s (B) 4 m/s (C) 2 m/s (D) $2\sqrt{2}$ m/s

134. A man is supplying a constant power of 500 J/s to a massless string by pulling it at a constant speed of 10 m/s as shown. It is known that kinetic energy of the block is increasing at a rate of 100 J/s. Then the mass of the block is :



(A) 5 kg (B) 3 kg (C) 10 kg (D) 4 kg

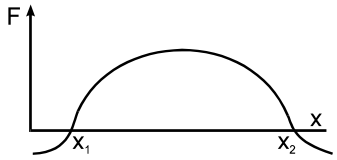
135. A force $\vec{F} = (3\hat{i} + 4\hat{j})$N acts on a 2 kg movable object that moves from an initial position $\vec{d}_i = (-3\hat{i} - 2\hat{j})$m to a final position $\vec{d}_f = (5\hat{i} + 4\hat{j})$m in 6 s. The average power delivered by the force during the interval is equal to :

(A) 8 watt (B) $\frac{50}{6}$ watt (C) 15 watt (D) $\frac{50}{3}$watt.

136. The potential energy of a particle varies with x according to the relation $U(x) = x^2 - 4x$. The point x = 2 is a point of :

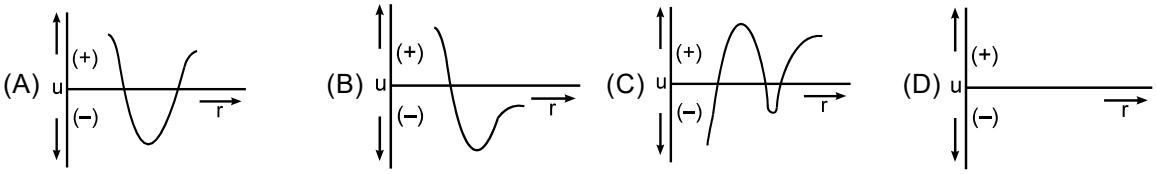
(A) stable equilibrium (B) unstable equilibrium
(C) neutral equilibrium (D) none of above

137. The force acting on a body moving along x axis varies with the position of the particle as shown in the fig. The body is in stable equilibrium at

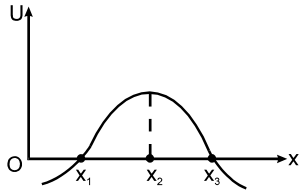


(A) $x = x_1$ (B) $x = x_2$ (C) both x_1 and x_2 (D) neither x_1 nor x_2

138. Figure represents potential energy of diatomic molecules as a function of atomic distance r. Which graph corresponds to most stable molecule.

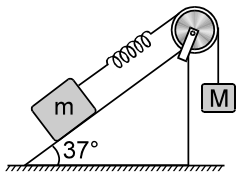


139. In the figure shown the potential energy U of a particle is plotted against its position 'x' from origin. Then which of the following statement is correct. A particle at:



(A) x_1 is in stable equilibrium (B) x_2 is in stable equilibrium
(C) x_3 is in stable equilibrium (D) none of these

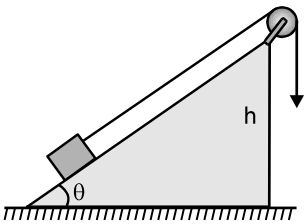
140. A block of mass m is attached with a massless spring of force constant k. The block is placed over a fixed rough inclined surface for which the coefficient of friction is $\mu = \frac{3}{4}$. The block of mass m is initially at rest. The block of mass M is released from rest with spring in undeformed state. The minimum value of M required to move the block up the plane is (neglect mass of string and pulley and friction in pulley.)



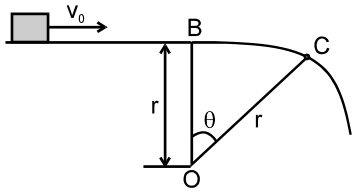
(A) $\frac{3}{5}m$ (B) $\frac{4}{5}m$ (C) $\frac{6}{5}m$ (D) $\frac{3}{2}m$

141. The total work done on a particle is equal to the change in its kinetic energy.
(A) always
(B) only if the forces acting on the body are conservative
(C) only if the forces acting on the body are gravitational
(D) only if the forces acting on the body are elastic.

142. A block of mass m is directly pulled up slowly on an smooth fixed inclined plane of height h and inclination θ with the help of a string parallel to the incline. Which of the following statement(s) is/are incorrect for the block when it moves up from the bottom to the top of the incline.
(A) work done by the normal reaction force is zero
(B) work done by the string is mgh
(C) work done by gravity is mgh
(D) total work done on the block is zero.

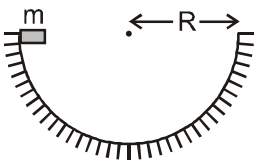


143. A small block slides with velocity $0.5\sqrt{gr}$ on the horizontal frictionless surface as shown in the Figure. The block leaves the surface at point C. The angle θ in the Figure is



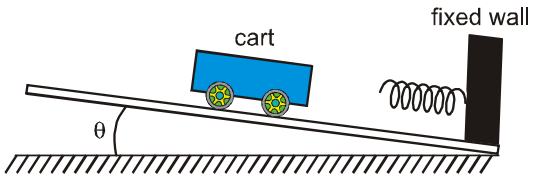
(A) $\cos^{-1}(4/9)$ (B) $\cos^{-1}(3/4)$ (C) $\cos^{-1}(1/2)$ (D) none of these

144. In the figure shown, a small block of mass m moves in fixed semicircular smooth track of radius R in vertical plane. It is released from the top. The resultant force on the block at the lowest point of track is.



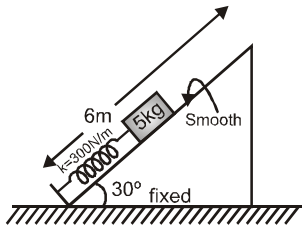
(A) 3 mg (B) 2 mg (C) mg (D) zero

145. The cart starting from rest moves down the incline. When the cart maximally compresses the spring (that is compression in the spring is maximum) at the bottom of the track, the cart's



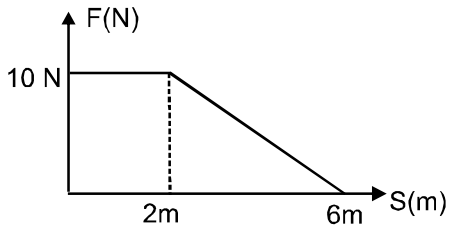
(A) velocity and acceleration are zero.
(B) velocity is nonzero but its acceleration is zero.
(C) acceleration is nonzero, but its velocity is zero.
(D) velocity and acceleration are both nonzero.

146. A block of mass 5 kg is released from rest when compression in spring is 2m. Block is not attached with the spring and natural length of the spring is 4m. Maximum height of block from ground is : ($g = 10\ m/s^2$)



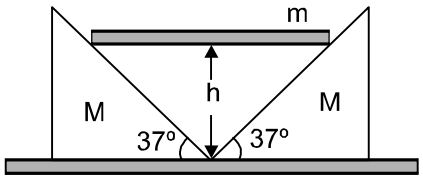
(A) 5.5 m (B) 4.5 m (C) 6 m (D) 7.5 m

147. A body of constant mass m = 1 kg moves under variable force F as shown. If at t = 0, S = 0 and velocity of the body is $\sqrt{20}$ m/s and the force is always along direction of velocity, then



(A) velocity of the particle will increase upto S = 2m and then decrease.
(B) the final velocity at S = 6 m is 10 m/s
(C) the final velocity at S = 6 m is $4\sqrt{5}$ m/s
(D) the acceleration is constant up to S = 2m and then it is negative.

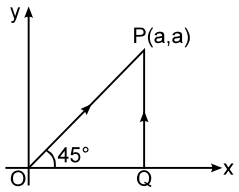
148. A body of mass m is held at rest at a height h on two smooth wedges of mass M each which are themseleves at rest on a horizontal frictionless surface (figure). When the mass m is released, it moves down, pushing aside the wedges. The speed of any of masses M, when m reaches the ground is :



(A) $\sqrt{\frac{8mgh}{m+2M}}$ (B) $\sqrt{\frac{40mgh\times 4}{5m+6M}}$ (C) $\sqrt{\frac{32mgh}{32m+9M}}$ (D) None of these a

149. When a conservative force does positive work, the potential energy of the system associated with that force:
(A) decreases (B) increases (C) remains constant
(D) depends on whether other non conservative force is working or not.

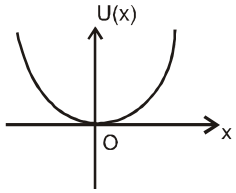
150. A particle is moved from (0, 0) to (a, a) under a force $F=(3\hat{i}+4\hat{j})$ from two paths. Path 1 is OP and Path 2 is OQP. Let W_1 and W_2 be the work done by this force in these two paths. Then

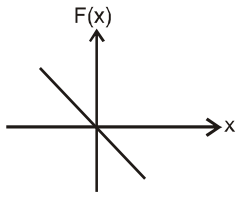


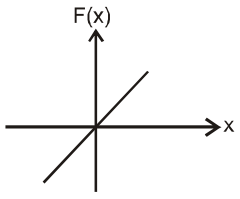
(A) $W_1 = W_2$ (B) $W_1 = 2W_2$ (C) $W_2 = 2W_2$ (D) $W_2 = 4W_1$

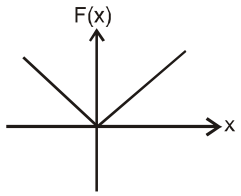
151. The work done by kinetic friction on a body :
(A) is always negative (B) is always zero
(C) may be +ve, –ve or zero (D) is always positive

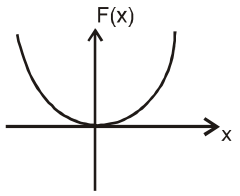
152. Figure shows a plot of potential energy function $U(x) = kx^2$ where x = displacement and k = constant. Identify the correct conservative force function F(x)



(A)


(B)


(C)


(D)


153. A force $\vec{F} = (3t\hat{i} + 5\hat{j})$ N acts on a particle whose position vector varies as $\vec{s} = (2t^2\hat{i} - 5\hat{j})$ m, where t is time in seconds. The work done by this force from t = 0 to t = 2s is :
(A) 23 J (B) 32 J (C) zero (D) can't be obtained

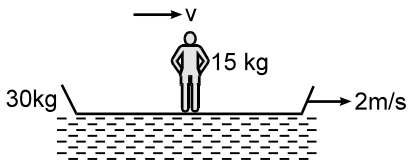
154. **STATEMENT-1 :** A force having constant magnitude is always conservative
STATEMENT-2 : A force is conservative if work done by it in every round trip is zero.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

SECTION (D) : CENTRE OF MASS, RIGID BODY DYNAMICS

155. A body is rotating with angular momentum L. If I is its moment of inertia about the axis of rotation, its kinetic energy of rotation is

(A) $\frac{1}{2}IL^2$ (B) $\frac{1}{2}IL$ (C) $\frac{1}{2}(I^2L)$ (D) $\frac{1}{2}\frac{L^2}{I}$

156. In the figure shown the initial velocity of **boat (30 kg) + person** (15 kg) is 2 m/s. Find velocity of person w.r.t. boat so that velocity of boat will be 1 m/s in right (Neglect friction between boat and water)

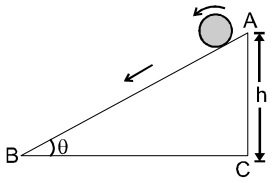


(A) 3 m/s towards right (B) 3 m/s towards left
(C) 4 m/s towards right (D) 4 m/s towards left

157. A ball of mass m moves towards a moving wall of infinite mass with a speed 'v' along the normal to the wall. The speed of the wall is 'u' toward the ball. The speed of the ball after 'elastic' collision with wall is:
(A) u + v away from the wall (B) 2u + v away from the wall
(C) | u – v| away from the wall (D) | v – 2u | away from the wall

158. The instantaneous angular position of a point on a rotating wheel is given by the equation $\theta(t) = 2t^3 - 6t^2$. The torque on the wheel becomes zero at :
(A) t = 1s (B) t = 0.5 s (C) t = 0.25 s (D) t = 2s

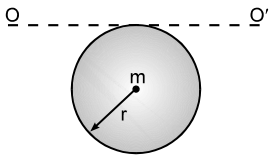
159. If a sphere rolling on an inclined plane with velocity υ without slipping, the vertical height of the incline in terms of velocity will be :



(A) $\frac{7\upsilon}{10g}$ (B) $\frac{7\upsilon^2}{10g}$ (C) $\frac{2\upsilon^2}{5g}$ (D) $\frac{3\upsilon}{5g}$

160. Two particle P and Q are in motion under earth's gravitational field only. Then:
(A) their relative acceleration is constant but not zero
(B) their relative velocity is constant
(C) their centre of mass has constant velocity
(D) their centre of mass has variable acceleration.

161. Moment of inertia of a disc about O O′ is:

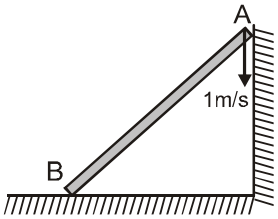


(A) $\frac{3\,m\,r^2}{2}$ (B) $\frac{m\,r^2}{2}$ (C) $\frac{5\,m\,r^2}{2}$ (D) $\frac{5\,m\,r^2}{4}$

162. A thin circular ring of mass M and radius r is rotating about its axis with constant angular velocity ω. Two objects each of mass m are attached gently to the opposite ends of a diameter of the ring. The ring now rotates with angular velocity given by

(A) $\frac{(M+2m)\omega}{2m}$ (B) $\frac{2M\omega}{M+2m}$ (C) $\frac{(M+2m)\omega}{M}$ (D) $\frac{M\omega}{M+2m}$

163. A rod of length 1m is sliding in a corner as shown. At an instant when the rod makes an angle of 60º with the horizontal plane, the velocity of point A on the rod is 1m/s. The angular velocity of the rod at this instant is :



(A) 2 rad/s (B) 1.5 rad/s (C) 0.5 rad/s (D) 0.75 rad/s

164. The moment of inertia of a thin uniform rod of mass M and length L about an axis passing through its midpoint and perpendicular to its length is I_0. Its moment of inertia about an axis passing through one of its ends and perpendicular to its length is :

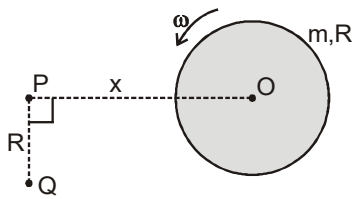
(A) $I_0 + ML^2/2$ (B) $I_0 + ML^2/4$ (C) $I_0 + 2ML^2$ (D) $I_0 + ML^2$

165. A body at rest splits into three parts of mass m, m and 4m respectively. The two equal masses fly off perpendicular to each other and each with speed of V. The speed of 4m will be

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

166. **STATEMENT-1 :** Two particles undergo rectilinear motion along different straight lines. Then the centre of mass of system of given two particles also always moves along a straight line.
STATEMENT-2 : If direction of net momentum of a system of particles (having nonzero net momentum) is fixed, the centre of mass of given system moves along a straight line.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

167. A uniform disc of mass m and radius R is undergoing fixed axis rotation about its own axis and centre O of disc remains stationary. The angular speed of disc is ω. Then the magnitude of angular momentum of disc about shown point Q is : (OP = x and PQ = R)



(A) $m\frac{(x^2+2R^2)}{2}\omega$ (B) $m\frac{(x^2+R^2)}{2}\omega$ (C) $\frac{mx^2}{2}\omega$ (D) $\frac{mR^2}{2}\omega$

ANSWER KEY

SECTION (A)

1.	(D)	**2.**	(A)	**3.**	(B)	**4.**	(D)	**5.**	(B)	**6.**	(D)	**7.**	(A)
8.	(A)	**9.**	(C)	**10.**	(B)	**11.**	(B)	**12.**	(A)	**13.**	(A)	**14.**	(C)
15.	(C)	**16.**	(D)	**17.**	(B)	**18.**	(B)	**19.**	(B)	**20.**	(D)	**21.**	(B)
22.	(A)	**23.**	(B)	**24.**	(D)	**25.**	(A)	**26.**	(C)	**27.**	(A)	**28.**	(A)
29.	(D)	**30.**	(C)	**31.**	(B)	**32.**	(C)	**33.**	(D)	**34.**	(D)	**35.**	(D)
36.	(A)	**37.**	(C)	**38.**	(C)	**39.**	(B)	**40.**	(B)	**41.**	(C)	**42.**	(B)
43.	(A)	**44.**	(D)	**45.**	(C)	**46.**	(D)	**47.**	(B)	**48.**	(A)	**49.**	(A)
50.	(C)	**51.**	(D)	**52.**	(D)	**53.**	(D)	**54.**	(A)	**55.**	(B)	**56.**	(D)
57.	(C)	**58.**	(C)	**59.**	(C)	**60.**	(D)	**61.**	(A)	**62.**	(B)	**63.**	(A)
64.	(C)	**65.**	(C)	**66.**	(A)	**67.**	(C)	**68.**	(B)	**69.**	(C)	**70.**	(A)
71.	(A)	**72.**	(B)	**73.**	(A)	**74.**	(D)	**75.**	(C)	**76.**	(A)	**77.**	(B)

SECTION (B)

78.	(A)	**79.**	(D)	**80.**	(D)	**81.**	(C)	**82.**	(B)	**83.**	(D)	**84.**	(D)
85.	(D)	**86.**	(C)	**87.**	(C)	**88.**	(A)	**89.**	(D)	**90.**	(C)	**91.**	(D)
92.	(D)	**93.**	(C)	**94.**	(B)	**95.**	(B)	**96.**	(D)	**97.**	(A)	**98.**	(B)
99.	(B)	**100.**	(A)	**101.**	(C)	**102.**	(B)	**103.**	(D)	**104.**	(C)	**105.**	(C)
106.	(B)	**107.**	(C)	**108.**	(D)	**109.**	(D)	**110.**	(B)	**111.**	(B)	**112.**	(B)

SECTION (C)

113.	(B)	**114.**	(C)	**115.**	(B)	**116.**	(D)	**117.**	(B)	**118.**	(D)	**119.**	(A)
120.	(C)	**121.**	(B)	**122.**	(C)	**123.**	(A)	**124.**	(C)	**125.**	(B)	**126.**	(A)
127.	(D)	**128.**	(D)	**129.**	(A)	**130.**	(D)	**131.**	(A)	**132.**	(A)	**133.**	(C)
134.	(D)	**135.**	(A)	**136.**	(A)	**137.**	(B)	**138.**	(B)	**139.**	(D)	**140.**	(A)
141.	(A)	**142.**	(C)	**143.**	(B)	**144.**	(B)	**145.**	(C)	**146.**	(A)	**147.**	(B)
148.	(C)	**149.**	(A)	**150.**	(A)	**151.**	(C)	**152.**	(A)	**153.**	(B)	**154.**	(D)

SECTION (D)

155.	(D)	**156.**	(A)	**157.**	(B)	**158.**	(A)	**159.**	(B)	**160.**	(B)	**161.**	(D)
162.	(D)	**163.**	(A)	**164.**	(B)	**165.**	(A)	**166.**	(D)	**167.**	(D)		

ASAT PREPARATION ASSIGNMENT (NURTURE COURSE)

1. If the subsidiary quantum number of a subenergy level is 4, the maximum and minimum values of the spin multiplicities are :

(A) 9, 1 (B) 10, 1

(C) 10, 2 (D) 8, 1

2. An electron in an atom jumps in a such a way that its K.E changes from x to $\frac{x}{4}$. The change in P.E will be

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

(C) $+\frac{3}{4}x$ (D $\frac{-3}{4}x$

3. An energy of 24.6 eV is required to remove one of the electrons from a helium atom. The energy required to remove both electrons from helium atom is :

(A) 38.2 eV (B) 49.2 eV

(C) 51.8 eV (D) 79 eV

4. Correct statements of following is/are

(A) For 2s orbital a boundary surface has constant value of probability density $|\psi^2|$

(B) The Probability density $|\psi^2|$ is constant throughout boundary surfaces for 'P' orbital

(C) In multi electronatoms energies of 2s and 2p are equal

(D) In Hydrogen atom orbitals with same principal quantum number but different azimuthal quantum number differ in energies

5. If γ_1 is the frequency of series limit of Lyman series. γ_2 is the frequency of first line of Lyman series and γ_3 be the frequency of the series limit of Balmer series then :

(A) $\gamma_1 + \gamma_2 = \gamma_3$ (B) $\gamma_2 - \gamma_1 = \gamma_3$

(C) $\gamma_1 - \gamma_2 = \gamma_3$ (D) $\gamma_3 = \frac{1}{3}(\gamma_1 + \gamma_2)$

6. For a hypothetical hydrogen like atom, the potential energy of the system is given by $u_{(r)} = \frac{-ke^2}{r^3}$, where r is the distance between the two particles. If Bohr's model of quantization of angular momentum is applicable then velocity of particle is given by

(A) $v = \frac{n^2h^3}{ke^2 8\pi^3 m^2}$ (B) $v = \frac{n^3h^3}{8ke^2\pi^3 m^2}$

(C) $v = \frac{n^3h^3}{24ke^2\pi^3 m^2}$ (D) $v = \frac{n^2h^3}{24ke^2\pi^3 m^2}$

7. If radiation corresponding to second line of "Balmer series" of Li^{2+} ion, knocked out electron from first excited state of H-atom, then kinetic energy of ejected electron would be :

(A) 2.55 eV (B) 4.25 eV

(C) 11.25 eV (D) 19.55 eV

8. Which of the following is /are correct?

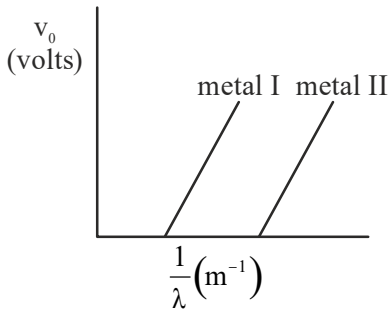
(A) As n decreases, deBroglie's wavelength of an electron in Bohr's orbit increases

(B) As n increases, orbit frequency decreases

(C) An atomic orbital wave function ψ represents the state of an electron in an atom

(D) If the velocity of the electron is suddenly increased by $\sqrt{2}$ times, the electron is knocked out of atom.

9. In a photoelectric experiment, the stopping potential is plotted against $\frac{1}{\lambda}$ of incident radiation for two different metals, the curve is like as shown in the fig. Predict which of the following statements are correct



work function of metal I = 0.24 eV

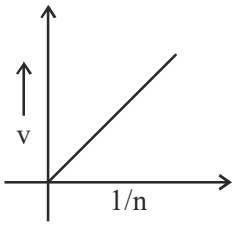
(A) Slope of the curves for both the metals is 1.242×10^{-6} Jm coulumb^{-1}

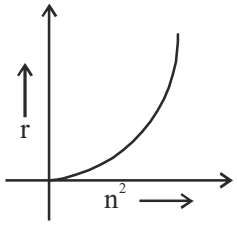
(B) When an electromagnetic radiation of wavelength 100 nm strikes the two metals separately, the stopping potential for metal I is 12.18V

(C) The stopping potential for metal I is more than that of metal II, if both the metals are exposed to electromagnetic radiation of wavelength 200 nm separately

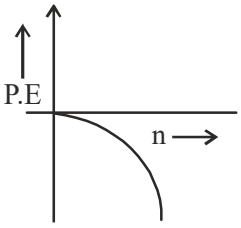
(D) The stopping potential for metal II is more than that of metal I, if both the metals are exposed to electromagnetic radiation of wavelength 200 nm separately

10. Select the INCORRECT curve(s):
If v = velocity of electron in Bohr's orbit
r = Radius of electron in Bohr's orbit
P.E = Potential energy of electron in Bohr's orbit
K.E. = Kinetic energy of electron in Bohr's orbit

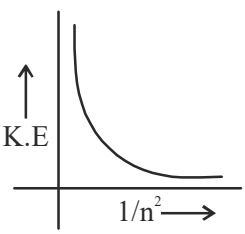
(A)


(B)


Parabolic curve

(C)


Parabolic curve

(D)


Rectangular hyperabola

11. Values of work functions (W_0) of few metals are given below. The number of metals which will show photoelectric effect when light of wavelength 400 nm falls on it is

Meta	Li	Na	K	Mg	Cu	Ag
$\mathbf{W_0(eV)}$	2.42	2.3	2.25	3.7	4.8	4.3

12. From the following reactions,

$2CoF_2 + F_2 \rightarrow 2CoF_3$

$(CH_2)_n + 4nCoF_3 \rightarrow (CF_2)_n + 2nHF + 4nCoF_2$

Calculate how much kilograms of F_2 (approx) will be consumed to produce 2 kg of $(CF_2)_n$.

13. Degeneracy of 2nd excited state of Li^{2+} ion is x, and degeneracy of 4th excited state of Li^{+} ion is y then x/y is

14. Ratio of frequency of revolution of electron in second excited state of He^+ and second state of H is $\frac{2^y}{3^y}$. What is the value of 'x + y'?

15. In de-excitation in a certain sample of Bohr atoms from 5th energy level to ground state. Paschen lines are prohibited. The total no. of spectral lines observed are

16. 4.62 g of sugar and 2.935 g of table salt were mixed with 28.2 g of water. The density of resulting solution is 357.55 g/ml. Then volume occupied by resultant solution properly reported in significant figures.

17. 0.1M solution of KI reacts with excess H_2SO_4 and KIO_3 solutions, according to equations

$5I^- + IO_3^- + 6H^+ \rightarrow 3I_2 + 3H_2O$

Which of the following statement is correct

(A) 400 ml of the KI solution react with $0.004\,mol\,KIO_3$

(B) $100\,ml$ of the KI solution react with $0.006\,mol$ of H_2SO_4

(C) 0.5ℓ of the KI solution produced $0.005\,mol$ of I_2

(D) Equivalent weight of KIO_3 is equal to $\left(\frac{\text{Molecular weight}}{5}\right)$

18. An open vessel at $27°C$ is heated assuming that volume of vessel remains constant. Which of the following is/are correct

(A) Temperature to which vessel was heated till $\left(\frac{3}{5}\right)^{th}$ of air is it has been expelled is $477°C$

(B) Fraction of molecules escaped out when vessel is heated to 900 K is $\frac{2}{3}$.

(C) Temperature at which half of air escapes out is $327°C$

(D) Fraction of molecules escaped out when vessel is heated to 900 K is $\frac{1}{3}$.

19. Two vessels connected by a valve of negligible volume. One container (I) has 2.8gm of N_2 and 12.7gm of I_2 at temperature $T_1(k)$. The other container (II) is completely evacuated. The container (I) is heated to $T_2(k)$ while container (II) is maintained at $\frac{T_2}{3}(k)$. The valve is opened. I_2 sublimes at $T_2(k)$ and volume of

vessel (I) is half that of vessel (II) neglect vapour pressure of $I_2(s)$

(A) The mass of N_2 in container I after a very long time is 0.4 gm

(B) The mass of N_2 in container II after a very long time is 0.4 gm

(C) The mass of N_2 is container I after a very long time is 2.4 gm

(D) The mass of N_2 in container II after a very long time is 2.4 gm

20. A piece of plumber's solder weighing 3 gm dissolved in nitric acid, then treated with dilute H_2SO_4. This precipitate the lead as $PbSO_4$, which after washing and drying weigned 2.93gm. The solution was then neutralized to precipitate stannic acid, which was decomposed by heating yielding 1.27 gm SnO_2. What is the analysis of the solder $(Pb = 207.2\,amu, Sn = 118.7\,amu)$

(A) 66.7% Pb, 33.3% Sn
(B) 33.3% Pb, 66.7% Sn
(C) 1 gm Pb, 2gm Sn
(D) 2 gm Pb, 1 gm Sn

21. For the reaction

$$Na_2S_2O_3 + 4Cl_2 + 5H_2O \rightarrow Na_2SO_4 + H_2SO_4 + 8HCl$$

Which of the following statement is/are correct

(A) Equivalent weigh of $Na_2S_2O_3$ is $\frac{Mol.wt}{8}$

(B) Equivalent weight of Cl_2 is $\frac{Mol.wt}{2}$

(C) Average oxidation state of S in $Na_2S_2O_3$ is +2

(D) $Na_2S_2O_3$ is getting oxidised is the above reaction

22. Which of the following statements is correct

(A) The compressibility factor less than one is due to the vander waals constant 'a' of a real gas
(B) The compressibility factor more than one is due to the excluded volume of the gas
(C) The excluded volume, represented as 'b' is the volume occupied by 1 mol of gas
(D) The gas showing +ve deviation will have compressibility factor more than 1

23. The van der waal's equation for 1 mol of real gas many be rearranged to give

$$V_m^3 - \left(b + \frac{RT}{P}\right)V_m^2 + \frac{a}{p}V_m - \frac{ab}{p} = 0$$

V_m being the molar volume of the gas. Indicate the correct statement amongst the following

(A) At temperature greater than T_c, there are three values of V_m, one real and two imaginary

(B) At temperature T_c, the three real values of V_m are identical.

(C) At temperature less than T_c there are three real values of V_m

(D) All are incorrect

24. Precisely 1 mol of helium and 1 mol of neon are placed in a container. Indicate the correct statements about the system

(A) Molecules of the two gases strike the wall of the container with same frequency
(B) Molecules of Helium strike the wall more frequently
(C) Molecules of helium has greater average molecular speed
(D) Helium exerts larger pressure

25. Which of the following are characteristic of real gas?

(A) The molecules attract each other

(B) It obeys the ideal gas law at low temperature and high pressure

(C) The mass of molecule is negligible

(D) It shows deviation from the ideal gas law

26. The correct relation is

(A) $T_c = \frac{8a}{27Rb}$ (B) $V_c = 3b$

(C) $P_c = \frac{a}{27b^2}$ (D) $\frac{P_c V_c}{RT_c} = \frac{3}{8}$

27. Which is/are correct for molecular speed of gases?

(A) $V_{rms} = \sqrt{\frac{3PV}{M}}$ (B) $V_{rms} > V_{av}$

(C) $V_{mp} > V_{av}$ (D) $V_{mp} = \sqrt{\frac{8RT}{\pi M}}$

28. Regarding H_2 gas the correct statement(s) are

(A) For H_2 gas $z > 1$ at 273 k

(B) When H_2 gas expands at above inversion temperature, then it shows heating effect

(C) The critical temperature of H_2 is very high

(D) The value of van der waal's constant 'a' is very low for H_2

29. According to kinetic theory of gases,

(A) Collision are always elastic

(B) Heavier molecules transfer more momentum to the wall of the container

(C) Only a small number of molecules have very high velocity

(D) Between collisions the molecules move in straight lines with constant velocities

30. When $Na_2S_2O_3$ is reacted with I_2 to form $Na_2S_4O_6$ and NaI, then which statement is (are) correct?

(A) n-factor for $Na_2S_2O_3$ is one

(B) n-factor for I_2 is two

(C) 2 moles of $Na_2S_2O_3$ is reacted with one mole of I_2

(D) n-factor for $Na_2S_4O_6$ is one

31. Choose the correct regarding indicator

Titration	Indicator
(A) NaOH vs CH_3COOH	Phenolphthalein
(B) $KMnO_4$ vs FeC_2O_4	$KMnO_4$
(C) I_2 vs $FeSO_4$	Starch
(D) $K_2Cr_2O_7$ vs $FeSO_4$	$K_3[Fe(CN)_6]$ as external indicator

32. The strength of '20 volume' H_2O_2 is equal to

(A) 60.86 g/L (B) 3.58 N

(C) 1.79 M (D) 3.035%

33. Consider the reaction $aFeS_2 + bO_2 \rightarrow cFe_2O_3 + dSO_2$

which is correct for the above reaction?

(A) n factor for FeS_2 is 11 (B) The ratio of a : b is 4 : 11

(C) The ratio of a : b is 11 : 4 (D) The ratio of c : d is 1 : 4

34. Which of the following statements are correct?

(A) Helium diffuses at a rate of 8.65 times as much as CO does.

(B) Helium escapes at a rate of 2.65 times as fastas CO does

(C) Helium escapes at a rate of 4 times as CO_2 does

(D) Helium escapes at a rate of 4 times as fast as SO_2 does.

35. Which of the following is the correct for critical temperature?

(A) It is the highest temperature at which liquid and vapour can co exist

(B) Beyond the critical temperature, there is no distinction between two phases and gas cannot be liquefied by compression

(C) At critical temperature, the surface tension of the system is zero

(D) At critical temperature, the gas and the liquid phases have the different critical densities

36. A gas can be liquefied

(A) When its inversion temperature is equal to the boyle's temperature

(B) Under adiabatic expansion

(C) Under pressure, when it is cooled below critical temperature

(D) At pressure, higher the critical pressure and temperature lower than the critical temperature

MULTI CORRECT CHOICE

37. Which one is correct for H_2O at 25°C

(A) Ionic product of water, $K_w = 10^{-14}$

(B) Equilibrium constant for dissociation of water $K_c = 1.8 \times 10^{-16}$

(C) Autoprotolysis constant of water, $K_{AP} = 3.2 \times 10^{-18}$

(D) On heating K_w increases with temperature

38. For the reaction : $X(g) \rightleftharpoons nY(g)$, the degree of dissociation is α, then which one is not correct

(A) $K_c = \dfrac{n^n \alpha^n}{(1-\alpha)} mol^{n-1} litre^{1-n}$ (B) $K_p = \left[\dfrac{n\alpha}{1-\alpha}\right]\left[\dfrac{P}{1-\alpha+n\alpha}\right]^{n-1} atm^{n-1}$

(C) $K_c = \dfrac{n\alpha^n}{(1-\alpha)n} mol^{n-1} litre^{1-n}$ (D) $K_p = \dfrac{n\alpha^n}{(1-\alpha)}\left[\dfrac{P}{1-\alpha+n\alpha}\right]^{n-1} atm^{n-1}$

39. The thermal dissociation equilibrium of $CaCO_3(s)$ is studied under different conditions.

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

For this equilibrium, the correct statement(s) is (are)

(A) ΔH is dependent on T

(B) K is independent of the initial amount of $CaCO_3$

(C) K is dependent on the pressure of CO_2 at a given T

(D) ΔH is independent of the catalyst, if any

40. The rate of effusion of an equilibrium mixture in one litre vessel of at 300 K $A_2 \rightleftharpoons 2A$ through a pin hole is 0.707 times of rate of diffusion of O_2 under identical conditions of P and T. Which of the following are correct if at wt of A is 46 :

(A) Mole ratio of $A / A_2 = 0.643$

(B) $K_c = 25.16$ mol / litre

(C) $\Delta G^0 = -8.01 \times 10^3$ J

(D) Molar mass of mixture = 64

41. For the reaction : $Cl_2(g) + 3F_2(g) \rightleftharpoons 2ClF_3(g)$; $\Delta H = -329$kJ , dissociation of $ClF_3(g)$ will be favoured by :

(A) Increasing the temperature

(B) Increasing the volume of the container

(C) Adding of F_2 gas

(D) Adding of inert gas at constant pressure

42. $N_2(g)$ and $H_2(g)$ are allowed to react in a closed vessel at given temperature and pressure for the formation of $NH_3(g)\left[N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) + 22.4\,\text{kcal}\right]$. If He(g) is added at equilibrium at constant pressure then which is / are correct ?

(A) Concentration of $N_2(g)$ and $H_2(g)$ and $NH_3(g)$ decrease

(B) Moles of $NH_3(g)$ decreases

(C) The extent of cooling depends on amount of He(g) added

(D) Concentration of N_2 and H_2 increases and concentration of NH_3 decreases

43. For a reversible reaction $aA + bB \rightleftharpoons cC + dD$; the variation of K with temperature is given by

$$\log\frac{K_2}{K_1} = \frac{-\Delta H^0}{2.303R}\left[\frac{1}{T_2} - \frac{1}{T_1}\right] \text{ then ,}$$

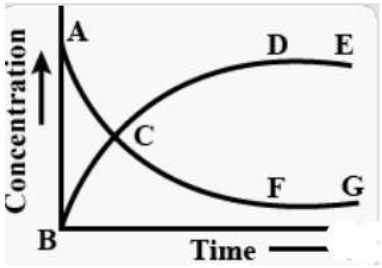
(A) $K_2 > K_1$ if $T_2 > T_1$ for an endothermic change

(B) $K_2 < K_1$ if $T_2 > T_1$ for an endothermic change

(C) $K_2 > K_1$ if $T_2 > T_1$ for an exothermic change

(D) $K_2 < K_1$ if $T_2 > T_1$ for an exothermic change

44. $N_2O_4(g) \rightleftharpoons 2NO_2(g), K_c = 4$. This reversible reaction is studied graphically as shown in figure. Select the correct statement(s)



I. Reaction quotient has maximum value at point A

II. Reaction proceeds left to right at a point when $[N_2O_4] = [NO_2] = 0.1M$

III. $K_c = Q$ when point D or F is reached

(A) I (B) II
(C) III (D) None

SINGLE CORRECT CHOICE

45. The equilibrium constant K_{P_1} and K_{P_2} for the reactions

$X \rightleftharpoons 2Y$ and $Z \rightleftharpoons P + Q$, respectively are in the ratio of 1 : 9. If the degree of dissociation of X and Z be equal, then the ratio of total pressures at these equilibria is :

(A) 1 : 36 (B) 1 : 1
(C) 1 : 3 (D) 1 : 9

46. When N_2O_5 is heated at temperature T, it dissociates as : $N_2O_5 \rightleftharpoons N_2O_3 + O_2$; $k_c = 2.5$. At the same tinme N_2O_3 decomposes as $N_2O_3 \rightleftharpoons N_2O + O_2$. If initially 4.0 moles of N_2O_5 are taken in 1.0 litre flask and allowed to attain equilibrium, concentration of O_2 was found to be 2.5 M. Equilibrium concentration of N_2O is :

(A) 1.0 (B) 1.5
(C) 2.166 (D) 0.334

47. If we know the equilibrium constant for a particular reaction, we can calculate the concentration in the equilibrium mixture from the initial concentration. Commonly only the initial concentration of reactants are given.
In a study of equilibrium

$H_2(g) + I_2(g) \rightarrow 2HI(g)$

1 mol of H_2 and 3 moles of I_2 gave rise at equilibrium to x moles of HI.

Addition of a further 2 moles of H_2 gave an additional x moles of HI. What is x ?

(A) 0.5 (B) 1
(C) 1.5 (D) None of these

48. The equilibrium constant for the reaction is 9.40 at 900°C $S_2(g) + C(s) \rightleftharpoons CS_2(g)$. Calculate the pressure in atom of two gases at equilibrium, when 1.42 atm of S_2 and excess of C(s) come to equilibrium.

49. PCl_5 dissociates according to the reaction $PCl_5 \rightleftharpoons PCl_3(g) + Cl_2(g)$. At 523 K, $K_p = 1.78$ atm. Find (g/L) the density of the equilibrium mixture at a total pressure of 1 atm.

50. The statements that are true for the long form of the periodic table are :

(A) It reflects the sequence of filling the electrons in the order of sub-energy level s, p, d and f

(B) It helps to predict the stable valency states of the elements

(C) It reflects tends to physical and chemical properties of the elements

(D) It helps to predict the relative ionicity of the bond between any two elements

51. Consider the Period 3 elements Na, Mg, Al, Si, P, S, Cl

Correct statements include :

(A) Na(g) has the largest atomic radius

(B) Na(s) has the highest electrical conductivity

(C) Cl(g) has the highest first ionisation enthalpy

(D) Cl^-(g) and S^{2-}(g) have the same ionic radius

52. Which of the following elements will have high ionization energy than the element next in atomic number

(A) N (B) Mg

(C) F (D) P

53. Which of the following is/are correct, for acidic strength of oxoacid

(A) $HOCl > HClO_2$ (B) $HClO_3 > HClO$

(C) $HClO_4 > HClO_3$ (D) $HClO_4 > HClO_2$

54. Identify the correct statements

(A) In group size of atom increases with increase in number of shell

(B) In period size of atom decreases with increasing nuclear charge

(C) Screening constant value (σ) increases moving down the group

(D) Effective nuclear charge remains constant in group

55. The charge/size ratio of a cation determines its polarizing power. Which one of the following sequences are incorrect order of polarizing power of the cationic species.

K^+, Ca^{2-}, Mg^{2+}, Be^{2+} ?

(A) $Ca^{2+} < Mg^{2+} < Be^{+2} < K^+$ (B) $Mg^{2+} < Be^{2+} < K^+ < Ca^{2+}$

(C) $Be^{2+} < K^+ < Ca^{2+} < Mg^{2+}$ (D) $K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$

56. Which of the following can be isoelectronic ?

(A) Two different cations (B) Two different anions

(C) Cations and anions (D) Two different elements

57. Which of the following is/are incorrect :

(A) Isoelectronic species have the same nuclear charge

(B) The effective nuclear charge is the nuclear charge minus the shielding effect

(C) An anion is larger than a cation if they are isoelectronic

(D) In group effective nuclear charge increased from top to bottom

58. Which of the following statements are true ?

(A) Electron affinity of 'Chlorine' is greater then fluorine

(B) Electron affinity of inert gas is zero

(C) Electron affinity of Nitrogen is very high

(D) Generally electron affinity increases from top to bottom in the group

59. Which of the following orders is not correct :

(A) Ionization energy : P > Si > S (B) Electronegativity : Cl > F > Br

(C) Acidic character : $Al_2O_3 < MgO < Na_2O$ (D) Atomic radius : I > Br > Cl

60. Sodium sulphate is soluble in water- whereas bariumsuphate is sparingly soluble because:
(A) The hydration energy of sodiumsulphate is more than its lattice energy
(B) The lattice energy of bariumsulphate is more than its hydration energy
(C) The lattice energy has no role to play in solubility
(D) The hydration energy of sodiumsulphate is less than its lattice energy.

61. Among the tri atomic molecules /ions

$BeCl_2, N_3^-, N_2O, NO_2^+, O_3, SCl_2, ICl_2^-, I_3^-$ and XeF_2. The total number of linear molecules/ions(s) where the hybridisation of the central atom does not have contribution from the d-orbital(s) is
[Atomic number S = 16, Cl = 17, I = 53, Xe = 54]

62. Among $H_2, He_2^+, Li_2, Be_2, B_2, C_2, N_2, O_2^-$ and F_2 the number of diamagnetic species is (atomic number of H=1, He = 2, Be = 4, B = 5, C= 6, N = 7, O = 8, F=9)

63. Each of the following options contains a set of four molecules. Identify the option(s) where all four molecules possess permanent dipolemoment at room temperature

(A) $NO_2, NH_3, POCl_3, CH_3Cl$
(B) BF_3, O_3, SF_6, XeF_6
(C) $BeCl_2, CO_2, BCl_3, CHCl_3$
(D) $SO_2, C_6H_5Cl, H_2Se, BrF_5$

64. Consider the following compounds in the liquid form.

$O_2, HF, H_2O, NH_3, H_2O_2, CCl_4, CHCl_3, C_6H_6, C_6H_5Cl$

When a charged comb is brought near their flowing stream, how many of then show deflection.

65. A list of species having formula XZ_4 is given below. Number of molecules having square planar structures are

$XeF_4, SF_4, SiF_4, BF_4^-, BrF_4^-, \left[Cu(NH_3)_4\right]^{+2}, \left[FeCl_4\right]^{-2}, \left[CoCl_4\right]^{-2}$, and $\left[PtCl_4\right]^{-2}$

66. The sum of the number of lone pairs of electrons on each central atom in the following species is

$\left[TeBr_6\right]^{-2}, \left[BrF_2\right]^+, SNF_3, \left[XeF_3\right]^-$

67. Among the spelies given below, the total number of diamagnetic species is

H -atom, NO_2 mononer, O_2^- (Superoxide), dimeric sulphur in vapour phase,

$Mn_3O_4, (NH_4)_2[FeCl_4], (NH_4)_2[NiCl_4], K_2MnO_4, K_2Cr_2O_7$

68. The molecules that will have dipolemoment are
(A) 2, 2 dimethyl propane
(B) Trans –2– pentene
(C) Cis –3– hexene
(D) 2, 2, 3, 3 tetramethylbutane

69. Match each of the di atomic molecule in column –I with its properly in column – II

Column –I	**Column –I**
(A) B_2	(p) Paramagnetic
(B) N_2	(q) Undergoes oxidation
(C) O_2^-	(r) Undergoes reduction
(D) O_2	(s) Bond order > 2
	(t) Mixing of 's' and 'p' orbitals

	A	B	C	D
(A)	q, r, s	p, r, t, s	q, r, t	p, q, t
(B)	p, q, r, t	q, r, s, t	p, q, r, t	p, r, s, t
(C)	q, r, s, t	p, q, r	r, s, t	p, q, r, t
(D)	p, q, s, t	p, q, s	p, t	q, r, t

70. According to molecular orbital theory which of the following statements are correct

(A) C_2^{-2} is expected to be diamagnetic

(B) O_2^{+2} is expected to have a longer bond length than O_2

(C) N_2^+ and N_2^- have same bond order

(D) He_2^+ has the same energy as two isolated He atoms

71. In the compounds of type ECl_3, where $E = B, P, As$ or Bi. The angle $Cl-E-Cl$ is in order

(A) $B > P > As = Bi$ (B) $B > P > As > Bi$

(C) $B < P = As = Bi$ (D) $B < P < As < Bi$

72. The correct order of increasing C – O bond length of CO, CO_3^{-2}, CO_2 is

(A) $CO_3^{-2} < CO_2 < CO$ (B) $CO_2 < CO_3^{-2} < CO$

(C) $CO < CO_3^{-2} < CO_2$ (D) $CO < CO_2 < CO_3^{-2}$

73. Among the following the correct statement (s) is (are)

(A) $AlCl_3$ has the $3C-2e^-$ bonds in its dimeric structure

(B) BH_3 has the $3C-2e^-$ bonds in its dimeric structure

(C) $Al(CH_3)_3$ has the $3C-2e^-$ bonds in dimeric structure

(D) The lewis acidity of BCl_3 is greater than that of $AlCl_3$

74. Based on VSEPR theory, the number of 90° F – Br – F angles in BrF_5 is

75. Among KO_2, AlO_2^-, BaO_2 and NO_2^+, unpaired electron is present in

(A) NO_2^+ and BaO_2 (B) KO_2 and AlO_2^-

(C) Only KO_2 (D) Only BaO_2

76. Number of specie(s) from the following which shows hydrogen bonding

Chloral, HF, H_2O_2, HPO_3^{-2}, HNO_3, H_3BO_3, $NaHCO_3$, $HF_2^{\ominus}$

77. Select the **CORRECT** order(s) of bond length.

(A) $d_{S-O}(SO_2) > d_{S-O}(SO_3)$ (B) $d_{O-O}(H_2O_2) > d_{O-O}(O_2F_2)$

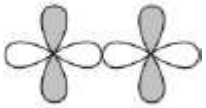
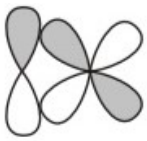
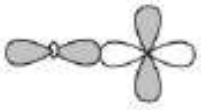
(C) $d_{N-O}(NO_3^-) > d_{N-O}(NO_2^-)$ (D) $d_{S-F_{(Axial)}} < d_{S-F_{(Equatorial)}}$ in SF_4

78. Find the value of (x+y) during lewis acid base interaction of given species.

x = number of species in which planarity/nonplanarity around underlined atom is changed by donation of lone pair among $H_2\underline{O}$, $\underline{N}H_3$, $\underline{P}Cl_3$

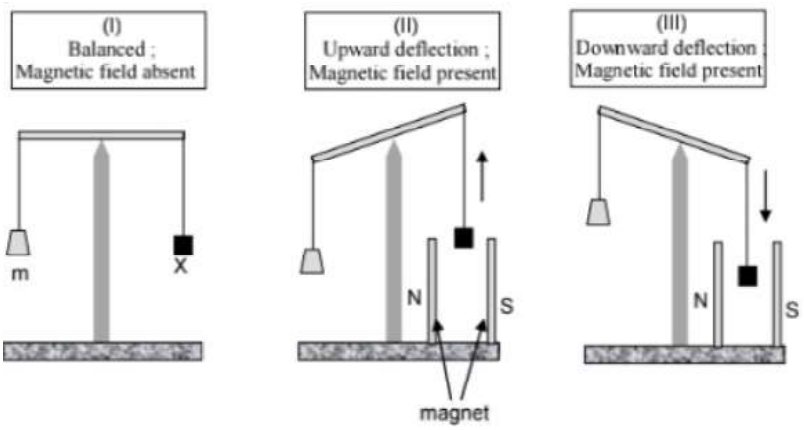
y = Number of species in which planarity/Non planarity around underlined atom is changed by acceptance of one lone pair among $\underline{B}F_3$, $\underline{P}Cl_5$, $\underline{Xe}F_4$

79. Match the orbital overlap figures shown in Column I with the description given in Column II and select the correct answer using the codes given below the Columns.

Column I	**Column II**
(a) 	(1) p – d π antibonding
(b) 	(2) d – d σ bonding
(c) 	(3) p – d π bonding
(d) 	(4) d – d σ antibonding

	a	**b**	**c**	**d**
(A)	4	1	2	4
(B)	3	2	3	1
(C)	2	3	1	2
(D)	1	4	4	3

80. In an experiment, m grams of a compound x (gas/liquid/solid) taken in a container is loaded in a balance as shown in figure I below. In the presence of a magnetic field, the pan with x is either deflected upwards (figure II), or deflected downwards (figure III), depending on the compound x. Identify the correct statement(s)



(A) If X is $H_2O(l)$, deflection of the pan is upwards

(B) If X is $K_4\left[Fe(CN)_6\right](s)$, deflection of the pan is upwards

(C) If X is $O_2(g)$, deflection of the pan is downwards

(D) If X is $C_6H_6(l)$, deflection of the pan is downwards

81. Choose the incorrect statement:

(A) All S – F bond lengths are identical in SF_4 (B) All Cl – F bond length are identical in ClF_3

(C) All $\angle FClF$ angles are identical in ClF_3 (D) All possible angle in BF_2Cl are 120°

82. Select the correct statement (s) :

(A) When $d_{x^2-y^2}$ or d_{xy} orbitals combine in parallel planes, then δ or δ^* molecular orbitals are formed.

(B) When $d_{x^2-y^2}$ or d_{xy} orbitals combine in parallel planes, then N.B.M.O, are formed

(C) When d_{yz} and d_{xz} orbitals combine in along the y-axis, then N.B.M.O. orbitals are formed

(D) No interaction is possible when p_z and d_{xz} orbitals overlap with collinear z-axis.

83. The dipole moment of AX_3, BX_3, and CY_3 are $4.97\times10^{-30}, 0.60\times10^{-30}$, and 0.00 C.M .repectivelpy, then the shape of molecules may be :

(A) Pyramidal,T-shape,trigonal planar (B) Pyramidal,trigonal planar, T-shape

(C) T-shape, pyramidal, trigonal planar (D) Pyramidal,T-shape, linear

84. Select the correct statement (s) following molecules :

(I) $PF_2(CH_3)_3$ (II) $PF_2(CF_3)_3$

(A) Both have trigonal bipyramidal structure

(B) Both have the dipole moment

(C) P–F bond length is longer in $PF_2(CH_3)_3$ than in $PF_2(CF_3)_3$

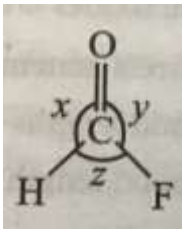
(D) P – F bond length is longer in $PF_2(CF_3)_3$ than in $PF_2(CH_3)_3$

85. Select the incorrect statement for adjacent bond angle

(A) In CF_2 and OF_2, OF_2 has higher bond angle (B) In PF_4^+ and PF_4^-, PF_4^- has higher bond angle

(C) In CIF_3 and BF_3 has lower bond angle (D) Both NH_3 and PH_3 have the same bond angle

86. Which of the following relationship is correct for the following figure :



(A) $x = y = z$ (B) $x = y > z$

(C) $x > 120°$ (D) $z < 120°$

87. Select the correct statement for non-bonding and anti-bonding orbitals :

(A) Non bonding orbitals have same energy than the atomic orbitals from which they are formed (B) Anti-bonding orbitals have higher energy than the atomic orbitals from which they are formed

(C) Non-bonding orbital have higher energy than the atomic orbitals from which they are formed

(D) Anti-bonding orbital have lower energy than the atomic orbitals from which they are formed

88. Select the correct statements :

(A) The combination of s-orbital and p-orbital, with the increase of p-character, the bond angle decreaes

(B) $H-\hat{C}-H$ bond angle $>$ $H-\hat{C}-F$ bond angle in CH_3F molecule

(C) $F-\hat{C}-F$ bond angle $>$ $H-\hat{C}-F$ bond angle in CH_3F molecule

(D) $H-\hat{C}-H$ bond angle $=$ $H-\hat{C}-F$ bond angle in CH_3F molecule

89. Select the incorrect statements :

(A) Peroxide ion has longer bond length than O_2

(B) Superoxide ion has longer bond length than peroxide ion.

(C) Dioxygenyl ion $\left(O_2^+\right)$ has longer bond length than O_2

(D) Dioxygenyl ion $\left(O_2^+\right)$ has smaller bond length than O_2

90. Select the correct order :

(A) Bond strength : $NO^- < NO < NO^+$

(B) N – O bond angle $NO_2^+ < NO_2^- < NO_3^-$

(C) Thermal stability : $LiF > NaF > KF > RbF > CsF$

(D) Size : $Be^{2+}(aq) < Mg^{2+}(aq) < Ca^{2+}(aq) < Sr^{2+}(aq) < Ba^{2+}(aq)$

91. If x is internuclear axis which type of overlapping is/are responsible for the formation of N.B.M.O ?

(A) $d_{xy} + p_x$ (B) $d_{xy} + s$

(C) $s + p_y$ (D) $s + p_z$

92. Select the correct statement(s)

(A) CH_3NCS is angular while SiH_3NCS is linear

(B) Both CH_3NCS and SiH_3NCS are linear

(C) CH_3NCS is linear while SiH_3NCS is bent

(D) The Lewis acid strength of boron halides runs as $BF_3 < BCl_3 < BBr_3 < BI_3$

93. Select the incorrect order for the given properties :

(A) $Li^+(aq) > Na^+(aq) > K^+(aq) > Rb^+(aq) > Cs^+(aq)$: Ionic mobility

(B) $Li^+(aq) > Na^+(aq) > K^+(aq) > Rb^+(aq) > Cs^+(aq)$: Hydrated size of ion

(C) $F^-(aq) > Cl^-(aq) > Br^-(aq) > I^-(aq)$: Hydrated size of ion

(D) $F^-(aq) < Cl^-(aq) < Br^-(aq) < I^-(aq)$: Ionic mobility

94. Select the correct statements :

(A) For a given cation, covalent character increases with increase in the size of the anion

(B) For a given anion, covalent character increases with decrease in the size of the cation

(C) Covalent character increases with increasing charge on either ion

(D) Covalent character is greater for cations with pseudo-inert gas configuration than the noble gas configureation.

95. Select the correct order of lattice energy

(A) $TiC > ScN > MgO > NaF$

(B) $BeO > MgO > SrO > BaO$

(C) $NaF > MgF_2 > AlF_3$

(D) $CdI_2 > CaF_2 > LiCl > KCl$

96. What is the correct order of solubility of following ionic compounds in water.

(A) $BeSO_4 > MgSO_4 > CaSO_4 > BaSO_4$

(B) $CaS_2O_3 > SrS_2O_3 > BaS_2O_3$

(C) $CS\,HCO_3 > RbHCO_3 > KHCO_3 > NaHCO_3$

(D) $LiCl > CsCl > RbCl > NaCl$

97. Which is/are not correct for B_2H_6 structure ?

(A) It has 4B–H terminal bonds and two 3C–2e bonds

(B) It has six B-H terminal bonds and one 3C–2e bonds

(C) It has four B–H terminal bonds two 3C–2e bonds and one B–B bond

(D) It has ionic interaction between $[BH_2]^+$ and $[BH_4]^-$

98. Select the correct statements :

(A) More electronegative atom prefers the hybrid orbital of the central atom in which the s-character is less

(B) More electronegative atom prefers the hybrid orbital of the central atom in which the s-character is more.

(C) Lone pair prefers to stay with that hybrid orbital which has less s-character

(D) Lone pair prefers to stay with that hybrid orbital which has more s-character.

99. Select the correct statement(s)

(A) Compared to $Me_3N, (SiH_3)_3N$ has got almost no basicity

(B) $BiH_3 > SbH_3 > NH_3 > AsH_3 > PH_3$: Boiling point

(C) The dipole moment of R_3NO is much greater compared to that of R_3PO

(D) All the B – O bond lengths are not identical in polyborates.

100. select the correct order for the given properties:

(A) $NaF > KF > LiF > RbF > CsF$: Melting point order

(B) CuCl>NaCl : Covelent character

(C) $BeSo_4 < CaSO_4 < SrSO_4 < BaSO_4$: Thermal stability order

(D) Lil> Nal>Kl>Rbl>Csl : Solubility order

* * * * * *

THERMODYNAMICS

1. For a spontaneous reaction the ΔG_1 equilibrium constant (K) and E^o_{cell} will be respectively

(A) –ve, > 1, +ve (B) +ve, > 1, –ve (C) –ve, < 1, –ve (D) –ve, > 1, –ve

2. Consider an endothermic reaction $X \rightarrow$ $_b$ and E_f for the backward and forward reactions, respectively. In general.

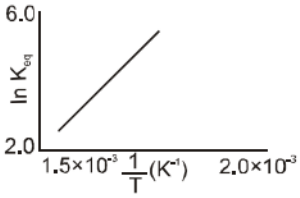
(A) $E_b < E_f$ (B) $E_b > E_f$

(C) $E_b = E_f$ (D) There is no definite relation between E_b and E_f

3. Consider the reaction: $N_2 + 3H_2 \rightarrow 2NH_3$ carried out at constant temperature and pressure. If ΔH and Δ expressions is true?

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

4. A schematic plot of ln K_{eq} versus invers temperature for a reaction is shown be



The reaction must be -

(A) Exothermic (B) Endothermic

(C) One with negligible enthalpy change (D) Highly spontaneous at ordin temperature

5. Which of the following pairs of a chemical reaction is certain to result in a spontaneous reaction

(A) Exothermic and increasing disorder (B) Exothermic and decreasing disorder

(C) Endothermic and increasing disorder (D) Endothermic and decreasing disorder

6. A reaction occurs spontaneously if –

(A) $T\Delta S < \Delta H$ and both ΔH and ΔS are +ve (B) $T\Delta S > \Delta H$ and ΔH is +ve and ΔS is -ve

(C) $T\Delta S > \Delta H$ and both ΔH and ΔS are +ve (D) $T\Delta S = \Delta H$ and both ΔH and ΔS are +ve

7. The absolute enthalpy of neutralisation of the reaction
$MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(\ell)$ will be -

(A) $-57.33\ kJ\ mol^{-1}$ (B) Greater than $-57.33\ kJ\ mol^{-1}$

(C) Less than $-57.33\ kJ\ mol^{-1}$ (D) $57.33\ kJ\ mol^{-1}$

8. A system absorbs 10 kJ of heat and does 4 kJ of work. The intrernal energy of the system -

(A) Decreases by 6 kJ (B) Increases by 6 kJ

(C) Decreases by 14 kJ (D) Increases by 14 kJ

9. One litre-atmosphere is approximately equal to -

(A) 19.2 J (B) 101 J (C) 8.31 J (D) 831 J

10. Heat evolved in the reaction
$H_2 + Cl_2 \rightarrow 2\,HCl$ is 182 kJ
Bond energies H–H = 430 kJ/mole, Cl–Cl = 242 kJ/mole. The H–Cl bond energy is
(A) 763 kJ/mole (B) 427 kJ/mole (C) 336 kJ/mole (D) 154 kJ/mole

11. 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. When of the following is true?
(A) x = y (B) x = 1/2 y (C) x = 2y (D) None of these

12. A gas expands isothermally and reversibly. The work done by the gas is
(A) Zero (B) Maximum (C) Minimum (D) Cannot be determined

13. One mole of methanol, when burnt in oxygen, gives out $723\,kj\,mol^{-1}$ heat. If one mole of oxygen is used, what will be the amount of heat evolved ?
(A) 723 kJ (B) 964 kJ (C) 482 kJ (D) 241 kJ

14. Enthalpy of a reaction at 27^oC 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 $50\,J\,mol^{-1}K^{-1}$

15. The heat of formation of CO and CO_2 are –26.4 Kcal. And –94.6 Kcal. Heat of combustion of carbon monoxide will be
(A) + 26.4 Kcal (B) – 68.2 Kcal (C) – 120.6 Kcal (D) None

16. One mole of an ideal gas at 300 K is expanded isothermally from an initial volume of 1 litre to 10 litres. The Δ
(A) 163.7 cal (B) Zero (C) 1381.1 cal (D) 9 lit atom

17. A solution of 500 ml. of 0.2 M KOH and 500 ml of 0.2 MHCl is mixed and stirred the rise in temperature is T_1. The experiment is repeated using 250 ml each of solution, the temperature rise is T_2. Which of the following is true ?
(A) $T_1 = T_2$ (B) $T_1 = 2T_2$ (C) $T_1 = 4T_2$ (D) $T_2 = 9\,T_1$

18. When 0.2 g of butanol –1 was burnt in a suitable apparatus, the heat evolved was sufficient to raise the temperature of 200 g of water by 5^oC. The heat of combustion of butanol –1 in kcal / mole will be (mol mass of butanol –1 =74)
(A) 14.8 (B) 74 (C) 37 (D) 370

19. A process in which no heat change takes place is called
(A) An isothermal process (B) An adiabatic process
(C) An isobaric process (D) An isochoric process

20. 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

21. An intensive property in thermodynamics means a property which depends

(A) On the amount of the substance only

(B) On the nature of the substance only

(C) Both on the amount as well as nature of the substance

(D) Neither on the amount nor on the nature

22. Given the bond energies of $N \equiv N, H-H$ and $N-H$ bonds are 945, 436 and 391 kJ mole^{-1} respectively, the enthalpy of the reaction $N_2(g)+3H_2(g) \rightarrow {}_3(g)$ is

(A) –93 kJ (B) 102 kJ (C) 90 kJ (D) 105 kJ

23. The heat required to decompose a compound into its elements is equal to the heat evolved when the compound is formed from its elements. This is in accordance with

(A) Hess's law (B) First law of thermodynamics

(C) Joule-Thomson law (D) Kirchoff's law

24. Which of the following relationship is correct?

(A) $\Delta G^{o} = -R\,T \ln k$ (B) $K = e^{-\Delta}$ (C) $K = 10^{-\Delta G^{o}/2.303\,RT}$ (D) All are correct

25. 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/Joule (D) 16 Joule

26. The entropy of a perfectly crystalline solid at absolute zero is

(A) Positive (B) Negative (C) Zero (D) Not definite

27. Which of the following describes the criterion of spontaneity

(A) ${}^{\Delta H}{}_{T.P} > 0$ (B) ${}^{\Delta S}{}_{Total} > 0$ (C) ${}^{\Delta G}{}_{T.P} > 0$ (D) All of these

28. The enthalpies of formation of N_2O and NO are 82 and 90 kj/mole respectively. The enthalpy of the reaction $2N_2O(g)+O_2(g) \rightarrow$

(A) 8 kJ (B) 88 kJ (C) – 16 kJ (D) 196 kJJ

29. Which one of the following is correct

(A) $-\Delta G = \Delta H - T\Delta S$ (B) $\Delta H = \Delta G - T\Delta S$

(C) $\Delta S = 1/T[\Delta G - \Delta H]$ (D) $\Delta S = 1/T[\Delta H - \Delta]$

30. "If a system A is in thermal equilibrium with B and B is in thermal equilibrium with C, then A and C are in equilibrium with each other." This is a statement of

(A) Cyclic rule (B) Zeroth law of thermodynamics

(C) First law of thermodynamics (D) Second law of thermodynamics

31. Given the following entropy values (in JK^{-1} mol^{-1}) at 298 K and 1 atm : $H_2(g):130.6, Cl_2(g):223.0$ and HCl (g) : 186.7. The entropy change $\left(\text{in KJ mol}^{-1}\right)$ for the reaction $H_2(g)+Cl_2(g) \rightarrow 2\,HCl(g)$ is

(A) + 540.3 (B) + 727.0 (C) –166.9 (D) 19.8

32. Free energy change of reversible reaction at equilibrium is

(A) Infinite (B) Zero (C) Positive (D) Negative

33. In a reversible process, $\Delta S_{sys} + \Delta_{surr.}$ is

(A) > 0 (B) < 0 (C) ≥ (D) ≤

34. The latent heat of vaporisation of a liquid at 500 K and 1 atm. pressure is 10.0 kcal/mol. What will be the change in internal energy of 3 moles of the liquid at the same temperature and pressure?

(A) 27.0 kcal (B) 13.0 kcal (C) – 27.0 kcal (D) –13.0 kcal

35. For the reaction $2\,SO_2(g)+O_2(g)\rightarrow {}_3(g)$ the entropy

(A) Increases (B) Decrease

(C) Remains unchanged (D) Change cannot be predicted

36. Under the same conditions how many ml of 1 MKOH and 0.5 M H_2SO_4 solutions, respectively, when mixed to form a total volume of 100 ml. produce the highest rise in temperature?

(A) 67,33 (B) 33,67 (C) 40,60 (D) 50,50

37. For a reversible isothermal process in equilibrium, the entropy change is given by the expression

(A) $\Delta S=\dfrac{T}{q_{rev}}$ (B) $\Delta S=\dfrac{q_{rev}}{T}$ (C) $\Delta S=\dfrac{\Delta V}{T}$ (D) $\Delta S=\dfrac{\Delta E}{T}$

38. The heat of combustion of yellow P and red P are –9.91 kJ mol^{-1} and –8.78 kJ mol^{-1} respectively. The heat of transition of yellow $P\rightarrow$

(A) – 18.69 kJ (B) +1.13 kJ (C) +18.69 kJ (D) –1.13 kJ

39. The bond energy of H_2 is 436.4 kJ. This means that

(A) 436.4 kJ of heat is required to break one bond in H_2 molecule to give two atoms of hydrogen

(B) 436.4 kJ of heat is required to dissociate 6.02×10^{23} molecules of H_2 to form H-atoms

(C) 436.4 kJ of heat is required to dissociate 3.01×10^{23} molecules of H_2 to 6.02×10^{23} atoms of hydrogen

(D) 436.4 kJ of electrical energy is required to dissociate 6.02×10^{23} molecules of H_2 to form H^+ and H^- ions

40. The heat of combustion of $CH_4(g)$ C (graphite), $H_2(g)$ –20 kcal, –40 kcal –10 kcal respectively. The heat of formation of methane is

(A) –40 kcal (B) +40 kcal (C) –80.0 kcal (D) +80 kcal

41. A hypothetical reaction, $A\rightarrow$

$A\rightarrow C;\ \Delta H=q_1$

$C\rightarrow D;\ \Delta H=q_2$

$1/2D\rightarrow B;\ \Delta_3$

The heat of reaction is :

(A) $q_1-q_2+2q_3$ (B) $q_1+q_2-2q_3$ (C) $q_1+q_2+2q_3$ (D) $q_1+2q_2-2q_3$

42. For the reaction $2\,NH_3(g)\rightarrow {}_2(g)+3\,H_2(g)$, which of the following statement is correct ?

(A) $\Delta H=\Delta E$ (B) $\Delta\geq\Delta E$ (C) $\Delta H>\Delta E$ (D) Δ

43. A heat engine operating between 227^oC and 27^oC absorbs 2 kcal of heat from the 227^oC reservoir percycle. The amount of work done in one cycle is

(A) 0.4 kcal (B) 4 kcal (C) 0.8 kcal (D) 8 kcal

44. The heats of neutralisation of four acides a, b, c and d when neutralised against a common base are 13.7, 9.4, 11.2 and 12.4 kcal respectively. The weakest among these acids is

(A) a (B) b (C) c (D) d

45. Given that

$2\,C(s)+2\,O_2(g)\rightarrow {}_2(g);\Delta$

$H_2(g)+1/2\,O_2(g)\rightarrow {}_2O(I):\Delta$

$C_2H_2(g)+2\frac{1}{2}O_2\rightarrow 2\,CO_2(g)+H_2O(I)$

$\Delta H=-130\,1\,kJ$

Heat of formation of acetylene is

(A) –1802 kJ (B) +1802 kJ (C) –800 kJ (D) +228 kJ

46. 1 mole of H_2SO_4 is mixed with 2 moles of NaOH. The heat evolved will be

(A) 57.3 kJ (B) 2×57.3 kJ (C) 57.3/2 kJ (D) Cannot be predicted

47. What percent T_1 is of T_2 for a heat engine whose efficiency is 10% ?

(A) 80 % (B) 90 % (C) 10 % (D) 100 %

48. If the heat of solution for one mole of KCl in 20 moles of water and 200 moles of water are + 3.80 kcal and + 4.40 kcal respectively, then the heat of dilution is

(A) +8.20 kcal (B) –8.2 kcal (C) +0.60 kcal (D) –0.60 kcal

49. The enthalpy of dissolution of $BaCl_2(s)$ and $BaCl_2, 2H_2O(s)$ are –20.6 and 8.8 kJ mol^{-1} respectively. The enthalpy of hydration for $BaCl_2(s)+2H_2O\rightarrow BaCl_2.2\,H_2O(s)$ is

(A) 29.4 kJ (B) –29.4 kJ (C) –11.8 kJ (D) 38.2 kJ

50. When 1 mole of H_2O_2 is decomposed by platinum black, the heat evolved is 96.6 kJ. The heat of formation of 1 mole of H_2O_2 is

(A) 96.6 kJ (B) 193.2 kJ (C) 386.4 kJ (D) 48.3 kJ

51. In which one of the following cases, the heat of neutralization is minimum ?

(A) Neutralization of NH_4OH with HCl (B) Neutralization of NaOH with CH_3COOH

(C) Neutralization of NaOH with HNO_3 (D) Neutralization of NH_4OH with CH_3COOH

52. 2 mole of an gas at 27^oC temperature is expanded reversible from 2 lit to 20 lit. Find entropy change (R = 2 cal/mol K)

(A) 92.1 (B) 0 (C) 4 (D) 9.2

53. Which one of the following expresses heat of formation of CO_2 ?

(A) $CaCO_3+2\,HCl\rightarrow {}_2H_2O+CO_2, \Delta H=-a$ kcal

(B) $CO+1/2\,O_2\rightarrow CO_2, \Delta$

(C) $C+O_2\rightarrow CO_2, \Delta$

(D) $2\,NaHCO_3\rightarrow Na_2CO_3+H_2O+CO_2, \Delta$

54. $C + O_2 \rightarrow CO_2, \Delta$, $CO + 1/2\, O_2 \rightarrow CO_2, \Delta$ Then Δ, for CO will be

(A) 2 x + y (B) x – y (C) y - 2x (D) y - x

55. The standard state in chemical energetics implies

(A) 283 K (B) 1 atmospheric pressure

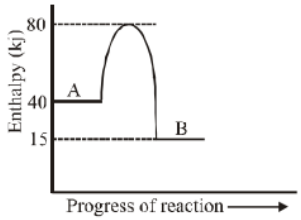
(C) 273 K, 1 atm pressure (D) 298 K, 1 atm pressure

56. Which one of the following not expresses Q as the heat of combustion ?

(A) $2\,H_2 + O_2 \rightarrow 2\,H_2O + Q$ (B) $C + 1/2\,O_2 \rightarrow CO + Q$

(C) $CH_4 + 2\,O_2 \rightarrow CO_2 + 2\,H_2O + Q$ (D) $2\,C_6H_6 + 15\,O_2 \rightarrow 12\,CO_2 + 6H_2O + Q$

57. Look at the following diagram :



The enthalpy change for the reaction $A \rightarrow$

(A) – 25 kJ (B) – 40 kJ (C) + 25 kJ (D) – 65 kJ

58. When ammonium chloride is dissolved in water, the solution becomes cold. The Change is

(A) Endothermic (B) Exothermic (C) Supercooling (D) None of these

59. The correct relationship between ΔH and Δ

(A) $\Delta H = \Delta E - P\Delta V$ (B) $\Delta H = \Delta E + P\Delta V$ (C) $\Delta H = \Delta E + \Delta P\Delta V$ (D) $\Delta H = E + P\Delta$

60. During the evaporation of a liquid

(A) Enthalpy decreases (B) Enthalpy increases

(C) Enthalpy remains unchanged (D) Internal energy decreases

61. In the reaction $C(s) + O_2(g) \rightarrow {}_2(g) + 93.4$ kcal

(A) Enthalpy of products is greater than that of reactants

(B) Enthalpy of products is less than that of reactants

(C) Enthalpy of products is same as that of reactants

(D) Enthalpy of products is half of that of reactants

62. Internal energy of one mole of a gas is

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

63. In an isothermal reversible cyclic process, the total change in internal energy

(A) Is always positive (B) Is always negative (C) In always zero (D) Can have any value

64. Internal energy of an ideal gas depends only upon

(A) Volume (B) Temperature (C) Pressure (D) Density

65. The change in internal energy of a system depends on

(A) Initial and final states of a system (B) Whether the path is reversible

(C) Whether the path is irreversible (D) None of these

ANSWER KEY

Q.No	1	2	3	4	5	6	7	8	9	10
Ans.	B	A	D	A	C	C	D	BCD	ABC	BCD
Q.No	11	12	13	14	15	16	17	18	19	20
Ans.	3	3	3	8	6	0.100	BD	ABC	AD	AD
Q.No	21	22	23	24	25	26	27	28	29	30
Ans.	ABCD	ABD	ABC	BC	AD	ABCD	AB	ABD	ACD	ABC
Q.No	31	32	33	34	35	36	37	38	39	40
Ans.	ABCD	ABC	ABD	BD	ABD	ABC	ABCD	AB	ABD	ABCD
Q.No	41	42	43	44	45	46	47	48	49	50
Ans.	ABD	ABC	AD	BC	A	D	C	1.28	2.69	ACD
Q.No	51	52	53	54	55	56	57	58	59	60
Ans.	AC	ABD	BCD	ABCD	ABC	ABC	AD	ABC	ABC	AB
Q.No	61	62	63	64	65	66	67	68	69	70
Ans.	4	6	A,D	6	4	6	8	B,C	B	A,C
Q.No	71	72	73	74	75	76	77	78	79	80
Ans.	B	D	B,C,D	0	C	6.00	A,B,C	2.00	C	A,B,C
Q.No	81	82	83	84	85	86	87	88	89	90
Ans.	A,B,C,D	A,B,C,D	A,C	A,B,C	A,B,D	C,D	A,B	A,B	B,C	A,C
Q.No	91	92	93	94	95	96	97	98	99	100
Ans.	A,B,C,D	A,D	A,B	A,B,C,D	A,B	A,B,C,D	B,C	A,D	A,B,C,D	A,B,C

THERMODYNAMICS

Q.No.	1	2	3	4	5	6	7	8	9	10
Ans.	A	A	C	B	A	C	C	B	B	B
Q.No.	11	12	13	14	15	16	17	18	19	20
Ans.	B	B	C	C	B	B	A	D	B	A
Q.No.	21	22	23	24	25	26	27	28	29	30
Ans.	B	A	B	D	A	C	B	D	D	B
Q.No.	31	32	33	34	35	36	37	38	39	40
Ans.	D	B	D	A	B	D	B	D	B	A
Q.No.	41	42	43	44	45	46	47	48	49	50
Ans.	C	C	C	B	D	B	B	C	B	A
Q.No.	51	52	53	54	55	56	57	58	59	60
Ans.	D	D	C	D	D	B	A	A	B	C
Q.No.	61	62	63	64	65					
Ans.	B	A	C	B	A					

ASAT PREPARATION ASSIGNMENT (NURTURE COURSE)

: Straight Line, Pair of Straigth Lines, Circle :

Comprehension V:

Read the following passage and answer the questions that follow. (1 – 2)

Suppose we define the distance between two points $P(x_1, y_1)$ and $Q(x_2, x_2)$ as $d(P,Q) = \max. \{|x_2 - y_1|, |y_2 - y_1|\}$, then

1. For a point P along the line $y = \sqrt{3}\,x$, $d(0, P)$ is equal to

(A) x (B) y

(C) x if $x < 0$ (D) y if $y \geq 0$

2. The area of the region bounded by the locus of a point P satisfying d(P, A) = 4, where A is (1, 2) is

(A) 64 sq. units (B) 54 sq. units

(C) 16π.sq. units (D) None of these

3. Suppose that points A and B have coordinates (1, 0) and (1, 0) respectively, then for a variable point P on this plane the equation d(P, A) + d(P, B) = 2 represents

(A) A line segment joining A and B

(B) An ellipse with foci at A and B

(C) Region lying inside a square of area 2

(D) Region inside a semicircle with AB as diameter

4. Suppose that points A and B have coordinates (1, 0) and (1, 0) respectively, then the area of the region bounded by the curves on which P lies, with $\{d(A, P)\}^2 + \{d(B, P)\}^2 = 4$

(A) 4π (B) $\frac{2}{3}\left[4\pi - 3\left(\sqrt{3}+1\right)\right]$

(C) 16 (D) $\frac{2\pi + \sqrt{3}}{4}$

5. The minimum value of $\max.\left\{|x_2 - x_1|, \left|\sqrt{1 - x_2} - \sqrt{6x_1 - x_1^2 - 8}\right|\right\}$ is

(A) 1 (B) 5

(C) 0 (D) None of these

6. Centre of circles touching both axes and passing through (2, –3)

(A) $\left(5 + 2\sqrt{3},\ -(5 + 2\sqrt{3})\right)$ (B) $\left(5 - 2\sqrt{3},\ -5 + 2\sqrt{3}\right)$

(C) $\left(5 + 2\sqrt{3},\ 5 + 2\sqrt{3}\right)$ (D) $\left(5 - 2\sqrt{3},\ 5 - 2\sqrt{3}\right)$

7. The circles $x^2 + y^2 + 2x - 4y + 4 = 0$ and $x^2 + y^2 - 2x - 4y + 4 = 0$ are such that they are such that they

(A) Touché internally (B) Touch externally

(C) Intersect on axis of y (D) Touch at (0, 2)

8. The equation of tangents drawn from origin to the circle $x^2 + y^2 - 2rx - 2hy + h^2 = 0$ are

(A) $x = 0$ (B) $y = 0$

(C) $\left(h^2 - r^2\right)x - 2rhy = 0$ (D) $\left(h^2 - r^2\right)x + 2rhy = 0$

9. Equation of a tangents to the circle $x^2 + y^2 = 25$ passing through (–2, 11) are

(A) $4x + 3y = 25$ (B) $3 + 4 = 38$

(C) $24x - 7y + 125 = 0$ (D) $7x + 24y = 230$

10. Equations of the circles which pass through the points (1, –2) and (3, –4) and touch the x-axis are

(A) $x^2 + y^2 + 6x + 2y + 9 = 0$ (B) $x^2 + y^2 + 10x + 20y + 25 = 0$

(C) $x^2 + y^2 - 6x + 4y + 9 = 0$ (D) $x^2 + y^2 - 4x - 3y + 5 = 0$

11. Equations of circle passing through the points (4, 3) and (2, 5) and touching the axis of y is/are

(A) $x^2 + y^2 - 20x - 22y + 121 = 0$ (B) $x^2 + y^2 - 4x - 6y + 9 = 0$

(C) $x^2 + y^2 - 10x - 6y + 13 = 0$ (D) $x^2 + y^2 + 4x + 6y + 9 = 0$

12. The points (2, 3), (0, 2), (4, 5) and (0, c) are concyclic if the value of c is/are

(A) 2 (B) 1

(C) 17 (D) 3

13. A rectangle ABCD is inscribed in the circle $x^2 + y^2 + 3x + 12y + 2 = 0$ .If the co-ordinates of A and B are (3, –2) and (–2, 0), then the other two vertices of the rectangle are

(A) (–6, –10) (B) (–1, –12)

(C) (1, 12) (D) (6, 10)

14. If α, β, γ are the parameters of points A, B, C on the circle $x^2 + y^2 = a^2$ and if the triangle ABC be equilateral, then

(A) $\sum \cos\alpha = 0$ (B) $\sum \sin\alpha = 0$

(C) $\sum \tan\alpha = 0$ (D) $\sum \cot\alpha = 0$

15. An isosceles triangle ABC with vertex at A (a, 0) is inscribed in the circle $x^2 + y^2 = a^2$. If the base angles B and C be each 75°, then the co-ordinates of B and C are

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

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

16. A square is inscribed in the circle $x^2 + y^2 - 10x - 6y + 30 = 0$. One side of the square is parallel to $y = x + 3$ then one vertex of the square is

(A) (3, 3) (B) (7, 3)

(C) $\left(6, 3 - \sqrt{3}\right)$ (D) $\left(6, 3 + \sqrt{3}\right)$

17. $P\left(\sqrt{2},\sqrt{2}\right)$ is a point on the circle $x^2+y^2=4$ and Q is another point on the circle such that are $PQ=\frac{1}{4}\times$ circumference. The co-ordinates of Q are

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

(C) $\left(-\sqrt{2},\sqrt{2}\right)$ (D) None of these

18. A circle which touches the axes, and whose centre is at distance $2\sqrt{2}$ from the origin, has the equation

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

(C) $x^2+y^2+4x+4y+4=0$ (D) None of these

19. The tangents drawn from the origin to the circle $x^2+y^2-2rx-2hy+h^2=0$ are perpendicular if

(A) $h=r$ (B) $h=-r$

(C) $r^2+h^2=1$ (D) $r^2=h^2$

: Quadratic Expression & Equations, Inequations, Progression :

20. The quadratic equations whose roots are x_1 & x_2 satisfy the condition $x_1^2 \pm x_2^2 = 5, 3\left(x_1^5 + x_2^3\right) = 11\left(x_1^3 + x_2^3\right)$ are $x^2 + px - q = 0$; $p, q \in N$ then for what values of 'a' the quadratic equation $x^2 + \left[a^2 - 5a + b + 4\right]x + b = 0$ has roots $-(p+q)$ and $p - q$. [where $[\bullet]$ denotes G.I.F]

(A) $a \in \left(-1, \frac{5-3\sqrt{5}}{2}\right]$ (B) $a \in \left[\frac{5+3\sqrt{5}}{2}, 6\right)$

(C) $a \in (6, \infty)$ (D) $a \in \left(-\infty, -\frac{20}{\sqrt{3}}\right)$

21. If $ax^2 - bx + c = 0$ have 2 distinct roots bying in the interval (0, 1), $a, b, c \in N$ then $\log_5(abc)$

(A) Can have values greater than or equal to 2 (B) Can have values less than 2
(C) Will always have values less than 5 (D) Will always have valves less than 1

22. The number of solution of the equation $x\left(\frac{3-x}{x+1}\right)\left(x + \frac{3-x}{x+1}\right) = 2$ is λ then

(A) λ equals one of the values of x satisfying the above equation
(B) λ is less than 4
(C) λ is greater than 2
(D) λ^{10} has the last digit 1

23. If each pair of the following three equations $x^2 + ax + b = 0, x^2 + cx + d = 0$ & $x^2 + ex + f = 0$ has exactly one root in common, then $(a + c + e)^2 = \lambda(ac + ce + ea - b - d - f)$ then λ is less than

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

24. Let $a, b, c \in R$. If $ax^2 + bx + c = 0$ has 2 real roots A & B where $A < -1$ & $B > 1$ then

(A) $1 + \left|\frac{b}{a}\right| + \frac{c}{a} < 0$ (B) $1 - \left|\frac{b}{a}\right| + \frac{c}{a} < 0$

(C) $|c| < |a|$ (D) $|c| < |a| - |b|$

25. The number of value of 'x' satisfying $\underline{|1} + \underline{|2} + \underline{|3} + \ldots\ldots\ldots + \underline{|x} = k^2$; $k \in I$ is λ then the values of x satisfying $|x + \lambda - 1| - |x| + 3|x - 1| - \lambda|x - \lambda| = x + \lambda$ can be

(A) $x \in \{-2\}$ (B) $x \in \{-3\} \cup (-2, -1)$

(C) $x \in [2, \infty)$ (D) $x \in (-\infty, 2)$

26. If $2x^3 + ax^2 + bx + 4 = 0$ (a & b are positive real numbers) has 3 real roots, then the value of (a + b) can never be

(A) 12 (B) 13
(C) 15 (D) 16

27. Given that $a,b,c,\alpha,\beta,\gamma$ are all positive quantities & $\alpha a,\beta b,\gamma c$ are all distinct, if a, b, c are in A.P , α,β,γ are in H.P and $a\alpha,b\beta,c\gamma$ are in GP then

(A) $a:b:c=\frac{1}{\gamma}:\frac{1}{\beta}:\frac{1}{\alpha}$ (B) $a:b:c=\frac{1}{\alpha}:\frac{1}{\beta}:\frac{1}{\gamma}$

(C) $a\gamma=b\beta=c\alpha$ (D) $a\alpha=b\beta=c\gamma$

28. If a, b, c are in H.P where a > c > 0, then

(A) $b>\frac{a+c}{2}$ (B) $\frac{1}{a-b}-\frac{1}{b-c}<0$

(C) $ac>b^2$ (D) $bc(1-a),ac(1-b),ab(1-c)$ are in A.P

29. The least positive integral value of x satisfying $\left(e^x-2\right)\left(\sin\left(x+\frac{\pi}{4}\right)\right)\left(x-\log_e 2\right)(\sin x-\cos x)<0$ is λ then λ is

(A) Prime number (B) Compoiste number
(C) Even number (D) Odd number

30. Possible integral value(s) of m for the equation $\sin x-\sqrt{3}\cos x=\frac{4m-6}{4-m}$ can be valid for some $x\in[0,2\pi]$ is

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

31. If the roots of the cubic $x^3-6x^2-24x+c=0$ are the first 3 terms of an A.P, then sum to first 'n' terms of the A.P is

(A) $n(3n-1)$ (B) $n(3n-7)$

(C) $n(5-3n)$ (D) $n(11-3n)$

32. If the roots of the equation x^3+px^2+qx-1 form an increasing GP where $p,q\in R$, then

(A) $p+q=0$

(B) $p\in(-3,\infty)$

(C) One of the roots is unity

(D) One root is smaller than 1 & one root is greater than 1

33. For $x,y,z\in\left(0,\frac{\pi}{2}\right)$. Let x,y,z be first three consecutive term of an A.P such that

$\cos x+\cos y+\cos z=1$ & $\sin x+\sin y+\sin z=\frac{1}{\sqrt{2}}$ then which of the following is / are correct

(A) $\cot y=\sqrt{2}$ (B) $\cos(x-y)=\frac{\sqrt{3}-1}{2\sqrt{2}}$

(C) $\tan 2y=\frac{2\sqrt{2}}{3}$ (D) $\sin(x-y)+\sin(z-y)=0$

34. Difference between the sum of the squares of the first fifty even natural numbers and the sum the squares of first fifty odd natural numbers is equal to

(A) The value of expression $y=\frac{x}{2}\sqrt{1+x\sqrt{1+(x+1)\sqrt{1+(x+2)(x+4)}}}$ wherer x = 100

(B) f(100) where $f(1)=1$ & $f(x)=x+f(x-1)$

(C) The sum of all such friendly natural numbers which lie in the interval $(0,101)$, where 'm' defines a friendly natural number satisfying the inequality $mx^2-4x+3m+1>0$ for every $x\in R$

(D) Sum of the reciprocals of all the 100 hormonic mean if they are inserted between 1 & 1/100

35. Let $A=\{x:x^2+(m-1)x-2(m+1)=0, x\in R\}$

$B=\{x:(m-1)x^2+mx+1=0, x\in R\}$ then the number of values of $m\in R$ such that $A\cup B$ has exactly 3 distinct elements is less that

(A) 5 (B) 7
(C) 9 (D) 11

36. If $S_n=\frac{1.2}{\lfloor 3}+\frac{2.2^2}{\lfloor 4}+\frac{3.2^3}{\lfloor 5}+$.....upto n terms and λ is the sum of infinite terms of S_n, then the value of 'm' if the roots of equation $\lambda x^4-(\lambda+2)(\lambda+4)x^3+140\left(\frac{\lambda}{\lambda+1}\right)x^2-120\lambda^2x+m=0$ form a geometric sequence is

(A) 46 (B) - 6
(C) 64 (D) 140

37. If a & b are the roots of x^4+x^3-1, then ab is the root of $x^6+\lambda_1x^4+\lambda_2x^3+\lambda_3x^2-1$; $\lambda_i\in\mathbb{Z}$; $i=1,2,3$, then the remainder when $4333^{(2\lambda_1+\lambda_2)1111}$ is divided by $6\lambda_1+4\lambda_2-\lambda_3$ is

(A) 1 (B) 9
(C) 2 (D) 3

38. The equation $2x^4+x^3-11x^2+x+2=0$ has a root of the form $\frac{p}{q}$; $p,q\in\mathbb{Z}-\{0\}$ & $(p,q)=1$ & $q\neq 1$. Let p(x) be a cubic polynomial with integer coefficient such that there exists different integers a, b & c such that p(a) = p(b) = p(c) = q. Then the number of integers 'd' satisfying p(d) = p + q is

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

39. The roots of equation $(\lambda^2.3x-1)(\lambda.3x-1)(2\lambda x-1)(3x-1)=5$ where $\lambda=\sqrt{7}\left(\sin\frac{2\pi}{7}+\sin\frac{4\pi}{7}+\sin\frac{8\pi}{7}\right)^{-1}$ is / are

(A) $-\frac{1}{12}$ (B) $\frac{7}{24}$

(C) $-\frac{7}{24}$ (D) $\frac{1}{2}$

40. The sum of values of 'x' satisfying $\frac{[x]}{[x-2]}-\frac{[x-2]}{[x]}=\frac{8\{x\}+12}{[x-2][x]}$ is λ $\left(\text{where } [\bullet]\to \text{GIF}, \{\bullet\}\to \text{FPF}\right)$. If the equation $ax^3+3bx^2+3cx+d=0$ has two equal roots then, $(bc-ad)^2=\mu\left(b^2-ac\right)\left(c^2-ad\right)$ then

(A) $\lambda=9.5$ & $\mu=2$ (B) $\lambda=9.5$ & $\mu=4$

(C) $\lambda+\mu=11.5$ (D) $\lambda+\mu=13.5$

41. If $\frac{\tan 3A}{\tan A}=k,\ (k\neq 1)$, then

(A) $\frac{\cos A}{\cos 3A}=\frac{k^2-1}{2k}$ (B) $\frac{\sin 3A}{\sin A}=\frac{2k}{k-1}$

(C) $k<\frac{1}{3}$ (D) $k<3$

42. Let $f_n(\theta)=\tan\frac{\theta}{2}(1+\sec\theta)(1+\sec 2\theta)(1+\sec 4\theta),\ .....(1+\sec 2^n\theta)$ then

(A) $f_2\left(\frac{\pi}{16}\right)=1$ (B) $f_3\left(\frac{\pi}{32}\right)=1$

(C) $f_4\left(\frac{\pi}{64}\right)=1$ (D) $f_5\left(\frac{\pi}{128}\right)=1$

43. Given that $\sin\beta=\frac{12}{13}$, $0<\beta<\pi$, then $\{5\sin(\alpha+\beta)-12\cos(\alpha+\beta)\}\operatorname{cosec}\alpha$ is equal to :

(A) 13 if $\tan\beta>0$ (B) 13 if $\tan\beta<0$

(C) $\frac{119+120\cot\alpha}{13}$ if $\tan\beta<0$ (D) $\frac{119+120\cot\alpha}{13}$ if $\tan\beta>0$

44. If $(a-b)\sin(\theta+\phi)=(a+b)\sin(\theta-\phi)$ and $a\tan\frac{\theta}{2}-b\tan\frac{\phi}{2}=c$, then

(A) $b\tan\phi=a\tan\theta$ (B) $a\tan\phi=b\tan\theta$

(C) $\sin\phi=\frac{2bc}{a^2-b^2-c^2}$ (D) $\sin\theta=\frac{2ac}{a^2-b^2+c^2}$

45. In a triangle ABC

(A) $\sin A\sin B\sin C\le\frac{3\sqrt{3}}{8}$ (B) $\sin^2 A+\sin^2 B+\sin^2 C\le\frac{9}{4}$

(C) $\sin A\sin B\sin C$ is always positive (D) $\sin^2 A+\sin^2 B\le 1+\cos C$

46. $\frac{\sin 3\alpha}{\cos 2\alpha}$ is

(A) Negative if $\alpha \in \left(\frac{13\pi}{48}, \frac{14\pi}{48}\right)$

(B) Negative if $\alpha \in \left(\frac{14\pi}{48}, \frac{18\pi}{48}\right)$

(C) Positive if $\alpha \in \left(\frac{18\pi}{48}, \frac{23\pi}{48}\right)$

(D) Positive if $\alpha \in \left(\frac{14\pi}{48}, \frac{18\pi}{48}\right)$

47. A solution (x, y) of the system of equation $x - y = \frac{1}{3}$ and $\cos^2(\pi x) - \sin^2(\pi y) = \frac{1}{2}$ is given by

(A) $\left(\frac{7}{6}, \frac{5}{6}\right)$

(B) $\left(\frac{2}{3}, \frac{1}{3}\right)$

(C) $\left(-\frac{5}{6}, -\frac{7}{6}\right)$

(D) $\left(\frac{13}{6}, \frac{11}{6}\right)$

48. $\sqrt{\cos 2x} + \sqrt{1 + \sin 2x} = 2\sqrt{\sin x + \cos x}$ if

(A) $\sin x + \cos x = 0$

(B) $x = 2n\pi$

(C) $x = n\pi - \frac{\pi}{4}$

(D) $x = 2n\pi \pm \cos\left(\frac{\pi}{5}\right)$

49. If $\cos^4 x + \sin^4 x - \sin 2x + \frac{3}{4}\sin^2 2x = y$, then

(A) $y = 1$ if $x = \frac{15\pi}{2}$

(B) $y \neq 0$ for any value of x

(C) $y = 0$ if $x = 15\pi$

(D) $y = 1$ if $\sin 2x = 0$

50. $\cos(x - y) - 2\sin x + 2\sin y = 3$ if $(n, k \in I)$

(A) $\sin x = \sin y$

(B) $x + y = 2n\pi, x - y = (4k + 1)\pi$

(C) $x = 2k\pi - \frac{\pi}{2}, y = 2n\pi + \frac{\pi}{2}$

(D) $\cos(x - y) = -1$

51. If the sides a, b, c of a triangle ABC form successive terms of G.P with common tario r(>1), then which of the following is/are correct

(A) $A < \frac{\sqrt{5} + 1}{2}$

(B) $A < B < \frac{\pi}{3}$

(C) $B > \frac{\pi}{3}$

(D) $C > \frac{\pi}{3}$

52. Sides of a triangle ABC are in A.P. If a < minimum {b, c}, then cos A may be equal to

(A) $\frac{4b-3c}{2b}$ (B) $\frac{3c-4b}{2c}$

(C) $\frac{4c-3b}{2b}$ (D) $\frac{4c-3b}{2c}$

53. In a triangle ABC, if $(a+b+c)(b+c-a)=xbc$ then x can be equal to

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

54. If in a triangle ABC $a^2+b^2+c^2=ca+ab\sqrt{3}$ then

(A) A, B, C are in A.P (B) Triangle is isoceles
(C) Triangle is right angled (D) a = 2c

55. In a triangle ABC, if $\sin A.\sin(B-C)=\sin C\sin(A-B)$, then

(A) tanA, tanB, tanC are in A.P (B) cotA, cotB, cotC are in A.P
(C) Cos2A, cos2B, cos2C are in A.P (D) sin2A, sin2B, sin2C are in A.P

56. A semi-circle is described with its diameter lying the side on AB of the triangle ABC. If this circle touches the sides AC and CB, then its radius is

(A) $\frac{\Delta}{c}$ (B) $\frac{\Delta}{s}$

(C) $\frac{2\Delta}{a+b}$ (D) $\frac{2abc}{s(a+b)}\cos\frac{A}{2}\cos\frac{B}{2}\cos\frac{C}{2}$

57. If the expression, $2\cos10^o+\sin100^o+\sin1000^o+\sin10000^o$ is simplified, then it simplifies to

(A) $\cos10^o$ (B) $3\cos10^o$

(C) $4\cos10^o$ (D) $5\cos10^o$

58. If $\log_{2\sqrt{2}}(32\sqrt[5]{4})=\alpha+\beta$ where α is an integer and $\beta\in[0,1)$ then 'α' is

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

59. The point of intersection of the curves $y=\frac{\sin\pi x}{2}$ and $y=\left[\sin\frac{\pi}{10}+\cos\frac{\pi}{10}\right]$, where [.] denotes greatest integer function, is given by $(n\in I)$

(A) $(4n+1, 1)$ (B) $(4n-1, -1)$

(C) $(4n-1, 1)$ (D) $(2n, 0)$

60. $\tan\theta+\tan2\theta+\tan\theta\tan2\theta=1$. Then θ is equal to

(A) $\frac{\pi}{12}$ (B) $\frac{5\pi}{12}$

(C) $\frac{-3\pi}{12}$ (D) $\frac{-7\pi}{12}$

61. If $x^{(\log_2 x)^2-6\log_2 x+11}=64,$ then x is equal to

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

62. If α,β,γ and δ are four solutions of the equation $\tan\left(\theta+\frac{\pi}{4}\right)=3\tan 3\theta,$ then

(A) $\sum\tan\alpha=0$
(B) $\sum\tan\alpha\tan\beta=-2$
(C) $\sum\tan\alpha\tan\beta\tan\gamma=\frac{-8}{3}$
(D) $\tan\alpha\tan\beta\tan\gamma\tan\delta=-3$

63. A set of value of x satisfying the equation $\cos^2\left(\frac{1}{2}px\right)+\cos^2\left(\frac{1}{2}qx\right)=1$ from an arithmetic progression with common differencce

(A) $\frac{2\pi}{p+q}$
(B) $\frac{2\pi}{p-q}$
(C) $\frac{\pi}{p+q}$
(D) 2π

64.

Column-I	Column-II
(A) The equation $\cos 2x+a\sin x=2a-7$ Possess a solution if a belongs to the interval	p. $[1,\infty)$
(B) The equation $7\cos x+5\sin x=2k+1$ has a solution if k belongs to the interval	q. [2, 6]
(C) If $\cos^2 x+a\cos^2 x+1=0$ has at least one solution then a belongs to the interval	t. $(-\infty,-2]$
(D) If the equation |sin2x|-|x|-a = 0 does not have any real solution then a belongs to the interval	s. [-4, 3]

: TRIGONOMETRY :

65. Let α and β be nonzero real numbers such that $2(\cos\beta-\cos\alpha)+\cos\alpha\cos\beta=1$. Then which of the following is/are true?

(A) $\tan\left(\frac{\alpha}{2}\right)+\sqrt{3}\tan\left(\frac{\beta}{2}\right)=0$ (B) $\sqrt{3}\tan\left(\frac{\alpha}{2}\right)+\tan\left(\frac{\beta}{2}\right)=0$

(C) $\tan\left(\frac{\alpha}{2}\right)-\sqrt{3}\tan\left(\frac{\beta}{2}\right)=0$ (D) $\sqrt{3}\tan\left(\frac{\alpha}{2}\right)-\tan\left(\frac{\beta}{2}\right)=0$

66. Let $-\frac{\pi}{6}<\theta<-\frac{\pi}{12}$. Suppose α_1 and β_1 are the roots of the equation $x^2-2x\sec\theta+1=0$ and α_2 and β_2 are the roots of the equation $x^2+2x\tan\theta-1=0$. If $\alpha_1>\beta_1$ and $\alpha_2>\beta_2$, then $\alpha_1+\beta_2$ equals

(A) $2(\sec\theta-\tan\theta)$ (B) $2\sec\theta$

(C) $-2\tan\theta$ (D) 0

67. The value of $\sum_{k=1}^{13}\frac{1}{\sin\left(\frac{\pi}{4}+\frac{(k-1)\pi}{6}\right)\sin\left(\frac{\pi}{4}+\frac{k\pi}{6}\right)}$ is equal to

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

(C) $2\left(\sqrt{3}-1\right)$ (D) $2\left(2+\sqrt{3}\right)$

68. If $\cos\left(\frac{\pi}{4}-x\right)\cos 2x+\sin x\sin 2x\sec x=\cos x\sin 2x\sec x+\cos\left(\frac{\pi}{4}+x\right)\cos 2x$ then possible value of secx is _____

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

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

69. Let $P=\{\theta:\sin\theta-\cos\theta=\sqrt{2}\cos\theta\}$ and $Q=\{\theta:\sin\theta+\cos\theta=\sqrt{2}\sin\theta\}$ be two sets. Then

(A) $P\subset Q$ and $Q-P\neq\varnothing$ (B) $Q\not\subset P$

(C) $P\not\subset Q$ (D) $P=Q$

70. The positive integer value of $n>3$ satisfying the equation $\frac{1}{\sin\left(\frac{\pi}{n}\right)}=\frac{1}{\sin\left(\frac{2\pi}{n}\right)}+\frac{1}{\sin\left(\frac{3\pi}{n}\right)}$ is _____

71. The maximum value of the expression $\frac{1}{\sin^2\theta+3\sin\theta\cos\theta+5\cos^2\theta}$ is _____

72. Two parallel chords of a circle of radius 2 are at a distance $\sqrt{3}+1$ apart. If the chords subtend at the centre, angles of $\frac{\pi}{k}$ and $\frac{2\pi}{k}$, where $k>0$, then the value of $[k]$ is _____

[Note: $[k]$ denotes the largest integer less than or equal to k].

73. If $\frac{\sin^4 x}{2}+\frac{\cos^4 x}{3}=\frac{1}{5}$, then

(A) $\tan^2 x=\frac{2}{3}$ (B) $\frac{\sin^8 x}{8}+\frac{\cos^8 x}{27}=\frac{1}{125}$

(C) $\tan^2 x=\frac{1}{3}$ (D) $\frac{\sin^8 x}{8}+\frac{\cos^8 x}{27}=\frac{2}{125}$

74. For $0<\theta<\frac{\pi}{2}$, the solution(s) of $\sum_{m=1}^{6}\operatorname{cosec}\left(\theta+\frac{(m-1)\pi}{4}\right)\operatorname{cosec}\left(\theta+\frac{m\pi}{4}\right)=4\sqrt{2}$ is (are)

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{6}$

(C) $\frac{\pi}{12}$ (D) $\frac{5\pi}{12}$

75. Let $\theta\in\left(0,\frac{\pi}{4}\right)$ and $t_1=(\tan\theta)^{\tan\theta}, t_2=(\tan\theta)^{\cot\theta}, t_3=(\cot\theta)^{\tan\theta}$ and $t_4=(\cot\theta)^{\cot\theta}$, then

(A) $t_1>t_2>t_3>t_4$ (B) $t_4>t_3>t_1>t_2$

(C) $t_3>t_1>t_2>t_4$ (D) $t_2>t_3>t_1>t_4$

76. Find the smallest positive number p for which the equation $\cos(p\sin x)=\sin(p\cos x)$ has a solution $x\in[0,2\pi]$.

77. Determine the smallest positive value of x (in degrees) for which

$\tan(x+100^\circ)=\tan(x+50^\circ)\tan(x)\tan(x-50^\circ)$.

: QUADRATIC & SEQUENCES :

78. Let a, b, c be the sides of a triangle. No two of them are equal and $\lambda \in R$. If the roots of the equation $x^2 + 2(a+b+c)x + 3\lambda(ab+bc+ca) = 0$ are real, then

(A) $\lambda < \frac{4}{3}$ (B) $\lambda > \frac{5}{3}$

(C) $\lambda \in \left(\frac{1}{3}, \frac{5}{3}\right)$ (D) $\lambda \in \left(\frac{4}{3}, \frac{5}{3}\right)$

79. For $r = 0,1,.....,10$, let A_r, B_r and C_r denote, respectively, the coefficient of x^r in the expansions of $(1+x)^{10}$, $(1+x)^{20}$ and $(1+x)^{30}$. Then $\sum_{r=1}^{10} A_r\left(B_{10}B_r - C_{10}A_r\right)$ is equal to

(A) $B_{10} - C_{10}$ (B) $A_{10}\left(B_{10}^2 - C_{10}A_{10}\right)$

(C) 0 (D) $C_{10} - B_{10}$

80. For $a > b > c > 0$, the distance between $(1,1)$ and the point of intersection of the lines $ax + by + c = 0$ and $bx + ay + c = 0$ is less than $2\sqrt{2}$, then

(A) $a + b - c > 0$ (B) $a - b + c < 0$

(C) $a - b + c > 0$ (D) $a + b - c < 0$

81. If the sum of first n terms of an A.P. is cn^2, then the sum of these n terms is

(A) $\frac{n\left(4n^2-1\right)c^2}{6}$ (B) $\frac{n\left(4n^2+1\right)c^2}{3}$

(C) $\frac{n\left(4n^2-1\right)c^2}{3}$ (D) $\frac{n\left(4n^2+1\right)c^2}{6}$

PARAGRAPH - 4 FOR Q.14 TO Q. 17

Let A_1, G_1, H_1 denote the arithmetic, geometric and harmonic means, respectively, of two distinct positive numbers. For $n \geq 2$, let A_{n-1} and H_{n-1} has arithmetic, geometric and harmonic means as A_n, G_n, H_n respectively.

82. Which one of the following statements is correct ?

(A) $G_1 > G_2 > G_3 > .....$ (B) $G_1 < G_2 < G_3 < .....$

(C) $G_1 = G_2 = G_3 = ...$ (D) $G_1 < G_3 < G_5 < .....$ and $G_2 > G_4 > G_6 > ...$

83. Which one of the following statements is correct ?

(A) $A_1 > A_2 > A_3 > ....$ (B) $A_1 < A_2 < A_3 < ....$

(C) $A_1 > A_3 > A_5 > \ldots$ and $A_2 < A_4 < A_6 < \ldots.$ (D) $A_1 < A_3 < A_5 < \ldots$ and $A_2 > A_4 > A_6 > \ldots.$

84. Which one of the following statements is correct ?

(A) $H_1 > H_2 > H_3 > \ldots$ (B) $H_1 < H_2 < H_3 < \ldots$

(C) $H_1 > H_3 > H_5 > \ldots$ and $H_2 < H_4 < H_6 > \ldots$ (D) $H_1 < H_3 < H_5 < \ldots$ and $H_2 > H_4 > H_6 > \ldots$

85. Consider the lines given by: $L_1 : x + 3y - 5 = 0$, $L_2 : 3x - ky - 1 = 0$, $L_3 : 5x + 2y - 12 = 0$

Match the Statements / Expressions in Column I with the Statements / Expressions in Column II and indicate your answer by darkening the appropriate bubbles in the 4×4 matrix given in the ORS.

Column I	Column II
(a) L_1, L_2, L_3 are concurrent, if	(p) $k = -9$
(b) One of L_1, L_2, L_3 is parallel to at least one of the other two, if	(q) $k = -\frac{6}{5}$
(c) L_1, L_2, L_3 form a triangle, if	(r) $k = \frac{5}{6}$
(d) L_1, L_2, L_3, do not form a triangle, if	(s) $k = 5$

86. Let X be the set consisting of the first 2018 terms of the arithmetic progression 1, 6, 11, ..., and Y be the

set consisting of the first 2018 terms of the arithmetic progression 9, 16, 23, ... Then, the number of elements in the set $X \cup Y$ is _____

: STRAIGHT LINES & CIRCLES :

87. The lines joining the origin to the point of intersection of $3x^2 + \lambda xy - 4x + 1 = 0$ and $2x + y - 1 = 0$ are at right angles for

(A) $\lambda = -4$ (B) $\lambda = 4$

(C) $\lambda = 7$ (D) No value of λ

88. Equation of a line passing through $(1, -1)$ and perpendicular to a line given by $x^2 - 5xy + 4y^2 = 0$ is

(A) $4x + y - 3 = 0$ (B) $x - 4y - 5 = 0$

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

89. One of the lines given by the equation $ax^2 + 2\lambda xy + 6y^2 = 0$ will bisect the angle between the coordinate axes if

(A) $a + b = 2\lambda$ (B) $a + b = -2\lambda$

(C) $a + b = 0$ (D) $a - b = 0$

90. The equation $ax^2 + 2xy + by^2 + 2ax + 2by = 0$ represents a pair of straight lines if

(A) $a = 0$ (B) $b = 0$

(C) $a + b = 2$ (D) $a - b = 2$

91. If the pair of lines $ax^2 - 2xy + by^2 = 0$ and $bx^2 - 2xy + ay^2 = 0$ be such that each pair bisects the angle between the other pair, then a - b is

(A) 2 (B) –2

(C) 1 (D) –1

92. If the slope of one of the lines represented by $ax^2 - 6xy + y^2 = 0$ is square of the other, then

(A) a = 1 (B) a = – 27

(C) a = 4 (D) a = 8

93. Equation of the a line which is parallel to the line common to the pair of lines $6x^2 - xy + 12y^2 = 0$ and $15x^2 + 14xy - 5y^2 = 0$ and at a distance of 7 from it is

(A) $3x + 4y = 35$ (B) $3x - 2y = 7$

(C) $3x + 4y = -35$ (D) $2x - 3y = 7$

94. If the coordinates of a triangle are rational points, then the rational points is / are

(A) Orthocentre (B) Circumcentre

(C) Centroid (D) Incentre

95. If the two of the lines given by $3x^2 + 3x^2y - 3xy^2 + \alpha y^3 = 0$ are at right angles, then the slope of one of the them is

(A) –1 (B) 1

(C) 3 (D) –3

96. If two of the straight lines represented by the equation $y^3 + axy^2 + \left(a^2 + 6\right)x^2y + 2x^3 = 0$ are perpendicular

to each other, then a is equal to

(A) –2 (B) –4

(C) 2 (D) 4

97. Two lines are given by $(x-2y)^2+k(x-2y)=0$ The value of k, so that the distance between them is 3, is

(A) $k=0$ (B) $k=3\sqrt{5}$

(C) $k=-3\sqrt{5}$ (D) $k=3$

98. Points on the line $x+y=4$ that lie at a unit distance from the line $4x+3y\ 10=0$ are

(A) (3, 1) (B) (–7, 11)

(C) (–3, 7) (D) (–7, –11)

99. If the two pairs of lines $x^2-2mxy-y^2=0$ and $x^2-2nxy-y^2=0$ are such that one of them represents the bisector of the angles between the other, then

(A) $mn+1=0$ (B) $mn-1=0$

(C) $\frac{1}{m}+\frac{1}{nb}=0$ (D) $\frac{1}{m}-\frac{1}{n}=0$

100. If a line is perpendicular to the line $5x\ y=0$ and forms a triangle, with the coordinate axes, of area 5 sq. units, then its equation is

(A) $x+5y+5\sqrt{2}=0$ (B) $x+5y-5\sqrt{2}=0$

(C) $5x+y-5\sqrt{2}=0$ (D) $5x-y-5\sqrt{2}=0$

ANSWER KEY

Que	1	2	3	4	5	6	7	8	9	10
Ans	B	A	C	B	A	AB	BD	AC	AC	BC
Que	11	12	13	14	15	16	17	18	19	
Ans	AB	AC	AB	AB	BD	AB	BC	ABC	ABD	
Que	20	21	22	23	24	25	26	27	28	29
Ans	AB	A	ABD	BD	AB	AC	ABC	AC	BCD	AD
Que	30	31	32	33	34	35	36	37	38	39
Ans	ABCD	BD	ACD	AD	ABD	CD	C	A	D	AD
Que	40	41	42	43	44	45	46	47	48	49
Ans	BD	BCD	ABCD	AC	BCD	ABCD	AC	ABD	ABC	ABD
Que	50	51	52	53	54	55	56	57	58	59
Ans	BC	ABD	AD	ABC	ACD	BC	CD	A	A	A
Que	60	61	62	63	64					
Ans	CD	ABD	ABC	AD						
Que	65	66	67	68	69	70	71	72	73	74
Ans	AC	C	C	A	D	7	2	3	AB	CD
Que	75	76	77							
Ans	B	$\frac{\pi\sqrt{2}}{4}$	30°							
Que	78	79	80	81	82	83	84	85	86	
Ans	A	D	A	C	C	A	B	a-s;b-pq;c-r;d-pqs	3748	
Que	87	88	89	90	91	92	93	94	95	96
Ans	ABC	AC	AB	ABC	AB	BD	AC	ABC	AB	AB
Que	97	98	99	100						
Ans	BC	AB	A	AB						