



UNIFIED COUNCIL

An ISO 9001:2015 Certified Organisation



NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION (UPDATED)

CLASS - 11 (PCB)

Question Paper Code : **UN449**

KEY

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

SOLUTIONS

BIOLOGY

- (A)** Glucose is oxidised to produce energy.
- (D)** When a cell is placed into a cell with higher salt concentration solution exosmosis of cell take place.
- (B)** Lipid changes to reddish orange when sudan red is added.
- (C)** By the end of meiosis I, the homologous chromosomes have been separated. In anaphase of meiosis II, sister chromatids are separated.
- (A)** Adrenaline is a hormone that is secreted to prepare the body for fight or flight response. More glucose is released into blood as adrenaline sent to the liver converts more glycogen into glucose.
- (B)** The hepatic portal vein carries blood rich in digested food substances e.g., glucose, amino acids, from the ileum of the small intestine to the liver.
- (C)** The blood vessel is located between the small intestine and the liver.
- (D)** Coronary denotes the arteries that surround and supply the heart.
- (B)** I, II,III,IV, and V are the rough endoplasmic reticulum, Golgi apparatus, smooth endoplasmic reticulum, mitochondrion and secretory vesicles

respectively. The ribosomes on the rough endoplasmic reticulum (I) will synthesise the proteins, which are transported to the Golgi apparatus (II) for chemical modification. The secretory vesicles (V) will transport the proteins to the cell surface membrane for release via exocytosis.

10. (B) Tricuspid valve is between right auricle and right ventricle.
11. (D) Lack of oxygen in water cause aquatic animals to die.
12. (B) In a dimmer environment, the size of pupil becomes bigger to allow more light to enter the eye.
13. (B) Only green plants are capable of converting glucose into starch for storage. In humans, glucose is converted into glycogen for storage.
14. (C) Active transport refers to the transport of substances (ions) across the cell membrane of the cell in which the movement of the substances is from a region of low concentration to a region of higher concentration (i.e. against its concentration gradient) using energy released during respiration.
15. (B) According to the lock and key hypothesis, the active site of an enzyme has a shape that is complementary to a specific substrate molecule.
16. (B) During accommodation, the lens will change its shape and thickness to change its focal length. The objective is to form a sharp and focused image on the retina.
17. (C) X is the vein as it has relatively thin wall of muscular tissue.
Y is the capillary as it has a squamous endothelium that is one -cell thick.
Z is the artery as the muscular walls are relatively thick and elastic
18. (C) Ultrafiltration occurs at the glomerulus while selective reabsorption of useful substances occurs at the kidney tubules.
19. (D) The main source of energy in a food chain is sunlight.

20. (C) I - Dendrites, II - Cellbody, III - Myelin sheath, IV - Axon terminals
21. (C, D) The secretion of glucagon is fluctuating as it only happens when the blood glucose level decreases below normal levels. As a result, the concentration of glucagon in the bloodstream is always fluctuating about a normal level.
22. (D) The neutrophils and lymphocytes are different types of white blood cells which help to fight infection. The antibodies are produced by white blood cells and they will recognise and bind to foreign particles.
23. (D) After the digestion of carbohydrates, glucose will be transported via the hepatic portal vein, from the small intestine to the liver.
24. (A) In response to a change in the external environment, the organism can respond to maintain a constant, internal environment about a set point
25. (D) The number of chromosomes in human somatic cells is 46

PHYSICS

26. (D) P.E. of water at a height $h = mgh$
 $= m \times 9.8 \times 200 = 1960 \text{ mJ}$
 Using this P.E. let the temperature of water rise by ΔT
 $DQ = mc \Delta T$
 $1960 \text{ m} = m \times 4200 \times \Delta T$
 $\Delta T = \frac{1960}{4200} = 0.4667 \text{ K}$
27. (B) There will be no over flowing of liquid in a tube of insufficient height but there will be adjustment of the radius of curvature of meniscus so that $hR = a$ finite constant.
28. (A) Escape velocity from the surface of Mars.

$$v = \sqrt{\frac{2GM_m}{R_m}}$$

Mass of Mars = $M_m = 6.42 \times 10^{23}$ kg

Radius of Mars = $R_m = 3.375 \times 10^6$ m

$$v = \sqrt{\frac{2GM_m}{R_m}} = \sqrt{\frac{2 \times 6.67 \times 10^{-11} \times 6.42 \times 10^{23}}{3.375 \times 10^6}}$$

$$= 5.037 \times 10^3 \text{ m/s}$$

29. (D) According to the definition of centre of mass, we can imagine one particle of mass $(1 + 2 + 3)$ kg at $(1, 2, 3)$; another particle of mass $(2 + 3)$ kg at $(-1, 3, -2)$.

Let the third particle of mass 5 kg be put at (x_3, y_3, z_3) i.e.,

$$m_1 = 6 \text{ kg}, (x_1, y_1, z_1) = (1, 2, 3)$$

$$m_2 = 5 \text{ kg}, (x_2, y_2, z_2) = (-1, 3, -2)$$

$$m_3 = 5 \text{ kg}, (x_3, y_3, z_3) = ?$$

$$\text{Given } (x_{cm}, y_{cm}, z_{cm}) = (1, 2, 3)$$

$$\text{Using } x_{cm} = \frac{m_1x_1 + m_2x_2 + m_3x_3}{m_1 + m_2 + m_3}$$

$$1 = \frac{6 \times 1 + 5 \times (-1) + 5x_3}{6 + 5 + 5}$$

$$5x_3 = 16 - 1 = 15, x_3 = 3$$

$$\text{Similarly, } y_3 = 1 \text{ and } z_3 = 8$$

30. (A) $R = \frac{u^2 \sin 2\theta}{g}$. Here $R = 0.5$. Therefore, $u^2/g = 1$ km. When $\theta = 45^\circ$, we have $R = u^2/g = 1$ km.

31. (A) As area = length²,

$$\therefore \frac{\Delta A}{A} \times 100 = 2 \frac{\Delta l}{l} \times 100 = 2 \times 2\% = 4\%$$

32. (B) $m = 20$ kg, angular speed = $\omega = 100 \text{ s}^{-1}$, $r = 0.25$ m

M.I. of the cylinder about its own

$$\text{axis } = I = \frac{1}{2}mr^2 \text{ Rotational K.E.}$$

$$= \frac{1}{2}I\omega^2 = \frac{1}{2} \times \frac{1}{2}mr^2 \times \omega^2$$

$$= \frac{1}{4} \times 20 \times (0.25)^2 \times (100)^2 = 3125 \text{ J}$$

Angular momentum $L = I \omega$

$$= \frac{1}{2}mr^2 \times \omega^2 = \frac{1}{2} \times 20 \times (0.25)^2 \times 100 = 62.5 \text{ J s}$$

33. (C) [Planck's constant] = [Moment of momentum]

$$= [\text{Momentum} \times \text{distance}] = ML^2T^{-1}.$$

34. (D) $s = 4t + \frac{1}{2}(1)t^2 = 2t + \frac{1}{2}(2)t^2$

$$\text{or } 4t + 0.5t^2 = 2t + t^2$$

$$\text{or } \frac{t^2}{2} = 2t$$

$$\text{or } t = 0 \text{ and } t = 4 \text{ s}$$

$$\therefore s = (4)(4) + \frac{1}{2}(1)(4)^2 = 16 + 8 = 24 \text{ m}$$

35. (A) Impulse = change in momentum
 $= m n \cos 60^\circ - (-m n \cos 60^\circ)$
 $= 2 m n \cos 60^\circ = 2 m n (1/2) = m n.$

36. (A) If there were no friction, velocity at the bottom of quarter circle = $\sqrt{2gR}$

$$\text{K.E.} = \frac{1}{2}m v^2 = \frac{1}{2}m \times 2gR = mgR$$

$$= 2 \times 10 \times 1 = 20 \text{ J}$$

$$\text{Actual K.E.} = \frac{1}{2} \times 2 \times 4^2 = 16 \text{ J.}$$

$$\therefore \text{Work done by friction} = 16 - 20 = -4 \text{ J}$$

37. (C) Bulk modulus = $K = \frac{F/A}{\Delta V/V} = \frac{PV}{\Delta V}$

$$\text{Change in pressure} = P = 10^6 \text{ Pa}$$

$$\text{Original volume} = V = V^3 = 1 \text{ m}^3$$

$$\text{Change in volume} = \Delta V = 1.5 \times 10^{-5} \text{ m}^3$$

$$= K = \frac{10^6 \times 1}{1.5 \times 10^{-5}} = 6.67 \times 10^{10} \text{ N/m}^2.$$

38. (B) As all the four spheres have same radius, their volumes are equal. As mass = volume \times density, the ratio of their masses = ratio of their densities.

$$\therefore m_1 : m_2 : m_3 : m_4 = 2 : 3 : 5 : 1$$

$$\text{Also, } c_1 : c_2 : c_3 : c_4 = 3 : 6 : 2 : 4$$

$$\text{As heat capacity} = \text{mass} \times \text{sp. Heat capacity} = 6 : 18 : 10 : 4$$

As the sphere with largest heat capacity has the fastest rate of cooling, therefore, sphere Q will exhibit the fastest cooling rate.

39. (D) Apparent weight = $m(g + a)$
 $= 80(10 + 5) = 1200 \text{ N}$.
40. (C) As energy = work = force \times distance, therefore, unit of energy becomes 3 \times 3 times. Hence, energy in new units $= \frac{81}{9} = 9$.

CHEMISTRY

41. (C) In graphite, each carbon atom is covalently bonded with only three other carbon atoms out of four. The fourth valence electron of each carbon atom is free to move that enables it to conduct electricity.
42. (C) $\text{Ca}_3\text{P}_2 + 6 \text{H}_2\text{O} \rightarrow 3 \text{Ca(OH)}_2 + 2 \text{PH}_3$
43. (B) The equation is
 $\text{BaO}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4(\text{s}) + \text{H}_2\text{O}_2$
 The most electronegative atom in the products is oxygen. The oxidation state of O in H_2O_2 is -1 , whereas that in BaSO_4 is -2 .
44. (A) As forward reaction is accompanied with decrease of randomness, it must be exothermic. Further $n_p \neq n_r$. Hence, equilibrium will be affected by temperature and pressure.
45. (A) Total volume after mixing = 3 L,
 $300 \times 1 = 3 \times p(\text{H}_2)$, i.e., $p(\text{H}_2) = 100 \text{ mm}$
 $600 \times 2 = 3 \times p(\text{O}_2)$, $p(\text{O}_2) = 400 \text{ mm}$,
 $P(\text{total}) = 100 + 400 = 500 \text{ mm}$
 Alternatively, $P_1V_1 + P_2V_2 = P_3(V_1 + V_2)$
 $300 \times 1 + 600 \times 2 = P_3(1 + 2)$
 or $3P_3 = 1500$ or $P_3 = 500 \text{ mm}$.
46. (A) NO_3^- and CO_3^{2-} both have same number of electrons (equal to 32) and central atom in each being sp^2 – hybridized are isostructural too.
47. (C) 100 g of crystalline salt contains $\text{H}_2\text{O} =$

55.9 g

\therefore Anhydrous salt = $100 - 55.9 = 44.1 \text{ g}$

Molecular mass of anhydrous Na_2SO_4
 $= 2 \times 23 + 32 + 4 \times 16 = 142$

44.1 g of anhydrous salt combines with $\text{H}_2\text{O} = 55.9 \text{ g}$

\therefore 142 g of anhydrous salt combine

with $\text{H}_2\text{O} = \frac{55.9}{44.1} \times 142 \text{ g} = 180 \text{ g}$

180 amu of $\text{H}_2\text{O} = \frac{180}{18} = 10$ molecules.

48. (B) Calcined gypsum is CaSO_4
 Marble and sea shells contain CaCO_3
 Dolomite is $\text{CaCO}_3 \cdot \text{MgCO}_3$.
49. (B) The reaction is
 $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g})$
 $4 \times 17 \text{ g} \quad 5 \times 32 \text{ g} \quad 4 \times (14 + 16) \text{ g}$
 $= 68 \text{ g} = 160 \text{ g} = 120 \text{ g}$
 10.0 g 20.0 g ?
 As per the given data, it shows that in the given reaction, oxygen is the limiting reagent.
 Therefore,
 Maximum mass of nitric oxide formed
 $= \frac{120 \text{ g} \times 20 \text{ g}}{160 \text{ g}} = 15 \text{ g}$
50. (B) Boron has three electrons in its valence shell ($2s^2 2p^1$), and three monovalent atoms for bonding. So, it shows sp^2 hybridization and trigonal planar geometry.
51. (D) H, E and V are all extensive.
52. (C) $\text{Cu}^+ = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$.
 Shells occupied = 3, sub-shells occupied = 6, filled orbitals = 14. Unpaired $e^- = 0$
53. (A) Pressure on mercury in the open arm = 743 mm = 74.3 cm. The mercury level in the arm connected to the bulb is lower than that in the open arm. So, pressure of the gas in the bulb is higher

than the barometric pressure.

Therefore,

$$P_{\text{gas}} = P_{\text{barometric}} + h \\ = 74.3 \text{ cm} + (43.7 \text{ cm} - 15.6 \text{ cm})$$

$$P_{\text{gas}} = 102.4 \text{ cm} \\ = \frac{102.4 \text{ cm}}{76 \text{ cm}} = 1.347 \text{ bar}$$

54. **(B)** A salt of strong acid and weak base on hydrolysis produces a strong acidic solution as they produce more H^+ ions and less OH^- ions when dissolved in water. Similarly, when a salt of strong base and weak acid on hydrolysis produces a strong basic solution as they produce more OH^- ions less H^+ ions when dissolved water.

If the salt is NH_4Cl , it hydrolyses as
 $\text{NH}_4\text{Cl} + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4\text{OH} + \text{HCl}$.

or $\text{NH}_4^+ + \text{Cl}^- + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4\text{OH} + \text{H}^+ + \text{Cl}^-$ or
 $\text{H}_2\text{O} + \text{NH}_4^+ \rightleftharpoons \text{NH}_4\text{OH} + \text{H}^+$.

As it produces H^+ ions, the solution of such a salt is acidic.

55. **(C)** $\text{Be} > \text{Mg} > \text{Ca} > \text{Sr} > \text{Ba}$. The size of the SO_4^{2-} ion is very big (approx. 3\AA). Therefore, as the size of cation increases, their hydration energies decrease more rapidly than their lattice energies. Consequently the solubilities of sulphates decrease down the group.

CRITICAL THINKING

56. **(D)** Minute hand covers $480 / 60 = 80$
57. **(D)** In fig. (X), one of the dots lies in the region common to the circle and the square only, another dot lies in the region common to the square, the triangle and the rectangle only and the third dot lies in the region common to the triangle and the rectangle only. In each of the figures (1), (2) and (3) there is no region common to the square, the triangle and the rectangle only. Only fig. (4) consists of all the three types of regions.
58. **(D)** The prices of petrol and diesel being stagnant in the domestic market and the increase in the same in the international market must be backed by independent causes.
59. **(C)**
60. **(B)** Seeing four girls surrounding another girl, while in possession of her backpack, is the most suspicious of the incidents described.

THE END
