

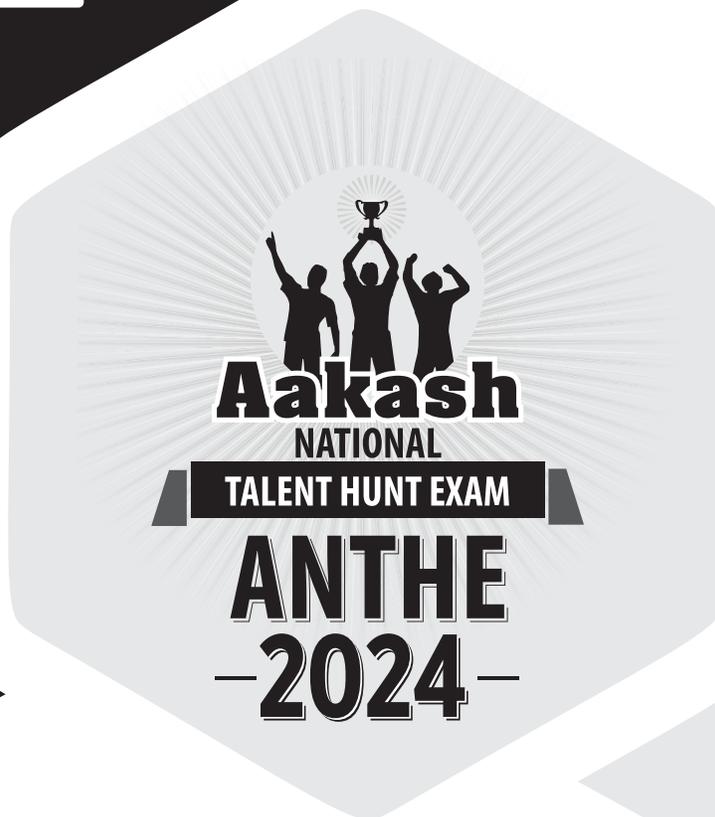
Sample Paper

ENGINEERING



Aakash

Medical | IIT-JEE | Foundations



(Class XII Studying Moving to XII Passed)

Physics, Chemistry & Mathematics

INSTRUCTIONS FOR CANDIDATE

1. Duration of Test is 1 hr.
2. The Test Booklet consists of **40** questions. The maximum marks are **90**. There is **no negative marking** for wrong answer.
3. Pattern of the questions are as under:
 - (i) The question paper consists of three parts *i.e.*, **Physics, Chemistry and Mathematics**. Each part has **two sections**.
 - (ii) **Section-I**: This section contains **35** multiple choice questions, which have **only one** correct answer. Each question carries **+2 marks** for correct answer.
 - (iii) **Section-II**: This section contains **5** multiple choice questions, in which **one or more than one** choice(s) is(are) correct. Each question carries **+4 marks** for correct answer.

Aakash National Talent Hunt Exam 2024**SAMPLE PAPER****(Class XII Studying Moving to XII Passed)**

(The questions given in sample paper are indicative of the level and pattern of questions that will be asked in ANTHE-2024)

Time : 1 Hour

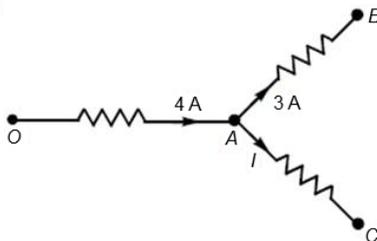
PHYSICS

MM : 90

SECTION-I**SINGLE CORRECT ANSWER TYPE**

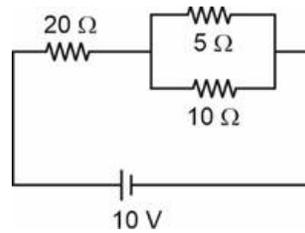
This section contains 11 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **ONLY ONE** choice is correct.

- Consider a tightly wound 100 turn coil of radius 12 cm carrying current of 10 A. What is the magnetic field at the centre of this coil?
(1) 1.2×10^{-3} T
(2) 5.2×10^{-3} T
(3) 4.6×10^{-3} T
(4) 1.9×10^{-6} T
- A point charge 4 C experience a constant force 500 N when moved between two points separated by a distance of 2 cm in a uniform electric field. The potential difference between the two points is
(1) 10 V
(2) 2.5 V
(3) 5 V
(4) 8 V
- Current in the branch AC of the given circuit is,

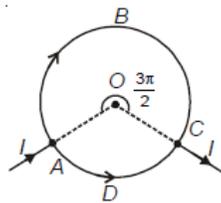


- (1) 2 A
(2) 1 A
(3) 3 A
(4) 4 A
- The resistance of a wire is 10Ω . Its length is increased by 10% by stretching. The new resistance will now be close to
(1) 12Ω
(2) 1.2Ω
(3) 13Ω
(4) 11Ω

5. The ratio of heat dissipated per second through the resistance $5\ \Omega$ and $10\ \Omega$ in the circuit given below is

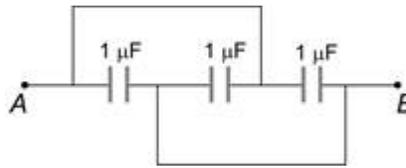


- (1) 4 : 1 (2) 1 : 2
 (3) 2 : 1 (4) 1 : 1
6. Two point charges $+3\ \mu\text{C}$ and $+8\ \mu\text{C}$ repel each other with a force of 40 N. If a charge of $-5\ \mu\text{C}$ is added to each of them, then the force between them will become
- (1) $-10\ \text{N}$ (2) $+10\ \text{N}$
 (3) $+20\ \text{N}$ (4) $-20\ \text{N}$
7. A di-electric slab of di-electric constant $k = 2$, is placed between the plates of a parallel plate capacitor such that its thickness is half of plate separation d . The area of each plate is A . The capacitance of the capacitor is
- (1) $\frac{4\ \epsilon_0 A}{3\ d}$ (2) $\frac{3\ \epsilon_0 A}{2\ d}$
 (3) $\frac{3\ \epsilon_0 A}{4\ d}$ (4) $\frac{2\ \epsilon_0 A}{3\ d}$
8. The magnitude of magnetic field at the centre O of the loop of radius r made of uniform wire, due to arc ABC as shown in figure is



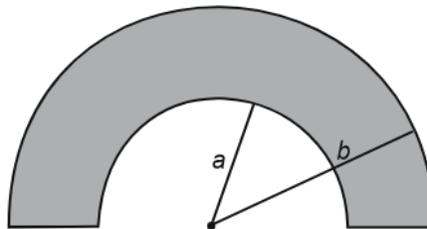
- (1) $\frac{\mu_0 I}{8r}$ (2) $\frac{3\mu_0 I}{8r}$
 (3) Zero (4) $\frac{3\mu_0 I}{32r}$
9. Proton, deuteron and α -particle all moving with same speed, enter a uniform and perpendicular magnetic field. The ratio of radii $r_p : r_d : r_\alpha$ is
- (1) 2 : 1 : 1 (2) 2 : 2 : 1
 (3) 1 : 2 : 2 (4) 1 : 2 : 1

10. The equivalent capacitance in the circuit between A and B will be



- (1) $1 \mu\text{F}$ (2) $2 \mu\text{F}$
 (3) $3 \mu\text{F}$ (4) $\frac{1}{3} \mu\text{F}$

11. A non-conducting semicircular disc as shown in figure has a uniform surface charge density σ . The electric potential at the centre of the disc is



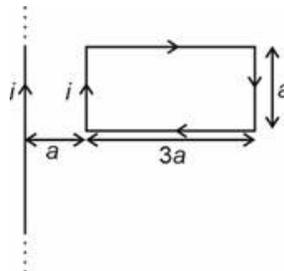
- (1) $\frac{\sigma}{2\pi\epsilon_0} \ln\left(\frac{b}{a}\right)$ (2) $\frac{\sigma(b-a)}{2\epsilon_0}$
 (3) $\frac{\sigma(b-a)}{4\epsilon_0}$ (4) $\frac{\sigma(b-a)}{4\pi\epsilon_0}$

SECTION-II

ONE OR MORE THAN ONE CORRECT ANSWER TYPE

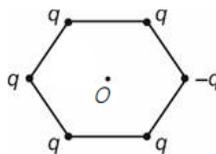
This section contains 2 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **ONE OR MORE THAN ONE** choice(s) is(are) correct.

12. A rectangular loop carrying current i is situated near a long straight wire such that the wire is parallel to one of the sides of the loop and is in the plane of the loop. Then



- (1) Force experienced by the loop is $\frac{5 \mu_0 i^2}{8 \pi}$ (2) Force experienced by the loop is $\frac{3 \mu_0 i^2}{8 \pi}$
 (3) The loop will move away from the wire (4) The loop will move towards the wire

13. 6 charges are placed at the corners of a regular hexagon of side a as shown. If O is the centre of hexagon, then



- (1) Electric field at O is $\frac{q}{2\pi\epsilon_0 a^2}$
- (2) Potential at O is $\frac{q}{2\pi\epsilon_0 a}$
- (3) Total electrostatic force on $-q$ is $\frac{q^2}{4\pi\epsilon_0 a^2} \left[\frac{1}{\sqrt{3}} + \frac{5}{4} \right]$
- (4) Potential at O is $\frac{q}{\pi\epsilon_0 a}$

CHEMISTRY

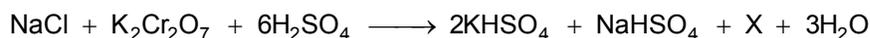
SECTION-I

SINGLE CORRECT ANSWER TYPE

This section contains 11 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **ONLY ONE** choice is correct.

14. The electrodes of a conductivity cell are 3 cm apart and have a cross-sectional area of 4 cm². The cell constant of the cell (in cm⁻¹) is
- (1) 4×3 (2) $\frac{4}{3}$
- (3) $\frac{3}{4}$ (4) $\frac{9}{4}$
15. The rate of reaction, $3A + 2B \rightarrow \text{product}$, is given by the expression, $\text{rate} = k[A][B]^2$. If A is taken in excess, the order of the reaction would be
- (1) 3 (2) 2
- (3) 1 (4) 5
16. Maximum number of isomers possible for which complex?
- (1) $[\text{Cr}(\text{ox})_3]^{3-}$ (2) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
- (3) $[\text{Ni}(\text{dmg})_2]$ (4) $[\text{Co}(\text{en})_2\text{Cl}_2]\text{Br}$
17. If the electrochemical equivalent of an element is 0.000238 then the equivalent weight of element is (approx)
- (1) 23 (2) 38
- (3) 15 (4) 56

18. In the reaction



X is a reddish brown gas. X could be

- (1) CrO_3 (2) H_2CrO_4
(3) CrO_2Cl_2 (4) CrO_5

19. If the activation energy for the forward reaction is 80 kJ/mol and activation energy for the backward reaction is 120 kJ/mol, then enthalpy of reaction will be

- (1) 40 kJ/mol
(2) -40 kJ/mol
(3) 200 kJ/mol
(4) -200 kJ/mol

20. The orange colour of $\text{K}_2\text{Cr}_2\text{O}_7$ and purple colour of KMnO_4 is due to

- (1) d → d transitions in $\text{K}_2\text{Cr}_2\text{O}_7$ and charge transfer transitions in KMnO_4
(2) d → d transitions in KMnO_4 and charge transfer transitions in $\text{K}_2\text{Cr}_2\text{O}_7$
(3) Charge transfer transition in both
(4) d → d transitions in both

21. van't Hoff factors of 3 aqueous solutions of equimolar A, B and C are 0.6, 1.2 and 1.8 respectively. The correct order of their freezing point is

- (1) $A > B > C$ (2) $B > A > C$
(3) $C > B > A$ (4) $C > A > B$

22. What weight of solute (molecular weight = 60) is required to dissolve in 180 g of water to reduce the vapour pressure to $\frac{4}{5}$ th of pure water?

- (1) 48 g (2) 96 g
(3) 150 g (4) 175 g

23. Among the following the species with the lowest conductance in aq. medium is

- (1) H^+ (2) Li^+
(3) Na^+ (4) K^+

24. Interstitial compounds are those which are formed when small atoms like H, C or N are trapped inside the crystal lattices of metals. From the following statements related to interstitial compounds, select the incorrect one.

- (1) They are usually non-stoichiometric
(2) They are highly reactive in nature
(3) Their melting points are higher than those of pure metals
(4) They are very hard

SECTION-II

ONE OR MORE THAN ONE CORRECT ANSWER TYPE

This section contains 2 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **ONE OR MORE THAN ONE** choice(s) is(are) correct.

25. In an experiment, osmotic pressure of 0.1 M aq CH_3COOH solution at 300 K is found to be 2.706 atm and osmotic pressure of 0.2 M aq CH_3COOH solution at 300 K is found to be 5.166 atm. Select the correct statement(s) on the basis of this experimental observation.

- (1) Degree of dissociation of CH_3COOH decreases as concentration increases from 0.1 M to 0.2 M
- (2) pH of 0.1 M CH_3COOH and 0.2 M CH_3COOH solution are equal
- (3) Concentration of CH_3COO^- ions in 0.1 M solution is same as that in 0.2 M solution
- (4) Dissociation constant of CH_3COOH decreases as concentration increases from 0.1 M to 0.2 M

$$\left[\text{Use : } R = \frac{0.082 \text{ L atm}}{\text{mol K}} \right]$$

26. The correct option(s) regarding the complex $[\text{Co}(\text{en})(\text{NH}_3)_3(\text{H}_2\text{O})]^{3+}$ is(are) (en = $\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$)

- (1) It has two geometrical isomers
- (2) It will have three geometrical isomers if bidentate 'en' is replaced by two cyanide ligands
- (3) It is paramagnetic
- (4) It absorbs light at longer wavelength as compared to $[\text{Co}(\text{en})(\text{NH}_3)_4]^{3+}$

MATHEMATICS

SECTION-I

SINGLE CORRECT ANSWER TYPE

This section contains 13 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **ONLY ONE** choice is correct.

27. The value of $\tan^{-1}(-\sqrt{3})$ is equal to

(1) $-\frac{\pi}{3}$

(2) $-\frac{\pi}{6}$

(3) $\frac{\pi}{6}$

(4) $\frac{\pi}{3}$

28. The matrix X for which $\begin{bmatrix} 2 & 1 \\ 1 & -1 \end{bmatrix} X = \begin{bmatrix} 1 & 10 \\ 2 & 2 \end{bmatrix}$ is

(1) $\begin{bmatrix} 1 & -4 \\ -1 & 2 \end{bmatrix}$

(2) $\begin{bmatrix} 1 & 4 \\ 1 & 2 \end{bmatrix}$

(3) $\begin{bmatrix} 1 & 4 \\ -1 & 2 \end{bmatrix}$

(4) $\begin{bmatrix} 1 & 4 \\ -1 & -2 \end{bmatrix}$

29. $\int_0^{2\pi} (\sin x + \cos x) dx =$
- (1) 0 (2) 2
(3) -2 (4) 1
30. If A is a square matrix of order 4 and $|A| = 3$, then $|\text{adj } A|$ is equal to
- (1) 27 (2) 81
(3) 9 (4) 3
31. The area bounded by the curves $y^2 = 4x$ and $x^2 = 4y$, is
- (1) $\frac{16}{3}$ sq. units (2) 4 sq. units
(3) $\frac{8}{3}$ sq. units (4) 16 sq. units
32. The function $f(x) = \begin{cases} x+2 & x \geq 1 \\ x+1 & x < 1 \end{cases}$ is
- (1) Discontinuous at $x = 2$ (2) Discontinuous at $x = 3$
(3) Continuous at $x = 1$ (4) Discontinuous at $x = 1$
33. The interval in which $f(x) = \ln(x^2 - 7x + 10)$ increases is
- (1) $x \in (5, \infty)$ (2) $x \in (2, 5)$
(3) $x \in R$ (4) $x \in \phi$
34. Consider $f(x) = \begin{cases} \sin \frac{\pi x}{2}, & x > 0 \\ x+a, & x \leq 0 \end{cases}$. Then, the value of a , if $x = 0$ is a point of local maxima, is
- (1) $a < 0$ (2) $a \leq 0$
(3) $a > 0$ (4) $a \geq 0$
35. The value of $\sin\left(2\tan^{-1}\left(\frac{1}{3}\right)\right) + \cos\left(\tan^{-1}2\sqrt{2}\right) =$
- (1) $\frac{16}{15}$ (2) $\frac{14}{15}$
(3) $\frac{12}{15}$ (4) $\frac{11}{15}$
36. $\int \frac{\sin 2x dx}{1 + \cos^2 x}$ is equal to
- (1) $\frac{1}{2} \log(1 + \cos^2 x) + c$ (2) $2 \log(1 + \cos^2 x) + c$
(3) $\frac{1}{2} \log(1 + \cos 2x) + c$ (4) $-\log(1 + \cos^2 x) + c$

37. If $A = \begin{bmatrix} 3 & 2 & 5 \\ 2 & 3 & 8 \\ 7 & 2 & 9 \end{bmatrix}$, then $|\text{adj}(A^{-1})|$ is equal to

(1) $\frac{1}{24}$

(2) 24

(3) 48

(4) $\frac{1}{(24)^2}$

38. The number of point(s) of non-differentiability of $f(x) = \max\{e^x, x^2\}$ for $x < 0$ is

(1) 0

(2) 1

(3) 2

(4) 3

39. The area enclosed by the curves $y^2 + 4x = 4$ and $y - 2x = 2$ is

(1) $\frac{23}{3}$

(2) $\frac{22}{3}$

(3) $\frac{25}{3}$

(4) 9

SECTION-II

ONE OR MORE THAN ONE CORRECT ANSWER TYPE

This section contains 1 multiple choice question, which has 4 choices (1), (2), (3) and (4) out of which **ONE OR MORE THAN ONE** choice(s) is(are) correct.

40. If A and B are symmetric as well as invertible matrices and commute, then which of the following is/are symmetric

(1) $A^{-1}B$

(2) AB^{-1}

(3) $A^{-1}B^{-1}$

(4) AB



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