VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Main Home Practice Test - 9 | JEE - 2024

Date: 17/1/2024 **Maximum Marks: 300**

Timing: 10:00 AM to 1:00 PM **Duration : 3.0 Hours**

General Instructions

1. The test is of **3 hours** duration and the maximum marks is **300.**
2. The question paper consists of **3 Parts** (Part I: **Physics**, Part II: **Chemistry**, Part III: **Mathematics**). Each Part has **two** sections (Section 1 & Section 2).
3. **Section 1** contains **20 Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.
4. **Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. You will NOT be allowed to attempt the sixth question. If you wish to attempt any other question apart from the five already attempted, then you will have to delete any one response from the five previously answered and then proceed to answer the new one.**
   The answer to each question should be **rounded off to the nearest integer**.
5. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. inside the examination room/hall.
6. On completion of the test, the candidate must hand over the Answer Sheet to the **Invigilator** on duty in the Room/Hall. **However, the candidates are allowed to take away this Test Booklet with them**.

Marking Scheme

1. **Section – 1:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.
2. **Section – 2:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.

Syllabus:

Physics: Full Syllabus
Chemistry: Full Syllabus
Mathematics: Full Syllabus

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

Candidate's Signature : _____ **Invigilator's Signature** _____

PART - I : PHYSICS 100 MARKS

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.

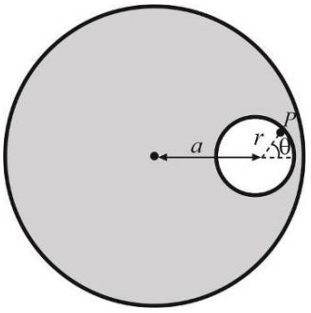
1. If time T, acceleration A and force F are regarded as base units, then the dimensional formula of work is:

(A) [FA] **(B)** [FAT] **(C)** $[FAT^2]$ **(D)** $[FA^2T]$

2. An electron of mass m when accelerated through a potential difference V has de Broglie wavelength λ. The de Broglie wavelength associated with a proton of mass M accelerated through the same potential difference will be:

(A) $\lambda\frac{m}{M}$ **(B)** $\lambda\sqrt{\frac{m}{M}}$ **(C)** $\lambda\frac{M}{m}$ **(D)** $\lambda=\sqrt{\frac{M}{m}}$

3. A solid non-conducting sphere of radius R is charged with a uniform volume charge density ρ. Inside the sphere a cavity of radius r is made as shown in the figure. The distance between the centres of the sphere and the cavity is a. An electron of charge `$e$' and mass `m' is kept at point P inside the cavity at angle $\theta=45°$ as shown. If at $t=0$ this electron is released from point P, calculate the time it will take to touch the sphere on inner wall of cavity again.



(A) $\sqrt{\frac{3Rm\varepsilon_0 r}{e\rho a}}$ **(B)** $\sqrt{\frac{6\sqrt{2}\,m\varepsilon_0 r}{e\rho a}}$ **(C)** $\sqrt{\frac{6\sqrt{3}\,m\varepsilon_0 R}{e\rho a}}$ **(D)** $\sqrt{\frac{6m\varepsilon_0 r}{e\rho a}}$

4. The kinetic energy of a body is increased by 300%. What is the percentage increase in the momentum of the body?

(A) 50% **(B)** 100% **(C)** 150% **(D)** 200%

SPACE FOR ROUGH WORK

5. If f be the number of degrees of freedom of a gas molecule, then the ratio of the specific heats $\frac{C_p}{C_v}$ is given by:

(A) $1+\frac{1}{f}$ **(B)** $1-\frac{1}{f}$ **(C)** $1-\frac{2}{f}$ **(D)** $1+\frac{2}{f}$

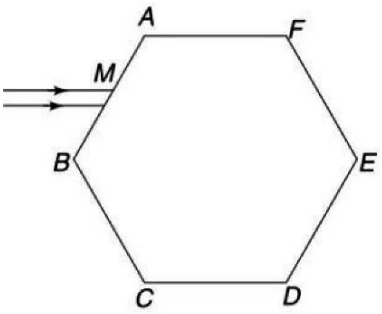
6. A particle is executing SHM with amplitude a and has maximum velocity v. Its speed at displacement $\frac{a}{2}$ will be:

(A) $0.866v$ **(B)** $\frac{v}{2}$ **(C)** v **(D)** $\frac{v}{4}$

7. A block of mass m is pulled by a constant power P placed on a rough horizontal plane. The friction coefficient between the block and the surface is μ. Maximum velocity of the block will be:

(A) $\frac{\mu P}{mg}$ **(B)** $\frac{\mu mg}{P}$ **(C)** μmgP **(D)** $\frac{P}{\mu mg}$

8. The cross section of a prism is a regular hexagon. A narrow beam of light strikes a face of the prism just below the midpoint (M) of the edge AB. The beam is parallel to the top and bottom faces of the prism. the minimum value of refractive indx of the material of the prism for which the emergent beam will be parallel to the incident beam is:



(A) $\frac{\sqrt{13}}{2}$ **(B)** $\frac{\sqrt{11}}{2}$

(C) $\frac{\sqrt{7}}{2}$ **(D)** $\frac{\sqrt{5}}{2}$

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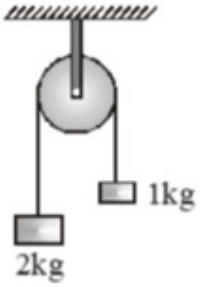
9. Two blocks of masses 1 kg and 2 kg are connected by a metal wire going over a pulley (smooth) as shown figure. The breaking stress of metal is $\frac{40}{3\pi}\times 10^6 \frac{N}{m^2}$. If $g = 10 m/s^2$, then what should be the minimum radius of the wire used if it is not to break?



(A) 1 mm **(B)** 2 mm
(C) 0.5 mm **(D)** 4 mm

10. A satellite is launched in a circular orbit of radius R and another satellite is launched in circular orbit of radius $1.01R$. The time period of second satellite is different from that of the first satellite by:

(A) 1.5% increased **(B)** 1% decreased
(C) 1% increased **(D)** 1.5% decreased

11. The energy contained in a small volume through which electromagnetic wave is passing oscillates with

(A) Double the frequency of the wave **(B)** Zero frequency
(C) The frequency of the wave **(D)** Half the frequency of the wave

12. A stationary nucleus of mass 25 u emits a photon of energy 3.05 MeV. The recoil energy of nucleus is close to:

(A) 0.2 keV **(B)** 2.0 keV **(C)** 0.4 keV **(D)** 4.0 keV

13. A body rolls without slipping. The radius of gyration of the body about an axis passing through its centre of mass is K. The radius of the body is R. The ratio of rotational kinetic energy to translational kinetic energy is

(A) $\frac{K^2}{R^2}$ **(B)** $\frac{R^2}{K^2+R^2}$ **(C)** $\frac{K^2}{K^2+R^2}$ **(D)** K^2+R^2

14. A source of 1 mW emit light of wavelength 4560 Å which is incident on ceisium surface. If work function and quantum efficiency of ceisium are 1.93 eV and 0.5% respectively, then photo-electric current liberated is:

(A) 2 A **(B)** 0.2 A **(C)** 2 mA **(D)** $2\mu A$

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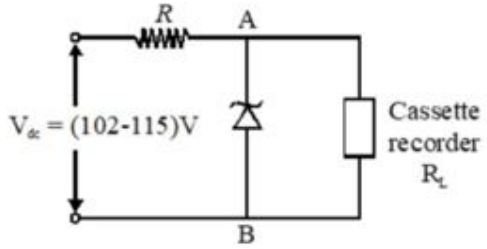
15. The surface energy of a liquid drop is E. It is sprayed into 1000 equal droplets. Then its surface energy becomes:

(A) $1000E$ **(B)** $100E$ **(C)** $10E$ **(D)** E

16. A Zener diode is used as a voltage regulator to run 12V-6W cassette recorder on dc line, as per the following circuit. The value resistance R is : (Range of V_{DC} indicate range of regulation by diode).



(A) 50Ω **(B)** 90Ω **(C)** 150Ω **(D)** 180Ω

17. The length of an elastic string is 'a' meter when the tension is $4N$, and 'b' meter when the tension is 5 N. The length in meter when the tension is $9N$ is:

(A) $5b - 4a$ **(B)** $4a - 5b$ **(C)** $a + b$ **(D)** $b - a$

18. If $\vec{P}$ and $\vec{Q}$ denote the sides of a parallelogram and its area is $\frac{1}{2}PQ$, then the angle between $\vec{P}$ and $\vec{Q}$ is:

(A) $0°$ **(B)** $30°$ **(C)** $45°$ **(D)** $60°$

19. In a LCR circuit having L = 8.0 Henry, C = 0.5 μF and $R = 100\,\Omega$ in series, the resonance frequency is:

(A) 900 radian s^{-1} **(B)** 500 Hz **(C)** 700 radian s^{-1} **(D)** None of these

20. A body is thrown vertically upwards in air. When air resistance is taken into consideration, let the time of ascent be t_1 and time of descent be t_2. Then:

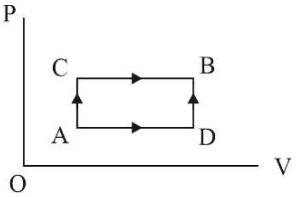
(A) $t_1 = t_2$ **(B)** $t_1 < t_2$ **(C)** $t_1 > t_2$ **(D)** $t_1 = 2t_2$

SPACE FOR ROUGH WORK

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 should be **rounded off to the nearest integer**.

1. When a thermodynamic system is taken from state A to state B via path ACB as shown in figure, 100cal is given to the system and 60cal worth work is done. Along the path ADB, the work done is worth 20cal; the heat flowing into the system in this case is x cal. Find the value of x _____.



2. A flywheel of moment of inertia $0.5 kg\,m^2$ is brought to rest in 10 second by a constant couple of $10Nm$ acting alone on the flywheel. What was the initial angular velocity of the flywheel in radian s^{-1}?

3. When the voltage drop across a PN junction diode is increased from $0.65V$ to $0.70V$, the change in the diode current is $5mA$. Find the dynamic resistance of diode in ohm.

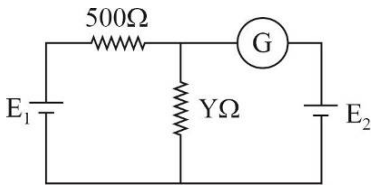
4. A lineman of mass $50kg$ is holding a vertical pole. The coefficient of friction between his hands and the pole is 0.5. If he is to climb the pole, the minimum force with which he should press the pole with his hands is k newton. Find the value of k _____. [Take g = $10ms^{-2}$]

5. A hollow sphere of mass $200g$ starting from rest rolls down, without slipping, an inclined plane which rises by 2 in every 5. The acceleration of the sphere is $(A\times10^{-2})ms^{-2}$. Find the value of A _____. $(g=10\,ms^{-2})$

SPACE FOR ROUGH WORK

6. The threshold frequency for certain metal is v_0. When light of frequency $2v_0$ is incident on it, the maximum velocity of photoelectrons is $4\times10^6 ms^{-1}$. If the frequency of incident radiation is increased to $5v_0$, then the maximum velocity of photoelectrons is $n\times10^6 ms^{-1}$. Find the value of n _____.

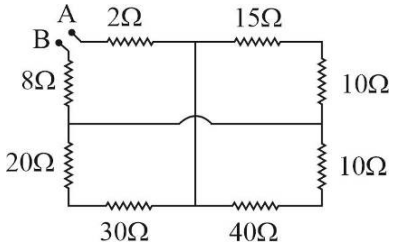
7. In the circuit shown in figure, the battery E_1 has an emf of 12 volt and zero internal resistance while the battery E_2 has an emf of 2 volt. If the galvanometer G reads zero, then the value of the resistance Y is $k\Omega$. Find the value of k.



8. Charge is uniformly distributed with density ρ in a cylindrical region of radius R and infinite length. The magnitude of electric field at distance $\frac{R}{2}$ and $2R$ from the axis of the cylinder is E_1 and E_2 respectively. The ratio $\frac{E_1}{E_2}$ is equal to $\frac{2}{x}$ then find value of x _____.

9. In Zener regulated power supply a Zener diode with $V_Z = 6.0V$ is used for regulation. The load current is to be 4.0 mA and the unregulated input is $10.0V$. The value of series resistance nearly is $x\,\Omega$. Find the value of x _____.

10. The equivalent resistance between A and B is $[P + 2.5]$ *ohm*. Find the value of P.



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PART - II : CHEMISTRY 100 MARKS

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.

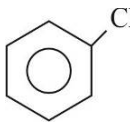
1. Which one of the following pairs of isomers is an example of metamerism?

(A) $CH_3CH_2CH_2CH_2OH$ and $CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_2OH$

(B) $C_2H_5OCH_3$ and $CH_3CH_2CH_2OH$

(C) $CH_3CH_2NH_2$ and CH_3NHCH_3

(D) $C_6H_5CH_2CH_2OH$ and $C_6H_5-\underset{OH}{\underset{|}{CH}}-CH_3$

2. 

$$\xrightarrow[\text{ether}]{LiAlH_4} A \text{ (major product)}$$

$$CH_3-CH=CH-CHO \xrightarrow[\text{ether}]{LiAlH_4} B\,(\text{major product})$$

In the above reactions, product A and product B respectively are:

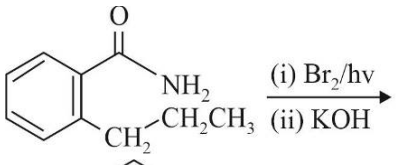
(A)  , $CH_3-CH=CH-CH_2OH$

(B)  , $CH_3-CH=CH-CH_2OH$

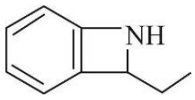
(C)  , $CH_3-CH_2CH_2CH_2OH$

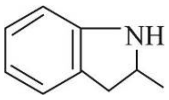
(D)  , $CH_3-CH_2CH_2CH_2OH$

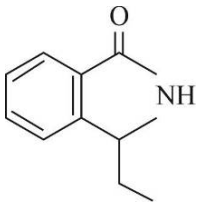
SPACE FOR ROUGH WORK

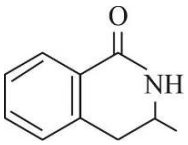
3. 

The major product is:

(A) 

(B) 

(C) 

(D) 

4. The rusting of iron takes place as follows :

$$2H^+ + 2e^- + \frac{1}{2}O_2 \longrightarrow H_2O(\ell)\ ;\ E^o = +1.23\,V$$

$$Fe^{2+} + 2e^- \longrightarrow Fe(s)\ ;\ E^o = -0.44\,V$$

Calculate ΔG^o for the net process

(A) $-322\ kJ\ mol^{-1}$ **(B)** $-161\ kJ\ mol^{-1}$

(C) $-152\ kJ\ mol^{-1}$ **(D)** $-76\ kJ\ mol^{-1}$

SPACE FOR ROUGH WORK

5. Rate constant k varies with temperature as:

$$\log k\,(\min^{-1}) = 5 - \frac{2000}{T}$$

Consider the following about this equation

I. Pre-exponential factor is 10^5

II. E_a is 9.212 kcal

III. Variation of log k with $\frac{1}{T}$ is linear

Select the correction statement

(A) I, II, III **(B)** I, III **(C)** II, III **(D)** I, II

6. A solution contains a mixture of 1×10^{-2} M NaBr and 1×10^{-2} M K_2SO_4 .Solid $AgNO_3$ is gradually added to this solution. Assuming that the addition does not change in volume and $K_{sp}(AgBr) = 5\times10^{-13}M^2$ and $K_{sp}(Ag_2SO_4) = 2\times10^{-6}M^3$.

Select correct statement from the following:

(A) AgBr and Ag_2SO_4 both precipitate simultaneously

(B) Ag_2SO_4 precipitates first as its K_{sp} is high

(C) Ag_2SO_4 precipitates first because the amount of Ag^+ needed is low

(D) AgBr will precipitate first as the amount of Ag^+ needed to precipitate is low

SPACE FOR ROUGH WORK

7. Outermost electronic configuration of a group 14 element, E, is $5s^2\ 5p^2$. The electronic configuration of element belonging to p-block of 6^{th} period placed diagonally to element, E is:

(A) $[Kr]4d^{10}6s^2 6p^3$ **(B)** $[Kr]4d^{10}5s^2 5p^3$

(C) $[Xe]4f^{14}5d^{10}6s^2 6p^3$ **(D)** $[Xe]4f^{7}5d^{10}6s^2 6p^3$

8. Metallic sodium does not react normally with:

(A) $(CH_3)_2O$ **(B)** $CH_3 - C \equiv CH$ **(C)** C_6H_5OH **(D)** $(CH_3)_3COH$

9. The calculated spin only magnetic moments of $[Ni(NH_3)_6]^{2+}$ and $[Co(ox)_3]^{3-}$ in B.M. respectively, are: (Atomic mass of Co and Ni are 27, 28, respectively)

(A) 0, 3.87 **(B)** 3.87, 1.73 **(C)** 2.83, 0 **(D)** 1.73, 4.9

10. Which of the following is not paramagnetic?

(A) NO **(B)** CO **(C)** MnO_4^{2-} **(D)** B_2

11. Two liquids A and B form an ideal solution at 300 K, vapour pressure of the solution containing 1 mol of A and 3 moles of B is 550 mm Hg. At the same temperature, if 1 mole of B is further added to this solution, vapour pressure of the solution increase by 10 mm Hg. Vapour pressure (in mm Hg) of A and B in their pure states will be, respectively

(A) 200 and 300 **(B)** 300 and 400 **(C)** 400 and 600 **(D)** 500 and 600

12. The hybridization of nitrogen atom in solid state structure of N_2O_5 is:

(A) sp^3, sp^3 **(B)** sp^2, sp^2 **(C)** sp, sp^2 **(D)** sp^2, sp^3

13. Copper exhibits only +2 oxidation state in its stable compounds. Why?

(A) Copper is transition metal in +2 state

(B) +2 state compounds of copper are formed by exothermic reactions

(C) Election configuration of copper in +2 state is $[Ar]3d^9, 4s^0$

(D) Copper gives coloured compounds in +2 state

SPACE FOR ROUGH WORK

14. Phenol forms picric acid in the presence of conc. HNO_3 and conc. H_2SO_4 mixture, where:

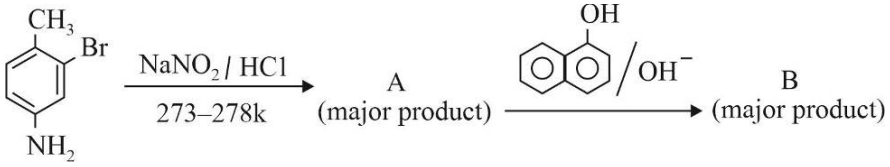
(A) Both HNO_3 and H_2SO_4 act as bronsted base

(B) HNO_3 acts as bronsted acid and H_2SO_4 act as bronsted Base

(C) Both HNO_3 and H_2SO_4 acts as bronsted acid

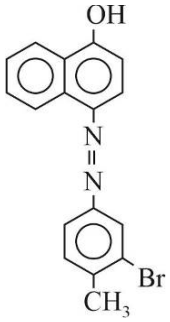
(D) HNO_3 acts as bronsted base and H_2SO_4 acts as bronsted acid

15.

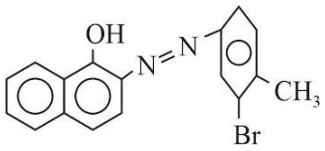


Consider the above reaction, compound B is:

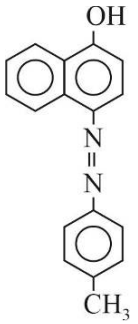
(A)



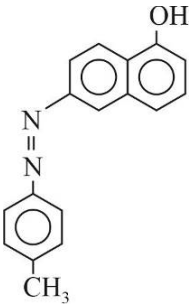
(B)



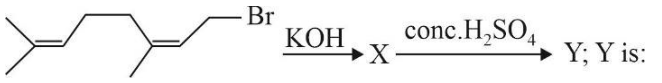
(C)



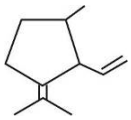
(D)

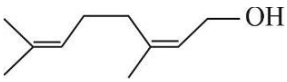


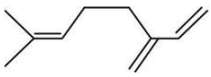
SPACE FOR ROUGH WORK

16. 

(A) 

(B) 

(C) 

(D) 

17. The gas formed when tin reacts with conc. HNO_3.

(A) NO **(B)** N_2O **(C)** NO_2 **(D)** N_2O_4

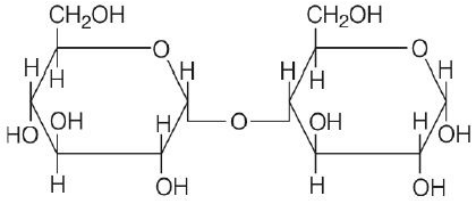
18. In duma's method nitrogen containing organic compound is heated with metal oxide strongly to oxidized C, H and S into CO_2, H_2O and SO_2 respectively, while N_2 is set free. The metal oxide is

(A) ZnO **(B)** CuO **(C)** Al_2O_3 **(D)** Cu_2O_2

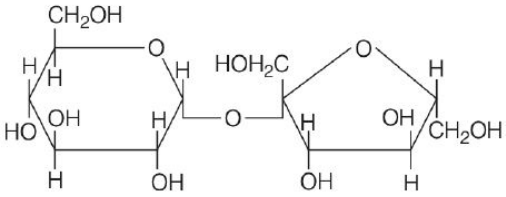
SPACE FOR ROUGH WORK

19. Which of the following disaccharide is a non-reducing sugar?

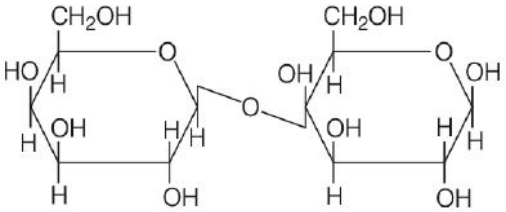
(A)



(B)



(C)



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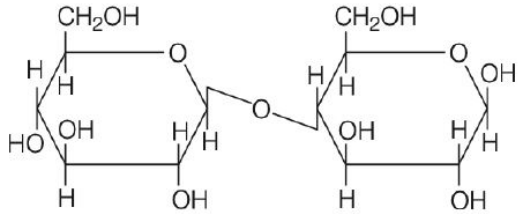

20. The correct order of reactivity of following acid derivatives towards nucleophilic substitution reaction is:

(i) RCOCl **(ii)** $(RCO)_2O$ **(iii)** RCOOR **(iv)** $RCONH_2$

(A) (i) > (ii) > (iii) > (iv) **(B)** (iv) > (iii) > (ii) > (i)

(C) (ii) > (i) > (iii) > (iv) **(D)** (iii) > (ii) > (i) > (iv)

SPACE FOR ROUGH WORK

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 should be **rounded off to the nearest integer**.

1. Calculate $\left|\Delta_f H^\circ\right|\left(\text{in kJ / mol}\right)$ for Cr_2O_3 from the $\Delta_r G^\circ$ and the S° values provided at 27°C _____.

$4Cr(s)+3O_2(g)\rightarrow 2Cr_2O_3(s);\ \Delta_r G^\circ=-2093.4\,\text{kJ / mol}$

$S^\circ\left(\text{J / K mol}\right): S^\circ(Cr,s)=24;\ S^\circ(O_2,g)=205;\ \ S^\circ(Cr_2O_3,s)=81$

2. If the lowest energy of electromagnetic radiation is 6.52×10^{-18} J. If the minimum difference in energy between two Bohr orbit is such that the electronic transition emits this electromagnetic ray. What minimum Z would a transition from second to the first will result in the emission of given electromagnetic ray _____.

3. Vapour pressure of $CHCl_3$ at 27°C is 280 mm Hg. 2g of non-volatile solute (molar mass = $40\,\text{g mol}^{-1}$) is dissolved in 100 ml of $CHCl_3$. The vapour pressure (in mm Hg) of the solution is _____.
(Given density of $CHCl_3$ $11.95\,\text{g / mL}$ and molar mass of H, C and Cl are 1, 12 and 35.5g mol^{-1} respectively)

4. How many gram of magnesium carbonate $(MgCO_3)$ can be completely dissolved in 3.26 litre of 5M HCl solution according to the following reaction? $MgCO_3+2HCl\longrightarrow MgCl_2+CO_2+H_2O$

5. An organic compound was analyzed by Duma's method. 0.305g of the compound on combustion gave 48.6ml of nitrogen at 27°C and 756 mm Hg pressure. What is the value of $\frac{\text{Nitrogen\%}}{6}$?

SPACE FOR ROUGH WORK

6. What will be the pH of a buffer solution prepared by dissolving 95.4 g of Na_2CO_3 in 500 mL of an aqueous solution containing 150 mL of 1 M HCl?

[K_a for $HCO_3^- = 2\times10^{-11}$, log 2 = 0.3, log 5 = 0.7] (Round of to Nearest integer)

7. $A_2(g) \longrightarrow B(g) + \frac{1}{2}C(g)$

Shows increase in pressure from 100 mm Hg to 120 mm Hg in 5 mins. What is the rate of disappearance of $A_2(g)$ in mm Hg/min?

8. When M_2CO_3 is heated at 120°C, CO_2 gas is evolved as per the given reaction:

$M_2CO_3(s) \rightleftharpoons M_2O(s) + CO_2(g)$ $K_p = 5$ atm at 120°C.

CO_2 evolved above is collected in a container in which inert gas is already present and the total present of this gaseous mixture becomes 6 atm. Find the partial pressure of the inert gas in the gaseous mixture.

9. $NiCl_2$ in the presence of dimethyl glyoxime (dmg) forms a complex $[Ni(dmg)_2]^{2+}$. The total change in number of unpaired electron on metal centre is _____.

10. Fumaric acid $C_4H_4O_4$ present in 522g sample of mushroom was titrated using phenolphthalein as indicator against OH^- ions which were obtained by electrolysis of water. As soon as OH^- ions are produced, they react with fumaric acid and at complete neutralization immediately a pink colour is obtained. If electrolysis was done for 8685 seconds using 50A current to each end point, what was percentage of fumaric acid in mushroom _____.

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PART - III : MATHEMATICS 100 MARKS

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.

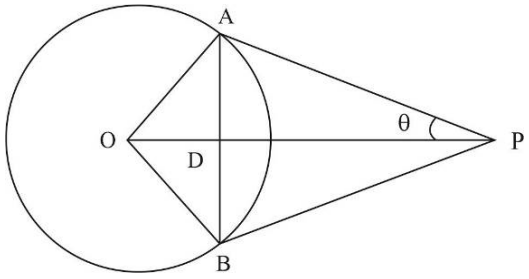
1. If coefficient of x and x^2 in $(1+x)^{10}(1-x^2)^n$ are equal then $n=?$

(A) 10 **(B)** 35 **(C)** 45 **(D)** 80

2. The value of $\tan\left(2\tan^{-1}\left(\frac{3}{5}\right)+2\sin^{-1}\left(\frac{3}{5}\right)\right)$ is equal to:

(A) $\frac{-181}{69}$ **(B)** $\frac{-297}{304}$ **(C)** $\frac{-291}{76}$ **(D)** $\frac{151}{63}$

3. Two tangents PA and PB are drawn from $P(3,0)$ *to* $x^2+y^2=1$. Then area of ΔPAB.



(A) $\frac{8\sqrt{2}}{3}$ **(B)** $\frac{8\sqrt{2}}{9}$ **(C)** $\frac{16\sqrt{2}}{9}$ **(D)** $\frac{16\sqrt{2}}{3}$

4. The value of 'α' so that the range of the function $y=\frac{x^2+\alpha}{x+1}$ is R, is

(A) $(-\infty,-2]$ **(B)** $(-\infty,-1]$ **(C)** $(-\infty,0]$ **(D)** None of these

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5. Let $f(x)=\begin{cases}\sin^2 x, & x \text{ rational}\\ -\sin^2 x, & x \text{ irrational}\end{cases}$. Then set of points, where $f(x)$ is continuous is

(A) $\left\{(2n+1)\frac{\pi}{2},\ n\in I\right\}$ **(B)** Null set

(C) $\{n\pi,\ n\in I\}$ **(D)** Set of all rational numbers

6. $\int_{-\frac{\pi}{2}}^{\pi/2}(\sin x)^{\lim_{t\to 0}\left[\frac{\sin t}{t}\right]}\,dx$. (Where [.] is GIF)

(A) 0 **(B)** π **(C)** $-\frac{\pi}{4}$ **(D)** 2

7. $\int_{0}^{arg\ z}[x]dx$, if $z=(i)^{3i}$. (arg (z) denotes principle argument)

(A) 0 **(B)** 1 **(C)** $\frac{\pi}{2}$ **(D)** $-\frac{3\pi}{2}$

8. If α is one of the solution of $\left(x^2+5x+4\right)=\sqrt{x+\frac{9}{4}}-\frac{5}{2}$ then $|2\alpha|$.

(A) 0 **(B)** 2 **(C)** 4 **(D)** 16

9. The number of positive integral solutions of the equation $x_1x_2x_3=60$ is

(A) 54 **(B)** 27 **(C)** 81 **(D)** None of these

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10. Let A, B and C be three events such that the probability that exactly one of A and B occurs is α, the probability that exactly one of B and C occurs is $(2\alpha-1)$, the probability that exactly one of C and A occurs is α and the probability of all A, B and C occur simultaneously is $(1-\alpha)^2$ where $0<\alpha<1$. If the probability that at least one of A, B and C occur is 0.75 then α is:

(A) Greater than $\frac{1}{8}$ but less than $\frac{1}{4}$ **(B)** Greater than $\frac{1}{2}$

(C) Greater than $\frac{1}{4}$ but less than $\frac{1}{2}$ **(D)** Exactly equal to $\frac{1}{2}$

11. $f(x)=2x^3-3x^2-f''(3)x-6x+f''\left(\frac{1}{2}\right)$ is strictly decreasing in:

(A) $(-\infty,-2)$ **(B)** $(-2,3)$ **(C)** $(0,6)$ **(D)** $(3,\infty)$

12. If $\vec{a},\vec{b},\vec{c}$ are such that $|a|<|b|<|c|$ and $\vec{a}.\vec{b}=0$, $\vec{a}+\vec{b}+\vec{c}=0$.

If $\frac{1}{|c|^2}+\frac{1}{|b|^2}=\frac{1}{|a|^2}$ then $\left|\hat{b}.\hat{c}\right|^2=$ ($\hat{b}$ and $\hat{c}$ are unit vectors along $\vec{b}$ and $\vec{c}$)

(A) $\frac{\sqrt{3}-1}{2}$ **(B)** $\frac{\sqrt{5}-1}{4}$ **(C)** $\frac{\sqrt{5}-1}{2}$ **(D)** $\frac{\sqrt{3}-1}{4}$

SPACE FOR ROUGH WORK

13. $x^3\dfrac{dy}{dx}-|A|=0$ and $y(1)=0$ then:

Where $A=\begin{bmatrix} e^x & \tan y & L \\ 4x^2 & \sec y & 0 \\ y & e^y & 1 \end{bmatrix}$; Where $L=\lim\limits_{x\to 0}|x\log x|$

(A) $\tan y=(x-2)e^x\log x$ **(B)** $\sin y=e^x(x-1)x^{-4}$

(C) $\sin y=(x-1)e^x x^{-3}$ **(D)** $\sin y=e^x(x-1)x^{-2}$

14. Let the image of point $P(1,2,1)$ in the line $L:\dfrac{x+1}{2}=\dfrac{y}{1}=\dfrac{z}{1}$ is $Q[\alpha,\beta,\gamma]$, A plane through Q and perpendicular to line L can contain the point.

(A) (1, 2, 3) **(B)** (3, 2, 0) **(C)** (0, 2, 3) **(D)** (2, 0, 3)

15. If sum of mean and variance of first n natural no. is 21 then possible value of n is:

(A) 11 **(B)** 13 **(C)** 14 **(D)** 15

16. $g(t)=\int\limits_{-\frac{\pi}{2}}^{\pi/2}\sin(t+f(x))dx$ where $f(x)=\log\left(\dfrac{1-\sin x}{1+\sin x}\right)$. Then $\int\limits_0^{\pi/2}\cos(f(x))dx=$

(A) $g\left(\dfrac{\pi}{4}\right)$ **(B)** $g\left(\dfrac{\pi}{2}\right)$ **(C)** $2g\left(\dfrac{\pi}{2}\right)$ **(D)** $\dfrac{g\left(\frac{\pi}{2}\right)}{2}$

SPACE FOR ROUGH WORK

17. Let P be the variable point on circle $x^2 + y^2 = 1$, the locus of the midpoint of the line segment PQ, where Q is the foot of perpendicular drawn from P to the line $y = x$.

(A) $5\left(x^2 + y^2\right) + 6xy = 2$ **(B)** $9\left(x^2 + y^2\right) - 6xy = 2$

(C) $5\left(x^2 + y^2\right) - 6xy = 2$ **(D)** $9\left(x^2 + y^2\right) + 6xy = 2$

18. If $f(x)$ be a differentiable function such that $f'(2) = 1,\ f'(3) = 2,$ then $\lim\limits_{h\to 0} \dfrac{f(2+5h^2-3h) - f(2)}{f(3+h^2-2h) - f(3)}$ equal to

(A) $\dfrac{1}{4}$ **(B)** $\dfrac{1}{2}$ **(C)** $-\dfrac{3}{2}$ **(D)** $\dfrac{3}{4}$

19. Sum of the series $\log_{a^{1/2}} x + \log_{a^{1/3}} x + \log_{a^{1/4}} x$....$n$ terms is $n^2 + 3n$. Then value of x can be:

(A) a **(B)** $\dfrac{1}{a}$

(C) a^2 **(D)** Can not be determined

20. In a triangle ABC, if $\left|\overrightarrow{BC}\right| = 4, \left|\overrightarrow{CA}\right| = 5$ and $\left|\overrightarrow{BA}\right| = 7,$ then the projection of the vector $\overrightarrow{BA}$ on $\overrightarrow{BC}$ is equal to:

(A) 5 **(B)** 6 **(C)** $\dfrac{11}{2}$ **(D)** $\dfrac{15}{2}$

SPACE FOR ROUGH WORK

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 should be **rounded off to the nearest integer**.

1. Let $A=\left\{a_{ij}\right\}$ be a 3×3 matrix, where $a_{ij}=\begin{cases}(-1)^{j-i} & if \quad i<j,\\ 2 & if \quad i=j,.\\ (-1)^{i+j} & if \quad i>j,\end{cases}$ Then det $\left(3Adj\left(\lambda A^{-1}\right)\right)$ is equal to 108. Then $\lambda=?$

2. Sum of all values of x satisfying the equation $25^{\left(2x-x^2+1\right)}+9^{\left(2x-x^2+1\right)}=34\left(15^{\left(2x-x^2\right)}\right)$ is _____.

3. Let $y=f\left(x\right)$ satisfies the differential equation $xy\left(1+y\right)dx=dy$. If $f\left(0\right)=1$ and $f\left(2\right)=\dfrac{e^2}{k-e^2}$. Then find the value of k _____.

4. The value of a for which the equation $(a^2+4a+3)x^2+(a^2-a-2)x+(a+1)a=0$ has more than two roots is $-k$, then the value of $k+2020$? is

5. Consider a triangle having vertices $A(-2,3), B(1,9)$ and $C(3,8)$. If a line L passing through the orthocentre of triangle ABC, also passes through A and intersects y-axis at point $(0,\alpha)$, then the value of real number α is _____.

SPACE FOR ROUGH WORK

6. If the point on the curve $x^2+y^2=4$, nearest to the point $\left(3,\frac{3}{2}\right)$ is (α,β), then $5\left(\alpha^2-\beta^2\right)$ is equal to_____.

7. Let a function $g:[0,4]\to R$ be defined as $g(x)=\begin{cases}\max\left\{t^3-6t^2+9t-3\right\}, & 0\le x\le 3\\ 4-x, & 3<x\le 4\end{cases}$. If the range of $g(x)$ is $[a, b]$ then $\left|a^2-b^2\right|=$

8. For $k\in N$, let $\frac{1}{\alpha(\alpha+1)(\alpha+2).....(\alpha+20)}=\sum_{K=0}^{20}\frac{A_k}{\alpha+k}$. Then the value of $\left[\frac{A_3+A_4}{A_2}\right]$ (where [.] is GIF) equal to _____.

9. Let a and b be positive integers. The value of xyz is 55 and $\frac{343}{55}$ when a, x, y, z, b are in arithmetic and harmonic progression respectively. Find the value of ab _____.

10. If $\lim_{x\to 0}\frac{a\cot x}{x}+\frac{b}{x^2}=\frac{1}{3}$, then $b-a=$

SPACE FOR ROUGH WORK

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