nstse
Test • Assess • Achieve

NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

CLASS - 12 (PCB)
Question Paper Code : UN478

KEY

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

SOLUTIONS

BIOLOGY

01. (A) When the changes are in the organism (living things) over the course of generations, it is called biological or organic evolution. Thus, organic evolution is defined as a process of cumulative change of living population of organism and in the descendant population of organism.

02. (B) Adrenaline is an amine hormone secreted by adrenal medulla on stimulation of sympathetic nervous system for meeting an emergency and reinforcing its role. The hormone meets emergency as in cold, injury, pain, emotional stress, anger, fear, grief, fall in blood sugar/blood pressure etc. Hence, emergency hormone or hormome for fight, fright and flight i.e., 3F hormone.

03. (B) It was due to non-disjunction of X-chromosome in females. Non-disjunction is failure of synapsid homologous chromosome to separate during anaphase-1 of meiosis. It was discovered by Bridges (1916) in XX chromosomes of Drosophila.

04. (D) Stanley Miller in 1953, clearly demonstrated that ultra-violet radiations or electric discharges or heat or a combination of these can produce, complex organic compounds from a mixture of methane, ammonia, water (steam) and hydrogen.

05. (C) Mitoplast are mitochondria which do not have outer membrane.

06. (D) Auto immunity is abnormal immune reaction in which the body immune system begins to reject substances and tissue of the body. All the disease mentioned above are auto immune disease, for e.g., In multiple sclerosis → antibodies attack myelin sheath of nerve cells, In insulin dependent diabetes → β-cells worns as autoantigen etc.

07. (C) Oestrogen is steroid hormone secreted by growing ovarian follicle and progesteron is secreted by corpus luteum. Decrease in their level will cause constriction of uterine blood vessels-leading to sloughing of endometrium or uterine epithelium.

08. (C) In case of test tube baby the fusion of ovum and sperm take place outside the body of women. Until an embryo is formed it develops outside the body and after this embryo is transplanted in uterus where it develops into a child.

09. (A) Deficiency of vitamin A causes xeropthalmia, night blindness, keratomalacia (dermatosis, toadskin) impairment of respiratory and urino genital tract epithelia, stunted growth.

10. (B) Over secretion of androgens (male sex hormone) is responsible for developing masculine characters in females.

11. (B) Appearance of teeth in the embryos of birds is an example of biogenetic law/ recapitulation theory. According to which ontogeny repeats phylogeny. Ontogeny is the life history of an organism while phylogeny is the evolutionary history of the organism.

12. (C) Cornea transplant is easy as it does not involve immune response due to absence of blood.

13. (C) Adrenal medulla accelerates heart beat by producing epinephrine and norepinephrine. Thyroid, emotions, anger, fear, temperature, oxygen and CO_2 also influence heart beat.

14. (C) Out of these crosses only Ww × Ww can produce white and black pigs.

15. (B) Man originated in central Asia, China, Java and India (Shivalik hills). The sequence of stages of evolution of man Australopithecus (Southern ape of Africa) → Homohabits (tool maker or handy man) → homo erectus (erect man or ape man) → Java ape man Peking man → Homo sapiens → Neanderthalensis (Neanderthal man) → Homo sapiens fossilis (Cro-magnon man) → Homo sapiens sapiens (man of today).

16. (A) During the cource of allopatric speciation a part of the population become geographically isolated from the main population.

17. (D) Coelacanth, limulus and sphenoden all belongs to living fossil. Sphenodon is a living fossil reptile.

18. (B) In our eyes, cones are responsible for colour vision not rods, hence colour blindness is related with a defect in cones. Colour blindness is a recessive X-linked disease in which affected person can not distinguish red colour from green colour.

19. (B) Shifting cultivation (Jhumming) has devastating effect on the ecosystem. Soil productivity is lost in 2nd of 3rd year of cultivation. Large scale denudation leads to soil erosion and loss of top soil. It takes long time for the nature to regenerate it.

20. (B) Mango is a drup type fruit. It is formed from monocarpillary, syncarpus, superior ovary. Each fruit is unilocular, one seeded. Mesocarp of these fruits is fleshy and edible. It is surrounded by a thin epicarp. While endocarp of mango is stony which surrounds a seed.

21. (A) Cells of certain bacteria e.g., Bacillus, Clostridium, Sporosarcina and Thesmoactinomyces form thick walled highly resistant bodies called endospores within the cells.

22. (B) Fluid mosaic model, which is currently accepted structure of most cell membranes was proposed by Singer and Nicolson in 1972. The evidence for this came from X-ray crystallography, freeze-fracture and freeze etching technique.

23. (C) In orthotropous ovules, the micropyle, chalaza and funicle lie in one straight line. Such type of ovules are also called atropous or erect ovules.

24. (A) Shoot tip culture includes shoot meristem cell as well as surrounding tissues. The callus formed undergoes differentiation to form all parts of the new plant therefore exhibiting totipotency.

25. (B) Haemophilia is a sex-linked recessive trait, in which the exposed blood takes abnormally long time to clot. It is of two major type, haemophilia-A (due to factor-VIII deficiency) and haemophilia-B (due to factor-IX deficiency).

PHYSICS

26. (B) No. of free electrons per unit volume

$$n = \frac{N}{M}\rho = \frac{6.023 \times 10^{23}}{63.5 \times 10^{-3}} \times 9 \times 10^3$$

$$\therefore v_d = \frac{1}{nAe}$$

$$= \frac{1.5 \times 635 \times 10^{-3}}{6.023 \times 10^{23} \times 9 \times 10^3 \times 10^{-7} \times 1.6 \times 10^{-19}}$$

$$= 1.1 \times 10^{-3} m\ s^{-1}$$

27. (C) When switch S is turned off; Bulb B_1 dies out promptly, but B_2 dies out with some delay because of self-induced e.m.f. across L.

28. (D) Magnetic field induction at the centre of circular coil carrying current is

$$B = \frac{\mu_0}{4\pi} \frac{2\pi ni}{r} \text{ i.e., } B \propto n/r.$$

But $2\pi r = 3 \times 2\pi r_1$ or $r_1 = r/3$

So, $\dfrac{B_1}{B} = \dfrac{n_1}{r_1} \times \dfrac{r}{n} = \dfrac{3 \times r}{(r/3) \times 1} = 9$

29. (B) As 1 mole, i.e., 63.5 g of copper contains 6×10^{23} atoms, the number of atoms in 10 g copper will be

$$\frac{6 \times 10^{23} \times 10}{63.5} = 9.45 \times 10^{22}$$

and as out of 1000 atoms, 1 electron is transferred from one piece of copper to the other, the total electrons transferred from one piece to the other will be

$$(1/1000) \times 9.45 \times 10^{22} = 9.45 \times 10^{19}$$

Due to transfer of these electrons, one piece will become negative while the other positive with magnitude of charge

$$q = ne = (9.45 \times 10^{19}) \times (1.6 \times 10^{-19})$$

$$= 15.12\ C$$

So, treating each piece of copper as point charge, electric force between them from Coulomb's law when they are 10 cm apart will be

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2} = 9\times 10^9\frac{15.12\times 15.12}{\left(10\times 10^{-2}\right)^2}$$

$$= 2.06\times 10^{14}\,\text{N}$$

30. (B) $eV_s = E - \phi_0$; $V_s \propto E$

Since energy E of ultraviolet light is greater than that of visible light, hence stopping potential is more for ultraviolet light than that for visible light.

31. (A)   Resistance of each bulb $R = V^2/P$

When connected in series

Total resistance of bulbs = 2 R

Current in each bulb, $I = V'/2R$

Power generated by each bulb $= I^2 R$

$$= \left(\frac{V'}{2R}\right)^2 \times R = \frac{V'^2}{4R} = \frac{V'^2}{4\times\left(V^2/P\right)}$$

$$= \frac{(110)^2\times 500}{4\times(220)^2} = 31.25\ \text{watt}$$

32. (A)   Infrared radiations are of higher wavelength than that of visible light. They arise due to minor electron transitions in atoms.

33. (A)   K.E. of particle, $E = \frac{1}{2}mv^2$ or

$$mv = \sqrt{2mE}$$

Also, $\lambda = \dfrac{h}{mv} = \dfrac{h}{\sqrt{2mE}}$

$E = \dfrac{h^2}{2\lambda^2 m}$ i.e., $E \propto \dfrac{1}{m}$

Since, the mass of photon is least as compared to electron and helium nucleus, so kinetic energy of photon is maximum.

34. (C)   As $f_1 = -20$ cm and $f_2 = 20$ cm

$\therefore$ F = ∞ The combination behaves as a plane refracting surface. Hence, image is erect and of same size.

35. (D)   Total magnetic moment at temperature 4.2 K is M_1

M_1 = 15% of $(2 \times 10^{24} \times 1.5 \times 10^{-23})$

= 4.5 JT^{-1}

From Curie's law, the susceptibility

$\psi = \dfrac{C}{T}$ where C is a constant and T is the temperature.

But $\psi = \dfrac{I}{H}$, where I is the magnetisation

and $I = \dfrac{M}{V}$ and V is the volume of the specimen.

$\psi = \dfrac{M}{VH} = \dfrac{C}{T}, \dfrac{M_1}{M_2} = \dfrac{H_1}{H_2}\dfrac{T_2}{T_1}$ because V and C are constants

$$M_2 = M_1 \times \frac{H_2}{H_1} \times \frac{T_1}{T_2}$$

$$= 4.5 \times \frac{0.98}{0.84} \times \frac{4.2}{2.8} = 7.9\ \text{JT}^{-1}$$

36. (A)   Through L, when current is maximum, voltage is minimum.

37. (B)   Let nth fringe of 2500 Å coincide with $(n-2)^{th}$ fringe of 3500 Å.
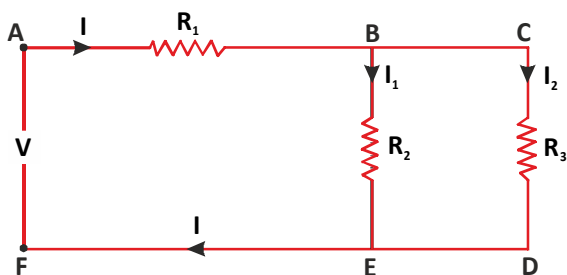
$\therefore$ 3500 (n − 2) = 2500 × n

1000 n = 7000, n = 7

$\therefore$ 7th order fringe of 1st source will coincide with 5th order fringe of 2nd source

38. (C)   As voltage across the resistors R_2 and R_3 is same and they show same dissipation of energy, so using the relation for energy, $H = \dfrac{V^2}{R}t$, we have $R_2 = R_3$. Thus, the current in each resistor R_2 and R_3 will be 1/2.

i.e., $I_1 = 1/2$ and $I_2 = 1/2$

Since the energy dissipation is same in all the three resistors, so

$I^2R_1t = I_1^2 R_2t$

or $I^2 R_1t = (I/2)^2 R_2t$

or $R_1 = R_2/4$

39. (B) From $s = ut + \dfrac{1}{2}at^2 = \dfrac{1}{2}at^2$ $(\because u = 0)$

$t = \sqrt{\dfrac{2s}{a}}$ As s is same, $\therefore t \propto \dfrac{1}{\sqrt{a}}$

$\dfrac{t_2}{t_1} = \sqrt{\dfrac{a_1}{a_2}} = \sqrt{\dfrac{q_e/M_e}{q_p/M_p}} = \sqrt{\dfrac{M_p}{M_e}}$

40. (A) $q_1 = 10 \times 50 = 500 \ \mu C$,

$C_1 = 10 \ \mu F$, $C_2 = ?$

$q_2 = 0$ As $V = \dfrac{q_1 + q_2}{C_1 + C_2}$

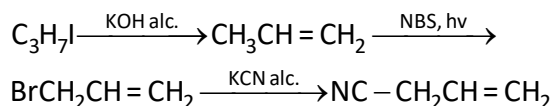$\therefore C_1 + C_2 = \dfrac{q_1 + q_2}{V} = \dfrac{500 + 0}{20} = 25 \ \mu F$

$C_2 = 25 - C_1 = 25 - 10 = 15 \ \mu F$

CHEMISTRY

41. (D) Oxidation of potential of Sn ($E°_{Sn/Sn}2^+$)

= + 0.136 V. It can reduce the substance having lower oxidation potential viz. Pb.

42. (C) CO is neutral whereas SO_3 is acidic. Also Al_2O_3 and ZnO are amphoteric in nature.

43. (C)

$C_3H_7I \xrightarrow{\text{KOH alc.}} CH_3CH = CH_2 \xrightarrow{\text{NBS, hv}}$

$BrCH_2CH = CH_2 \xrightarrow{\text{KCN alc.}} NC - CH_2CH = CH_2$

44. (A) Amount of $NaCl = \dfrac{1.00 \ g}{58.5 \ g/mol}$

No. of unit cells in 1.00 g of NaCl

$= \dfrac{6.02 \times 10^{23} \ mol^{-1}}{4} \times \dfrac{1.00 \ g}{58.5 \ g \ mol^{-1}} = 2.57 \times 10^{21}$

45. (D) Na_2S is quite soluble - alkali metal salts are more soluble.

The K_{sp} values for ZnS and CuS are 2.5 × 10^{-24} and 8.5 × 10^{-45}

46. (C) $C_6H_5CH \boxed{O + H_2} CHCOCH_3 \xrightarrow{\text{Aq NaOH}}$

$C_6H_5CH = CHCOCH_3 + H_2O$.
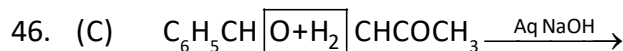
47. (D) Mass of the solute, w_2 = 3.5 g

Mass of water, w_1 = 125 g = 0.125 kg

Elevation of boiling point,

ΔT_b = (373.52 − 373.0) K = 0.52K

Molar mass of the solute = M (?)

We know that,

$\Delta T_b = \dfrac{K_b n_2}{w_1} = \dfrac{K_b(w_2/M)}{w_1}$

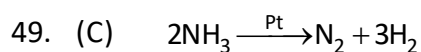$= \dfrac{0.52 \ K \ kg \ mol^{-1} \times 3.5 \ g}{M \times 0.125 \ kg}$

$0.52 \ K = \dfrac{0.52 \times 3.5 \ K \ kg \ mol^{-1} g}{M \times 0.125 \ kg}$

or $M = \dfrac{0.52 \times 3.5 \ K \ kg \ mol^{-1} g}{0.52 \ K \times 0.125 \ kg}$

$$= \frac{3.5}{0.125} \text{ g mol}^{-1} = 28 \text{ g mol}^{-1}$$

48. (D) Urea contains 46.6% N and $(NH_4)_2SO_4$ contains 20% N.

49. (C) $2NH_3 \xrightarrow{\text{Pt}} N_2 + 3H_2$

$$\text{Rate} = -\frac{1}{2}\frac{d[NH_3]}{dt} = \frac{d[N_2]}{dt}$$
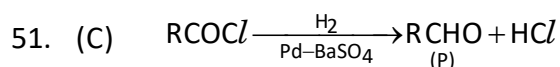
$$= \frac{1}{3}\frac{d[H_2]}{dt} = k = 2.5 \times 10^{-4} \text{mol L}^{-1}\text{s}^{-1}$$

Rate of production of H_2,

$$\frac{d[H_2]}{dt} = 3 \times 2.5 \times 10^{-4}$$

$$= 7.5 \times 10^{-4} \text{mol L}^{-1}\text{s}^{-1}$$

50. (A) In acidic solution, NH_3 forms a bond with H^+ to give NH_4^+ ion which does not have a lone pair on N to act as a ligand.

51. (C) $RCOCl \xrightarrow[\text{Pd}-\text{BaSO}_4]{\text{H}_2} \underset{(P)}{RCHO} + HCl$

52. (C) Doping of Si with P gives extra electrons while doping with Al gives rise to holes.

53. (B) HCl gas in the presence of moisture in air forms droplets of liquid solution in the form of cloudy smoke.

54. (D) $CH_3CHOHCH_2CH_3 \xrightarrow{[O]} CH_3COCH_2CH_3$

$$\xrightarrow{[O]} CH_3COOH + CH_3CH_2COOH$$
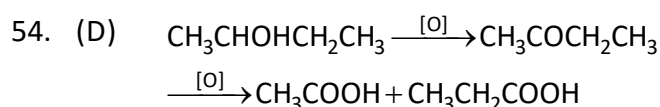
55. (D) Greater is the critical temp. of a gas, greater is the adsorption. Critical temp. (K) are NH_3 (406), CO_2(304), CH_4 (190) H_2(33). Thus, adsorption decreases from NH_3 to H_2 in this order.

CRITICAL THINKING

56. (B) The bar will expand as it is heated so the pins will be pushed away from the blocks;

57. (A) In this question, all of the inputs (Red, Yellow, Green, Blue) are on.

When these inputs pass through the first switch, all colours are allowed to pass if the switch is working and only red is allowed to pass if the switch is at fault.

This modified input passes through the second switch which allows only red and yellow to pass if the switch is working and only green and blue to pass if the switch is at fault.

This modified input passes through the third switch which turns on red and green if the switch is working and turns on yellow and blue if the switch is at fault.

Once again, you need to compare the input and output and determine which of the switches is at fault. In this case, it is switch 'A' (the first switch) which allows all colours to pass when working but allows only red to pass when at fault.

58. (D) Some people eating vitamin-fortified foods exceed the daily intake for vitamin C that is recommended by the National Academy of Sciences

Explanation:

This question stem is asking you to form a conclusion based on the information given, so you must pick the one answer that is guaranteed. As is true for all inference style questions, you should use process of elimination by evaluating each potential conclusion

For "Most people eating vitamin-fortified foods are consuming dangerous amounts of vitamin C.", you do know that "most consumers overestimate the amount of one serving for these foods, ingesting two to four times what is considered one serving by the manufacturer" so it is safe to say that most people get more than their daily intake as recommended by the NAS.

However, to be dangerous the recommended amounts must be "greatly exceeded" and we have no idea if "two to four times" meets that threshold. As a result this is not a proper inference.

For "Manufacturers need to change the amount listed as one serving on the packaging for vitamin-fortified foods.", there is no proof given in the stimulus that manufacturers need to do anything. While it is true that many consumers overestimate the amount of one serving, this does not allow you to conclude that manufacturers need to make a change (maybe the consumers just need to get better at estimating!). This type of prescription is virtually impossible to prove in an inference style question.

For "Any person eating vitamin-fortified foods will receive the daily intake for vitamin C that is recommended by the National Academy of Sciences.", the word "any" makes this easy to eliminate. We know that many, but not necessarily all, vitamin fortified foods contain 100% of the recommended vitamin C and that "most" consumers overestimate a serving. However, this still leaves open the possibility that some people are eating vitamin-fortified foods that do not contain vitamin C or that they are not getting a full serving's worth.

For "Some people eating vitamin-fortified foods exceed the daily intake for vitamin C that is recommended by the National Academy of Sciences.", you know with certainty that most consumers are eating 2-4 servings of vitamin-fortified foods containing vitamin C, which provides more than 100% of the recommended amount. Since you only need to prove one person has consumed more than a serving of these foods to be sure of this conclusion, it must be true and "Some people eating vitamin-fortified foods exceed the daily intake for vitamin C that is recommended by the National Academy of Sciences." is correct.

For "People should avoid taking supplemental vitamin C if they are eating vitamin-fortified foods.", this is a similar prescription to what you saw in "Manufacturers need to change the amount listed as one serving on the packaging for vitamin-fortified foods.". There might be many reasons why someone wants or needs to take a vitamin C supplement even if they are eating the vitamin-fortified foods. Maybe their doctor wants them to have lots of extra vitamin C or maybe they are eating the vitamin-fortified foods that do not contain 100% of the recommended amount. This is not a proper inference.

59. (D)

The courier boy ends his ride at R3.

60. (A) As India is democratic country and every person has its right about where he wants to work and singing such bonds does not esure the correct use of talent of a country. So, argument I is strong but argument II and III are weak also argument IV is a vague and hence is weak argument.