

MHT CET 2023 Mathematics Memory Based Question Paper PDF

Mathematics

Question 1

A group consists of 8 boys and 5 girls, then the number of committees of 5 persons that can be formed, if committee consists of at least 2 girls and at most 2 boys, are

Options:

- A. 300
- B. 320
- C. 321
- D. 322

Question 2

Scalar projection of the line segment joining the points $A(-2, 0, 3)$, $B(1, 4, 2)$ on the line whose direction ratios are 6, $-2, 3$ is

Options:

- A. $\frac{23}{7}$
- B. 1
- C. 7
- D. $\frac{1}{7}$

Question 3

For a binomial variate X with $n = 6$ if $P(X = 4) = \frac{135}{2^{12}}$, then its variance is

Options:

- A. $\frac{8}{9}$
- B. $\frac{1}{4}$
- C. 4
- D. $\frac{9}{8}$

Question 4

If $\bar{a} = 2\hat{i} + 3\hat{j} + 2\hat{k}$, $\bar{b} = 2\hat{i} + \hat{j} - \hat{k}$ and $\bar{c} = \hat{i} + 3\hat{j}$ are such that $(\bar{a} + \lambda\bar{b})$ is perpendicular to $\bar{c}$, then the value of λ is

Options:

- A. $\frac{5}{11}$
- B. $\frac{11}{5}$

- C. $\frac{-11}{5}$
D. $\frac{-5}{11}$

Question 5

The number of integral values of p in the domain $[-5, 5]$, such that the equation $2x^2 + 4xy - py^2 + 4x + qy + 1 = 0$ represents pair of lines, are

Options:

- A. 3
B. 4
C. 7
D. 8

Question 6

An open metallic tank is to be constructed, with a square base and vertical sides, having volume 500 cubic meter. Then the dimensions of the tank, for minimum area of the sheet metal used in its construction, are

Options:

- A. 5 m, 5 m, 10 m
B. 10 m, 10 m, 5 m
C. 2 m, 2 m, 8 m
D. 15 m, 15 m, 5 m

Question 7

The p.d.f. of a discrete random variable is defined as $f(x) = \begin{cases} kx^2, & 0 \leq x \leq 6 \\ 0, & \text{otherwise} \end{cases}$ Then the value of $F(4)$ (c.d.f) is

Options:

- A. $\frac{30}{91}$
B. $\frac{30}{97}$
C. $\frac{15}{47}$
D. $\frac{15}{97}$

Question 8

The variance, for first six prime numbers greater than 5, is

Options:

- A. 27
B. 28
C. 15

D. 20

Question 9

The value of $\lim_{x \rightarrow a} \frac{\sqrt{a+2x}-\sqrt{3x}}{\sqrt{3a+x}-2\sqrt{x}}$ is

Options:

- A. $\frac{1}{3\sqrt{3}}$
- B. $\frac{2}{\sqrt{3}}$
- C. $\frac{2}{3\sqrt{3}}$
- D. $\frac{4}{3\sqrt{3}}$

Question 10

The points $(1, 3), (5, 1)$ are opposite vertices of a diagonal of a rectangle. If the other two vertices lie on the line $y = 2x + c$, then one of the vertex on the other diagonal is

Options:

- A. $(1, -2)$
- B. $(0, -4)$
- C. $(2, 0)$
- D. $(3, 2)$

Question 11

Considering only the principal values of an inverse function, the set $A = \{x \geq 0 / \tan^{-1} x + \tan^{-1} 6x = \frac{\pi}{4}\}$

Options:

- A. is an empty set.
- B. is a singleton set.
- C. contains more than two elements.
- D. contains two elements.

Question 12

The line $\frac{x-2}{3} = \frac{y-1}{-5} = \frac{z+2}{2}$ lies in the plane $x + 3y - \alpha z + \beta = 0$, then the value of $\alpha^2 + \alpha\beta + \beta^2$ is

Options:

- A. 127
- B. 43
- C. 109
- D. 61

Question 13

The vector projection of $\vec{AB}$ on $\vec{CD}$, where $A \equiv (2, -3, 0)$, $B \equiv (1, -4, -2)$, $C \equiv (4, 6, 8)$ and $D \equiv (7, 0, 10)$, is

Options:

- A. $\frac{1}{49}(3\hat{i} - 6\hat{j} + 2\hat{k})$
- B. $\frac{1}{6}(-\hat{i} - \hat{j} - 2\hat{k})$
- C. $-\frac{1}{49}(3\hat{i} - 6\hat{j} + 2\hat{k})$
- D. $-\frac{1}{6}(-\hat{i} - \hat{j} - 2\hat{k})$

Question 14

If the circles $x^2 + y^2 = 9$ and $x^2 + y^2 + 2\alpha x + 2y + 1 = 0$ touch each other internally, then the value of α^3 is

Options:

- A. $\frac{27}{64}$
- B. $\frac{125}{27}$
- C. $\frac{27}{125}$
- D. $\frac{64}{27}$

Question 15

If $y = \cos^{-1}\left(\frac{a^2}{\sqrt{x^4+a^4}}\right)$, then $\frac{dy}{dx}$ is

Options:

- A. $\frac{2a^2x}{x^4+a^4}$
- B. $\frac{2a^2x^2}{x^4+a^4}$
- C. $\frac{a^4x^4}{x^4+a^4}$
- D. $\frac{a^4x^2}{2\sqrt{x^4+a^4}}$

Question 16

The population $P = P(t)$ at time t of certain species follows the differential equation $\frac{dP}{dt} = 0.5P - 450$. If $P(0) = 850$, then the time at which population becomes zero is

Options:

- A. $2 \log 18$
- B. $\log 9$
- C. $\frac{1}{2} \log 18$
- D. $\log 18$

Question 17

The vertices of the feasible region for the constraints $x + y \leq 4$, $x \leq 2$, $y \leq 1$, $x + y \geq 1$, $x, y \geq 0$ are

Options:

- A. $(1, 0), (2, 0), (2, 1), (0, 4)$
- B. $(0, 1), (4, 0), (0, 4), (1, 0)$
- C. $(1, 0), (2, 0), (2, 1), (0, 1)$
- D. $(1, 0), (4, 0), (2, 1), (0, 4)$

Question 18

The value of $\tan \frac{\pi}{8}$ is

Options:

- A. $1 - \sqrt{2}$
- B. $-1 - \sqrt{2}$
- C. $\sqrt{2} - 1$
- D. $\sqrt{2} + 1$

Question 19

If $B = \begin{bmatrix} 1 & \alpha & 2 \\ 1 & 2 & 2 \\ 2 & 3 & 3 \end{bmatrix}$ is the adjoint of a 3×3 matrix A and $|A| = 5$, then α is equal to

Options:

- A. 25
- B. 27
- C. $3\sqrt{3}$
- D. 5

Question 20

The logical statement $[\sim (\sim p \vee q) \vee (p \wedge r)] \wedge (\sim q \wedge r)$ is equivalent to

Options:

- A. $(p \wedge r) \wedge \sim q$
- B. $(p \wedge \sim q) \vee r$
- C. $\sim p \vee r$
- D. $\sim p \wedge r$

Question 21

If $w = \frac{z}{z - \frac{1}{3}i}$ and $|w| = 1, i = \sqrt{-1}$, then z lies on

Options:

- A. circle.
- B. line.

- C. parabola.
- D. ellipse.

Question 22

If one side of a triangle is double the other and the angles opposite to these sides differ by 60° , then the triangle is

Options:

- A. obtuse angled
- B. right angled
- C. acute angled
- D. isosceles

Question 23

If $\int \sqrt{\frac{x-7}{x-9}} dx = A\sqrt{x^2 - 16x + 63} + \log |(x-8) + \sqrt{x^2 - 16x + 63}| + c$, (where c is a constant of integration) then A is

Options:

- A. -1
- B. $\frac{1}{2}$
- C. 1
- D. $\frac{-1}{2}$

Question 24

A player tosses 2 fair coins. He wins 5 if 2 heads appear, 2 if one head appears and 1 if no head appears. Then the variance of his winning amount is :

Options:

- A. 6
- B. $\frac{5}{2}$
- C. $\frac{9}{4}$
- D. $\frac{17}{2}$

Question 25

Area of the region bounded by the curve $y = \sqrt{49 - x^2}$ and X-axis is

Options:

- A. 49π sq. units
- B. $\frac{49\pi}{2}$ sq. units
- C. $\frac{49\pi}{4}$ sq. units
- D. 98π sq. units

Question 26

The solution of the equation $\tan^{-1}(1+x) + \tan^{-1}(1-x) = \frac{\pi}{2}$ is

Options:

- A. $x = 1$
- B. $x = 0$
- C. $x = -1$
- D. $x = \pi$

Question 27

The differential equation $\frac{dy}{dx} = \frac{\sqrt{1-y^2}}{y}$ determines a family of circles with

Options:

- A. variable radii and fixed centre at $(0, 1)$.
- B. variable radii and fixed centre at $(0, -1)$.
- C. fixed radius of 1 unit and variable centre along the Y-axis.
- D. fixed radius of 1 unit and variable centre along the X-axis.

Question 28

A square plate is contracting at the uniform rate $4 \text{ cm}^2/\text{sec}$, then the rate at which the perimeter is decreasing, when side of the square is 20 cm , is

Options:

- A. $\frac{1}{5} \text{ cm/sec}$.
- B. 4 cm/sec .
- C. 2 cm/sec .
- D. $\frac{2}{5} \text{ cm/sec}$.

Question 29

If the function $f(x)$ is continuous in $0 \leq x \leq \pi$, then the value of $2a + 3b$ is where

$$f(x) = \begin{cases} x + a\sqrt{2}\sin x & \text{if } 0 \leq x < \frac{\pi}{4} \\ 2x \cot x + b & \text{if } \frac{\pi}{4} \leq x \leq \frac{\pi}{2} \\ a \cos 2x - b \sin x & \text{if } \frac{\pi}{2} < x \leq \pi \end{cases}$$

Options:

- A. $\frac{\pi}{12}$
- B. $\frac{\pi}{6}$
- C. $\frac{\pi}{4}$
- D. $\frac{\pi}{10}$

Question 30

For $x > 1$, if $(2x)^{2y} = 4e^{2x-2y}$, then $(1 + \log 2x)^2 \frac{dy}{dx}$ is equal to

Options:

- A. $\frac{x \log 2x + \log 2}{x}$
 B. $\frac{x \log 2x - \log 2}{x}$
 C. $x \log 2x$
 D. $\log 2x$

Question 31

The vectors are $\vec{a} = 2\hat{i} + \hat{j} - 2\hat{k}$, $\vec{b} = \hat{i} + \hat{j}$. If $\vec{c}$ is a vector such that $\vec{a} \cdot \vec{c} = |\vec{c}|$ and $|\vec{c} - \vec{a}| = 2\sqrt{2}$, angle between $\vec{a} \times \vec{b}$ and $\vec{c}$ is $\frac{\pi}{4}$, then $|(\vec{a} \times \vec{b}) \times \vec{c}|$ is

Options:

- A. 3
 B. $\frac{3}{\sqrt{2}}$
 C. $3\sqrt{2}$
 D. 1

Question 32

$$\int \frac{1}{7-6x-x^2} dx =$$

Options:

- A. $\frac{1}{4} \log \left(\frac{7+x}{1-x} \right) + c$
 B. $\frac{1}{8} \log \left(\frac{7+x}{1-x} \right) + c$
 C. $\frac{1}{16} \log \left(\frac{7+x}{1-x} \right) + c$
 D. $\frac{1}{32} \log \left(\frac{7+x}{1-x} \right) + c$

Question 33

$$\int \frac{dx}{\sin x + \cos x} =$$

Options:

- A. $\sqrt{2} \log \tan \left(x + \frac{\pi}{4} \right) + c$
 B. $\frac{1}{\sqrt{2}} \log \tan \left(\frac{x}{2} + \frac{\pi}{8} \right) + c$
 C. $\frac{1}{\sqrt{2}} \log \left(\frac{\tan \frac{x}{2} - \sqrt{2} + 1}{\tan \frac{x}{2} + \sqrt{2} + 1} \right) + c$
 D. $-\frac{1}{\sqrt{2}} \log \left(\frac{\tan \frac{x}{2} - (\sqrt{2} + 1)}{\tan \frac{x}{2} + \sqrt{2} - 1} \right) + c$

Question 34

A ladder of length 17 m rests with one end against a vertical wall and the other on the level ground. If the lower end slips away at the rate of 1 m/sec., then when it is 8 m away from the wall, its upper end is coming down at the rate of

Options:

- A. $\frac{5}{8}$ m/sec.
 B. $\frac{8}{15}$ m/sec.

- C. $\frac{-8}{15}$ m/sec.
D. $\frac{15}{8}$ m/sec.

Question 35

Let P be a plane passing through the points $(2, 1, 0)$, $(4, 1, 1)$ and $(5, 0, 1)$ and R be the point $(2, 1, 6)$. Then image of R in the plane P is

Options:

- A. $(6, 5, 2)$
B. $(4, 3, 2)$
C. $(6, 5, -2)$
D. $(3, 4, -2)$

Question 36

The co-ordinates of the point, where the line through $A(3, 4, 1)$ and $B(5, 1, 6)$ crosses the XZ-plane, are

Options:

- A. $(\frac{11}{3}, 0, \frac{21}{3})$
B. $(\frac{17}{3}, 0, \frac{23}{3})$
C. $(\frac{-11}{3}, 0, \frac{21}{3})$
D. $(\frac{17}{3}, 0, \frac{-23}{3})$

Question 37

The number of possible solutions of $\sin \theta + \sin 4\theta + \sin 7\theta = 0$, $\theta \in (0, \pi)$ are

Options:

- A. 3
B. 4
C. 6
D. 8

Question 38

If $I = \int \frac{dx}{x^2(x^4+1)^{\frac{3}{4}}}$, then I is

Options:

- A. $\left(\frac{x^4+1}{x}\right)^{\frac{1}{4}} + c$
B. $\frac{(x^4-1)^{\frac{1}{4}}}{x} + c$
C. $-\frac{(x^4+1)^{\frac{1}{4}}}{x} + c$
D. $-\left(\frac{x^4+1}{x^4}\right)^{\frac{1}{4}} + c$

Question 39

If $\bar{a} = \hat{i} + 2\hat{j} + \hat{k}$, $\bar{b} = \hat{i} - \hat{j} + \hat{k}$, $\bar{c} = \hat{i} + \hat{j} - \hat{k}$, then a vector in the plane of $\bar{a}$ and $\bar{b}$, whose projection on $\bar{c}$ is $\frac{1}{\sqrt{3}}$, is

Options:

- A. $\hat{i} + \hat{j} - 2\hat{k}$
- B. $3\hat{i} + \hat{j} - 3\hat{k}$
- C. $4\hat{i} - \hat{j} + 4\hat{k}$
- D. $2\hat{i} + 3\hat{j} - \hat{k}$

Question 40

The number of solutions of $\tan x + \sec x = 2 \cos x$ in $[0, 2\pi]$ are

Options:

- A. 6
- B. 4
- C. 3
- D. 2

Question 41

If $\int_0^{\frac{1}{2}} \frac{x^2}{(1-x^2)^{\frac{3}{2}}} dx = \frac{k}{6}$, then the value of k is

Options:

- A. $2\sqrt{3} - \pi$
- B. $2\sqrt{3} + \pi$
- C. $3\sqrt{2} + \pi$
- D. $3\sqrt{2} - \pi$

Question 42

General solution of the differential equation $\cos x(1 + \cos y)dx - \sin y(1 + \sin x)dy = 0$ is

Options:

- A. $(1 + \cos x)(1 + \sin y) = c$
- B. $1 + \sin x + \cos y = c$
- C. $(1 + \sin x)(1 + \cos y) = c$
- D. $1 + \sin x \cdot \cos y = c$

Question 43

If the line $ax + by + c = 0$ is a normal to the curve $xy = 1$, then

Options:

- A. $a > 0, b > 0$
- B. $a > 0, b < 0$

C. $a < 0, b < 0$

D. $a = 0, b = 0$

Question 44

Let $\vec{a}, \vec{b}, \vec{c}$ be three non-zero vectors, such that no two of them are collinear and $(\vec{a} \times \vec{b}) \times \vec{c} = \frac{1}{3}|\vec{b}||\vec{c}|\vec{a}$. If θ is the angle between the vectors $\vec{b}$ and $\vec{c}$, then the value of $\sin \theta$ is

Options:

A. $\frac{2\sqrt{2}}{3}$

B. $\frac{-\sqrt{2}}{3}$

C. $\frac{\sqrt{2}}{3}$

D. $\sqrt{\frac{2}{3}}$

Question 45

If $f(x) = e^x, g(x) = \sin^{-1} x$ and $h(x) = f(g(x))$, then $\frac{h'(x)}{h(x)}$ is

Options:

A. $e^{\sin^{-1} x}$

B. $\frac{1}{\sqrt{1-x^2}}$

C. $\sin^{-1} x$

D. $\frac{e^{\sin^{-1} x}}{\sqrt{1-x^2}}$

Question 46

The given circuit is equivalent to
(Blue image of circuit in page 45)

Options:

A. B. C. D.

Question 47

A kite is 120 m high and 130 m of string is out. If the kite is moving away horizontally at the rate of 39 m/sec, then the rate at which the string is being out, is

Options:

A. 12 m/sec.

B. 15 m/sec.

C. 18 m/sec.

D. 20 m/sec.

Question 48

ABC is a triangle in a plane with vertices $A(2, 3, 5)$, $B(-1, 3, 2)$ and $C(\lambda, 5, \mu)$. If median through A is equally inclined to the co-ordinate axes, then value of $\lambda + \mu$ is

Options:

- A. 17
- B. 10
- C. 7
- D. 3

Question 49

Three critics review a book. For the three critics the odds in favor of the book are $2 : 5$, $3 : 4$ and $4 : 3$ respectively. The probability that the majority is in favor of the book, is given by

Options:

- A. $\frac{183}{343}$
- B. $\frac{160}{343}$
- C. $\frac{209}{343}$
- D. $\frac{134}{343}$

Question 50

$f : R \rightarrow R$; $g : R \rightarrow R$ are two functions such that $f(x) = 2x - 3$, $g(x) = x^3 + 5$, then $(f \circ g)^{-1}(-9)$ is

Options:

- A. -2
- B. 2
- C. $-\sqrt{2}$
- D. $\sqrt{2}$

Chemistry

Question 51

Identify the compound with highest acidic strength from following.

Options:

- A. Ethanol
- B. t-Butyl alcohol
- C. Phenol
- D. p-Nitrophenol

Question 52

Which of the following species is NOT isoelectronic with neon?

Options:

- A. O^{2-}
- B. Na
- C. Mg^{2+}
- D. Al^{3+}

Question 53

Conductivity of a solution is $1.26 \times 10^{-2} \Omega^{-1} \text{ cm}^{-1}$. Calculate molar conductivity for 0.01 M solution.

Options:

- A. $1.26 \times 10^3 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$
- B. $2.52 \times 10^3 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$
- C. $4.82 \times 10^3 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$
- D. $6.30 \times 10^3 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$

Question 54

Identify the molecule from following that does NOT involve sp^3 hybridisation.

Options:

- A. CH_4
- B. C_2H_2
- C. H_2O
- D. NH_3

Question 55

Which among the following compounds is hemiacetal?

Options:

- A. B. C. D.

Question 56

Calculate the concentration of H^+ ions in a solution if pOH is 11.

Options:

- A. 10^{-11} M
- B. 10^{-8} M

- C. 10^{-6} M
- D. 10^{-3} M

Question 57

Identify the name of compound from following.

Options:

- A. Sulphanilic acid
- B. Sulphonic acid
- C. Benzene sulphonic acid
- D. Amino benzoic acid

Question 58

Identify the physical quantity that is measured in Candela.

Options:

- A. Energy
- B. Work
- C. Force
- D. Luminous intensity

Question 59

Calculate the edge length of unit cell of metal which crystallises to bcc structure. (Radius of metal atom = 173 pm)

Options:

- A. 5.01×10^{-8} cm
- B. 4.00×10^{-8} cm
- C. 4.5×10^{-8} cm
- D. 5.5×10^{-8} cm

Question 60

What is new temperature of a gas when its initial volume 3 dm^3 at 300 K is doubled at constant pressure?

Options:

- A. 450 K
- B. 600 K
- C. 750 K
- D. 900 K

Question 61

Which among the following phenols does NOT correctly match with their IUPAC names?

Options:

- A. Catechol : Benzene-1,2-diol
- B. Resorcinol : Benzene-1,3-diol
- C. o-Cresol : Benzene-1,2,3-triol
- D. Quinol : Benzene-1,4-diol

Question 62

Which among following statements is NOT true according to principles of green chemistry?

Options:

- A. In a chemical synthesis the waste product should be zero or minimum.
- B. Good atom economy means very few atoms of reactants are incorporated in the product.
- C. Only small amounts of unwanted by products are formed.
- D. Use of lindane is better than DDT.

Question 63

What is the value of effective atomic number of cobalt in $[Co(NH_3)_6]^{3+}$ complex if $Co(Z = 27)$?

Options:

- A. 30
- B. 32
- C. 35
- D. 36

Question 64

For the reaction, $3I^- + S_2O_8^{2-} \rightarrow I_3^- + 2SO_4^{2-}$, at a particular time t , $\frac{d[SO_4^{2-}]}{dt}$ is $2.2 \times 10^{-2} \text{ mol dm}^{-3} \text{ s}^{-1}$. What is the value of $-\frac{d[I^-]}{dt}$?

Options:

- A. $1.1 \times 10^{-2} \text{ mol dm}^{-3} \text{ s}^{-1}$
- B. $3.3 \times 10^{-2} \text{ mol dm}^{-3} \text{ s}^{-1}$
- C. $4.4 \times 10^{-2} \text{ mol dm}^{-3} \text{ s}^{-1}$
- D. $6.6 \times 10^{-2} \text{ mol dm}^{-3} \text{ s}^{-1}$

Question 65

What is the total number of Bravais lattices present for different crystal systems?

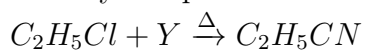
Options:

- A. 14

- B. 7
- C. 4
- D. 3

Question 66

Identify compound Y in the following reaction.



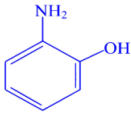
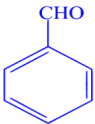
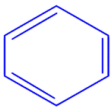
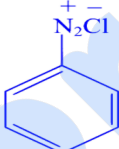
Options:

- A. NH_3
- B. HNO_3
- C. KCN (alc)
- D. $AgCN$ (alc)

Question 67

Aniline is treated with $NaNO_2 + HCl$ at low temperature to form:

Options:

- A. 
- B. 
- C. 
- D. 

Question 68

Which of the following is NOT a difficulty in setting SHE?

Options:

- A. To obtain pure hydrogen gas
- B. To obtain dry hydrogen gas
- C. To maintain exactly 1 atm pressure
- D. To bring the reaction in reverse direction

Question 69

Lewis acid is a substance that :

Options:

- A. gives H^+ ions aqueous solution
- B. accepts a proton
- C. accepts electron pair
- D. donates a proton

Question 70

Which among the following α -amino acids does NOT have chiral carbon atom?

Options:

- A. Histidine
- B. Glutamic acid
- C. Serine
- D. Glycine

Question 71

The difference between ΔH and ΔU is usually significant for systems consisting of :

Options:

- A. only solids
- B. only gases
- C. only liquids
- D. both solids and liquids

Question 72

Which of the following elements is doped with to obtain fibre amplifiers for optical fibre communication system?

Options:

- A. Zn
- B. Cu
- C. Er
- D. La

Question 73

What is the half life of a first order reaction if rate constant is 4.2×10^{-2} per day?

Options:

- A. 5.0 day
- B. 16.5 day
- C. 28.0 day
- D. 9.0 day

Question 74

What type of solution is the ethyl alcohol in water?

Options:

- A. Liquid in solid
- B. Solid in liquid

- C. Liquid in liquid
- D. Gas in liquid

Question 75

Which among the following colours is obtained in Schiff test of aldehydes?

Options:

- A. Blue
- B. Green
- C. Magenta
- D. Black

Question 76

Which from following monomers is used to prepare thermocol?

Options:

- A. Bisphenol and acrylamide
- B. Acrylamide
- C. Butadiene
- D. Styrene

Question 77

Which of the following is character of lyophilic colloid?

Options:

- A. Particles of dispersed phase have no affinity for dispersion medium.
- B. Particles easily detected under ultramicroscope.
- C. Addition of large amount of electrolyte causes precipitation.
- D. These are irreversible colloids.

Question 78

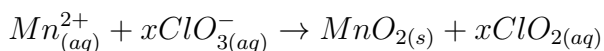
Find the depression in freezing point of solution when 3.2 gram non volatile solute with molar mass 128 g mol^{-1} is dissolved in 80 gram solvent if cryoscopic constant of solvent is $4.8 \text{ K kg mol}^{-1}$.

Options:

- A. 3.0 K
- B. 1.5 K
- C. 2.0 K
- D. 2.5 K

Question 79

What is the value of x in order to balance following redox reaction?



Options:

- A. $x = 1$
- B. $x = 2$
- C. $x = 3$
- D. $x = 4$

Question 80

The reaction, $3ClO^{-} \rightarrow ClO_3^{-} + 2Cl^{-}$ occurs in two steps:

- i. $2ClO^{-} \rightarrow ClO_2^{-} + Cl^{-}$
- ii. $ClO_2^{-} + ClO^{-} \rightarrow ClO_3^{-} + Cl^{-}$

the reaction intermediate is:

Options:

- A. Cl^{-}
- B. ClO_2^{-}
- C. ClO_3^{-}
- D. ClO^{-}

Question 81

Acetic acid dissociated to 1.20% in its 0.01 M solution. What is the value of its dissociation constant?

Options:

- A. 2.20×10^{-2}
- B. 1.60×10^{-4}
- C. 1.44×10^{-6}
- D. 2.40×10^{-4}

Question 82

The structure of functional group of secondary amide is :

Options:

- A. $-NH-$
- B. C. D.

Question 83

Which of the following solutions exhibits lowest value of boiling point elevation assuming complete dissociation?

Options:

- A. 0.1 m $AlCl_3$
- B. 0.01 m $MgCl_2$
- C. 1 m KCl
- D. 0.5 m $NaCl$

Question 84

Identify heteroleptic complex from following.

Options:

- A. Tetraammineaquacobalt (III) chloride
- B. Hexaamminecobalt (III) bromide
- C. Potassium tetrahydroxozincate (II)
- D. Tetracarbonyl nickel (0)

Question 85

Which among the following statements of group-1 elements is NOT true?

Options:

- A. Unipositive ions have inert gas configuration.
- B. Compounds of unipositive ions are paramagnetic.
- C. These form colourless compounds in +1 state.
- D. These have high negative values of standard reduction potential.

Question 86

Identify glycosidic linkage present in lactose.

Options:

- A. $\beta - 1, 2$
- B. $\alpha - 1, 4$
- C. $\beta - 1, 4$
- D. $\beta - 1, 6$

Question 87

Which of the following compounds reacts with HBr to form 1-Bromo-1-methylcyclohexane?

Options:

- A. B. C. D.

Question 88

Identify degenerate orbitals from following for hydrogen atom.

Options:

- A. 1s and 2s
- B. 1s and 2p
- C. 2s and 2p
- D. 3s and 2p

Question 89

Identify the product P obtained in following reaction.



Options:

- A. Benzoic acid
- B. Benzaldehyde
- C. Phenol
- D. Glyoxal

Question 90

Identify strongest oxoacid of halogen from following.

Options:

- A. Hypochlorous acid
- B. Chlorous acid
- C. Chloric acid
- D. Perchloric acid

Question 91

Identify the reagent R used in the reaction stated below.



Options:

- A. HCl
- B. $\text{H}_3\text{PO}_2/\text{H}_2\text{O}$
- C. $\text{H}_2\text{O}/\text{HCl}$
- D. $\text{CH}_3 - \text{CH}_2 - \text{OH}$

Question 92

Identify lanthanoid element from following.

Options:

- A. Eu
- B. Cm
- C. Am
- D. Np

Question 93

What is change in internal energy when system releases 8 kJ of heat and performs 660 J of work on the surrounding?

Options:

- A. -7340 J
- B. -5400 J
- C. -8660 J
- D. -1212 J

Question 94

Identify the method used to obtain SO_2 gas in industry.

Options:

- A. By burning sulphur in air
- B. By treating sodium sulphite with dil. sulphuric acid
- C. By treating sodium sulphite with dil. hydrochloric acid
- D. By roasting zinc sulphide and iron pyrites

Question 95

Which among the following compounds reacts fastly with HBr ?

Options:

- A. B. C. D.

Question 96

Identify biodegradable polymer from following.

Options:

- A. Nylon 2-nylon 6
- B. Terylene
- C. Nylon 6
- D. Nylon 6,6

Question 97

What mass of Mg is produced during electrolysis of molten $MgCl_2$ by passing 2 amp current for 482.5 second?

(Molar mass $Mg = 24 \text{ g mol}^{-1}$)

Options:

- A. 0.12 g
- B. 0.24 g
- C. 1.2 g
- D. 0.4 g

Question 98

Calculate the final volume when 2 moles of an ideal gas expand from 3 dm^3 at constant external pressure 1.6 bar and the work done in the process is 800 J.

Options:

- A. 2.66 dm^3
- B. 4.8 dm^3
- C. 5.0 dm^3
- D. 8.0 dm^3

Question 99

Calculate the molar mass of an element with density 2.7 g cm^{-3} that forms fcc structure.

$[a^3 \cdot N_A = 40 \text{ cm}^3 \text{ mol}^{-1}]$

Options:

- A. 112 g mol^{-1}
- B. 54 g mol^{-1}
- C. 27 g mol^{-1}
- D. 78 g mol^{-1}

Question 100

Identify ketone from the following.

Options:

- A. Ethyl ethanoate
- B. Acetophenone
- C. N-Methylphthalimide
- D. Methyl salicylate

Physics

Question 101

An open organ pipe having fundamental frequency (n) is in unison with a vibrating string. If the tube is dipped in water so that 75% of the length of the tube is inside the water then the ratio of fundamental frequency of the air column of dipped tube with that of string will be (Neglect end corrections)

Options:

- A. 1 : 1
- B. 2 : 1
- C. 2 : 3
- D. 3 : 2

Question 102

A graph of magnetic flux (ϕ) versus current (I) is plotted for four inductors A, B, C, D. Larger value of self inductance is for inductor

Options:

- A. A
- B. B
- C. C
- D. D

Question 103

An electron accelerated through a potential difference ' V_1 ' has a de-Broglie wavelength ' λ '. When the potential is changed to ' V_2 ' its de-Broglie wavelength increases by 50%. The value of $\left(\frac{V_1}{V_2}\right)$ is

Options:

- A. 3 : 1
- B. 9 : 4
- C. 3 : 2
- D. 4 : 1

Question 104

In case of a stationary wave pattern which of the following statement is CORRECT?

Options:

- A. The distance between the consecutive nodes is equal to the wavelength.
- B. In a pipe at both ends only even harmonics are present in an air column.
- C. In a pipe closed at one end, all harmonics are present in an air column.

D. In case of a stretched string when vibrated, frequency of first overtone is same as second harmonic.

Question 105

If 'I' is moment of inertia of a thin circular disc about an axis passing through the tangent of the disc and in the plane of disc. The moment of inertia of same circular disc about an axis perpendicular to plane and passing through its centre is

Options:

- A. $\frac{4I}{5}$
- B. $\frac{2I}{5}$
- C. $\frac{4I}{3}$
- D. $\frac{2I}{3}$

Question 106

A parallel plate capacitor has plate area 'A' and separation between plates is 'd'. It is charged to a potential difference of V_0 volt. The charging battery is then disconnected and plates are pulled apart three times the initial distance. The work done to increase the distance between the plates is (ϵ_0 = permittivity of free space)

Options:

- A. $\frac{3\epsilon_0 AV_0^2}{d}$
- B. $\frac{\epsilon_0 AV_0^2}{2d}$
- C. $\frac{\epsilon_0 AV_0^2}{3d}$
- D. $\frac{\epsilon_0 AV_0^2}{d}$

Question 107

The shortest wavelength in the Balmer series of hydrogen atom is equal to the shortest wavelength in the Brackett series of a hydrogen like atom of atomic number z. The value of z is

Options:

- A. 2
- B. 3
- C. 4
- D. 6

Question 108

If the length of stretched string is reduced by 40% and tension is increased by 44% then the ratio of final to initial frequencies of stretched string is

Options:

- A. 2 : 1

- B. 3 : 2
- C. 3 : 4
- D. 1 : 3

Question 109

A square loop of area 25 cm^2 has a resistance of 10Ω . This loop is placed in a uniform magnetic field of magnitude 40 T . The plane of loop is perpendicular to the magnetic field. The work done in pulling the loop out of the magnetic field slowly and uniformly in one second, will be

Options:

- A. $1 \times 10^{-4} \text{ J}$
- B. $1.0 \times 10^{-3} \text{ J}$
- C. $5 \times 10^{-3} \text{ J}$
- D. $2.5 \times 10^{-3} \text{ J}$

Question 110

Two capacitors $C_1 = 3\mu F$ and $C_2 = 2\mu F$ are connected in series across d.c. source of 100 V . The ratio of the potential across C_2 to C_1 is

Options:

- A. 2 : 3
- B. 3 : 2
- C. 6 : 5
- D. 5 : 6

Question 111

To obtain the truth-table shown, from the following logic circuit, the gate G should be

Options:

- A. AND
- B. NAND
- C. OR
- D. NOR

Question 112

An electric dipole consisting of two opposite charges of $2 \times 10^{-6} \text{ C}$ separated by a distance of 3 cm placed in an electric field of $2 \times 10^5 \text{ N/C}$ then the maximum torque acting on dipole is

Options:

- A. $12 \times 10^{-1} \text{ N-m}$
- B. $24 \times 10^{-3} \text{ N-m}$

- C. 12×10^{-3} N-m
D. 24×10^{-1} N-m

Question 113

In insulators

Options:

- A. valence band is empty and conduction band is filled with electrons.
B. conduction band is empty and valence band is completely filled with electrons.
C. valence band is partially filled.
D. conduction band is partially filled with electrons.

Question 114

Seven identical discs each of mass M and radius R are arranged in a hexagonal plane pattern so as to touch each neighbour disc as shown in the figure. The moment of inertia of the system of seven discs about an axis passing through the centre of central disc and normal to the plane of all discs is

Options:

- A. $\frac{7}{2}MR^2$
B. $\frac{13}{2}MR^2$
C. $\frac{29}{2}MR^2$
D. $\frac{55}{2}MR^2$

Question 115

A satellite moves in a stable circular orbit round the earth if (where V_H , V_c and V_e are the horizontal velocity, critical velocity and escape velocity respectively)

Options:

- A. $V_H < V_c$
B. $V_H = V_e$
C. $V_H = V_c$
D. $V_H > V_e$

Question 116

The mean electrical energy density between plates of a charged air capacitor is (where q = charge on capacitor, A = Area of capacitor plate)

Options:

- A. $\frac{q^2}{2\varepsilon_0 A^2}$
B. $\frac{q}{2\varepsilon_0 A^2}$

- C. $\frac{q^2}{2\epsilon_0 A}$
 D. $\frac{\epsilon_0 A}{q^2}$

Question 117

A person is observing a bacteria through a compound microscope. For better observation and to improve its resolving power he should

Options:

- A. increase the wavelength of light.
 B. increase the refractive index of the medium between the object and objective lens.
 C. decrease the focal length of the eyepiece.
 D. decrease the diameter of the objective lens.

Question 118

The inductive reactance of a coil is ' X_L '. If the inductance of a coil is tripled and frequency of a.c. supply is doubled, then the new inductive reactance will be

Options:

- A. $\frac{2}{3}X_L$
 B. $\frac{3}{2}X_L$
 C. $\frac{1}{6}X_L$
 D. $6X_L$

Question 119

In the circuit shown the ratio of quality factor and the bandwidth is

Options:

- A. 10 s
 B. 8 s
 C. 6 s
 D. 4 s

Question 120

Water flows through a horizontal pipe at a speed ' V '. Internal diameter of the pipe is ' d '. If the water is coming out at a speed ' V_1 ' then the diameter of the nozzle is

Options:

- A. $d\sqrt{\frac{V_1}{V}}$
 B. $d\sqrt{\frac{V}{V_1}}$
 C. $\frac{dV}{V_1}$
 D. $\frac{V_1}{dV}$

Question 121

In Young's double slit experiment the separation between the slits is doubled without changing other setting of the experiment to obtain same fringe width, the distance 'D' of the screen from slit should be made

Options:

- A. $\frac{D}{2}$
- B. $\frac{D}{\sqrt{2}}$
- C. $2D$
- D. $4D$

Question 122

A body is released from the top of a tower 'H' metre high. It takes t second to reach the ground. The height of the body $\frac{t}{2}$ second after release is

Options:

- A. $\frac{H}{2}$ metre from ground
- B. $\frac{H}{4}$ metre from ground
- C. $\frac{3H}{4}$ metre from ground
- D. $\frac{H}{6}$ metre from ground

Question 123

There is a second's pendulum on the surface of earth. It is taken to the surface of planet whose mass and radius are twice that of earth. The period of oscillation of second's pendulum on the planet will be

Options:

- A. $2\sqrt{2}$ s
- B. 2 s
- C. $\frac{1}{\sqrt{2}}$ s
- D. $\frac{1}{2}$ s

Question 124

Two long parallel wires carrying currents 8 A and 15 A in opposite directions are placed at a distance of 7 cm from each other. A point 'P' is at equidistant from both the wires such that the lines joining the point to the wires are perpendicular to each other. The magnitude of magnetic field at point 'P' is $(\sqrt{2} = 1.4)(\mu_0 = 4\pi \times 10^{-7} \text{ SI units})$

Options:

- A. $68 \times 10^{-6} \text{ T}$
- B. $48 \times 10^{-6} \text{ T}$
- C. $32 \times 10^{-6} \text{ T}$
- D. $16 \times 10^{-6} \text{ T}$

Question 125

A body of mass 200 gram is tied to a spring of spring constant 12.5 N/m, while other end of spring is fixed at point 'O'. If the body moves about 'O' in a circular path on a smooth horizontal surface with constant angular speed 5 rad/s then the ratio of extension in the spring to its natural length will be

Options:

- A. 1 : 2
- B. 1 : 1
- C. 2 : 3
- D. 2 : 5

Question 126

Which of the following is NOT involved in the formation of secondary rainbow?

Options:

- A. Refraction
- B. Angular dispersion
- C. Interference
- D. Total internal reflection

Question 127

For a satellite orbiting around the earth in a circular orbit, the ratio of potential energy to kinetic energy at same height is

Options:

- A. $\frac{1}{\sqrt{2}}$
- B. $\frac{1}{2}$
- C. $\sqrt{2}$
- D. 2

Question 128

Maximum kinetic energy of photon is 'E' when wavelength of incident radiation is ' λ '. If wavelength of incident radiations is reduced to $\frac{\lambda}{3}$ then energy of photon becomes four times. Then work function of the metal is

Options:

- A. $\frac{3hc}{\lambda}$
- B. $\frac{hc}{3\lambda}$
- C. $\frac{hc}{\lambda}$
- D. $\frac{hc}{2\lambda}$

Question 129

Consider the Doppler effect in two cases. In the first case, an observer moves towards a stationary source of sound with a speed of 50 m/s. In the second case, the observer is at rest and the source moves towards the observer with the same speed of 50 m/s. Then the frequency heard by the observer will be [velocity of sound in air = 330 m/s.]

Options:

- A. same in both the cases.
- B. more in the second case than in the first case.
- C. less in the second case than in the first case.
- D. less than the actual frequency in both the cases.

Question 130

According to Curie's law in magnetism, the correct relation is (M = magnetization in paramagnetic sample, B = applied magnetic field, T = absolute temperature of the material, C = curie's constant)

Options:

- A. $M = \frac{T}{CB}$
- B. $M = \frac{CB}{T}$
- C. $C = \frac{MB}{T}$
- D. $C = \frac{T^2}{MB}$

Question 131

A double convex air bubble in water behaves as

Options:

- A. convergent lens
- B. divergent lens
- C. plane slab
- D. concave mirror

Question 132

Three liquids have same surface tension and densities ρ_1, ρ_2 , and ρ_3 ($\rho_1 > \rho_2 > \rho_3$). In three identical capillaries rise of liquid is same. The corresponding angles of contact θ_1, θ_2 and θ_3 are related as

Options:

- A. $\theta_1 > \theta_2 > \theta_3$
- B. $\theta_1 > \theta_3 > \theta_2$
- C. $\theta_1 < \theta_2 < \theta_3$
- D. $\theta_1 = \theta_2 = \theta_3$

Question 133

If a lighter body of mass ' M_1 ' and velocity ' V_1 ' and a heavy body (mass M_2 and velocity V_2) have the same kinetic energy then

Options:

- A. $M_2V_2 < M_1V_1$
- B. $M_2V_2 = M_1V_1$
- C. $M_2V_1 < M_1V_2$
- D. $M_2V_2 > M_1V_1$

Question 134

Electron of mass ' m ' and charge ' q ' is travelling with speed ' v ' along a circular path of radius ' R ', at right angles to a uniform magnetic field of intensity ' B '. If the speed of the electron is halved and the magnetic field is doubled, the resulting path would have radius

Options:

- A. $4R$
- B. $2R$
- C. $\frac{R}{2}$
- D. $\frac{R}{4}$

Question 135

In a series LR circuit, $X_L = R$, power factor is P_1 . If a capacitor of capacitance C with $X_C = X_L$ is added to the circuit the power factor becomes P_2 . The ratio of P_1 to P_2 will be

Options:

- A. $1 : 3$
- B. $1 : \sqrt{2}$
- C. $1 : 1$
- D. $1 : 2$

Question 136

If only 1% of total current is passed through a galvanometer of resistance ' G ' then the resistance of the shunt is

Options:

- A. $\frac{G}{25}\Omega$
- B. $\frac{G}{49}\Omega$
- C. $\frac{G}{2}\Omega$
- D. $\frac{G}{99}\Omega$

Question 137

A voltmeter of resistance 150Ω connected across a cell of e.m.f. 3 V reads 2.5 V . What is the internal resistance of the cell?

Options:

- A. 10Ω
- B. 15Ω
- C. 20Ω
- D. 30Ω

Question 138

Two conducting circular loops of radii ' R_1 ' and ' R_2 ' are placed in the same plane with their centres coinciding. If $R_1 > R_2$, the mutual inductance M between them will be directly proportional to

Options:

- A. $\frac{R_1}{R_2}$
- B. $\frac{R_2}{R_1}$
- C. $\frac{R_1^2}{R_2^2}$
- D. $\frac{R_2^2}{R_1^2}$

Question 139

The average force applied on the walls of a closed container depends on T^x where T is the temperature of an ideal gas. The value of ' x ' is

Options:

- A. 4
- B. 3
- C. 2
- D. 1

Question 140

A black body radiates maximum energy at wavelength ' λ ' and its emissive power is E . Now due to change in temperature of that body, it radiates maximum energy at wavelength $\frac{2\lambda}{3}$. At that temperature emissive power is

Options:

- A. $\frac{51E}{8}$
- B. $\frac{81E}{16}$
- C. $\frac{61E}{27}$
- D. $\frac{71E}{19}$

Question 141

A Carnot engine with efficiency 50% takes heat from a source at 600 K. To increase the efficiency to 70%, keeping the temperature of the sink same, the new temperature of the source will be

Options:

- A. 360 K
- B. 1000 K
- C. 900 K
- D. 300 K

Question 142

The amplitude of a particle executing S.H.M. is 3 cm. The displacement at which its kinetic energy will be 25% more than the potential energy is

Options:

- A. 1 cm
- B. 2 cm
- C. 3 cm
- D. 4 cm

Question 143

A piece of metal at 850 K is dropped in to 1 kg water at 300 K. If the equilibrium temperature of water is 350 K then the heat capacity of the metal, expressed in JK^{-1} is (1 cal = 4.2 J)

Options:

- A. 420
- B. 240
- C. 100
- D. No Solution

Question 144

Heat energy is incident on the surface at the rate of $X \text{ J/min}$. If ' a ' and ' r ' represent coefficient of absorption and reflection respectively then the heat energy transmitted by the surface in ' t ' minutes is

Options:

- A. $(a + r)xt$
- B. $\frac{(a+r)}{xt}$
- C. $-(a + r)xt$
- D. $\frac{xt}{(a+r)}$

Question 145

Identify the mismatch out of the following.

Options:

- A. Zener diode - voltage regulator.
- B. Photodiode-optocouplers.
- C. Solar cell - Electrical energy into light.
- D. Light emitting diode - optical communication.

Question 146

Two sources of light 0.6 mm apart and screen is placed at a distance of 1.2 m from them. A light of wavelength $6000\text{\AA}$ used. Then the phase difference between the two light waves interfering on the screen at a point at a distance 3 mm from central bright band is

Options:

- A. 6π radian
- B. 3π radian
- C. 4π radian
- D. 5π radian

Question 147

The ratio of longest to shortest wavelength emitted in Paschen series of hydrogen atom is

Options:

- A. $\frac{144}{63}$
- B. $\frac{25}{9}$
- C. $\frac{9}{25}$
- D. $\frac{63}{144}$

Question 148

The height of liquid column raised in a capillary tube of certain radius when dipped in liquid 'A' vertically is 5 cm. If the tube is dipped in a similar manner in another liquid 'B' of surface tension and density double the values of liquid 'A', the height of liquid column raised in liquid 'B' would be (Assume angle of contact same)

Options:

- A. 0.20 m
- B. 0.5 m
- C. 0.05 m
- D. 0.10 m

Question 149

A particle of mass 'm' is rotating along a circular path of radius 'r' having angular momentum 'L'. The centripetal force acting on the particle is given by

Options:

- A. $\frac{L^2}{mr}$
- B. $\frac{L^2}{mr^2}$
- C. $\frac{mL^2}{r}$
- D. $\frac{L^2}{mr^3}$

Question 150

A sample of gas at temperature T is adiabatically expanded to double its volume. The work done by the gas in the process is $\left(\frac{C_p}{C_v} = \gamma = \frac{3}{2}\right)$ (R = gas constant)

Options:

- A. $TR(\sqrt{2} - 2)$
- B. $\frac{T}{R}(\sqrt{2} - 2)$
- C. $\frac{R}{T}(2 - \sqrt{2})$
- D. $RT(2 - \sqrt{2})$

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