12. Among statements (a) – (d), the correct ones are:

(a) Cryolite $Na_3[AlF_6]$ lowers the melting point of Al_2O_3 in Hall-Heroult process

(b) The method of zone refining of metals is based on the principle of solubility of the impurity in the molten state than in the solid state

(c) Extraction of Pb is possible by carbon reduction method

(d) In Hall-Heroult process, Aluminium is obtained at cathode and CO_2 at anode

(A) (a), (b), (c) and (d) **(B)** (a), (c) and (d) only

(C) (c) and (d) only **(D)** (b). (c) and (d) only

13. The elements Europium and Rutherfordium belong respectively to:

(A) Group 3 and Group 6 **(B)** Group 4 and Actinoids

(C) Lanthanoids and Group 4 **(D)** Group 4 and Group 10

14. Match the following

(i)	Paints	(P)	Solid sol
(ii)	Cloud	(Q)	Foam
(iii)	Hair cream	(R)	Sol
(iv)	Whipped cream	(S)	Emulsion
		(T)	Aerosol

(A) $(i) \rightarrow (P), (ii) \rightarrow (R), (iii) \rightarrow (S), (iv) \rightarrow (Q)$

(B) $(i) \rightarrow (S), (ii) \rightarrow (Q), (iii) \rightarrow (T), (iv) \rightarrow (P)$

(C) $(i) \rightarrow (R), (ii) \rightarrow (T), (iii) \rightarrow (S), (iv) \rightarrow (Q)$

(D) $(i) \rightarrow (T), (ii) \rightarrow (R), (iii) \rightarrow (Q), (iv) \rightarrow (S)$

15. Insoluble component of starch in water constituting 80% to 85% of starch is composed of –

(A) $\beta - D -$ glucose, $C_1 - C_4$ and $C_2 - C_6$ linkages

(B) $\alpha - D -$ glucose, $C_1 - C_4$ and $C_2 - C_6$ linkages

(C) $\beta - D -$ glucose, $C_1 - C_4$ and $C_1 - C_6$ linkages

(D) $\alpha - D -$ glucose, $C_1 - C_4$ and $C_1 - C_6$ linkages

16. Which of the following statement is incorrect?

(A) Work done is zero during expansion of 1 mole of an ideal gas into vacuum under isolated conditions

(B) For isothermal process, ΔU and ΔH are equal to zero

(C) Change in internal energy is zero during the mixing of equal volume of two ideal gases at constant temperature and pressure in an isolated container

(D) The change in internal energy of the gas is (i) zero, if it is expanded reversibly with $T_1 = T_2$ and (ii) positive, if it is expanded reversibly under adiabatic conditions with $T_1 \neq T_2$

17. The pair in which both the species have the same hybridization is

(A) $\left[Ni(NH_3)_6\right]^{2+}$ and $\left[Mn(CN)_6\right]^{4-}$ **(B)** $\left[Co(NH_3)_6\right]^{2+}$ and $\left[Mn(CN)_6\right]^{4-}$

(C) $\left[Cr(NH_3)_6\right]^{3+}$ and $\left[Co(H_2O)_6\right]^{2+}$ **(D)** $\left[Co(H_2O)_6\right]^{2+}$ and $\left[Ni(NH_3)_6\right]^{2+}$

18. Number of spectral line produced when electron jumps from gamma line region of Balmer series to ground state in hydrogen atom.

(A) 15 **(B)** 10 **(C)** 20 **(D)** 5

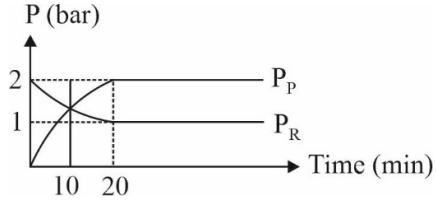
19. Arrange the following in the decreasing order of their thermal stability of Cl_2, F_2, I_2, Br_2.

(A) $F_2 > Cl_2 > Br_2 > I_2$ **(B)** $Cl_2 > Br_2 > F_2 > I_2$

(C) $Cl_2 > F_2 > Br_2 > I_2$ **(D)** $F_2 > Br_2 > Cl_2 > I_2$

20. For the reaction $R(g) \rightarrow 2P(g)$

Following observation is made at 300K.



Select the correct statements(s)

(A) $(\Delta_r G)$ at 10 min $= 0$ **(B)** $(\Delta_r G)$ at 20 min $= 0$

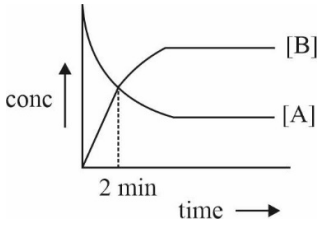
(C) $\Delta_r G^0$ at 10 min $= +ve$ **(D)** $\Delta_r G^0$ at 20 min $= 0$

SECTION-2

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted.

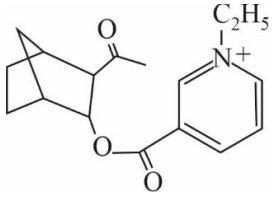
The answer to each question is a NUMERICAL VALUE. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, Θ sign should be bubbled.* (Example: 6, 81, 1.50, 3.25, 0.08)

21. For the first order reaction, $A_{(g)} \rightarrow 3B_{(g)}$ the concentration versus time graph is given below



What is the half-life in minutes? (log 2 = 0.3, log 3 = 0.48)

22. The number of asymmetric centres present in the following compound are_____.



23. An ideal solution is formed by mixing of 460 g. of ethanol with xg. of methanol. The total vapour pressure of the solution is 72 mm of Hg. The vapour pressure of pure ethanol and pure methanol are 48 and 80 mm of Hg respectively. Find the value of x. [Given: Atomic mass H = 1, C = 12, O = 16]

24. A 0.0020 m aqueous solution of an ionic compound $Co(NH_3)_4(Cl)_3$ freezes at – 0.00732°C. Number of moles of AgCl precipitated when 1 mole of the above ionic compound is treated with $AgNO_3$ solution. $(K_f = 1.86^oC/m)$

25. A 20 ml solution containing 0.2 g impure H_2O_2 reacts completely with 0.316 g of $KMnO_4$ in acidic medium. What would be volume strength of H_2O_2 solution? [Given: Molar mass of H_2O_2 = 34 & $KMnO_4$ = 158 g/mol

26. The mass of dinitrogen in grams produced by the thermal decomposition of 2 moles of ammonium dichromate.

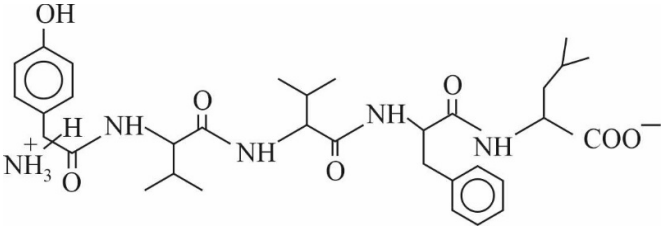
27. Amongst given polymers, how many of them are addition polymer.

(i)	Melmac	(ii)	ABS rubber	(iii)	Plexiglass
(iv)	Orlon	(v)	Teflon	(vi)	Kevlar
(vii)	Dextron	(viii)	Polyurethanes		

28. The maximum recommended levels in ppm of Zn metal in water sample which makes water suitable for drinking is_____.

29. The Reagent which is commercially known as 'calgon' that is used to remove the permanent hardness of water in Calgon's method. Find out the number of moles of calgon required to remove 12 moles of Ca^{2+} ion present in hard water.

30. The total number of distinct essential amino acids obtained after complete acidic hydrolysis of the peptide shown below is _____.



SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

1 $\int \frac{2x^2\left(1+2x^2\right)}{\left(1+x^2+x^4\right)^2}dx$ is equal to

(A) $-\frac{x}{1+x^2+x^4}+\frac{1}{2\sqrt{3}}\tan^{-1}\left(\frac{x-\frac{1}{x}}{\sqrt{3}}\right)-\frac{1}{4}\log\left(\frac{x+\frac{1}{x}-1}{x+\frac{1}{x}+1}\right)+C$

(B) $-\frac{x}{1+x^2+x^4}-\frac{1}{2\sqrt{3}}\tan^{-1}\left(\frac{x-\frac{1}{x}}{\sqrt{3}}\right)+\frac{1}{2}\log\left(\frac{x+\frac{1}{x}-1}{x+\frac{1}{x}+1}\right)+C$

(C) $-\frac{x}{1+x^2+x^4}-\frac{1}{2\sqrt{3}}\tan^{-1}\left(\frac{x-\frac{1}{x}}{\sqrt{3}}\right)+\frac{1}{4}\log\left(\frac{x+\frac{1}{x}+1}{x+\frac{1}{x}-1}\right)+C$

(D) $-\frac{x}{1+x^2+x^4}+\frac{1}{2\sqrt{3}}\tan^{-1}\left(\frac{x-\frac{1}{x}}{\sqrt{3}}\right)+\frac{1}{4}\log\left(\frac{x+\frac{1}{x}-4}{x+\frac{1}{x}-4}\right)+C$

2. A vertical pole of length 15m standing on the point A. ABC are points on horizontal ground forming a triangle with $\angle A=90°$.

If $AB=6m$ and AC = $8m$ and a point 'D' (on horizontal plane) is equidistant from A, B, C. Find distance of D from top of the pole

(A) $5\sqrt{10}\,m$ **(B)** $10\sqrt{5}\,m$ **(C)** $6\sqrt{10}\,m$ **(D)** None of these

3. Find the sum of the series $\frac{^{100}C_{25}}{100}+\frac{^{99}C_{25}}{99}+\frac{^{98}C_{25}}{98}.....+\frac{^{50}C_{25}}{50}$

(A) $\frac{1}{25}\left[^{100}C_{25}+{}^{50}C_{25}\right]$ **(B)** $\frac{1}{25}\left[^{100}C_{25}-{}^{51}C_{25}\right]$

(C) $\frac{1}{25}\left[^{100}C_{25}-{}^{49}C_{25}\right]$ **(D)** $\frac{1}{25}\left[^{100}C_{25}-{}^{50}C_{26}\right]$

4. Given the following two statements

$S_1:(p\wedge\sim p)\to(p\wedge q)$ is a tautology.

$S_2:(p\vee\sim p)\to(p\vee q)$ is a fallacy

(A) S_1 is true **(B)** S_2 is true

(C) Both S_1 *and* S_2 *are true* **(D)** None of these

5. If $f(x)=\sqrt{\cos^2 x}+\sqrt{\sin^2 x}$ *then* $\int_{-3/2}^{3/2}\left[f(x)\right]dx=$

Where [ ] G.I.F.

(A) 3 **(B)** 4 **(C)** 5 **(D)** 6

6. $f(x)=\sin^{-1}(\sin x)$ then $\frac{d}{dx}f(x)$ at $x=\frac{7\pi}{2}$ is

(A) 1 **(B)** –1

(C) Not differentiable **(D)** None of these

7. Let $f(x)=\begin{vmatrix}\bar{a}.\bar{a} & \bar{a}.\bar{b} & \bar{a}.\bar{c}\\ \bar{b}.\bar{a} & \bar{b}.\bar{b} & \bar{b}.\bar{c}\\ \bar{c}.\bar{a} & \bar{c}.\bar{b} & \bar{c}.\bar{c}\end{vmatrix}$ where

$\bar{a}=\hat{i}+x\hat{j}+x^2\hat{k}$

$\bar{b}=x\hat{i}+x^2\hat{j}+\hat{k}$

$\bar{c}=x^2\hat{i}+\hat{j}+x\hat{k}$

Then stationary points of $f(x)$ are-

(A) $x=0,1$ **(B)** $x=-1,0$ **(C)** $x=-1$ only **(D)** None of these

8. If an ellipse and a hyperbola having centre at origin and foci on (± 10, 0), if the distance between their Directix (both in positive direction of x axis) is 10 units, find Difference of Squares of the Lengths of their major Axis and Transverse axis

(A) 400 **(B)** 300 **(C)** 200 **(D)** 160

9. $f(x)=\int_0^x\frac{x^2+x+1}{x+1+\sqrt{x}}dx$, then $f(1)=$

(A) $\frac{7}{6}$ **(B)** $\frac{2}{3}$ **(C)** $\frac{11}{6}$ **(D)** $\frac{5}{6}$

10. If roots of $px^2-3x+2=0$ are α,β and that of $qx^2-7x+2=0$ are γ,δ are such that $\alpha,\beta,\gamma,\delta$ are in HP then p + q =

(A) 5 **(B)** 7 **(C)** 11 **(D)** 13

11. Equation of normal to hyperbola $x^2-y^2=2$

Passing through (6, 0)

(A) $\frac{x}{3}\pm\frac{y}{\sqrt{7}}=2$ **(B)** $\frac{x}{3}\pm\frac{y}{\sqrt{5}}=2$ **(C)** $\frac{x}{3}\pm\frac{y}{7}=2$ **(D)** $\frac{x}{3}\pm\frac{y}{5}=2$

12. Three natural numbers in AP are removed from first 21 natural numbers. Mean of remaining numbers is 11. The sum of all common difference of all such possible increasing AP is.

(A) 36 **(B)** 45 **(C)** 55 **(D)** 67

13. If $z_1=3+4i$ *and* $z_2=2+i$, *and* z satisfy the equation $2\left(z+\bar{z}\right)+3\left(z-\bar{z}\right)i=0$, Then for Minimum value of $|z-z_1|+|z-z_2|$, possible value of z can be

(A) $\frac{15}{7}+\frac{10}{7}i$ **(B)** $\frac{15}{7}+\frac{8}{7}i$ **(C)** $\frac{15}{7}+\frac{9}{7}i$ **(D)** $\frac{10}{7}+\frac{15}{7}i$

14. If $\left(x+\sqrt{1+x^2}\right)\left(y+\sqrt{1+y^2}\right)=1$ then $\frac{dy}{dx}$ may be equals to

(A) 0 **(B)** -1 **(C)** 1 **(D)** None of these

15. If $A=\begin{bmatrix}\cos\theta & \sin\theta\\ -\sin\theta & \cos\theta\end{bmatrix}$ where $\theta=\frac{2\pi}{7}$ then $\sum_{r=1}^{6}A^r=$

(A) $\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$ **(B)** $\begin{bmatrix}3 & 0\\ 0 & 3\end{bmatrix}$ **(C)** $\begin{bmatrix}-1 & 0\\ 0 & -1\end{bmatrix}$ **(D)** None of these

16. A survey shows that in a city 60% families own a car, 80% families have a scooter, and 40% have a bicycle. Also 30% own both a Car and scooter, 35% Car and bicycle and 25% scooter and bicycle, and some families owns all the three. Now the families who have neither of the three can be

(A) 7 % **(B)** 11% **(C)** 12% **(D)** 15%

17. $\left(1^2-2^2+3^2\right)+\left(4^2-5^2+6^2\right)+\left(7^2-8^2+9^2\right)....30\,\text{terms}$

(A) 82395 **(B)** 80396 **(C)** 82389 **(D)** 82399

18. $xdy-ydx=2x^3y\left(xdy+ydx\right)$ if $y(1)=1$, then $y(2)+y\left(\frac{1}{2}\right)=$

(A) $\frac{65}{8}$ **(B)** $\frac{8}{65}$ **(C)** $\frac{65}{\sqrt{8}}$ **(D)** 65

19. In an equilateral triangle having vertex $A(8,9)$, $B(-4,3)$, $C(h,k)$ sum of all possible h and k

(A) 13 **(B)** 16 **(C)** 26 **(D)** 43

20. $\sum_{r=1}^{10}\left(r+\left\{\frac{r}{7}\right\}+\left\{\frac{2r}{7}\right\}\right)=$ where $\{x\}\to$ fractional part function

(A) $\frac{445}{7}$ **(B)** $\frac{454}{7}$ **(C)** $\frac{447}{17}$ **(D)** $\frac{447}{7}$

SECTION-2

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21. If $f(x)+f(y)=f\left(xy-\sqrt{1-x^2}\sqrt{1-y^2}\right)$, $f(0)=\frac{\pi}{2}$ and f is differentiable in (–1, 1).

Then $\left|\lim_{x\to 0}\frac{2f(x)-\pi}{x}\right|=$

22. Plane $x+y+z=1$ cuts the *x, y, z* Axis at A,B,C respectively the distance of plane from point *P* such that $OP=PA=PB=PC$ is *D*, then $4\sqrt{3}\,D=$ (where O is origin)

23. $4x+3y+2z=1$
$x-y+3z=4$
$2x+5y-4z=6$ has *n* solution than *n* =

2**4.** 15 identical balls are placed in 3 different boxes, find the probability that each box contain at least 3 balls is *p* than 34*p* =

25. $\left(1+2x+3x^2\right)^{15}=\sum_{r=0}^{30}a_r x^r$ then digit at the unit place of $a_0+a_1+a_{30}$ *is*

26. $\int\sqrt{\cos x\left(\cos^3 x+\sin 2x\right)}dx=\frac{1-\sin x}{k}\sqrt{1+2\sin x-\sin^2 x}+\sin^{-1}\left(\frac{1-\sin x}{\sqrt{2}}\right)+c$ then 3k =

27. In a series of 7, T-20 matches between India and England, winning probability is $\frac{2}{5}$ *and* $\frac{3}{5}$ respectively for India and England. If probability of India winning n matches is highest then *n* is

28. If $[a,b]$ is Range of function $f(x)=\sin^{-1}x+\cos^{-1}x+\tan^{-1}x$ then no. of roots of the equation $1-|x|=\tan^{-1}x$ is [*b*] + *k* then *k* =

29. If $A(0,0)$ and $C(6,-8)$ are end points of diagonal of a square then sum of square of abscissa of other vertex is

30. No. of digits while counting from 1 to 10,000 is N, then digits at unit place of N is

End of Mock JEE Main-3 [JEE-2021]