UNIFIED COUNCIL

An ISO 9001:2015 Certified Organisation

nstse
Test • Assess • Achieve

NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION (UPDATED)

CLASS - 11 (PCB)

Question Paper Code : UN446

KEY

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

SOLUTIONS

BIOLOGY

1. **(C)** Exsomosis of the cell causes the shrinking of cell

2. **(B)** III, II, I, IV

3. **(D)** In the kidney machine, a concentration gradient is maintained between the dialysis fluid and blood plasma. Urea from the blood diffuses from a higher concentration in the blood plasma into the dialysis fluid.

4. **(C)** The cilia in the air passages move in a sweeping motion to keep the air passages clean. The constant action of these cilia carry mucous and debris upward into the pharynx where upon they are swallowed.

5. **(D)** Bile breaks up large fat molecules into smaller size physically.

6. **(C)** X is veins, Y is blood capillary and Z is artery.

7. **(D)** Antibodies are released by lymphocytes and WBC's attack bacteria.

8. **(C)** Hepatic portal vein carries nutrients from the small intestine to the liver.

9. **(B)** Phleom carries sugars made of radioactive carbon.

10. **(A)** In bright light, the pupil size becomes smaller to reduce the amount of light to enter the eye.

11. **(B)** Since the toxin was no longer functional after heating, it may be an enzyme, as are proteins which may become irreversibly denatured after heating. Also, as the toxin is found in the largest cell structure, it must be present in the sap vacuole of the plant cells. The toxin is also unable to diffuse out from the sap vacuole, as the plant cells were not killed by their own toxins.

12. **(A)** Increasing the diffusion distance the rate of diffusion as diffusing particles have a longer distance to travel. Increasing the size of diffusing particles also decreases the rate of diffusion as larger particles move more slowly than smaller particles.

13. **(C)** Trypsin is a protease enzyme that breaks down proteins to form small peptide fragments by breaking peptide bonds.

14. **(B)** If the pancreatic duct is blocked, the patient cannot secrete pancreatic juice containing the protease trypsinogen into the small intestine. Hence protein digestion would be incomplete.

15. **(A)** All organs are part of the alimentary canal and they are capable of carrying out peristalsis due to the antagonistic action of the circular and longitudinal muscles.

16. **(D)** RBC's with A antigens and B antibodies hence he can receive Blood from blood group A or Blood group O.

17. **(D)** The neutrophils and lymphocytes are different types of while blood cells which help to fight infection. The antibodies are produced by white blood cells and they will recognise and bind to foreign particles.

18. **(C)** Most of the water that enters the tubules via osmosis will be reabsorbed back at the proximal convoluted tubule and loop of Henle.

19. **(D)** The lens will undergo elastic recoil to become thicker and more convex when Tom is focusing on a object nearer to him.

20. **(D)** Voluntary actions originate from conscious decisions made by the brain and nervous impulses are intiated by the brain.

21. **(B)** When a person runs to catch the bus, the adrenaline levels will increase (endocrine coordination) and the brain will fire nerve impulses to the muscles in the legs to increase their speed of contraction (nervous coordination)

22. **(B)** The main site of absorption in the body is the ileum of the small intestine. Chemical digestion of proteins occurs in the stomach, where pepsin breaks down proteins to form peptide fragments.

23. **(D)** Instead of chemical energy, light energy from the sun is required or photosynthesis.

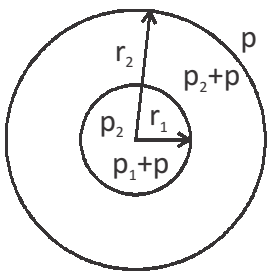
24. **(A)** When the vetricle contracts, the semi-lunar valves presentin the aarta will open. This allows oxygenated blood to be pumped out from the left vehicle into the aarta, for transport to the real of the body.

25. **(B)** By being highly folded, the dialysis tubings increase the surface area for metabolic waste products to diffuse out from the blood into the dialysis fluids.

PHYSICS

26. **(C)** $\frac{dU}{dW} = \frac{C_v dT}{RdT} = \frac{C_v}{R} = \frac{3R/2}{R} = \frac{3}{2}$

27. **(C)** p = atmospheric pressure, p_1 = excess pressure inside smaller bubble of radius r_1 = 1 cm



p_2 = excess pressure inside bigger bubble of radius r_2 = 3 cm

Now, $p_2 = \frac{4\sigma}{r_2}$; $111p_1 - p_2 = \frac{4\sigma}{r_1}$

$$\Rightarrow p_1 = p_2 + \frac{4\sigma}{r_1} = \frac{4\sigma}{r_2} + \frac{4\sigma}{r_1}$$

Also $p_1 = \frac{4\sigma}{r}$

Hence $\frac{4\sigma}{r} = \frac{4\sigma}{r_2} + \frac{4\sigma}{r_1}$

$$\Rightarrow \frac{1}{r} = \frac{1}{r_2} + \frac{1}{r_1}$$

$$\Rightarrow r = \frac{r_1 r_2}{r_1 + r_2} = \frac{1\times 3}{1+3} = \frac{3}{4}\text{ cm}$$

28. **(A)** Let R be the original radius of a planet. Then attraction on a body of mass m placed on its surface will be $F = \frac{GMm}{R^2}$

If size of the planet is made double i.e., R' = 2 R, then mass of the planet becomes

$$M' = \frac{4}{3}\pi (2R)^3 \rho = 8\times\frac{4}{3}\pi R^3 \rho = 8M$$

New force

$$F' = \frac{GM'm}{R'^2} = \frac{G\ 8\ M\times m}{(2R)^2} = 2F$$

i.e., force of attraction increases due to the increase in mass of the planet.

29. **(B)** The mass of the complete disc will be m = 2M and its moment of inertia about the x – axis will be $\frac{mR^2}{4}$

Therefore, the moment of inertia of the half disc about the x – axis will be

$$\frac{1}{2}\left(\frac{mR^2}{4}\right) = \frac{1}{2}\left(\frac{2MR^2}{4}\right) = \frac{MR^2}{4}$$

30. **(A)** Relative velocity = 5 + 7 = 12 m/s

Time required to meet

$$= \frac{\text{distance}}{\text{relative vel.}} = \frac{120}{12} = 10\text{ s}$$

Distance from 1st point = vel. of first × t = 5 × 10 = 50 m

31. **(C)** 1. Energy density $= \frac{\text{energy}}{\text{volume}}$

$$= \frac{ML^2T^{-2}}{L^3} = [M^1\ L^{-1}\ T^{-2}]$$

4. Young's modulus $= \frac{\text{stress}}{\text{strain}}$

$$= \frac{MLT^{-2}/L^2}{1} = [M^1\ L^{-1}\ T^{-2}]$$

32. **(A)** Mass of flywheel = m = 100 kg

Radius = r = 1 m

$I = mr^2 = 100 \times I^2 = 100$ kg m^2

Initial angular velocity

$$= \omega_0 = 2\pi\ n = 2\times 3\cdot 14\times\frac{420}{60}$$

$$= 43\cdot 96\text{ rad/s}^2$$

Final angular velocity $= \omega = 0$

Angular displacement in 14 revolutions = 14 × 2 π = 28 π radian

$$\alpha = \frac{\omega^2 = \omega_0^2}{2\theta} = \frac{0 - 43\cdot 96^2}{2\times 28\,\pi}$$

$$= -10\cdot 99\text{ rad/s}^2$$

Torque required to stop the flywheel

$$= \tau = I\alpha = 100\times 10\cdot 99 = 1099\text{ Nm}$$

33. **(D)** [pc] = $(MLT^{-1})\ (LT^{-1}) = ML^2T^{-2}$ = [torque].

34. **(B)** Instantaneous velocity = υ = 2 bt

t = 4s, υ_1 = 2 × 1 × 4 = 8.00 m/s

t = 4.01 s, υ_2 = 2 × 1 × 4.01 = 8.02 m/s

Average velocity

$$= \frac{\upsilon_1 + \upsilon_2}{2} = \frac{8 + 8.02}{2} = 8.01 \text{ m/s}$$

35. **(D)** Apply the law of conservation of momentum $V = \frac{100\upsilon}{1000} = \frac{\upsilon}{10}$

36. **(C)** The total work done is (40 J) + (–20 J) = 20 J. So, by the work-energy theorem, $W_{total} = \Delta K$, we have 20 J = ΔK. Since $\Delta K = K_f - K_i$, we find $K_f = K_i + \Delta K$ = 10 J + 20 J = 30 J.

37. **(C)** When a metal wire elongates by hanging a load Mg on it, decrease in potential energy of the load = Mgl

(where l = elongation in metal wire)

Elastic potential energy stored in stretched wire

$$= \frac{1}{2} \times Mgl$$

Difference of Mgl and $\frac{1}{2} Mgl$ appears as heat energy in the stretched wire.

$\therefore$ Energy appearing as heat

$$= Mgl = -\frac{1}{2} Mgl = \frac{1}{2} Mgl$$

38. **(A)** The coefficient of expansion of iron is less than that of the water but its density is more than the liquids. The relative decrease in the density of water will be more than that or iron. As a result, the buoyant force will decrease and the apparent weight will increase.

39. **(B)** m = 0.15 kg

$$u = 54 \text{ km} = \frac{54 \times 1000}{60 \times 60} = 15 \text{ m s}^{-1}$$

$$\theta = 22 \cdot 5^\circ$$

Impulse imparted to the ball = – 2 mu cos θ

= – 2 × 0·15 × 15 × cos (22·5°)

= – 2 × 0·15 × 15 × 0·9239

= – 4·157 kg m s^{-1}

The impulse imparted to the ball is 4·157 kg m s^{-1} directed along the bisector of initial and final direction.

40. **(A)** x = elongation in spring due to mass 10 kg

$$= \frac{10 \times 10}{100} = 1\text{m}$$

$W_F = \frac{1}{2} \times 100 \times [(3)^2 - (1)^2] - 10 \times 10 \times 2 = 200$ J.

CHEMISTRY

41. **(C)** In B_2H_6, the B atoms are linked through hydrogen bridges. The structure is not similar to that of C_2H_6, there is no B–B bond and also all the atoms do not lie in the same plane.

42. **(D)** In the 1st oxide, oxygen = 27.6 parts,

metal = 100 – 27.6 = 72.4 parts.

In the 2nd oxide, oxygen = 30 parts,

metal = 100 – 30 = 70 parts.

As 1st oxide is M_3O_4, 72.4 parts of M = 3 atoms of M and 27.6 parts of O = 4 atoms of O.

$\therefore$ 70 parts of

$$M = \frac{3}{72.4} \times 70 \text{ atoms of M}$$

= 2.9 atoms of M

$$30 \text{ parts of } O = \frac{4}{27.6} \times 30 \text{ atoms of O}$$

= 4.35 atoms of O.

$\therefore$ Ratio of M : O in the 2nd oxide = 2.9 : 4.35 = 1 : 1.5 = 2 : 3.

Hence, the formula is M_2O_3.

43. **(B)** In H_2O_2 structure, two O–H bonds lie in different planes.

44. **(B)** Initial pressure: p atm

$C(s) + CO_2(g) \rightleftharpoons 2CO(g)$

Equilibrium pressure : (p–.5p) p

As given: p –.5p + p = 12; p = 8 atm.

$\therefore$ At equilibrium: Pco = 8 atm

P_{CO_2} = 4 atm

$$K_p = \frac{p^2CO}{PCO_2} = \frac{8^2}{4} = 16 \text{ atm.}$$

45. **(A)** $$\text{Mole of P} = \frac{0.50}{60} = 0.0083.$$

$$\text{Mole of Q} = \frac{0.20}{45} = 0.0044.$$

Total mole = 0.0127.

Total pressure = 750 mm.

Partial pressure of P

$$= \frac{\text{moles of P}}{\text{total moles}} \times \text{total pressure}$$

$$= \frac{0.0083}{0.0127} \times 750 = 490 \text{ mm.}$$

Partial pressure of Q

$$= \frac{0.0044}{0.0127} \times 750 = 260 \text{ mm}.$$

46. **(C)** The given ions of elements belong to 2nd period. The atomic radius decreases from left to right (Li, B, O, F) in the period.

Cations are smaller, whereas anions are larger than the corresponding atoms.

The anion carrying more negative charge is larger.

So, O^{2-} has the highest value of ionic radius.

47. **(B)** N_2 (g) + 3 H_2 (g) $\rightarrow$ 2 NH_3 (g)

1 L of N_2 reacts with 3 L of H_2 to form 2 L of NH_3.

Thus, N_2 is the limiting reactant.

10 L N_2 will react with 30 L H_2 to form 20 L NH_3.

As actual yield is 50% of the expected value, NH_3 formed = 10 L, N_2 reacted = 5 L,

H_2 reacted = 15 L

$\therefore$ Mixture will contain 10 L NH_3, 25 L N_2, 15 L H_2.

48. **(A)** Element with At. No. 19 will lose one electron and element with At.No. 17 will gain that electron to form an ionic water soluble compound.

49. **(A)** $KMnO_4$ +1 + x – 8 = 0 Ox. no. of Mn

x = + 7 +7

K_2MnO_4 + 2 + x – 8 = 0

x = +6 +6

MnO_2 x – 4 = 0

x = + 4 +4

Mn_2O_3 2x – 6 = 0

x = +3 +3

Thus, the highest oxidation number of + 7 for Mn is in $KMnO_4$.

50. **(C)** Given that,

(i) C (graphite) + O_2 (g) $\rightarrow$ CO_2 (g); ΔH = 94.05 kcal.

(ii) C (diamond) +O_2 (g) CO_2 (g); ΔH = – 94.50 kcal

Thus, applying the inspection method,

[Eqn. (i) – Eqn. (ii)] we get

C(graphite) + O_2(g) – C (diamond) – O_2 (g) $\rightarrow$ CO_2(g) – CO_2(g);

ΔH = – 94.05 – (–94.50)

or C(graphite) $\rightarrow$ C (diamond); ΔH= + 0.45 kcal

Since this enthalpy change is only for conversion of 1 mole, i.e., 12 g of C (graphite) to C (diamond), therefore, for the conversion of 10 g of C (graphite) to C (diamond)

$$\Delta H = 0.45 \times \frac{10}{12} = 0.375 \text{ kcal}$$

51. **(D)** C has six, N has seven and O has eight electrons. Thus, the total number of electrons and their distribution for each species are given below :

Species	Total no. of electrons
CN^-	14
NO^+	14
O_2^-	17

MO configuration									
	$\sigma 1s$	$\sigma^* 1s$	$\sigma 2s$	$\sigma^* 2s$	$\pi 2p_x$	$\pi 2p_y$	$\sigma 2p_z$	$\pi^* 2p_x$	$\pi^* 2p_y$
CN^-	2	2	2	2	2	2	2	–	–
NO^+	2	2	2	2	2	2	2	–	–
O_2^-	2	2	2	2	2	2	2	2	1

	N_b	N_a	Bond Order
CN^-	10	4	3
NO^+	10	4	3
O_2^-	10	7	3/2

So, the species CN^- and NO^+ have the same bond order.

52. **(A)** Lines cannot be assigned quantum numbers.

53. **(C)** 'a' is directly related to forces of attraction. Hence, greater the value of 'a', more easily the gas is liquefied.

54. **(B)** $H_2 + I_2 \; f \; 2HI$

Applying law of mass action,

$$K_c = \frac{[HI]^2}{[H_2][I_2]}$$

Given $[H_2]$ = 8.0 mole litre^{-1}

$[I_2]$ = 3.0 mole litre^{-1}

$[HI]$ = 28.0 mole litre^{-1}

So, $K_c = \frac{(28.0)^2}{(8.0)\times(3.0)} = 32.66$

55. **(D)** $2\,Mg + O_2 \rightarrow 2MgO$

2×24 g $\quad 2 \times 16$ g $\quad 2 \times (24 + 16)$g

Thus, 48 g of Mg requires 32 g of O_2 to form 80 g of MgO

Therefore, 30 g of Mg requires $\frac{32}{48}\times 30$ g of O_2 to form $\frac{80}{48}\times 30$ g of MgO or 30 g of Mg requires 20 g of O_2 to form 50 g of MgO.

The residual mixture thus contains 50 g of MgO and 10 g 0f O_2.

CRITICAL THINKING

56. **(C)** 57. **(D)** 58. **(Del)**

59. **(A)** 60. **(D)**

THE END