



UNIFIED COUNCIL

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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION (UPDATED)

CLASS - 12 (PCB)

Question Paper Code : UN444

KEY

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

SOLUTIONS

BIOLOGY

- (A)** Testosterone synthesis begins with the conversion of cholesterol to pregnenolone. The latter is converted into androstenedione and finally to testosterone.
- (A)** Meniere's disease, named after the French physician Prosper Meniere, is a chronic disease of inner ear.
- (D)** Ivan P. Pavlov (1910), the Russian physiologist, developed the concept of conditioned reflex.
- (A)** Parkinsonism, named after James parkinson, is caused by various lesions in the extrapyramidal motor system of brain. Parkinsonism frequently occurs in old persons and the patients treated with antipsychotic drugs.
- (C)** Glucose is the respiratory fuel utilized by brain for its working.
- (C)** Calcium ions are the regulators of contraction of skeletal muscle. The calcium binds to troponin C. The calcium troponin complex undergoes a conformational change which is transmitted to tropomyosin and causes tropomyosin to shift position.

7. **(D)** Increasing colloidal osmotic pressure would decrease filtration of fluid from capillaries into tissues.
8. **(C)** GA treatment of dwarf plant changes only its phenotype and not genotype.
9. **(B)** Oxygen produced in photosynthesis comes from water was said by Ruben and Kamen.
10. **(D)** Adrenaline increases heart rate as well as cardiac putput. This promotes increase of blood pressure.
11. **(B)** Arthritis is an inflammatory condition of joints characterized by pain and swelling.
12. **(B)** Bright's disease, named after English physician Richard Bright, is an obsolete term for glomerulonephritis.
13. **(D)** The principal physiological action of ADH is to increase water retention by the kidney. The hormone acts on the DCT to increase its permeability.
14. **(D)** Emotional disturbance and excitement increase heart rate, cardiac output and blood pressure.
15. **(C)** Root tip contains actively dividing meristematic cells.
16. **(C)** The number of chromosomes drops by half after meiosis is completed, producing haploid gametes that fuse to restore the normal diploid condition in the zygote during fertilisation.
17. **(D)** Deoxyribonucleotides that make up DNA comprise a deoxyribose sugar, a phosphate group and a nitrogenous base that can be adenine, thymine, guanine or cytosine. Ribose and uracil only occur in RNA.
18. **(C)** Gene therapy refers to the insertion of genes into an individual's cells and tissues to treat a disease. Essentially, defective/mutant genes that are harmful to the organism are replaced with healthy, functional ones.
19. **(A)** Biomass refers to the total dry mass of all organisms in a tropical level.
20. **(A)** Somatic mutations refer to mutations affecting cells other than the sex cells. Thus, the impact of the mutation is effectivley confined to the organism itself and is not inherited by offspring, since only sex cells contribute to the genetic makeup of offspring. Since somatic cells also undergo cell division, they can pass mutations to subsequent generations of cells (B). C is incorrect since there are many possible mutations that could affect the gametes with a variety of effects. D is incorrect since mutations affecting other cells in the body can also lead to cancer.
21. **(A)** Sickle-cell anaemia is caused by a mutation in the gene for haemoglobin. Down's syndrome is caused by the presence of an extra copy of chromosome 21.
22. **(C)** Since all of the resulting seeds are smooth, it is likely that the smooth seed allele is dominant over the wrinkled seed allele. The plant with wrinkled seeds should be a homozygote since the wrinkled seed phenotype, being recessive, will only be expressed in the homozygote. It is not possible to tell if the plant with smooth seeds is a homozygote given the small number of offspring.
23. **(C)** A large proportion of energy available at each trophic level is lost at each successive step along a food chain.
24. **(A)** Warm-blooded animals typically have to extend a lot more energy to keep themselves warm. Thus, they usually need a higher intake of food, which is used to drive metabolism and thus generate heat.
25. **(D)** It decreases the amount of sunlight reading the bottom of the water body. It occurs due to excessive enrichment of the water in river and lakes, it results in a decrease in water clarity, dissolved oxygen and aquatic life.

PHYSICS

26. (D) $j = nev_d$

$$\text{or, } v_d = \frac{j}{ne} = \frac{i}{Ane}$$

$$= \frac{1 \text{ A}}{(2 \times 10^{-6} \text{ m}^2)(8.5 \times 10^{22} \times 10^6 \text{ m}^{-3})(1.6 \times 10^{-19} \text{ C})}$$

$$= 0.036 \text{ mm/s.}$$

We see that the drift speed is indeed small.

27. (B) Here, $B = 0.3 \text{ T}$; $\theta = 30^\circ$; $\tau = 0.06 \text{ N m}$
Now, $\tau = M B \sin \theta$

$$\therefore M = \frac{\tau}{B \sin \theta} = \frac{0.06}{0.3 \times \sin 30^\circ} = 0.4 \text{ A m}^2$$

28. (B) $B = 8 \times 10^{-7} \text{ T}$, $c = 3 \times 10^8 \text{ m/s}$, $E = ?$
 $E = c \times B = 3 \times 10^8 \times 8 \times 10^{-7} = 240 \text{ V/m}$

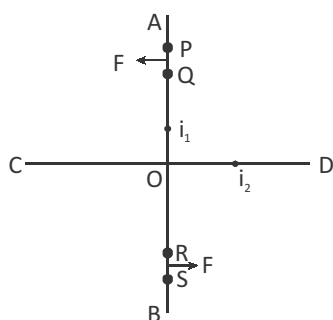
29. (C) The de Broglie wavelength of a particle whose momentum is p is $\lambda = h/p$. For this proton, we find that

$$\lambda = \frac{h}{p} = \frac{6.63 \times 10^{-34} \text{ Js}}{3.3 \times 10^{-23} \text{ kg m/s}}$$

$$= 2.0 \times 10^{-11} \text{ m} = 0.02 \text{ nm}$$

30. (C) Due to the property of self-induction, a coil opposes the time variations in the own current.

31. (A) Applying Ampere's law to the rectangle shown below.



$$(2Bl) = \mu_0 (\lambda l)$$

$$\therefore B = \frac{\mu_0 \lambda}{2}$$

32. (C) Here, $p = 4 \times 10^{-9} \text{ C m}$, $E = 5 \times 10^4 \text{ N C}^{-1}$; $\theta = 30^\circ$

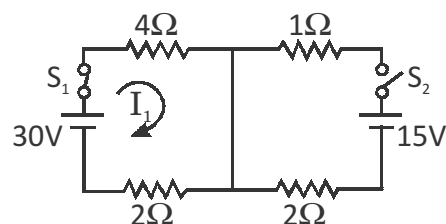
Now, magnitude of torque acting on the dipole,

$$\tau = p E \sin \theta = 4 \times 10^{-9} \times 5 \times 10^4 \sin 30^\circ$$

$$= 2 \times 10^{-4} \times \frac{1}{2} = 10^{-4} \text{ N m}$$

33. (D) When the switch S_1 is closed and S_2 is opened, the current flows only in the first loop.

$$\therefore I_1 = \frac{30}{4+2} = 5 \text{ A}$$



34. (A) At points where the two interfering waves meet in the same phase, the resultant intensity is maximum.

The resulting intensity at any point depends upon the phase difference (ϕ) between the two waves at that point

$$I = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \phi$$

For maximum intensity or constructive interference $I_{\max} = I_1 + I_2 + 2\sqrt{I_1 I_2}$

$$= (\sqrt{I_1} + \sqrt{I_2})^2 = K(a_1 + a_2)^2$$

(Since, intensity \propto amplitude square.)

For destructive interference or minimum intensity,

$$I_{\min} = I_1 + I_2 - 2\sqrt{I_1 I_2}$$

$$= (\sqrt{I_1} - \sqrt{I_2})^2 = K(a_1 - a_2)^2$$

Given, $\frac{I_1}{I_2} = \frac{9}{16} = \frac{a_1^2}{a_2^2}$

$$\Rightarrow \frac{a_1}{a_2} = \frac{3}{4}$$

$$\therefore \frac{I_{\max}}{I_{\min}} = \frac{(a_1 + a_2)^2}{(a_1 - a_2)^2} = \frac{(3 + 4)^2}{(3 - 4)^2} = \frac{49}{1}$$

35. (D) When the key is open, 120 V is divided among C_1 and C_2 in the inverse ratio of their capacitances.

$$\therefore V_1 = \frac{120}{2+3} \times 3 = 72 \text{ V}$$

$$V_2 = \frac{120}{2+3} \times 2 = 48 \text{ V}$$

$$\therefore q_1 = 72 \times 2 = 144 \mu\text{C}$$

$$\text{and } q_2 = 48 \times 3 = 144 \mu\text{C}$$

When the key is closed let q_1 and q_2 be the steady charge on C_1 and C_2 . Then by the loop rule

$$60 - \frac{q_1}{2 \times 10^{-6}} = 0 \Rightarrow q_1 = 120 \mu\text{C}$$

$$\text{and } 60 - \frac{q_2}{3 \times 10^{-6}} = 0 \Rightarrow q_2 = 180 \mu\text{C}$$

\therefore Charge that flows through section 1 = $144 - 120 = 24 \mu\text{C}$

Charge that flows through section 2 = $180 - 144 = 36 \mu\text{C}$

Charge that flows through section 3 = $24 + 36 = 60 \mu\text{C}$

36. (A) Angular magnification

$$= \frac{15}{0.01} = 1500$$

37. (D) Voltage lags the current.

Hence, $X_c > X_L$

$$\text{Further } \cos\phi = \frac{R}{Z} = \frac{R}{\sqrt{R^2 + (X_c - X_L)^2}}$$

$$= \frac{1}{\sqrt{1 + \left(\frac{X_c - X_L}{R}\right)^2}}$$

To raise the power factor, the denominator should decrease. For this either R should increase or $X_c - X_L$ should decrease. If a resistance is added in series, the denominator will

decrease $X_c - X_L$ or $\frac{1}{\omega C} = \omega L$ can be

decreased either by increasing C or L. If we put a capacitor in series the

equivalent capacitance $\left(= \frac{C_1 C_2}{C_1 + C_2} \right)$ of

the circuit will decrease. Hence, either an inductor or a resistance should be placed in series to raise the power factor.

38. (A) The equivalent resistance of 6Ω and 3Ω resistors is $\frac{(6\Omega) \times (3\Omega)}{6\Omega + 3\Omega} = 2 \Omega$.

This is connected in series with the 1Ω resistor. The equivalent resistance of the circuit is $R = 2 \Omega + 1 \Omega = 3 \Omega$.

The current through the battery is

$$i = \frac{9 \text{ V}}{3 \Omega} = 3 \text{ A.}$$

- (a) The current through the 1Ω resistor is, therefore, 3 A.

The heat developed in this resistor is

$$H = i^2 R t$$

$$= (3 \text{ A})^2 \times (1 \Omega) \times (60 \text{ s}) = 540 \text{ J.}$$

- (b) The current through the 6Ω resistor is

$$(3 \text{ A}) = \frac{3 \Omega}{6 \Omega + 3 \Omega} = 1 \text{ A.}$$

The heat developed in it

$$= (1 \text{ A})^2 \times (6 \Omega) \times (60 \text{ s}) = 360 \text{ J.}$$

- (c) The current through the 3Ω resistor is $3 \text{ A} - 1 \text{ A} = 2 \text{ A}$.

The heat developed in it

$$= (2 \text{ A})^2 \times (3 \Omega) \times (60 \text{ s}) = 720 \text{ J.}$$

39. (C) Here, $V = 18 \text{ kV} = 18 \times 10^3 \text{ V}$

if v_{\max} is the velocity of the fastest electron, then

$$\frac{1}{2} v_{\max}^2 = e V \text{ or}$$

$$v_{\max} = \sqrt{\frac{2eV}{m}} = \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 18 \times 10^8}{9 \times 10^{-31}}}$$

$$= 8 \times 10^7 \text{ m s}^{-1}$$

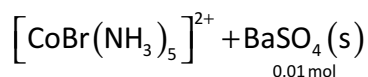
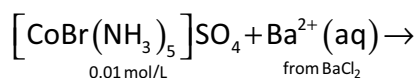
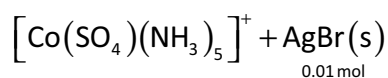
40. (D) Initially the capacity of the capacitor increases and then decreases. So, positive charge on plate A first increases and then decreases i.e., current in the outer circuit first flows from B to A and then from A to B.

CHEMISTRY

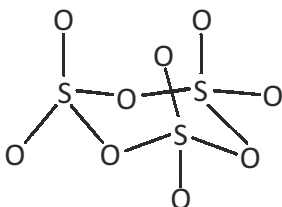
41. (D) The reaction at high temperature in the blast furnace is



42. (A) $[\text{Co}(\text{SO}_4)(\text{NH}_3)_5]\text{Br} + \text{Ag}^+ (\text{excess}) \rightarrow$
0.01 mol/L from AgNO₃



43. (C) Ethyl alcohol forms stronger H-bonds than ethylamine or ammonia due to greater electronegativity of oxygen than nitrogen atom. Diethyl ether, however, does not form H-bonds since it does not have a H-atom attached to O-atom.
44. (D) Ag does not react with $\text{Cu}(\text{NO}_3)_2$ solution as e.m.f. of cell reaction is negative.
45. (C) Reformatsky reaction is used to prepare β -hydroxy esters.
46. (C) Yellow colour on heating NaCl in the presence of Na is due to the presence of electrons in anion vacancies (F-centres)
47. (D) There are no S-S bonds in sulphur trioxide trimer (S_3O_9) as shown below.



48. (A) Mass of 5 L solution
 $= 5 \text{ L} \times 0.981 \text{ kg L}^{-1} = 4.905 \text{ kg} = 4905 \text{ g}$
 Mass of 2 m solution
 $= 1000 \text{ g} + 2 \text{ moles of methanol}$

$$= 1000 + 2 \times 32$$

$$= 1000 + 64 = 1064 \text{ g}$$

Now 1064 g of solution contains methanol = 2 mol

4905 g of solution contains methanol

$$\frac{2}{1064} \times 4905 = 9.22 \text{ mol.}$$

49. (C) Colloidal solution of liquid-in-liquid is emulsion and not a gel.
50. (B) Co^{2+} and Fe^{2+} ions are coloured.
51. (A) Aromatic primary amines i.e., aniline gives dye test.
52. (D) For the same alkyl group, boiling point increases as the size of halogen increases. Thus, $\text{C}_2\text{H}_5\text{I}$ has the highest boiling point.
53. (A) For a first order reaction, $t_{1/2}$ is independent of the initial concentration of the reactants.

From the given data, $t_{1/2} = 15 \text{ min}$

$$\text{So, } 0.1 \text{ M} \xrightarrow{t_{1/2}} 0.05 \text{ M} \xrightarrow{t_{1/2}} 0.025 \text{ M}$$

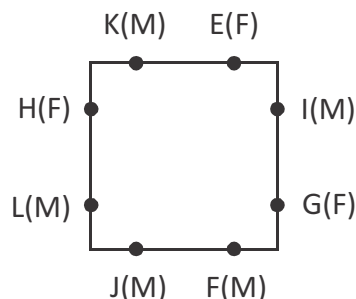
So, time required for concentration to change from 0.1 M to 0.025 M = $2t_{1/2}$
 $= 2 \times 15 \text{ minutes} = 30 \text{ minutes}$

54. (A) Cl_2 is a weaker oxidising agent than F_2 and hence cannot displace F_2 from NaF .
55. (A) $(\text{C}_6\text{H}_5\text{COO})_2\text{Ca} + \text{Ca}(\text{OOCCH}_3)_2 \xrightarrow{\text{Heat}}$



CRITICAL THINKING

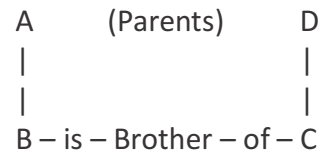
56. (D)
57. (D)



Here M = Male, F = Female
 Both are male.

58. **(B)** The government must have seen the unawareness of the people as a strong factor in the primary education programme being not successful. The step indicated in I must, thus, have been sought for as a remedy for the same.

59. **(A)** A is the mother of B, B is the brother of C and C is the daughter of D. Hence, D is the father.



60. **(B)**

THE END
