



NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION (UPDATED)

CLASS - 11 (PCB)
Question Paper Code : UN497

KEY

| | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. A | 2. B | 3. A | 4. D | 5. B | 6. C | 7. C | 8. A | 9. B | 10. A |
| 11. A | 12. D | 13. D | 14. D | 15. D | 16. A | 17. C | 18. B | 19. D | 20. A |
| 21. B | 22. A | 23. C | 24. B | 25. D | 26. D | 27. C | 28. D | 29. D | 30. C |
| 31. D | 32. C | 33. A | 34. A | 35. B | 36. C | 37. B | 38. B | 39. A | 40. B |
| 41. C | 42. C | 43. C | 44. A | 45. D | 46. C | 47. D | 48. A | 49. C | 50. A |
| 51. B | 52. B | 53. A | 54. B | 55. A | 56. A | 57. A | 58. B | 59. B | 60. A |

SOLUTIONS

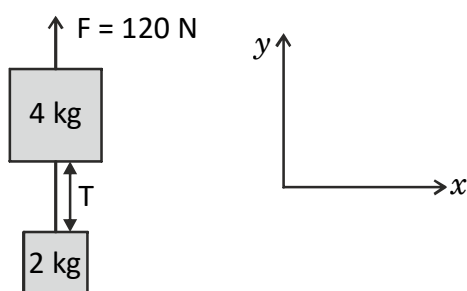
BIOLOGY

- | | |
|--|---|
| <p>01. (A) Organic food moves upwardly and downwardly through phloem.</p> <p>02. (B) Providing nutrition during germination.</p> <p>03. (A) Nerium</p> <p>04. (D) Lysine</p> <p>05. (B) Aschelminthes is a pseudocoelomate.</p> <p>06. (C) Malpighian tubules.</p> <p>07. (C) In option 'c' all organisms belong to mammalia. Option 'a' has dogfish and starfish as odd ments out. Option 'b' has animals from three different taxa. Option 'd' also has animals from three different taxa.</p> | <p>08. (A) Presence of notochord.</p> <p>09. (B) Slime moulds have cellulosic spore wall.</p> <p>10. (A) Cuvier</p> <p>11. (A) Monera</p> <p>12. (D) Meiosis, Karyogamy and Plasmogamy.</p> <p>13. (D) Regulating metabolism</p> <p>14. (D) RBCs as well as plasma transport both oxygen and CO₂</p> <p>15. (D) All of the above</p> <p>16. (A) Atmospheric O₂ level is less and hence, more RBCs are needed to absorb the required amount of O₂ to survive.</p> |
|--|---|

17. (C) Respiratory Rhythm Centre
18. (B) III \rightarrow II \rightarrow I \rightarrow IV
19. (D) Prophase \rightarrow Metaphase \rightarrow Anaphase \rightarrow Telophase
20. (A) Golgi apparatus
21. (B) Anabaena is a cyanobacterium which belongs to Kingdom Monera. Monerans are prokaryotic organisms
22. (A) Mycoplasma does not have cell wall. PPLO (Pleuro Pneumonia Like Organisms)
23. (C) Fluorine
24. (B) First carbohydrates, next fats and lastly proteins
25. (D) Nearly 99 percent of the glomerular filtrate is reabsorbed by the renal tubules.

PHYSICS

26. (D) During upward motion, the gravity effect and air resistance will oppose its motion. Due to which the speed of the body decreases and becomes zero at the highest point. Afterwards the body moves downwards due to gravity pull but air resistance opposes. Still the velocity of body increases.
27. (C) Let 'a' be the acceleration of the blocks and T the tension in the string as shown below.



Taking the two blocks and the string as the system,

Using $\Sigma F_y = ma_y$, we get

$$F - 4g - 2g = (4 + 2)a$$

$$120 - 40 - 20 = 6a$$

$$60 = 6a$$

$$a = 10 \text{ m/s}^2$$

Diagram of 2 kg block is as shown below in fig II

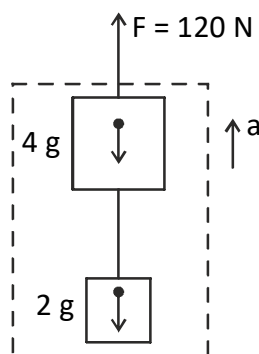


Fig I

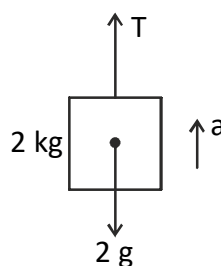


Fig II

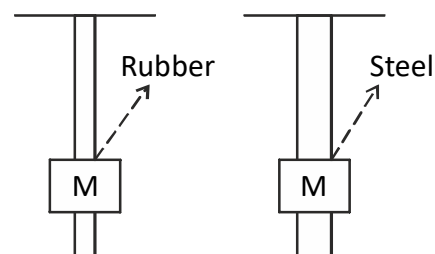
Using $\Sigma F_y = ma_y$, we get

$$T - 2g = 2a$$

$$\text{or } T - 20 = (2)(10)$$

$$\therefore T = 40 \text{ N}$$

28. (D) According to the diagram shown below in which a mass M is attached at the centre of each rod, then both the rods will be elongated. But due to different elastic properties of material, the steel rod will elongate without making any perceptible change in shape, but the rubber rod will elongate with the shape of the bottom edge tapered to a tip at the centre.



29. (D) Solid and hollow balls can be distinguished by any one of the three methods. $I_h > I_s$. When torques are equal, angular acc. a of hollow ball must be smaller than a of solid ball.

The velocity of a rolling body is inversely proportional to the moment of inertia. As the moment of inertia for a hollow sphere is more than that of a solid sphere, the solid sphere rolls down faster than a hollow sphere.

Similarly, on rolling, solid ball will reach the bottom before the hollow ball.

30. (C) SI unit of energy is $u_1 = [M_1 L_1^2 T_1^{-2}]$
 Now, $M_2 = 1 \text{ kg}$, $T_2 = 1 \text{ minute} = 60 \text{ s}$,
 $L_2 T_2^{-2} = 10 \text{ ms}^{-2}$
 From $L_2 T_2^{-2} = 10$
 $L_2 = 10 T_2^2 = 10(60)^2 = 36000 \text{ m}$
 $u_2 = M_2^1 L_2^2 T_2^{-2}$
 $= (1 \text{ kg})^1 (36000 \text{ m})^2 (60 \text{ s})^{-2}$
 $= 0.36 \times 10^6 \text{ J}$

31. (D) As there is no component of gravity along the horizontal (x - axis), therefore
 $a_x = 0$

$$v_x = \text{constant or } \frac{dx}{dt} = \text{constant.}$$

32. (C) The gravitational attraction on a body due to the earth decreases with height and increases due to the moon. At a certain height, it becomes zero and with further increase in height, the gravitational attraction of the moon becomes more than that of the earth.

33. (A) According to continuity equation (Law of Conservation of mass)

$$a_1 v_1 = a_2 v_2$$

$$\frac{v_1}{v_2} = \frac{a_2}{a_1} = \frac{\pi \left(\frac{d_2}{2} \right)^2}{\pi \left(\frac{d_1}{2} \right)^2} = \frac{d_2^2}{d_1^2} \cdot \frac{4}{4} = \frac{d_2^2}{d_1^2}$$

$$\frac{v_1}{v_2} = \frac{(3.75)^2}{(2.50)^2} = \left[\frac{3}{2} \right]^2$$

$$\frac{v_1}{v_2} = \frac{9}{4}$$

$$\text{or } v_1 : v_2 : 9 : 4$$

34. (A) According to Work - Energy theorem the work done by all the forces acting on a particle is equal to the change in its kinetic energy i.e., $W = \Delta K$.

35. (B) Maxwell derived equation gives the distribution of molecules in different speeds as follows:

The masses of hydrogen and oxygen molecules are different.

For a function $f(v)$, the number of molecules $n = f(v)$, which are having speeds between v and $+dv$. The Maxwell-Boltzmann speed distribution function ($N_v = dn/dv$ depends on the mass of the gas molecules.

For each function $f_1(v)$ and $f_2(v)$, n will be different. Hence, each function $f_1(v)$ and $f_2(v)$ will obey the Maxwell's distribution law separately.

36. (C) Vertical velocity after 10 s is

$$v = (98 \sin 60^\circ) - (9.8) \times 10 = 98 \times \frac{\sqrt{3}}{2} - 98$$

$$= 98 \left[\frac{\sqrt{3}}{2} - 1 \right] = 98 \times (0.866 - 1)$$

$$= -98 \times 0.134$$

Vertical momentum of the ball after 10 s = $m.v$

$$= 0.5 \times (-98 \times 0.134) \text{ kg m/s.}$$

Initial vertical momentum of the ball

$$= mu \sin 60^\circ$$

$$= 0.5 \times 98 \times \frac{\sqrt{3}}{2} = 0.5 \times 98 \times 0.866$$

Change in vertical momentum

$$= 0.5 \times 98 \times 0.866 - (-0.5 \times 98 \times 0.134)$$

$$= 0.5 \times 98 [0.866 + 0.134]$$

$$= 0.5 \times 98 = 49 \text{ kg m/s}$$

Horizontal component velocity remains the same, so no change in momentum along horizontal direction

$$\therefore \text{change in momentum} = 49 \text{ kg m/s}$$

37. (B) Here, $T_1 = T$, $W = 6R$

$$\gamma = \frac{C_p}{C_v} = \frac{5}{3}, T_2 = ?$$

In an adiabatic process,

$$W = \frac{R(T_2 - T_1)}{1 - \gamma}$$

$$6R = \frac{R(T_2 - T)}{1 - \frac{5}{3}}$$

$$T_2 - T = 6\left(-\frac{2}{3}\right) = -4$$

$$T_2 = (T - 4)K$$

38. (B) On the surface of the earth $g = \frac{GM}{R^2}$;

$$\text{Weight } mg = 99 \text{ N}$$

At a height h above the earth

$$g' = \frac{GM}{(R+h)^2}; \text{ where } h = \frac{R}{2}$$

$$\frac{g'}{g} = \frac{R^2}{(R+h)^2} = \frac{R^2}{\left(R + \frac{R}{2}\right)^2} = \frac{R^2}{\frac{9}{4}R^2}$$

$$g' = \frac{4g}{9}$$

$$\text{Weight} = mg' = m \times \frac{4g}{9} = mg \times \frac{4}{9}$$

$$\text{Here } mg = 99 \text{ N} = 99 \times \frac{4}{9} = 44 \text{ N}$$

39. (A) $F \propto A^a v^b D^c$

$$[MLT^{-2}] \propto [L^2]^a [LT^{-1}]^b [ML^{-3}]^c$$

$$[MLT^{-2}] \propto M^c L^{2a+b-3c} T^{-b}$$

Equating the powers of M, L and T, we get $c = 1$, $2a + b - 3c = 1$, $-b = -2$

Solving we get $a = 1$, $b = 2$, $c = 1$

40. (B) Sum of P.E. and K.E. of the ball at A = Sum of P.E. and K.E. of the ball at B. At the point A the ball is at rest, so K.E. = 0.

At B, the speed of the ball is v .

At B, $h = 0$, So P.E. = 0

(P.E. + K.E.) at A = (P.E. + K.E.) at B

$$mgh + 0 = 0 + \frac{1}{2}mv^2$$

$$v = \sqrt{2gh}$$

$$= \sqrt{2 \times 9.8 \times 10}$$

$$= 14 \text{ m/s}$$

CHEMISTRY

41. (C) The electronic configuration of Gadolinium Gd ($Z = 64$) is $[Xe] 4f^7 5d^1 6s^2$

42. (C) London dispersion forces operate only over very short distance. The energy of interaction varies as

$$\frac{1}{r^6}$$

(Distance between two interacting particles)

Large or more complex are the molecules, greater is the magnitude of London forces. This is obviously due to the fact that the large electron clouds are easily distorted or polarised.

Hence, greater the polarisability of the interacting particles, greater is the magnitude of the interaction energy.

43. (C) $[Ag^+] = 2.2 \times 10^{-4} \text{ mol L}^{-1}$

$$[C_2O_4^{2-}] = 0.5 [Ag^+]$$

$$= 0.5 \times 2.2 \times 10^{-4} \text{ mol L}^{-1}$$

$$= 1.1 \times 10^{-4} \text{ mol L}^{-1}$$

$$K_{sp} = [Ag^+]^2 [C_2O_4^{2-}]$$

$$K_{sp} = (2.2 \times 10^{-4} \text{ mol L}^{-1})^2 \times 1.1 \times 10^{-4} \text{ mol L}^{-1}$$

$$K_{sp} = 5.3 \times 10^{-12}$$

44. (A) Molarity

$$= \frac{\text{Weight of HNO}_3}{\text{Molecular mass of HNO}_3 \times \text{Volume of solution (in L)}}$$

$$\therefore \text{Weight of HNO}_3 = \text{Molarity} \times \text{Molecular mass} \times \text{Volume (in L)}$$

$$= 2 \times 63 \times \frac{1}{4} = 31.5 \text{ g}$$

It is the weight of 100% HNO₃

But the given acid is 70% HNO₃

$$\therefore \text{Its weight} = 31.5 \times \frac{100}{70} \text{ g} = 45 \text{ g}$$

45. (D) On moving down the group from B to Tl, a regular decreasing trend in the ionisation energy values is not observed.

| Elements | B | Al | Ga | In | Tl |
|----------------------------|-----|-----|-----|-----|-----|
| IE (kJ/mol ⁻¹) | 801 | 577 | 579 | 558 | 589 |

In Ga, there are ten d-electrons in the penultimate shell which screen the nuclear charge less effectively and thus, outer electron is held firmly. As a result, the ionisation energy of both Al and Ga is nearly the same. The increase in ionisation energy from In to Tl is due to poor screening effect of 14f electrons present in the inner shell.

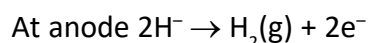
The correct order of Ionisation enthalpy of group 13 elements is

$$B > Al < Ga > In < Tl.$$

46. (C) LiCl would ionize more in water than NaCl is a wrong statement because LiCl has covalent character.

47. (D) BaCO₃ is most thermally stable as the size of Ba²⁺ is big due to which it is having low polarising power and thus cannot polarize oxygen electrons due to which carbonates of large cations are stable.

48. (A) Ionic hydrides in their molten state can conduct electricity and on electrolysis liberate dihydrogen gas at anode.



49. (C) It has maximum surface tension due to maximum intermolecular hydrogen bonding.

50. (A) Iodine oxidises S₂O₃²⁻ to S₄O₆²⁻ in which sulphur has low oxidation state of +2.5. But bromine oxidises S₂O₃²⁻ to S₂O₄²⁻ in which sulphur has higher oxidation state of +6.

So, bromine oxidises more and therefore, it is a stronger oxidant than iodine.

51. (B) ΔH = Enthalpy of vapourisation
= 30 kJ/mol = 30000 J/mol

$$\Delta S = \text{entropy of vaporisation} = 75 \text{ J/mol/K}$$

At boiling point, the reversible process of liquid = vapour is in equilibrium at 1 atm pressure.

$$\therefore T = \frac{\Delta H}{\Delta S} = \frac{30000 \text{ J mol}^{-1}}{75 \text{ J mol}^{-1}\text{K}^{-1}} = 400 \text{ K}$$

52. (B) Strength of hydrogen bonding depends on the size and electronegativity of the atom. Smaller the size of the atom, greater is the electronegativity and hence stronger is the hydrogen bonding and also the number of hydrogen bonds.

Thus, the order of strength of H bonding is H.....F > H.....O > H.....N.

But each HF molecule is linked only to two other HF molecules while each H₂O molecule is linked to four other H₂O molecules through H-bonding.

Hence, the correct decreasing order of the boiling points of given compounds is H₂O > HF > NH₃

53. (A) The blue colour of the solution of alkali metal like sodium dissolved in liquid ammonia is due to the ammoniated electron which absorbs energy in the visible region of light and thus imparts blue colour to the solution.



54. (B) Frequency of first line in Balmer series is

$$\nu = 3.29 \times 10^{15} \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right] \text{ s}^{-1}$$

$$\text{Here, } n_1 = 2, \quad n_2 = 3 \\ = 3.29 \times 10^{15}$$

$$\left[\frac{1}{(2)^2} - \frac{1}{(3)^2} \right]$$

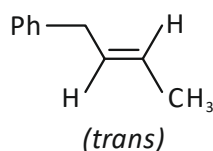
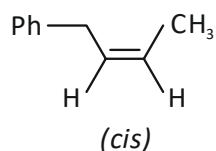
$$= 3.29 \times 10^{15}$$

$$\left[\frac{1}{4} - \frac{1}{9} \right]$$

$$= 3.29 \times 10^{15} \times \frac{5}{36}$$

$$= 4.57 \times 10^{14} \text{ s}^{-1}$$

55. (A) 1-phenyl-2-butene shows geometrical isomerism in the form of cis and trans isomers as both the double bonded carbons are differently substituted as given below.



CRITICAL THINKING

56. (A) When the automobile is in a tunnel the horn sound will be louder than normal.

57. (A)



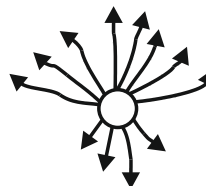
58. (B) The passage says the opposite, "When Europeans first reach the Americas they found healers who used many plants to cure illnesses. The Europeans adopted many of these treatments..."

59. (B)

Yes
 M T W Th F Sat S
 ↓ ↓
 Two days Today
 before
 yesterday

 Thursday and Monday

60. (A)



==== The End =====