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1. The distances of two planets from the sun are  $10^{13}$  and  $10^{12}$  m respectively. The ratio of time periods of these two planet is
- (a)  $1/\sqrt{10}$  (b) 100 (c)  $11/\sqrt{3}$  km/s (d) 33 km/s
2. An engine pumps water continuously through a hose. Water leaves the hose with a velocity  $v$  and  $m$  is the mass per unit length of the water jet. What is the rate at which kinetic energy is imparted to water ?
- (a)  $1/2mv^3$  (b)  $mv^3$  (c)  $1/2mv^2$  (d)  $1/2m^2v^2$
3. An explosion blows a rock into three parts. Two parts go off right angles to each other. These two are 1 kg .First part moving with a velocity of  $12 \text{ ms}^{-1}$  and 2 kg second part moving with a velocity of  $8 \text{ ms}^{-1}$  . If the third part flies off with a velocity of  $4 \text{ ms}^{-1}$ , its mass would be
- (a) 5 kg (b) kg (c) 17 kg (d) 3 kg
4. A satellite A of mass  $m$  is at a distance  $r$  from the surface of the earth. Another satellite B of mass  $2m$  is at a distance of  $2r$  from the earth's surface. Their time periods are in the ratio of
- (a) 1 : 2 (b) 1 : 16 (c) 1 : 32 (d)  $1 : 2\sqrt{2}$
5. A bomb of mass 30 kg at rest explodes into two pieces of masses 18 kg and 12 kg. The velocity of 18 kg mass is  $6 \text{ ms}^{-1}$ . The kinetic energy of the other mass is
- (a) 256 j (b) 486 j (c) 524 j (d) 324 j
6. A particle of mass  $m_1$  is moving with a velocity  $v_1$  and another particle of mass  $m_2$  is moving with a velocity  $v_2$ . Both of them have the same momentum, but their different kinetic energies are  $E_1$  and  $E_2$  respectively. If  $m_1 > m_2$ , then
- (a)  $E_1 < E_2$  (b)  $E_1/E_2 = M_1/M_2$  (c)  $E_1 > E_2$  (d)  $E_1 = E_2$
7. A ball of mass 2 kg and another of mass 4 kg are dropped together from a 60 ft tall building. After a fall of 30 ft each towards earth, respective kinetic energies will be in the ratio of
- (a)  $\sqrt{2} : 1$  (b) 1 : 4 (c) 1 : 2 (d)  $1 : \sqrt{2}$
8. If kinetic energy of a body is increased by 300%, then percentage change in momentum will be
- (a) 100% (b) 150% (c) 265% (d) 73.2%
9. A stone is thrown at an angle of  $45^\circ$  to the horizontal with kinetic energy  $K$ . The kinetic energy at the highest point is
- (a)  $K/2$  (b)  $K/\sqrt{2}$  (c)  $K$  (d) Zero
10. A child is swinging a swing. Minimum and maximum heights of swing from the earth's surface are 0.75 m and 2 m respectively. The maximum velocity of the swing is
- (a) 5 m/s (b) 10 m/s (c) 15 m/s (d) 20 m/s
11. Two bodies with kinetic energies in the ratio 4:1 are moving with equal linear momentum. The ratio of their masses is
- (a) 1 : 2 (b) 1 : 1 (c) 4 : 1 (d) 1 : 4
11. Two equal masses  $m_1$  and  $m_2$  moving along the same straight line with velocities  $+3 \text{ m/s}$  and  $-5 \text{ m/s}$  respectively collide elastically. Their velocities after the collision will be respectively
- (a)  $+4 \text{ m/s}$  for both (b)  $-3 \text{ m/s}$  and  $+5 \text{ m/s}$   
(c)  $-4 \text{ m/s}$  and  $+4 \text{ m/s}$  (d)  $-5 \text{ m/s}$  and  $+3 \text{ m/s}$
12. A force acts on a 3.0 g particle in such a way that the position of the particle as a function of time is given by  $x = 3t - 4t^2 + t^3$ , where  $x$  is in metre and  $t$  in second. The work done during the first 4 s is
- (a) 570 mJ (b) 450 mJ (c) 490 mJ (d) 528 mJ

13. A metal ball of mass 2 kg moving with a velocity of 36 km/h has a head on collision with a stationary ball of mass 3 kg. If after the collision, the two balls move together, the loss in kinetic energy due to collision is
- (a) 140 J (b) 100 J (c) 60 J (d) 40 J
14. A body of mass  $m$  moving with velocity 3 km/h collides with a body of mass  $2m$  at rest. Now, the coalesced mass starts to move with a velocity
- (a) 1 km/h (b) 2 km/h (c) 3 km/h (d) 4 km/h
15. If the momentum of a body is increased by 50%, then the percentage increase in its kinetic energy is
- (a) 50% (b) 100% (c) 125% (d) 200%
16. Two masses 1 g and 9 g are moving with equal kinetic energies. The ratio of the magnitudes of their respective linear momenta is
- (a) 1 : 9 (b) 9 : 1 (c) 1 : 3 (d) 3 : 1
17. A position dependent force  $F = (7 - 2x + 3x^2)$  N, acts on a small body of mass 2 kg and displace it from  $x = 0$  to  $x = 5$  m. Work done in joule is
- (a) 35 (b) 70 (c) 135 (d) 270
18. Two identical balls A and B moving with velocities  $+0.5$  m/s and  $-0.3$  m/s respectively, collide head on elastically. The velocity of the balls A and B after collision will be respectively
- (a)  $+0.5$  m/s and  $+0.3$  m/s (b)  $-0.3$  m/s and  $+0.5$  m/s  
(c)  $+0.3$  m/s and  $0.5$  m/s (d)  $-0.5$  m/s and  $+0.3$  m/s
19. A bullet of mass 10 g leaves a rifle at an initial velocity of 1000 m/s and strikes the earth at the same level with a velocity of 500 m/s. The work done in joule to overcome the resistance of air will be
- (a) 375 (b) 3750 (c) 5000 (d) 500
20. The coefficient of restitution  $e$  for a perfectly elastic collision is
- (a) 1 (b) Zero (c) infinite (d) -1
21. The escape velocity from the earth is 11.2 km/s. If a body is to be projected in a direction making an angle  $45^\circ$  to the vertical, then the escape velocity is
- (a)  $11.2 \times 2$  km/s (b) 11.2 km/s (c)  $11.2/\sqrt{2}$  km/s (d)  $11.2\sqrt{2}$  km/s
22. Two persons of masses 55 kg and 65 kg respectively, are at the opposite ends of a boat. The length of the boat is 3 m and weighs 100 kg. The 55 kg man walks upto the 65 kg man and sits with him. If the boat is in still water the centre of mass of the system shifts by
- (a) 3 m (b) 2.3 m (c) zero (d) 0.75 m
23. A seconds pendulum is mounted in a rocket. Its period of oscillation decreases when the rocket
- (a) comes down with uniform acceleration (b) moves round the earth in a geostationary orbit  
(c) moves up with a uniform velocity (d) moves up with uniform acceleration
24. A particle moves in a circle of radius 5 cm with constant speed and time period  $0.2\pi$  s. The acceleration of the particle is
- (a)  $25 \text{ m/s}^2$  (b)  $36 \text{ m/s}^2$  (c)  $5 \text{ m/s}^2$  (d)  $15 \text{ m/s}^2$
25. The instantaneous angular position of a point on a rotating wheel is given by the equation  $Q(t) = 2t^3 - 6t^2$ . The torque on the wheel becomes zero at
- (a)  $t = 0.5$  s (b)  $t = 0.25$  s (c)  $t = 2$  s (d)  $t = 1$  s
26. The escape velocity of a sphere of mass  $m$  is given by ( $G$  = universal gravitational constant,  $M_e$  = mass of the earth and  $R_e$  = radius of the earth)

- (a)  $\sqrt{GM_e/R_e}$  (b)  $\sqrt{2} GM_e/R_e$  (c)  $\sqrt{2GM/R_e}$  (d)  $GM_e/R_e^2$

27. If  $F$  is the force acting on a particle having position vector  $r$  and  $(\tau)$  be the torque of this force about the origin, then

- (a)  $r \cdot (\tau) \neq 0$  and  $F \cdot (\tau) = 0$  (b)  $r \cdot (\tau) > 0$  and  $F \cdot (\tau) < 0$   
 (c)  $r \cdot (\tau) = 0$  and  $F \cdot (\tau) = 0$  (d)  $r \cdot (\tau) = 0$  and  $F \cdot (\tau) \neq 0$

28. The largest and the shortest distance of the earth from the sun are  $r_1$  and  $r_2$ . Its distance from the sun when it is perpendicular to the major axis of the orbit drawn from the sun

- (a)  $r_1 + r_2/4$  (b)  $r_1 + r_2/r_1 - r_2$  (c)  $2 r_1 r_2 / r_1 + r_2$  (d)  $r_1 + r_2/3$

29. The moment of inertia of a uniform circular disc of radius  $R$  and mass  $M$  about an axis passing from the edge of the disc and normal to the disc is

- (a)  $\frac{1}{2} MR^2$  (b)  $MR^2$  (c)  $\frac{7}{2} MR^2$  (d)  $\frac{3}{2} MR^2$

30. A solid homogeneous sphere of mass  $M$  and radius  $R$  is moving on a rough horizontal surface, partly rolling and partly sliding. During this kind of motion of the sphere

- (a) total kinetic energy is conserved  
 (b) the angular momentum of the sphere about the point of contact with the plane is conserved  
 (c) only the rotational kinetic energy about the centre of mass is conserved  
 (d) angular momentum about the centre of mass is conserved

31. A rod is of length 3 m and its mass acting per unit length is directly proportional to distance  $x$  from its one end. The centre of gravity of the rod from that end will be at

- (a) 1.5 m (b) 2 m (c) 2.5 m (d) 3 m

32. A disc is rotating with angular velocity. If a child sits on it what is conserved ?

- (a) Linear momentum (b) Angular momentum (c) Kinetic energy (d) Moment of inertia

33. Three identical metal balls each of radius  $r$  are placed touching each other on a horizontal surface such that an equilateral triangle is formed with centres of three balls joined. The centre of mass of the system is located at

- (a) horizontal surface (b) centre of one of the balls  
 (c) line joining the centres of any two balls (d) point of intersection of the medians

34. A couple produces

- (a) no motion (b) linear and rotation motion  
 (c) purely rotational motion (d) purely linear motion

35. The angular speed of an engine wheel making 90 rev/min is

- (a)  $1.5 \pi \text{ rad/s}$  (b)  $3 \pi \text{ rad/s}$  (c)  $4.5 \pi \text{ rad/s}$  (d)  $6 \pi \text{ rad/s}$

36. Angular momentum is

- (a) vector (axial) (b) vector (polar) (c) scalar (d) None of these

37. In a rectangle ABCD ( $BC = 2AB$ ). The moment of inertia is minimum along axis through

- (a) BC (b) BD (c) HF (d) EG

38. If a sphere is rolling, the ratio of the translational energy to total kinetic energy is given by

- (a) 7 : 10 (b) 2 : 5 (c) 10 : 7 (d) 5 : 7

39. The following four wires are made of same material. Which of these will have the largest extension when the same tension is applied?

- (a) Length = 50 cm, diameter = 0.5 mm (b) Length = 100 cm, diameter = 1 mm  
(c) Length = 200 cm, diameter = 2 mm (d) Length = 300 cm, diameter = 3 mm
40. Escape velocity from the earth is 11.2 km/s. Another planet of same mass has radius  $\frac{1}{4}$  times that of the earth. What is the escape velocity from another planet?
- (a) 11.2 km/s (b) 44.8 km/s (c) 22.4 km/s (d) 5.6 km/s
41. A geostationary satellite is orbiting the earth at a height of  $5R$  above that surface of the earth,  $R$  being the radius of the earth. The time period of another satellite in hour at a height of  $2R$  from the surface of the earth is
- (a) 5 (b) 10 (c)  $6\sqrt{2}$  (d)  $6/\sqrt{2}$
42. A body projected vertically from the earth reaches a height equal to earth's radius before returning to the earth. The power exerted by the gravitational force is greatest
- (a) at the instant just before the body hits the earth (b) it remains constant all through  
(c) at the instant just after the body is projected (d) at the highest position of the body
43. For a satellite moving in an orbit around the earth, the ratio of kinetic energy to potential energy is
- (a) 2 (b)  $\frac{1}{2}$  (c)  $1/\sqrt{2}$  (d)  $\sqrt{2}$
44. A body attains a height equal to the radius of the earth. The velocity of the body with which it was projected is
- (a)  $\sqrt{GM/R}$  (b)  $\sqrt{2GM/R}$  (c)  $\sqrt{5/4 GM/R}$  (d)  $\sqrt{3GM/R}$
45. The escape velocity of a body on the surface of the earth is 11.2 km/s. If the earth's mass increase to twice its present value and the radius of the earth becomes half, the escape velocity would become
- (a) 44.8 km/s (b) 22.4 km/s (c) 11.2 km/s (remain unchanged) (d) 5.6 km/s
46. The sublimation energy of  $I_2(s)$  is 57.3 kJ/mol and the enthalpy of fusion is 15.5 kJ/mol. The enthalpy of vaporisation of  $I_2$  is:
- (a) 41.8 kJ/mol (b) - 41.8 kJ/mol (c) 72.8 kJ/mol (d) - 72.8 kJ/mol
47. Consider the reaction,  $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ ; carried out at constant temperature and pressure. If  $\Delta H$  and  $\Delta U$  are enthalpy change and internal energy change respectively, which of the following expression is true?
- (a)  $\Delta H = 0$  (b)  $\Delta H = \Delta U$   
(c)  $\Delta H < \Delta U$  (d)  $\Delta H > \Delta U$
48. Standard entropies of  $X_2$ ,  $Y_2$  and  $XY_3$  are 60, 40 and 50  $JK^{-1} mol^{-1}$  respectively. For the reaction;  $\frac{1}{2} X_2 + \frac{3}{2} Y_2 \rightarrow XY_3$ ,  $\Delta H = -30$  KJ to be at equilibrium, the temperature will be?
- (a) 1000 K (b) 1250 K (c) 500 K (d) 750 K
49. A 1 g sample of substance A at  $100^\circ C$  is added to 100 ml of  $H_2O$  at  $25^\circ C$ . Using separate 100 mL portion of  $H_2O$ , the procedure is repeated with substance B and then with substance C. How will the final temperatures of the water compare?

Substance

Specific heat

A

 $0.6 J g^{-1} ^\circ C^{-1}$ 

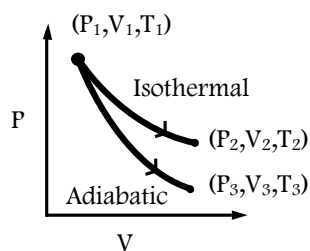
B

 $0.4 J g^{-1} ^\circ C^{-1}$ 

C

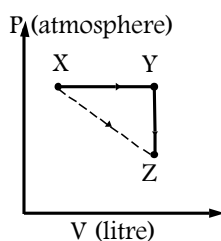
 $0.2 J g^{-1} ^\circ C^{-1}$ (a)  $T_C > T_B > T_A$ (b)  $T_B > T_A > T_C$ (c)  $T_A > T_B > T_C$ (d)  $T_A = T_B = T_C$

50. The reversible expansion of an ideal gas under adiabatic and isothermal condition is shown in the figure. Which of the following statement(s) is (are) correct?



- (a)  $T_1 + T_2$  (b)  $T_3 > T_1$   
 (c)  $W_{\text{isothermal}}$  (d)  $\Delta U_{\text{isothermal}} > \Delta U_{\text{adiabatic}}$

51. For an ideal gas, consider only P-V work in going from an initial state X to the final state Z. The final state Z can be reached by either of the two paths shown in the figure. Which of the following choice(s) is (are) correct? [take  $\Delta S$  as change in entropy and  $w$  as work done]



- (a)  $\Delta S_{X \rightarrow Z} = \Delta S_{X \rightarrow Y} + \Delta S_{Y \rightarrow Z}$  (b)  $W_{X \rightarrow Z} = W_{X \rightarrow Y} + W_{Y \rightarrow Z}$   
 (c)  $W_{X \rightarrow Y \rightarrow Z} = W_{X \rightarrow Y}$  (d)  $\Delta S_{X \rightarrow Y \rightarrow Z} = \Delta S_{X \rightarrow Y}$

52. The value of  $10 \log_{10} K$  for a reaction  $A \rightleftharpoons B$  is: (given,  $\Delta_r H^\circ_{298K} = -54.07 \text{ KJ mol}^{-1}$ ,  $\Delta_r S^\circ_{298K} = 10 \text{ JK}^{-1} \text{ mol}^{-1}$  and  $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$ ;  $2.303 \times 8.314 \times 298 = 5705$ )

- (a) 5 (b) 10 (c) 95 (d) 100

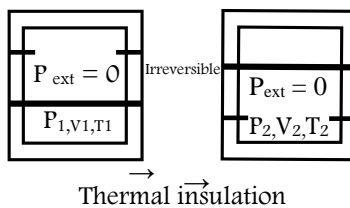
53. A gas expands adiabatically at constant pressure such that:  $T \propto 1/\sqrt{V}$ . The value of  $\gamma$ , i.e.,  $(C_p / C_v)$  of the gas will be

- (a) 1.30 (b) 1.50 (c) 1.70 (d) 2

54. For an ideal gas [ $C_{pm}/C_{vm} = \gamma$ ]; of molar mass, its specific heat capacity at constant volume is:

- (a)  $\gamma R / (\gamma - 1) M$  (b)  $\gamma / M(\gamma - 1)$  (c)  $M / R(\gamma - 1)$  (d)  $\gamma R M / \gamma - 1$

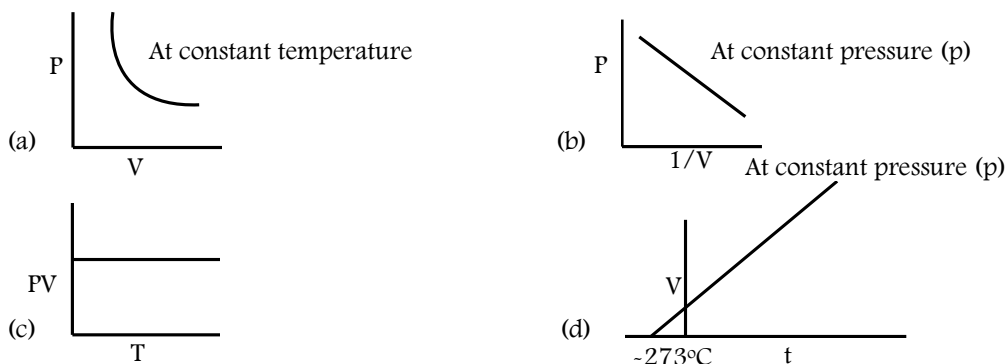
55. An ideal gas in a thermally insulated vessel at internal pressure =  $P_1$ , volume =  $V_1$  and absolute temperature =  $T_1$  expands irreversibly against zero external pressure, as shown in the diagram. The final external pressure, volume and absolute temperature of the gas are  $P_2$ ,  $V_2$  and  $T_2$  respectively. For this expansion:



- (a)  $q = 0$  (b)  $T_2 = T_1$   
 (c)  $P_2 V_2 = P_1 V_1$  (d)  $P_1 V_2^\gamma = P_1 V_1^\gamma$

56. One mole of an ideal gas is taken from a to b along two paths denoted by the solid and the dashed lines as shown in the graph below. If the work done along the solid line path is  $W_s$  and that along the dotted line path is  $W_d$ , then the integer closest to the ratio  $W_d / W_s$  is:

61. The graph that does represent the behaviour of an ideal gas is:



- (a)    (i) > (ii) > (iii) > (iv)
- (b)    (i) < (ii) < (iii) < (iv)

- (c) (ii) < (iii) < (i) < (iv) (d) (iii) < (i) < (iv) < (ii)

65. Which of the following chemical reaction depicts the oxidising behaviour of  $\text{H}_2\text{SO}_4$ ?

- (a)  $2\text{HI} + \text{H}_2\text{SO}_4 \rightarrow \text{I}_2 + \text{SO}_2 + 2\text{H}_2\text{O}$  (b)  $\text{Ca}(\text{OH})_2 + \text{H}_2\text{SO}_4 \rightarrow \text{CaSO}_4 + 2\text{H}_2\text{O}$   
 (c)  $\text{NaCl} + \text{H}_2\text{SO}_4 \rightarrow \text{NaHSO}_4 + \text{HCl}$  (d)  $2\text{PCl}_5 + \text{H}_2\text{SO}_4 \rightarrow 2\text{POCl}_3 + 2\text{HCl} + \text{SO}_2\text{Cl}_2$

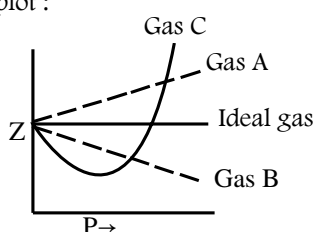
66. The pair in which phosphorous atoms have a formal oxidation state of +3 is ;

- (a) Orthophosphorous and pyrophosphorous acids (b) Pyrophosphorous and hypophosphoric acids  
 (c) Orthophosphorous and hypophosphoric acids (d) pyrophosphorous and pyrophosphoric acids

67. The oxidation states of sulphur in caro's and Marshall's acid are:

- (a) +6, +6 (b) +4, +6 (c) +6, -6 (d) +6, +4

68. Consider the following plot :



Which of the following statement is wrong ?

- (a) For a gas A,  $a = 0$ , and Z will linearly depend on pressure  
 (b) For a gas B,  $b = 0$ , and Z will linearly depend on pressure  
 (c) Gas C is a real gas and we can find 'a' and 'b' if intersection data is given  
 (d) All van der Waals gases will behave like gas C and gives positive slope at high pressure

69. If the ratio of the masses of  $\text{SO}_3$  and  $\text{O}_2$  gases confined in a vessel is 1:1, then the ratio of their partial pressure would be

- (a) 5 : 2 (b) 2 : 5 (c) 2 : 1 (d) 1 : 2

70. 50 mL of each gas A and of gas B takes 150 and 200 seconds respectively for effusing through a pin hole under the similar condition. If molecular mass of gas A is 36, the molecular mass of gas B will be

- (a) 96 (b) 128 (c) 32 (d) 64

71. The compressibility factor for a real gas at high pressure is

- (a) 1 (b)  $1 + pb/RT$  (c)  $1 - pb/RT$  (d)  $1 + RT/pb$

72. In thermodynamics, a process is called reversible when

- (a) surroundings and system change into each other  
 (b) there is no boundary between system and surroundings  
 (c) the surroundings are always in equilibrium with the system  
 (d) the system change into surroundings spontaneously

73. Considering entropy (s) as a thermodynamic parameter, the criterion for the spontaneity of any process is

- (a)  $\Delta S_{\text{System}} - \Delta S_{\text{Surrounding}} > 0$  (b)  $\Delta S_{\text{System}} > 0$   
 (c)  $\Delta S_{\text{Surrounding}} > 0$  (d)  $\Delta S_{\text{System}} + \Delta S_{\text{Surrounding}} > 0$



74. Which of the following reaction are correct ?

- (a)  $\Delta S = \Delta H - \Delta T/T$  (b)  $\Delta S = q_{\text{irrev}}/T$   
 (c)  $K = e^{\Delta G^\circ/RT}$  (d)  $[d(\Delta H)^T/dT]_p = \Delta C_p$

75. The incorrect expression among the following is

- (a) in isothermal process,  $W_{\text{reversible}} = -nRT \ln V_f/V_i$  (b)  $\ln K = \Delta H^\circ - T \Delta S^\circ/RT$   
 (c)  $K = e^{-\Delta G^\circ(\text{degree})/RT}$  (d)  $\Delta G_{\text{system}}/\Delta S_{\text{total}} = -T$

76. If Z is a compressibility factor, van der waals' equation at low pressure<sup>3</sup> can be written as

- (a)  $Z = 1 - pb/RT$  (b)  $Z = 1 + p[b/RT$  (c)  $Z = 1 + RT/pb$  (d)  $Z = 1 - a/VRT$

77. The intermolecular interaction that is dependent on the inverse cube of distance between the molecules is

- (a) hydrogen bond (b) ion-ion interaction (c) ion-dipole interaction (d) London force

78. A gas described by van der waals' equation:

- (a) behaves similar to an ideal gas in the limit of large molar volume  
 (b) behaves similar to an ideal gas in the limit of large pressures  
 (c) is characterised by van der waals' constant that are dependent on identity of the gas but are independent of the temperature  
 (d) has the pressure that is lower than the pressure exerted by the same behaving ideally

79. When  $\text{KMnO}_4$  acts as an oxidising agent and ultimately forms  $\text{MnO}_4^{2-}$ ,  $\text{MnO}_2$ ,  $\text{Mn}_2\text{O}_3$  and  $\text{Mn}^{2+}$ , then the number of electrons transferred in each case respectively is

- (a) 4, 3, 1, 5 (b) 1, 5, 3, 7 (c) 1, 3, 4, 5 (d) 3, 5, 7, 1

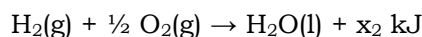
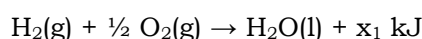
80. Which of the following is a redox reaction?

- (a)  $\text{NaCl} + \text{KNO}_3 \rightarrow \text{NaNO}_3 + \text{KCl}$  (b)  $\text{CaC}_2\text{O}_4 + 2\text{HCl} \rightarrow \text{CaCl}_2 + 2\text{NH}_4\text{OH}$   
 (c)  $\text{Mg}(\text{OH})_2 + 2\text{NH}_4\text{Cl} \rightarrow \text{MgCl}_2 + 2\text{NH}_4\text{OH}$  (d)  $\text{Zn} + 2\text{AgCN} \rightarrow \text{Zn}(\text{CN})_2$

81. Which is a correct relationship?

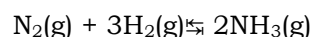
- (a)  $[dH/dT]_p - [dU/dT]_T = (+ve)$  (b)  $[dU/dV]_T = 0$  (for ideal gas)  
 (c)  $[dV/dT]_p = nR/P$  (for ideal gas) (d) All of the above

82. For the two equation given below:



- (a)  $x_1 > x_2$  (b)  $x_2 > x_1$  (c)  $x_1 = x_2$  (d)  $x_1 + x_2 = 0$

83. The Haber's process for production of ammonia involves the equilibrium:



Assuming  $\Delta H^\circ$  and  $\Delta S^\circ$  for the reaction do not change with temperature, which of the statement is true? ( $\Delta H^\circ = -95 \text{ kJ}$  and  $\Delta S^\circ = -190 \text{ JK}^{-1}$ )

- (a) Ammonia dissociates spontaneously below 500 K  
 (b) Ammonia dissociates spontaneously above 500 K

- (c) Ammonia dissociates at all temperatures  
 (d) Ammonia does not dissociate at any temperature

84. What is the value of internal energy change ( $\Delta U$ ) at  $27^\circ\text{C}$  of a gaseous reaction  $2\text{A}_2(\text{g}) + 5\text{B}_2(\text{g}) \rightarrow 2\text{A}_2\text{B}_5(\text{g})$  (whose heat change at constant pressure is  $-50700 \text{ J}$ )?

( $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$ )

- (a)  $-50700 \text{ J}$  (b)  $-63171 \text{ J}$  (c)  $-38229 \text{ J}$  (d)  $+38229 \text{ J}$

85. The root mean square velocity of an ideal gas at constant pressure varies with density as:

- (a)  $d^2$  (b)  $d$  (c)  $\sqrt{d}$  (d)  $1/\sqrt{d}$

86. The compressibility of a gas is less than unity at STP. Therefore:

- (a)  $V_m > 22.4 \text{ litre}$  (b)  $V_m < 22.4 \text{ litre}$   
 (c)  $V_m = 22.4 \text{ litre}$  (d)  $V_m = 44.8 \text{ litre}$

87. For three different gases values of van der waals' constant 'a' and 'b' are given. What is the correct order of liquefaction of gases?

Gases	a	b
X <sub>2</sub>	1.3	0.990
Y <sub>2</sub>	4.1	0.223
Z <sub>2</sub>	2.2	0.075

- (a)  $X_2 > Y_2 > Z_2$  (b)  $Y_2 > Z_2 > X_2$   
 (c)  $Z_2 > Y_2 > X_2$  (d)  $X_2 > Z_2 > Y_2$

88. The root mean square speed of molecules of nitrogen gas is  $v$  at a certain temperature. When the temperature is doubled, the molecules dissociate into individual atoms. The new rms speed of the atom is

- (a)  $\sqrt{2}v$  (b)  $2v$  (c)  $v$  (d)  $4v$

89. At same temperature, calculate the ratio of average velocity of  $\text{SO}_2$  to  $\text{CH}_4$ :

- (a)  $2 : 3$  (b)  $3 : 4$  (c)  $1 : 2$  (d)  $1 : 6$

90. Which is the correct expression that relates changes of entropy with the change of pressure for an ideal gas at constant temperature, among the following?

- (a)  $\Delta S = nRT \ln P_2/P_1$  (b)  $\Delta S = T (P_2 - P_1)$   
 (c)  $\Delta S = nRT \ln (P_1/P_2)$  (d)  $\Delta S = 2.303 nRT \ln (P_1/P_2)$

91. Growth in plants is largely restricted to specialised regions of active cell division called

- (a) Meristems (b) Cambium (c) Primordium (d) Permanent tissue

92. Which of the following characteristic is not found in parenchyma?

- (a) It forms the major component within organs  
 (b) Their walls are thick and made up of cellulose.  
 (c) They may either be closely packed or have small intercellular spaces

- (d) The parenchyma performs various functions like photosynthesis, storage and secretion.
93. Intercalary meristem produces
- (a) Secondary growth (b) Primary growth (c) Apical growth (d) Secondary overgrowth
94. Common between sclerenchyma and collenchyma is
- (a) Material transport (b) Conduction of water and minerals  
(c) Providing buoyancy (d) Providing support
95. Fill in the blank :
- a. In... 1... type of a vascular bundles, the xylem and phloem are situated at the same radius of vascular bundles. Such vascular bundles are common in ...2...
- b. When xylem and phloem within a vascular bundle are arranged in an alternate manner on different radii, the arrangement is called ...3...such as in ..4...
- (a) 1---- radial, 2----conjoint, 2---stem and leaves, 4---roots  
(b) 1---- radial, 3----conjoint, 4---stem and leaves, 2---roots  
(c) 3---- radial, 1----conjoint, 2---stem and leaves, 4---roots  
(d) 3---- radial, 1----conjoint, 4---stem and leaves, 4---roots
96. Root hairs are
- (a) always unicellular (b) sometimes unicellular  
(c) sometimes multicellular (d) always multicellular
97. Which statement is incorrect about dicot stem?
- (a) Collenchymatous hypodermis, sclerenchymatous pericycle, parenchymatous pith  
(b) Ring arrangement of vascular bundles, parenchymatous medullary rays and endodermal starch sheath  
(c) Multiple layered cortex; semi-lunar pericycle ;conjoint, open and endarch protoxylem  
(d) None of the above
98. In dicot leaves, size of vascular bundles are dependent on the
- (a) Size of the leaves (b) Size of the mesophyll cells  
(c) Size of the veins (d) Size of the bundles sheath cells
99. In order trees, the greater part of ...a....is dark brown due to deposition of tannin, resins, oil, gums, aromatic substances and essential oil in the central layers of the stem. These substances make it hard durable and resistant to the attacks of microorganisms and insect. This region is called ...b...
- (a) a----secondary xylem, b----sapwood (b) a----secondary xylem, b----heartwood  
(c) a----secondary phloem, b----softwood (d) a----secondary xylem, b----hardwood
100. Which of the following statement about cilia is not correct ?
- (a) Organised beating of cilia is controlled by fluxes of  $\text{Ca}^{2+}$  across the membrane  
(b) Cilia are hair like cellular appendages

(c) Cilia contain an outer ring of nine doublet microtubules surrounding two singlet microtubules

(d) Microtubules of cilia are composed of tubulin

101. Which is wrong?

(a) Both chloroplast and mitochondrion have an internal compartment or thylakoid space bounded by thylakoid membrane

(b) Both contain DNA (c) Chloroplast is generally larger

(d) Both are covered by double membrane

102. In plant cell, the vacuole

(a) Contains air and lacks membrane

(b) Contains water and excretory substances but lacks membrane

(c) Contains storage protein and lipids and is membrane bound

(d) is membrane bound, contain water and excretory substances

103. Plasmodesmata are

(a) Locomotory structure

(b) Lignified cement between cells

(c) Connection between adjacent cells

(d) Membrane connecting nucleus and plasmalemma

104. Which is correct?

(a) Oil storage---Rhodoplast

(b) Protein storage---Amyloplast

(c) Starch storage---Aleuroplast

(d) Fat storage---Elaioplast

105. Cell theory was propounded by

(a) A botanist

(b) A zoologist

(c) Both a botanist and a zoologist

(d) A psychologist

106. Detailed structure of the membrane was studied after the advent of electron microscope in

(a) 1930s

(b) 1950s

(c) 1970s

(d) 1990s

107. Nuclear membrane is absent in

(a) Plantae

(b) Protista

(c) Monera/Nostoc

(d) Fungi

108. Match the following and select the correct answer

(a) Centriole

(i) Infoldings in mitochondria

(b) Chlorophyll II

(ii) Thylakoids

(c) Cristae

(iii) Nucleic acids

(d) Ribozymes

(iv) Basal body, cilia or flagella

(A) a---iv, b---iii, c---i, d---ii

(B) a---iv, b---ii, c---iv, d---iii

(C) a---i, b---ii, c---iv, d---iii

(D) a---i, b---iii, c---ii, d---iv

109. Phase of cell cycle when DNA polymerase is active

- (a) Genotype (b) Phenotype (c) Genome (d) Genetic system

110. Telophase is characterised by

- (a) Chromosomes cluster at opposite spindle poles and their identity is lost as discrete elements  
(b) Nuclear envelope assembles around the chromosome cluster  
(c) Nucleolus, golgi complex and ER reform  
(d) All of the above

111. Prophase-1 is subdivided into five phases based on

- (a) Chromosomal movement (b) Chromosomal alignment  
(c) Chromosomal behaviour (d) Chromosomal structure

112. Synapsis occurs between

- (a) Spindle fibres and centromeres (b) mRNA and ribosomes  
(c) A male and female gamete (d) Two homologous chromosomes

113. During cell cycle, RNA and proteins are synthesised in

- (a) S-phase (b) G<sub>1</sub>-phase (c) G<sub>2</sub>-phase (d) Both B and C

114. Select the correct matches:

- (a) S-phase---- DNA replication (b) Zygotene--- Synapsis  
(c) Diplotene--- Crossing over (d) Meiosis--- Both haploid and diploid cells  
(e) Gap 2 phase--- Question?

- (A) a and b (B) c and d (C) c and e (D) a, c and e

115. The complex formed by a pair of synapsed homologous chromosomes is called

- (a) Bivalent (b) Axoneme (c) Equatorial plate (d) Kinetochore

116. A bacteria divides in every one minute. A cup is filled in one hour. Time taken to fill one – fourth cup is

- (a) 30 minutes (b) 59 minutes (c) 29 minutes (d) 58 minutes

117. The complex formed by a pair of synapsed homologous chromosomes is called

- (a) Kinetochore (b) Bivalent (c) Axoneme (d) Equatorial plate

118. A cell increase in volume if the external medium is

- (a) Hypotonic (b) Hypertonic (c) Isotonic (d) None of the above

119. A and B cells are contiguous. Cell A has OP = 1 atm, TP = 7 atm and DPD = 5 atm. The result would be

- (a) No movement of water (b) Equilibrium between the two  
(c) Movement of water from A to B (d) Movement of water from B to A

120. For the same amount of CO<sub>2</sub> fixed, a C<sub>4</sub> plant as compared to C<sub>3</sub> plant loses only

- (a) Half amount of water (d) double amount of water

- (c) Equal amount of water (d) None of the above
121. Compared to 1 M sucrose solution, the  $\Psi_{\text{omega}}$  of 1 M sodium chloride solution is
- (a) High (b) same (c) Lower (d) None of the above
122. Which is not directly connected with ascent of sap?
- (a) Cohesion theory (b) Root pressure (c) Apoplast-symplast (d) Capillarity
123. Which is not a purpose of transpiration?
- (a) Prevents loss of water (b) Helps in absorption and transport
- (c) Makes cells rigid (d) Cools leaf surfaces
124. The osmotic expansion of a cell kept in water is chiefly regulated by
- (a) Ribosomes (b) Mitochondria (c) Vacuoles (d) Plastids
125. Which of the following statement is correct?
- (a) Organic and mineral nutrients undergo multi-directional transport
- (b) Water transport in phloem is unidirectional
- (c) Transport of minerals occurs in xylem and is multidirectional
- (d) During senescence nutrients move from healthy plant parts of senescing regions
126. Which of the following scientists is credited with the mechanism of opening and closing of stomata related to  $K^+$  exchange?
- (a) Levitt (b) sayre (c) Scarth (d) Lloyd
127. The ion controlling stomatal movement is
- (a)  $Na^+$  (b)  $Ca^{2+}$  (c)  $Mg^{2+}$  (d)  $K^+$
128. Which is a symbiotic  $N_2$ -fixer in non-leguminous plants?
- (a) Rhizobium (b) Frankia (c) Rhodospirillum (d) Both A and B
129. Micronutrients are needed in amounts
- (a) 8 m mole/kg dry matter (b) 18 m mole/kg dry matter
- (c) 25 m mole/kg dry matter (d) 30 m mole/kg dry matter
130. Function of leghaemoglobin during biological nitrogen fixation in root nodules of legumes is to
- (a) Convert atmospheric nitrogen to ammonia (b) Convert ammonia to nitrite
- (c) Transport oxygen for activity of nitrogenase (d) Protect nitrogenase from oxygen
131. For its activity nitrogenase requires
- (a) High input of energy (b) Light (c)  $Mn^{2+}$  (d) Super oxygen radicals
132. Deficiency symptoms of nitrogen and potassium are visible first in
- (a) Buds (b) Senescent leaves (c) Young leaves (d) Roots
133. Which of the following is a free living nitrogen fixing bacterium?

- (a) Rhizobium (b) Azotobacter (c) Xanthomonas (d) Rhizopus

134. The first nif genes were isolated from

- (a) Klebsiella aerogenosa (b) Klebsiella oxytoca  
(c) Klebsiella pneumoniae (d) Klebsiella granulomatis

135. Ferredoxin (Fd) is a

- (a) Non-heme iron protein (b) Heme iron protein  
(c) Copper containing protein (d) None of the above

136. Part of bile useful in digestion is

- (a) Bile pigments (b) Bile salts (c) Bile matrix (d) All the above

137. Which one is fat soluble?

- (a) A, D, E, K (b) A, D, C, K (c) A, B, C, K (d) A, B, D, E

138. Find out the correct sequence of substrate, enzyme and product

- (a) Small intestine : Protein  $\xrightarrow{\text{Pepsin}}$  Amino acid  
(b) Stomach : Fat  $\xrightarrow{\text{Lipase}}$  Micelle  
(c) Duodenum : Triglycerides  $\xrightarrow{\text{Trypsin}}$  Monoglycerides  
(d) Small intestine : starch  $\xrightarrow{\alpha\text{-Amylase}}$  Maltose

139. Stool in infant feeding entirely on whitish mother's milk is yellowish due to

- (a) Intestinal juice (b) Pancreatic juice (c) Bile pigments (d) Undigested milk casein

140. Which are all proteolytic enzymes?

- (a) Ptyalin, trypsin, pepsin (b) Lipase, erepsin, trypsin  
(c) Erepsin, trypsin, pepsin (d) Pepsin, nuclease, nucleotidase

141. Which is not a disorder of digestive system

- (a) Emphysema (b) Jaundice (c) Constipation (d) Vomiting

142. Sphincter of Oddi is associated with opening of

- (a) Hepato-pancreatic ampulla (b) Oesophagus  
(c) Common hepatic duct (d) Pyloric stomach

143. Select the answer which gives correct matching of the end products of digestion in humans with the site and mechanism of absorption

Product	Site of absorption	Mechanism
(a) Galactose	Mouth	Active absorption
(b) Proline	Stomach	Passive absorption
(c) Fructose	Small intestine	Active transport
(d) Glucose	Small intestine	Active transport

144. Gastric juice of infants contains

- (a) Pepsinogen, Lipase, rennin
- (b) Amylase, rennin, pepsinogen
- (c) Maltase, pepsinogen, rennin
- (d) Nuclease, pepsinogen, lipase

145. Pneumotaxic centre occurs in

- (a) Cerebellum
- (b) Cerebrum
- (c) Medulla oblongata
- (d) Pons varolii

146. Vital capacity of lungs is

- (a) Inspiratory reserve volume plus expiratory reserve volume
- (b) Inspiratory reserve volume plus tidal volume
- (c) Total lungs capacity minus expiratory reserve volume
- (d) Total lung capacity minus residual volume

147. In a resting person, oxygen saturation of haemoglobin as blood leaves the tissue capillaries is

- (a) 25%
- (b) 40%
- (c) 46%
- (d) 75%

148. Partial pressure of oxygen in alveolar air is

- (a) 45 mm Hg
- (b) 15 mm Hg
- (c) 100 mm Hg
- (d) 104 mm Hg

149. What is true about RBCs in human?

- (a) They transport 99.5% of  $O_2$
- (b) They transport 80% oxygen, the rest 20% being transport by plasma
- (c) They do not carry  $CO_2$  at all
- (d) They carry 20-25% of  $CO_2$

150. Amount of  $CO_2$  in expired air is about

- (a) 0.04%
- (b) 0.03%
- (c) 21%
- (d) 4.5%

151. A large proportion of oxygen is left unused in the human blood even after uptake by the body tissue. This oxygen

- (a) is enough to keep oxyhaemoglobin saturation at 96%
- (b) Helps in releasing more oxygen to epithelial tissues
- (c) Acts as a reserve during muscular exercise
- (d) Raise  $pCO_2$  of blood to 75 mm Hg

152. After forceful inspiration, the amount of air that can be breathed out with maximum forced expiration is equal to

- (a)  $TV + RV + ERV$
- (b)  $IRV + TV + ERV$
- (c)  $IRV + RV + ERV$
- (d)  $IRV + ERV + TV + RV$

153. Name the chronic respiratory disorder caused mainly by cigarette smoking

- (a) Emphysema
- (b) Asthma



- (c) Respiratory acidosis (d) Respiratory alkalosis
154. A person on long hunger strike and surviving only on water will have
- (a) Less amino acids in urine (b) More glucose in blood
- (c) Less urea in urine (d) More sodium in urine
155. Which one is a component of ornithine cycle?
- (a) Ornithine, citrulline and alanine (b) Ornithine, citrulline and arginine
- (c) Amino acids are not used (d) Ornithine, citrulline and fumaric in human blood
156. Which is wrongly matched?
- (a) DCT---Absorption of glucose (b) Bowman's capsule -Glomerular filtration
- (c) Henle's loop---Concentration of urine (d) PCT---Absorption of  $\text{Na}^+$  and  $\text{K}^+$  ions
157. Which one of the following statement in regard to the excretion by the human kidneys is correct?
- (a) Distal convoluted tubule is incapable of reabsorbing  $\text{HCO}_3$
- (b) Nearly 99% of glomerular filtrate is reabsorbed by renal tubules
- (c) Ascending limb of loop of Henle is impermeable to electrolytes
- (d) Descending limb of loop OF Henle is impermeable to water
158. Which is correct?
- (a) Distal convoluted tubule— Reabsorption of  $\text{K}^+$  ions
- (b) Afferent arteriole— Carries blood away from glomerulus
- (c) Podocytes — Create minute spaces (slit pores) for filtration
- (d) Henle's loop— Most reabsorption of major substances
159. Maximum amount of electrolytes and 70—80% water from glomerular filtrate is reabsorbed in
- (a) PCT (b) Descending limb of Henle's loop
- (c) Ascending limb of Henle's loop (d) DCT
160. Which is correct in normal humans?
- (a) pH of urine is around 8 (b) 20—30 mg of urea is excreted per day
- (c) Ketone bodies in urine indicate diabetes mellitus
- (d) Glycosuria is treated with hemodialysis
161. Reaction of ornithine cycle occur in
- (a) liver to produce urea (b) kidney to produce urine
- (c) liver to produce ammonia (d) kidney to form urea
162. Human urine is usually acidic because
- (a) excreted plasma proteins are acidic
- (b) potassium and sodium exchange generates acidity

- (c) Hydrogen ions are actively secreted into the filtrate
- (d) The sodium transporter exchanges one hydrogen for each sodium ion, in peritubular capillaries

163. Which one is anatomically correct?

- (a) Collar bones-----3 pair                      (b) salivary glands ---1 pair
- (c) Cranial nerves ---10 pair                      (d) Floating ribs---2 pair

164. Which is correct paired?

- (a) Heart--- Involuntary, unstriated muscle      (b) Iris---Involuntary, smooth muscle
- (c) Biceps---Smooth muscle                      (d) Abdominal wall---smooth muscle

165. Which one is correct match of three items and their grouping category?

Item	Group
(a) Cytosine, uracil, thiamine	pyrimidines
(b) Malleus, incus, cochlea	Ear ossicles
(c) Ilium, ischium, pubis	Coxal bones of pelvic girdle
(d) Actin, myosin, rhodopsin	muscle proteins

166. In a resting muscle fibre, troponin partially covers

- (a) Ca-binding sites on actin                      (b) Ca- binding sites on troponin
- (c) actin binding sites on myosin                      (d) Myosin binding sites on actin

167. Which is correct description ?

- (a) First vertebra is axis which articulates with occipital condyles
- (b) parietal bone and temporal bone of skull are jointed by fibrous joint
- (c) 9<sup>th</sup> and 10<sup>th</sup> pairs of ribs are called floating ribs
- (d) Glenoid cavity is depression to which thigh bone articulates

168. What is the location of troponin in the process of muscle contraction?

- (a) Attached to myosin                      (b) Attached to tropomyosin
- (c) Attached to myosin cross-bridges      (d) Attached to T-tubule

169. Symphysis consist of

- (a) Hyaline cartilage      (b) Elastic cartilage      (c) fibrocartilage      (d) Synovial fluid

170. Rigor mortis is due to

- (a) Depletion of ATP                      (b) Excess ATP
- (c) Excess availability of calcium                      (d) Release of magnesium

171. Select the correct matching of the type of the joint with the example in human skeletal system

Type of joint	Example
(a) Gliding joint	Between carpals

- (b) Cartilaginous joint                      Between frontal and parietal  
(c) Pivot joint                                  Between third and fourth cervical vertebrae  
(d) Hinge joint                                  Between humerus and pectoral girdle

172. Sliding filament theory can be best explained as

- (a) Actin and myosin filaments do not shorten but rather slide pass each other  
(b) When myofilaments slide pass each other, myosin filaments shorten while Actin filaments do not shorten  
(c) When myofilaments slide pass each other Actin filaments shorten while myosin filaments do not shorten  
(d) Actin & Myosin filaments shorten and slide pass each other

173. Cervical vertebrae are characterized by

- (a) Transverse processes                      (b) Neural spines  
(c) Vertebro-arterial canals                      (d) Odontoid process

174. At times ligaments and tendons are overstretched or torn. The phenomenon is

- (a) Sprain                      (b) Dislocation                      (c) Fracture                      (d) Tension

175. Friction is lessened in ball-and -socket joint by

- (a) Coelomic fluid                      (b) Synovial fluid                      (c) Pericardial fluid                      (d) Mucin

176. Axis vertebra is identified by

- (a) Sigmoid notch                      (b) Odontoblast                      (c) Odontoid process                      (d) Olecranon processs

177. Largest synovial joint is

- (a) Hip joint                                      (b) Knee joint  
(c) Shoulder joint                                      (d) Ankle joint

178. The movable skull bone is

- (a) Maxilla                                      (b) Vomer  
(c) Urostyle                                      (d) Pygostyle

179. Tail vertebrae of birds form

- (a) Wish bone                                      (b) Chevron bone  
(c) Urostyle                                      (d) Pygostyle

180. Which is not a function of bones?

- (a) Protection of vital organs                      (b) Haemopoiesis  
(c) Muscle attachment                      (d) Secretion of hormones