



## NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

**CLASS - 12 (PCB)**  
**Question Paper Code : UN497**

### KEY

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

### SOLUTIONS

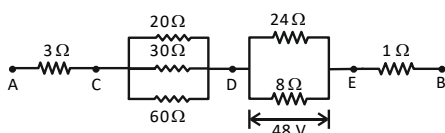
#### BIOLOGY

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| <p>01. (B) Thymus</p> <p>02. (D) Isolated protoplast (surrounded by plasma membranes) from two different varieties can be fused to get hybrid protoplasts which grow to form new plant. The enzyme required to obtain wall free or naked protoplasts are cellulase, hemiceilulase and pectinase, which dissolves cell wall. Somatic cell hybrid (protoplast hybrid) are produced with the help of polyethylene glycol (PEG) and sodium nitrate which promote fusion. In protoplast fusion,</p> | <p>chemofusion and electrofusion are employed.</p> <p>03. (D) Infectious disease : Cancer, Allergy<br/>Non-infectious disease : Influenza, Small pox</p> <p>04. (D) Most of the species of Pseudomonas are pathogens; causing diseases in plants and animals.</p> <p>05. (B) In a DNA strand the nucleotides are linked together by Phosphodiester bonds.</p> <p>06. (D) AAU GCU UAG GCA.</p> |
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| <p>07. (C) The physical position and functional role of a species within the community.</p> <p>08. (D) Sickle cell anaemia: It is molecular disease, autosomal recessive disorder, an example of pleiotropy, it cannot be treated with iron supplements and it confers resistance to acquiring malaria.</p> <p>09. (C) Gametophytic structure (n) of rice plant contain 12 chromosomes and sporophytic structure (2n) of rice contain 24 chromosomes. Female gamete (n) = 12.<br/>Zygote (2n) = 24<br/>The cells of the seedling (2n) = 24</p> <p>10. (C) These plants have various medicinal uses in traditional medicines and hence they are exploited and prone to increased exploitation.</p> <p>11. (B) The genetic variation shown by the medicinal plant Rauwolfia vomitoria growing in different Himalayan ranges might be in terms of potency and concentration of the active chemical (Reserpine) obtained from roots of plants.</p> <p>12. (B) IUCN</p> <p>13. (A) In rainforest of North-East India pitcher plants are spotted because moist and humid climate is favourable to them.</p> <p>14. (C) Destruction of habitat, invasion by alien species, and over-exploitation, of natural resources are cause for loss of biodiversity.</p> <p>15. (B) Bacterial DNA.</p> <p>16. (D) If the process of replication of DNA is repeated many times, the segment of DNA can be amplified to approximately billion times i.e., 1 billion copies are made. Such repeated amplification is achieved by the use of a thermostable DNA polymerase (isolated from a thermophilic bacterium <i>Thermus aquaticus</i>), which is active during the high temperature induced denaturation of double stranded DNA.</p> <p>17. (C) Plasmids.</p> | <p>18. (D) Genetic engineering or r-DNA technology can be accomplished only if we have the key tools:<br/>Restriction enzymes.<br/>Polymerase enzymes.<br/>Ligases.<br/>Vectors.<br/>Host organism.</p> <p>19. (C) Polymerase chain reaction.</p> <p>20. (C) Entamoeba coli is not a bacterium and Haemophilus influenzae, Escherichia coli and Bacillus subtilis are source of restriction endonuclease.</p> <p>21. (A) Origin of replication is a sequence from where replication starts and any piece of DNA when linked to this sequence can be made to replicate within the host cells. This sequence is also responsible for controlling the copy number of the linked DNA. So, if one wants to recover many copies of the target DNA it should be cloned in a vector whose origin support high copy number.</p> <p>22. (A) ADA deficiency.</p> <p>23. (A) Golden rice.</p> <p>24. (D) All are true.</p> <p>25. (B) Lymphocytes are involved in secretion of ADA.</p> |
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## PHYSICS

26. (D) The equivalent circuit is as shown below.



Resistance between C and D

$$\frac{1}{R_p} = \frac{1}{20} + \frac{1}{30} + \frac{1}{60} = \frac{3+2+1}{60} = \frac{1}{10}$$

or  $R_p = 10 \Omega$ .

Resistance between D and E

$$= \frac{24 \times 8}{24 + 8} = 6 \Omega$$

Total resistance between A and B

$$= 3 + 10 + 6 + 1 = 20 \Omega$$

$$\text{Current through D to E} = \frac{48}{6} = 8 \text{ A}$$

$$\therefore \text{Potential difference between A and B} \\ = 20 \times 8 = 160 \text{ V}$$

27. (A) On rotating the magnet, no change in flux is linked with the coil. Therefore, induced e.m.f./current is zero.

28. (A) Magnetic field will be independent of the motion of the observer because the velocity with which the observer is moving is comparable to drift velocity of electron which is very small as compared to the speed of flow of current from one end of wire to other end. So it can be neglected and hence, magnetic field due to the wire w.r.t the observer

$$\text{will be } B = \frac{\mu_0 i}{2\pi r}$$

29. (C) The magnitude of electric field is proportional to the density of electric field lines. Density of electric field lines at A and C are same. i.e.,  $E_A = E_C$ . Electric field lines density at A and C is greater as compared to electric field line density at B. So,  $E_A = E_C > E_B$ .

30. (A) After absorption of energy, the hydrogen atom goes to the  $n^{\text{th}}$  excited state.

Therefore, the energy absorbed can be written as,

$$10.2 = 13.6 \times \left( \frac{1}{1^2} - \frac{1}{n^2} \right)$$

$$\frac{10.2}{13.6} = 1 - \frac{1}{n^2}$$

$$\frac{1}{n^2} = \frac{13.6 - 10.2}{13.6}$$

$$\frac{1}{n^2} = \frac{3.4}{13.6}$$

$$n^2 = 4 \quad n = 2$$

The orbital angular momentum of the electron in the  $n^{\text{th}}$  state is given by,

$$L_n = \frac{nh}{2\pi}$$

Change in the angular momentum,

$$\Delta L = \frac{2h}{2\pi} - \frac{h}{2\pi} = \frac{h}{2\pi}$$

$$= \frac{6.625 \times 10^{-34}}{2 \times 3.14}$$

$$= 1.05 \times 10^{-34} \text{ J s}$$

31. (C) Number of copper atoms = Charge delivered to cathode per second

$$(0.002 \times 10^{25})$$

$$= \frac{0.002 \times 10^{25} \times 2 \times 1.6 \times 10^{-19}}{100 \times 60} = 1.06 \text{ C}$$

32. (B) Given energy flux  $\phi = 20 \frac{\text{W}}{\text{cm}^2}$

$$\text{Area, } A = 30 \text{ cm}^2$$

$$\text{Time, } t = 30 \text{ min} = 30 \times 60 \text{ s}$$

Now, total energy falling on the surface in time  $t$  is,

$$U = \phi A t = 20 \times 30 \times (30 \times 60) \text{ J}$$

$$\text{Momentum of the incident light} = \frac{U}{c}$$

$$= \frac{20 \times 30 \times (30 \times 60)}{3 \times 10^8} = 36 \times 10^{-4} \text{ kg m/s}$$

Momentum of the reflected light = 0

∴ Momentum delivered to the surface

$$= 36 \times 10^{-4} - 0 = 36 \times 10^{-4} \text{ kg m/s}$$

33. (A) Here  $2l = 12 \text{ cm} = 0.12 \text{ m}$   
 $m = 20 \text{ Am}$ ,  $d = 10 \text{ cm} = 0.1 \text{ m}$

$$\text{On axial line, } B = \frac{\mu_0}{4\pi} \frac{2Md}{(d^2 - l^2)^2}$$

$$B = 10^{-7} \times \frac{2(20)(0.12) \times 0.1}{[(0.1)^2 - (0.06)^2]^2}$$

$$= 1.17 \times 10^{-3} \text{ T}$$

34. (C) By using the equation  $f = \frac{R}{\mu - 1}$

$$R = 20 \text{ cm}, \mu = 15$$

$$f = \frac{20}{1.5 - 1} = 40 \text{ cm}$$

As the focal length is greater than zero, i.e.,  $f > 0$  of converging nature.

Therefore, lens act as a convex lens irrespective of the side on which the object lies.

35. (D) The minimum capacitance can be obtained by connecting all capacitors in series. It can be calculated as follows:

$$\frac{1}{C} = \frac{1}{6} + \frac{1}{6} + \frac{1}{6} = \frac{1}{2}$$

$$C = 2\mu\text{F}$$

The maximum capacitance can be obtained by connecting all capacitors in parallel. It can be calculated as follows:

$$C = 6 + 6 + 6 = 18\mu\text{F}$$

36. (D) Here

$$X_L = \omega L = 2\pi nL$$

$$= 2\pi \times 50 \times \frac{0.4}{\pi} = 40 \Omega$$

$$R = 30 \Omega$$

$$\therefore Z = \sqrt{R^2 + X_L^2} = \sqrt{30^2 + 40^2} = 50 \Omega$$

$$I_v = \frac{E_v}{Z} = \frac{200}{50} = 4 \text{ A}$$

37. (A) An electromagnetic wave bends round the corners of an obstacle if the size of the obstacle is comparable to the wavelength of the wave. An AM wave has less frequency than an FM wave, So, an AM wave has a higher wavelength than an FM wave and it bends round the corners of a  $1\text{m} \times 1\text{m}$  board.

38. (B) In series combination;

$$\frac{V^2}{nR} = 4 \quad \dots (i)$$

In parallel combination;

$$\frac{V^2}{R/n} = 64 \quad \dots (ii)$$

Dividing (ii) by (i), we get,  $n^2 = 16$  or  $n = 4$

39. (B) In the coolidge tube, the electrons are produced by thermionic effect from a tungsten filament heated by an electric current. The filament is the cathode of the tube. The high voltage potential is between the cathode and anode. The electrons are thus accelerated and then hit the anode. The kinetic energy of the free electrons of the target is the source of energy of a photon of a characteristic X-ray from a Coolidge tube.

40. (A) As the two positive charges  $q_2$  and  $q_3$  exert a net electric force in  $+\hat{x}$  direction on the charge  $q_1$  fixed along the  $x$ -axis, the charge on  $q_1$  is negative.

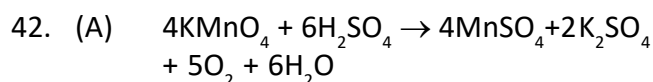
Due to the addition of positive charge  $Q$  at  $(x, 0)$ , the force on  $-q$  shall increase along the positive  $x$ -axis.

### CHEMISTRY

41. (D) 
$$\frac{\text{Wt. of O}_2}{\text{Wt. of Ag}} = \frac{\text{Eq. wt. of oxygen}}{\text{Eq. wt. of Ag}}$$

Or 
$$\frac{1.6}{\text{wt. of Ag}} = \frac{8}{108}$$

Or wt. of Ag 
$$\frac{1.6 \times 108}{8} = 21.6 \text{ g}$$



The number of electrons gained by  $\text{KMnO}_4$  in acidic solution is 5.

$$\therefore \text{Eq. wt.} = \frac{\text{Mol. wt}}{5}$$

43. (A) Ionic solids have high electrical conductivity in the molten state as they have free ions to move and carry electric charge. Rest of the characteristics of ionic solids is true.

44. (A) IUPAC name of m-cresol is 3-methylphenol

45. (C) 
$$t_{90\%} = \frac{2.303}{k} \log \frac{a}{a-0.9a}$$

$$= \frac{2.303}{k} \log 10 = \frac{2.303}{k}$$

$$t_{1/2} = \frac{2.303}{k} \log \frac{a}{a-a/2}$$

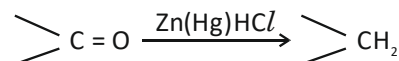
$$= \frac{2.303}{k} \log 2 = \frac{2.303}{k} \times 0.3010$$

$$\therefore t_{90\%} / t_{1/2} = \frac{1}{0.3010} = 3.3$$

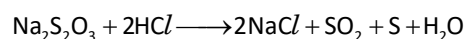
i.e.,  $t_{90\%} = 3.3 \text{ times } t_{1/2}$

46. (B) Zone refining method is based on the principle that impurities are more soluble in molten metal than in the solid state of the metal.

47. (A) In Clemmensen reduction, carbonyl compound is treated with Zinc amalgam and  $\text{HCl}$  act as reagent in this reaction as given below:



48. (B) Thiosulphate ion ( $\text{S}_2\text{O}_3^{2-}$ ) contains two sulphur atoms in different oxidation states of +6 and -2 and is highly unstable in the presence of acids.



49. (C) For equimolar solutions,  $x_B = x_T = 0.5$

$$P_B = x_B \times P_B^\circ = 0.5 \times 160 = 80 \text{ mm}$$

$$P_T = x_T \times P_T^\circ = 0.5 \times 60 = 30 \text{ mm}$$

$$P_{\text{Total}} = 80 + 30 = 110 \text{ mm}$$

Mole fraction of toluene in vapour phase

$$= \frac{30}{110} = 0.27$$

50. (A) In physisorption, adsorbent does not show specificity for any particular gas, because involved Vander Waal's forces are universal. It means that extent of Vander Waal's interaction between adsorbate and adsorbent is constant for all gases.

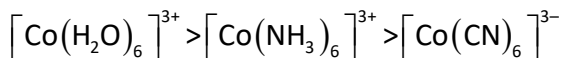
51. (C) In strong field ligand, there is more energy separation than weak field ligand. It means that as the strength of the ligand increases, crystal field splitting energy increases.

$$\Delta E = \frac{hc}{\lambda} \text{ or } \Delta \frac{E_0}{\lambda}$$

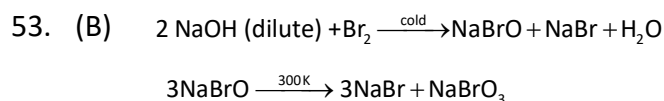
As  $\Delta E$  increases, wavelength of light absorbed decreases.

Further, the colour of coordination compounds depends on nature and the magnitude of crystal field splitting of the ligands bonded with central atom. A stronger ligand has higher splitting power than a weak ligand. Amongst the given ligands in Coordination complexes, the order of splitting power is:

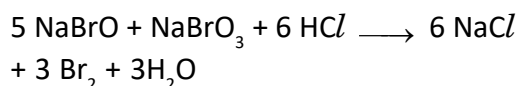
$H_2O < NH_3 < CN$ ; As CN has higher splitting power it would absorb more. Hence, the correct order of absorption of wavelength of light in the visible region is



52. (D) Amorphous solids are isotropic in nature because it has no long range order and any physical property will be the same on all directions. On the other hand, anisotropic nature is a characteristic feature of crystalline solids.



On acidification, the final mixture gives bromine



Thus, during the reaction, bromine is present in four different oxidation states i.e., zero in  $Br_2$ , +1 in  $NaBrO$ , -1 in  $NaBr$  and +5 in  $NaBrO_3$ . The greatest difference between various oxidation states of bromine is 6 and not 5. On acidification of the final mixture,  $Br_2$  is formed and disproportionation of  $Br_2$  occurs during the reaction giving

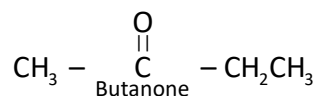
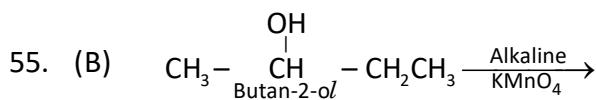
$BrO^-$ ,  $Br^-$  and  $BrO_3^-$  ions.

54. (A) The higher the surface area, the higher will be the intermolecular forces of attraction and thus boiling point too. Boiling point increases with increase in molecular mass of halogen atom for the similar type of alkyl halide. Butane has no halogen atom and rest of all three compounds are halo derivatives of butane.

Atomic mass of iodine is highest, so the boiling point of 1-iodobutane is maximum among all the given compounds.

Given below are the boiling points along with their molecular mass in the increasing order.

Name of the Compound	Boiling Point in $^{\circ}C$	Molecular Mass in g/mol
Butane	-0.5	58.12
1-Chlorobutane	78	92.57
1-Bromobutane	102	137.02
1-Iodobutane	130	184.02

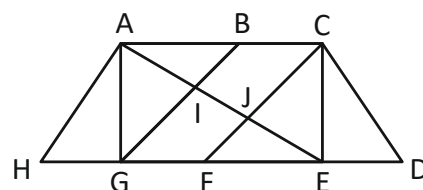


### CRITICAL THINKING

56. (B) If Gmail is slower than Hot mail and faster than Yahoo. It logically follows that Yahoo is slower than Gmail, and Hot mail is slower than Gmail as well.

$\therefore$  Statement 3, Yahoo runs faster than Hot mail is false if statement 1 and 2 are true.

57. (D) There are 14 triangles in the given figure.



$\triangle AGE$  ;  $\triangle AGI$  ;  $\triangle AIB$  ;  $\triangle AGE$  ;  $\triangle ACE$  ;  
 $\triangle ACJ$  ;  $\triangle GIE$  ;  $\triangle AGB$  ;  $\triangle CJE$  ;  $\triangle CEF$  ;  
 $\triangle CED$  ;  $\triangle CFD$  ;  $\triangle JFE$  ;  $\triangle EAH$

58. (C) Option (A) figure is ball-pen hammer for metal work.

Option (B) figure is claw hammer for carpentry.

Option (C) figure is sledge hammer for concrete.

59. (B) Smaller administrative units can often result in a more precise distribution of resources and better attention to specific needs. This is a direct benefit of having additional districts.

60. (B) The one who likes Renault car.

