



# UNIFIED COUNCIL

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## NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION (UPDATED)

CLASS - 11 (PCB)

Question Paper Code : UN444

### KEY

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

### SOLUTIONS

#### BIOLOGY

- (A)** Muscle cells are responsible for coordinated movement within the body. Smooth muscle is capable to grow by mitosis (hyperplasia) or by increase in diameter by addition of new myofibrils (hypertrophy).
- (C)** Hormones secreted by hypothalamus control the release of anterior pituitary hormones.
- (A)** During swallowing tongue acts as a lever system of second order, the weight is in the centre and fulcrum towards one end.
- (D)** Eustachian tube, named after the Italian anatomist Bartolomeo Eustachio, is a tube lined with mucous membrane. It joins the nasopharynx and tympanic cavity.
- (B)** Myelin is largely composed of fat which gives the fibres a white creamy colour.
- (A)** Lateral ventricles are located in the cerebral hemispheres of vertebrates.
- (A)** Radius of the lower arm is a cartilaginous bone.
- (D)** The kidney which is left out in the body undergoes enlargement and carries out the extra work of missing kidney. This is called compensatory hypertrophy.

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9. (C) Sinusoids are small blood vessels, somewhat larger than capillaries lined with Kupffer cells in liver.
10. (C) Blood in the right ventricles is relatively deoxygenated after returning from the tissues.
11. (D) Gaseous exchange in the booklungs takes place with the help of lamellae arranged one over another like the leaves of a book.
12. (C) Thomas Addison, a London physician, in 1855 reported a life threatening disease caused by partial or complete failure of adrenocortical function. Some authors consider W.H.Bayliss and E.H. Starling as the founders of endocrinology and birth date of endocrinology as a science is usually given as 1902.
13. (C) Two common marine poisonous snakes are Enhydrina and Hydrophis.
14. (B) Stapes is one of the three ossicles in the middle ear. It transmits sound vibrations from the incus to the internal ear.
15. (A) Biocatalysts refer to enzymes.
16. (C) Excessive amount of fluorine can mottle tooth enamel and cause osteosclerosis.
17. (C) Cytochromes (electron carries) were discovered by McMunn.
18. (C) Enzymes of glycolysis are present in cytosol (cytoplasm – organelles)
19. (A) Enamel is a hard white substance that covers the dentine of the crown of a tooth.
20. (A) Cyclic photophosphorylation is the most effective anaerobic phosphorylation mechanism.
21. (B) Sugarcane is a monocot, where scattered vascular bundles occur in stem and hence girdling experiments cannot be performed by it.
22. (A) Water absorption through roots (passive absorption) can be increased by increased transpiration as it is due to transpiration pull.
23. (B) Sargassum is the genus of a large brown alga floating on the sea surface. It has a diploid plant body and gametic meiosis.
24. (A) Citrus (lemon and oranges) develops hesperidium fruit in which juicy placental hairs contain glucose (monosaccharide) with vitamin-C (ascorbic acid) and citric acid.
25. (B) Heterophylly occurs in attached emergent hydrophytes such as Limnophylla heterophylla, Ranunculus aquatilis or sagittaria sagittifolia. They produce two types of leaves, those submerged in water are deeply lobed but those produced above the level of water are well developed with entire or serrate margins.

### PHYSICS

26. (B) 
$$\eta = 1 - \frac{T_2}{T_1} = \frac{T_1 - T_2}{T_1}$$

For given  $(T_1 - T_2) = 20^\circ$  in each case, efficiency is highest when  $T_1$  is lowest.

The correct combination of working temperature is 40 K, 20 K, to achieve the highest efficiency of Carnot's engine.

27. (C)  $d = 0.005 \text{ mm} = 0.005 \times 10^{-3} \text{ m}$ ,  $R = 10/2 = 5 \text{ cm} = 0.05 \text{ m}$ ,  $\sigma = 0.072 \text{ N m}^{-1}$

$$\text{Force required} = \frac{2\sigma}{d} \times \pi R^2$$

$$= \frac{2 \times 0.072 \times 3.14 \times (0.05)^2}{0.005 \times 10^{-3}} = 226 \text{ N}$$

28. (B) According to the law of conservation of angular momentum;  $m v_A \times OA = m v_B \times OB$ ;

$$\text{or } v_B / v_A = OA / OB = x$$

29. (A)  $x = (m_1 x_1 + m_2 x_2 + m_3 x_3) / m_1 + m_2 + m_3$   
 $= (2 \times 1 + 2 \times 2 + 2 \times 3) / 6 = 2$ .

Similarly  $y = 2$ .

30. (B) Relative velocity of train w.r.t. car = velocity of train - velocity of car. Hence, velocity of train =  $8 \text{ m s}^{-1}$  eastward +  $15 \text{ m s}^{-1}$  northward. Magnitude of velocity =  $(8^2 + 15^2)^{1/2} = 17 \text{ m s}^{-1}$ .

31. (D)  $\text{Area} = \pi r^2 = \frac{22(1.22)^2}{7} = 4.6778 \text{ sq m.}$   
 $= 4.68 \text{ m}^2$ , having three significant digits.
32. (C) Let the origin be at the C atom. Then:  

$$R_{\text{cm}} = \frac{12 \times 0 + 16 \times 0.12 \text{ nm}}{12 + 16} \cong 0.07 \text{ nm}$$
33. (D) [Frequency] =  $T^{-1}$   
 [Angular frequency] =  $T^{-1}$   
 [Angular velocity] =  $T^{-1}$   
 [Velocity gradient] =  $T^{-1}$   

$$[\text{Potential energy gradient}] = \frac{ML^2T^{-2}}{L}$$
  
 $= MLT^{-2} = [\text{force}]$
34. (D)  $F = YA/L = 90 \times 10^9 \times 10^{-6} \times 1 / 2$   
 $= 45000 \text{ N.}$
35. (C) For the first 30 minutes, distance travelled =  $15 \times 1800 = 27000 \text{ m}$   
 For the next 20 minutes, distance travelled =  $25 \times 1200 = 30000 \text{ m}$   
 Total distance travelled =  $27000 + 30000 = 57000 \text{ m}$   
 The total time taken =  $1800 + 1200 + 120 = 3120 \text{ s}$   
 Average speed  

$$= \frac{\text{Total distance travelled}}{\text{Total time taken}}$$
  

$$= \frac{57000}{3120} = 18.3 \text{ m/s}$$
36. (A) Forces are represented by vectors and can be added and subtracted. Therefore, an 8 N force to the left added to a 20 N force to the right yields a net force of  $20 - 8 = 12 \text{ N}$  to the right. Then Newton's second law gives  $a = F_{\text{net}}/m = (12 \text{ N to the right}) / (4\text{kg}) = 3 \text{ m/s}^2$  to the right.
37. (A) The work done on the crate by the mover is  $W = Fd = (300 \text{ N}) (6 \text{ m}) = 1,800 \text{ J}$ . If this much work is done in 20 s, then the power delivered is  $P = W/t = (1,800 \text{ J}) / (20 \text{ s}) = 90 \text{ W}$ .

38. (C) The average temperature of  $94^\circ\text{C}$  and  $86^\circ\text{C}$  is  $90^\circ\text{C}$ , which is  $70^\circ\text{C}$  above the room temperature. Under these conditions the pan cools to  $8^\circ\text{C}$  in 2 minutes.

$$\frac{\text{Change in temperature}}{\text{Time}} = K\Delta T$$

$$\frac{8^\circ\text{C}}{2 \text{ min}} = K(70^\circ\text{C})$$

The average of  $69^\circ\text{C}$  and  $71^\circ\text{C}$  is  $70^\circ\text{C}$ , which is  $50^\circ\text{C}$  above room temperature. K is the same for this situation as for the original.

$$\frac{2^\circ\text{C}}{\text{Time}} = K(50^\circ\text{C})$$

When we divide above two equations, we get

$$\frac{8^\circ\text{C} / 2 \text{ min}}{2^\circ\text{C} / \text{time}} = \frac{K(70^\circ\text{C})}{K(50^\circ\text{C})}$$

$$\text{Time} = 0.7 \text{ min} = 42 \text{ s}$$

39. (C) Resultant of three forces represented completely by three sides of a triangle taken in the same order is zero. Therefore, velocity of particle remains unaffected.
40. (A) As the ball rises, the initial kinetic energy is converted into potential energy. Also, the potential energy is directly proportional to the height. When kinetic energy is reduced to 70%, the potential energy is 30%. It will happen at a height of 30 m.
- CHEMISTRY**
41. (C) As there are three electrons in the valence shell of group 13 elements they show + 3 oxidation state. Also in case of heavier members, due to inert pair effect, + 1 oxidation state is most stable.
42. (B) Mass of one mole of the oxide

$$= \frac{100}{30.4} \times 14 \text{ g}$$

$\therefore$  Density of the oxide relative to  $\text{O}_2$

$$= \frac{(100 / 30.4) \times 14}{32} = 1.44$$

43. (A) Hydrogen has ionization enthalpy value which is too high as compared to alkali metals and too low as compared to halogens and thus cannot be placed in any of these two groups.

44. (D) Average kinetic energy of methane

$$\text{molecule} = \frac{3}{2} \times \frac{RT}{N_A}$$

$$= \frac{3}{2} \times \frac{8.314 \text{ J K}^{-1} \text{ mol}^{-1} \times 300 \text{ K}}{6.023 \times 10^{23} \text{ molecule mol}^{-1}}$$

$$\bar{E}_k = 6.21 \times 10^{-21} \text{ J molecule}^{-1}$$

Total kinetic energy of 32 g methane

$$= n \times \frac{3}{2} RT = \frac{w}{M} \times \frac{3}{2} RT$$

$$= \frac{32 \text{ g}}{16 \text{ g/mol}} \times \frac{3}{2} \times 8.314 \text{ J K}^{-1} \text{ mol}^{-1} \times 300 \text{ K}$$

$$= 7482.6 \text{ J}$$

45. (C) In (iii), H<sub>2</sub>O donates a proton and in (iv), H<sub>2</sub>O accepts proton.

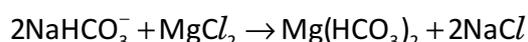
46. (B) The electronic configurations of these elements are



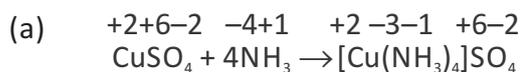
In the case of chromium, the second electron has to be removed from the half-filled d-shell which is more stable.

47. (C) The weights of oxygen which combine with the fixed weight of nitrogen (= 28 g) in N<sub>2</sub>O, NO, N<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>4</sub> and N<sub>2</sub>O<sub>5</sub> are 16, 32, 48, 64 and 80 g respectively. They are in the ratio 1 : 2 : 3 : 4 : 5. This proves the law of multiple proportions.

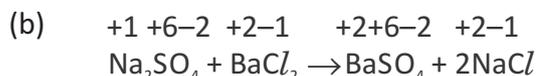
48. (B) The anion is HCO<sub>3</sub><sup>-</sup> which gives the reaction as follows:



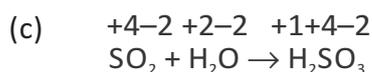
49. (D) The reaction in which change in oxidation numbers of some of the atoms takes place is termed as a redox reaction.



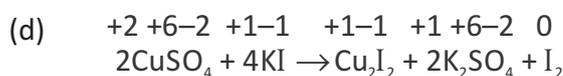
No change in oxidation number of any of the atoms.



No change in oxidation number of any one of the atoms.



No change in oxidation number of any one of the atoms.



Oxidation number of Cu decreases from +2 to +1 and oxidation number of iodine increases from -1 to 0.

Thus, out of the above four reactions, the reaction given in option (D) is a redox reaction.

50. (C) The process given in option (C) cannot go by itself after initiation.

51. (D) Dipole moment corresponding to 100% ionic character of KCl

= 1 unit charge × Interionic distance between K<sup>+</sup> and Cl<sup>-</sup>

$$= (1.602 \times 10^{-19} \text{ C}) (2.6 \times 10^{-10} \text{ m})$$

$$= 4.1652 \times 10^{-29} \text{ C m}$$

Actual dipole moment of KCl = 3.336 × 10<sup>-29</sup> C m

Percentage of ionic character

$$= \frac{3.336 \times 10^{-29} \text{ C m}}{4.1652 \times 10^{-29} \text{ C m}} \times 100 = 80.1$$

Thus, the percentage of ionic character in KCl is 80.1

$$52. (B) \quad E_n = -\frac{13.6}{n^2} \text{ eV}, \Delta E = E_2 - E_1$$

$$= -13.6 \left( \frac{1}{2^2} - \frac{1}{1^2} \right) = 13.6 \times \frac{3}{4} = 10.2 \text{ eV}$$

53. (D) Higher the values of 'a' higher is the critical temperature.
54. (B) pH of buffer remains almost constant.
55. (C) Mg burns in air to form  $Mg_3N_2$  which then reacts with  $H_2O$  to form  $NH_3$ .

**CRITICAL THINKING**

56. (C) Because the first two sentences are true, both John and David saw more movies than Suman. However, it is uncertain as to whether David saw more movies than John.

57. (A) All Fridays in March:

+7    +7    +7    +7  
 1st → 8th → 15th → 22nd → 29th

There are 31 days in March

Sat	Sun	Mon
30th	31st	1st

Since 1st April fell on Monday.

+7    +7  
 1st → 8th → 15th

15th April fell on a Monday in the same year.

58. (D) Closing the schools for a week and the parents withdrawing their wards from the local schools are independent issues, which must have been triggered by different individual causes.

59. (C) Bench I     P     T     S  
 Bench II     U     Q  
 Bench III     V     R

= Boy     = Girl

QRS are group of girls.

60. (D) The first sentence makes this statement true. There is no support for choice a. The passage tells us that the spa vacation is more expensive than the island beach resort vacation, but that doesn't necessarily mean that the spa is overpriced; therefore, choice b cannot be supported. And even though the paragraph says that the couple was relieved to find a room on short notice, there is no information to support choice c, which says that it is usually necessary to book at the spa at least six months in advance.

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**THE END**

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