VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Main - 5 | JEE-2024

Date: 20/11/2023 **Maximum Marks: 300**

Timing: 4:00 PM to 7:00 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 : Ray Optics, Wave Optics, Optical Instruments (Excluding Resolving Power)

Chemistry : OCOC – 3, NCOC, Acidity and Basicity, Coordination Compounds, d-Block, Biomolecules

Mathematics : IC – I, IC – 2, Differential Equations, Vectors

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

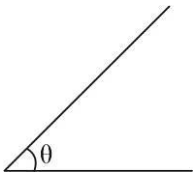
Candidate's Signature : _____ **Invigilator's Signature** _____

PART I : PHYSICS	MARKS: 100

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. Two mirrors are inclined at an angle θ as shown in the figure. Light ray is incident parallel to one of the mirrors. Light will start retracing its path after third reflection if :



(A) $\theta = 45°$ **(B)** $\theta = 30°$ **(C)** $\theta = 60°$ **(D)** All three

2. In an experiment of single slit diffraction pattern, first minimum for red light coincides with the first maximum of some other wavelength. If wavelength of red light is 6600Å, then wavelength of first maximum will be:

(A) 3300 Å **(B)** 4400 Å **(C)** 5500 Å **(D)** 6600 Å

3. A plane mirror is moving with velocity $4\hat{i} + 5\hat{j} + 8\hat{k}$. A point object in front of the mirror moves with a velocity $3\hat{i} + 4\hat{j} + 5\hat{k}$. Here $\hat{k}$ is along the normal to the plane mirror and facing towards the object. The velocity of the image is :

(A) $-3\hat{i} - 4\hat{j} + 5\hat{k}$ **(B)** $3\hat{i} + 4\hat{j} + 11\hat{k}$

(C) $-3\hat{i} - 4\hat{j} + 11\hat{k}$ **(D)** $7\hat{i} + 9\hat{j} + 11\hat{k}$

4. A concave mirror forms a real image three times larger than the object on a screen. Object and screen and moved until the image becomes twice the size of object. If the shift of object is 6 cm. The shift of the screen and focal length of mirror are :

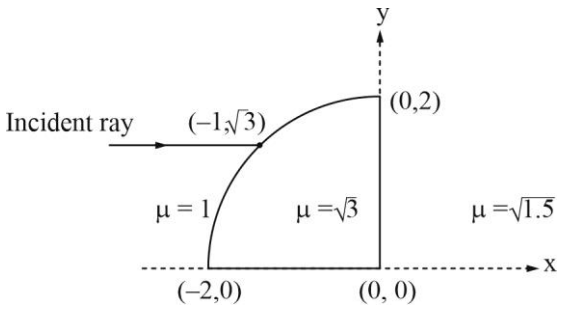
(A) 36 cm, 36 cm **(B)** 36 cm, 16 cm **(C)** 72 cm, 36 cm **(D)** None of these

5. A point object is kept between a plane mirror and a concave mirror facing each other. The distance between the mirror is 22.5 cm. Plane mirror is placed perpendicular to principal axis of concave mirror. The radius of curvature of the concave mirror is 20 cm. What should be the distance of the object from the concave mirror so that after two successive reflections the final image is formed on the object itself? (Consider first reflection from concave mirror)

(A) 5 cm **(B)** 15 cm **(C)** 10 cm **(D)** 7.5 cm

SPACE FOR ROUGH WORK

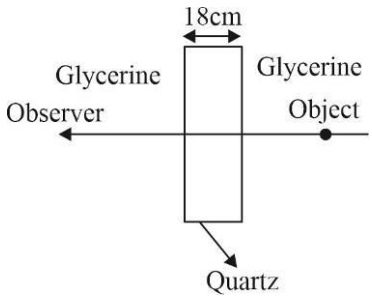
6. The cross section of quarter cylinder of glass is shown in figure. Medium on both side of y-axis have different refractive index. With respect to the incident ray, the emergent ray is deviated by an angle:



(A) 45° Anticlockwise **(B)** 15° Anticlockwise

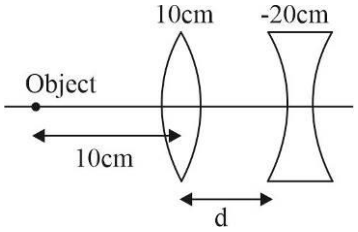
(C) 45° Clockwise **(D)** 15° Clockwise

7. Given that velocity of light in quartz $=1.5\times10^8\, m/s$ and velocity of light in glycerine $=\left(\frac{9}{4}\right)\times10^8\, m/s.$ Now a slab of quartz is placed in glycerine as shown. The shift of the object produced by slab is:



(A) 6 cm **(B)** 3.55 cm **(C)** 9 cm **(D)** 2 cm

8. What should be the value of distance *d* so that final image is formed on the object itself? (Focal lengths of the lenses are as given in the figure).



(A) 10 cm **(B)** 20 cm **(C)** 5 cm **(D)** None of these

SPACE FOR ROUGH WORK

9. A small fish, 4cm below the surface of a lake, is viewed through a thin converging lens of focal length 30 cm held 2cm above the water surface. Refractive index of water is 1.33. The image of the fish from the lens is at a distance of :

(A) 10 cm **(B)** 8 cm **(C)** 6 cm **(D)** 4 cm

10. An unpolarized light is passed through a polarizer and then through an analyzer. The intensity received is one fourth the intensity of unpolarized light. Now if the polarizer is rotated by 90° and analyzer is rotated by an unknown angle the intensity of polarized light received increases by a factor of 1.5. The unknown angle is :

(A) 30° **(B)** 15° **(C)** 45° **(D)** 75°

11. In YDSE, let A and B be two slits. Films of thickness t_A and t_B and refractive indices μ_A and μ_B are placed in front of A and B, respectively. If $\mu_A t_A = \mu_A t_B$ then the central maxima will:

(A) Not shift **(B)** Shift towards A if $t_B < t_A$

(C) Shift towards B if $t_B > t_A$ **(D)** Shift towards A if $t_B > t_A$

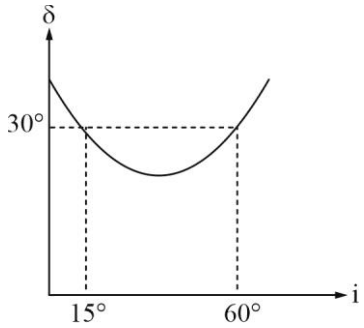
12. If YDSE is performed with a light of wavelength 500nm the 6^{th} bright fringe is found 18mm from centered maxima. If the distance between the slits is 5mm, the distance of the screen from the slits is:

(A) 60 m **(B)** 30 m **(C)** 80 m **(D)** 90 m

13. A parallel beam of light pass through a slit of width 0.45 mm. The screen is 50 cm away where fringe pattern is formed. The distance between two second order minima is: (The wavelength of light is 450 nm)

(A) 2 mm **(B)** 4 mm **(C)** 1.2 m **(D)** 2.6 mm

14. Figure shows the graph of angle of deviation δ versus angle of incidence *i* for a light ray striking a prism. The prism angle is:



(A) 30° **(B)** 45° **(C)** 60° **(D)** 75°

SPACE FOR ROUGH WORK

15. A ray of light passes through a prism whose refracting angle is 5° and dispersive power is 0.03. The refractive index for the mean ray in a spectrum is 1.62. the mean deviation and angle of dispersion respectively are:

(A) 3.1°, 0.077° **(B)** 3.1°, 0.093° **(C)** 6.2°, 0.093° **(D)** 6.2°, 0.077°

16. An object should be placed at a distance x to produce maximum angular magnification for a normal eye by a convex lens of focal length 5 cm. Value of x is:

(A) $\frac{-15}{4}cm$ **(B)** $\frac{-25}{6}cm$ **(C)** $\frac{-20}{3}cm$ **(D)** $\frac{-18}{7}cm$

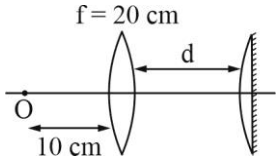
17. A myopic person can see clearly upto a distance 3m. The power of lens the person should use to cure this defect is:

(A) –0.33 D **(B)** –0.72 D **(C)** 0.33 D **(D)** 0.52 D

18. In YDSE a monochromatic light is used. If one slit is covered by a sheet of thickness $1.2\times10^{-5}m$ of refractive index 1.4 the number of fringes shifted is: (Wavelength of light is 480 nm)

(A) 10 **(B)** 12 **(C)** 16 **(D)** 14

19. A convex lens of focal length 20 cm and another plano-convex lens of focal length 40 cm are placed co-axially (see figure). The plano-convex lens is silvered on plane surface. What should be the distance d(in cm) so that final image of the object 'O' is formed on O itself:



(A) 10 **(B)** 15 **(C)** 20 **(D)** 25

20. In a Llody's mirror experiment if the mirror reflect 75% of light incident on the ratio of intensity at interference maxima and minima will be:

(A) 75 **(B)** 150 **(C)** 194 **(D)** 200

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.

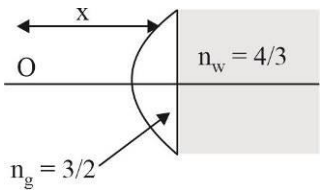
The answer to each question should be **rounded off to the nearest integer**.

1. When an object is kept at a distance 30 cm from a concave mirror, the image is formed at a distance of 10 cm. If the object is moved with a speed of 9 m/s, the speed with which image moves is _____ m/s.

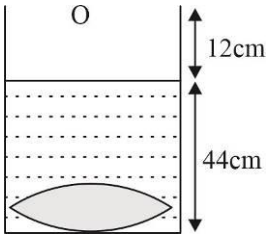
2. A ray of light is incident on one face of a transparent slab of thickness 15 cm. The angle of incidence is 60°, If the lateral displacement of the ray on emerging from the parallel plane is $5\sqrt{3}\,cm$, the refractive index of the material of the slab is $\sqrt{n}$. Then *n* is_____.

3. The refracting angle of prism is 75° and the index of refraction is $\sqrt{2}$ relative to surrounding. The limiting angle of incidence of a ray that will be transmitted through the prism is 5n°. Then value of *n* is _____.

4. In the given figure an object 'O' is kept in air in front of a thin plane convex lens of radius of curvature 10 cm. Its refractive index is $\frac{3}{2}$ and the medium towards right of plane surface is water of refractive index $\frac{4}{3}$. What should be the distance '*x*' (in cm) of the object so that the rays become parallel finally?



5. An object O is kept in air and a lens of focal length 10 cm (in air) is kept at the bottom of a container which is filled upto a height 44 cm by water. The refractive index of water is $\frac{4}{3}$ and that of glass is $\frac{3}{2}$. The bottom of the container is closed by a thin glass slab of refractive index $\frac{3}{2}$. Find the distance (in cm) of the final image formed by the system from bottom of container (refer to figure shown).



SPACE FOR ROUGH WORK

6. The angular magnification produced by a simple microscope of focal length 6.25 cm, for the image formed at the near point of normal eye is_____.

7. If white light is used in a double slit experiment the first violet fringe is formed at a distance 1mm from central white fringe. If distance between slits is 4 mm and fringe pattern is observed at a distance 10 m away. The wavelength of violet light in nm is_____.

8. In YDSE of equal width slits, if intensity at the centre of screen is I_0, then intensity at a distance of $\beta/4$ from the central maxima is $\frac{I_0}{n}$ then *n* is _____. (β is the fringe width).

9. A compound microscope has objective focal length is 1.8cm and eyepiece focal length 1.25 cm. An object is placed at a distance 3.6 cm from objective lens. The angular magnification for normal adjustment is_____.

10. An achromatic convergent doublet of two lens in contact has a power of +2D. The convex lens has power +5D. The ratio of the dispersive power of the convergent and dispersive power of the convergent and divergent lenses is $\frac{a}{b}$ where *a* and *b* are co-prime. The *a* + *b* is _____.

SPACE FOR ROUGH WORK

PART II : CHEMISTRY	MARKS: 100

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. The naturally occurring amino acid that contains only one basic functional group in its chemical structure is:

(A) Arginine **(B)** Lysine **(C)** Asparagine **(D)** Histidine

2. The Stability of Cu^{2+} is more than Cu^{+} salts in aqueous solution due to :

(A) Enthalpy of atomization **(B)** Hydration energy

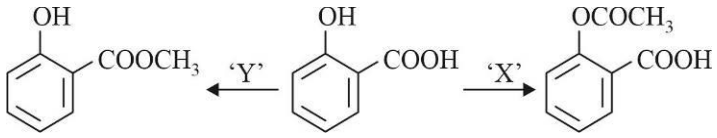
(C) Second ionization enthalpy **(D)** First ionization enthalpy

3. Which of the following process will produce 2° amine?

(A) Gabriel synthesis **(B)** Hoffmann bromamide reaction

(C) Reduction of carbylamine **(D)** Reduction of nitro compounds

4. In a reaction,



Reagents 'X' and 'Y' respectively are :

(A) $(CH_3CO)_2O / H^+$ and $CH_3OH / H^+, \Delta$

(B) $(CH_3CO)_2O / H^+$ and $(CH_3CO)_2O / H^+$

(C) $CH_3OH / H^+, \Delta$ and $CH_3OH / H^+, \Delta$

(D) $CH_3OH / H^+, \Delta$ and $(CH_3CO)_2O / H^+$

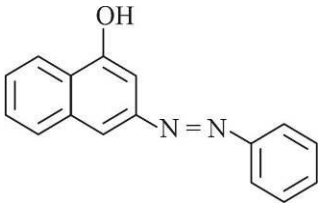
SPACE FOR ROUGH WORK

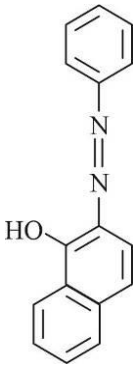
5. Homoleptic octahedral complexes of a metal ion 'M^{3+}' with three monodentate ligands L_1, L_2 and L_3 absorb wavelengths in the region of green, blue and red respectively. The increasing order of the ligand strength is:

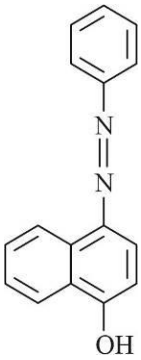
(A) $L_1 < L_2 < L_3$ **(B)** $L_3 < L_2 < L_1$

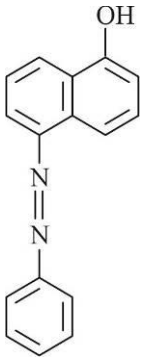
(C) $L_3 < L_1 < L_2$ **(D)** $L_2 < L_1 < L_3$

6. Coupling of benzene diazonium chloride with 1-naphthol in alkaline medium followed by acidification will mainly give :

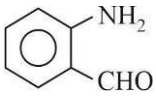
(A) 

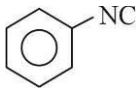
(B) 

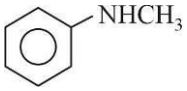
(C) 

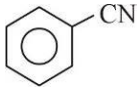
(D) 

7. Which of the following compound is formed when aniline is reacted with chloroform in alkaline medium?

(A) 

(B) 

(C) 

(D) 

SPACE FOR ROUGH WORK

8. An organic compound (A) on treatment with benzene sulphonyl chloride gives compound (B). (B) is soluble in dil. NaOH solution. Compound (A) is :

(A) $C_6H_5-N(CH_3)_2$ **(B)** $C_6H_5-NHCH_2CH_3$

(C) $C_6H_5-\underset{\displaystyle CH_3}{\underset{|}{CH}}-NH_2$ **(D)** $C_6H_5-CH_2NHCH_3$

9. Match the column I and II, and choose the correct combination from the option given:

Column I (Vitamin)		**Column II (Deficiency Diseases)**	
I.	Vitamin A	**P.**	Rickets
II.	Vitamin B_{12}	**Q.**	Scurvy
III.	Vitamin C	**R.**	Pernicious anaemia
IV.	Vitamin D	**S.**	Xerophthalmia

(A) I – R ; II – P ; III – S ; IV – Q **(B)** I – R ; II – S ; III – Q ; IV – P

(C) I – S ; II – R ; III – Q ; IV – P **(D)** I – Q ; II – R ; III – S ; IV – P

10. One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Amylose is water insoluble component.

Reason (R) : Amylose is a long unbranched chain molecule with more than 200 $\alpha-D-(+)-$glucose units.

In the light of the above statements

(A) Both (A) and (R) are correct and (R) is the correct explanation of (A)

(B) Both (A) and (R) are correct and (R) is NOT the correct explanation of (A)

(C) (A) is correct but (R) is not correct

(D) (A) is not correct but (R) is correct

SPACE FOR ROUGH WORK

11. Match the column I and II, and choose the correct combination from the option given:

Column I		Column II	
I.	Glucose + HI	**P.**	Gluconic acid
II.	Glucose + Br_2 water	**Q.**	Glucose pentaacetate
III.	Glucose + acetic anhydride	**R.**	Saccharic acid
IV.	Glucose + HNO_3	**S.**	Hexane

(A) I – S ; II – P ; III – Q ; IV – R **(B)** I – S ; II – R ; III – Q ; IV – P

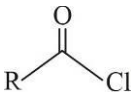
(C) I – R ; II – P ; III – S ; IV – Q **(D)** I – P ; II – R ; III – S ; IV – Q

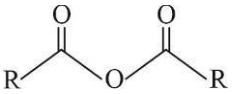
12. Wilkinson catalyst is :

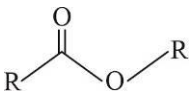
(A) $[(Et_3P)_3RhCl]\,(Et = C_2H_5)$ **(B)** $[(Ph_3P)_3RhCl]$

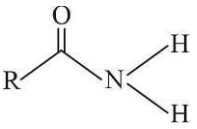
(C) $[(Ph_3P)_3IrCl]$ **(D)** $[(Et_3P)_3IrCl]$

13. The correct order of reactivity towards hydrolysis at room temperature of following compounds is :

I. 

II. 

III. 

III. 

(A) I > II > III > IV **(B)** IV > I > II > III

(C) IV > II > I > III **(D)** I > III > II > IV

SPACE FOR ROUGH WORK

14. Given below are two statements:

Statement I : Insulin and glucagon both are hormones.

Statement II : Insulin and glucagon together regulate the glucose level in the blood.

In the light of the above statements choose the correct answer from the options given below.

(A) Both Statement I and II arc true

(B) Both Statement I and II are false

(C) Statement I is true but Statement II is false

(D) Statement I is false but Statement II is true

15. **Statement-1 :** Aqueous solution of copper sulphate solution gives a bright green solution with aqueous KCl.

Statement-2 : When KCl is added, H_2O ligands are replaced by Cl^- ligands forming $[CuCl_4]^{2-}$ ion which has bright green colour.

(A) Statement – 1 is True, Statement – 2 is True; Statement – 2 is correct explanation for Statement – 1.

(B) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.

(C) Statement – 1 is True, Statement – 2 is False.

(D) Statement – 1 is False, Statement – 2 is True.

16. Match the column I and II, and choose the correct combination from the option given:

Column I		**Column II**	
I.	Nucleoside	**P.**	Base and pentose sugar
II.	Nucleotide	**Q.**	Guanine
III.	Purine	**R.**	Base, pentose sugar and phosphate
IV.	Pyrimidine	**S.**	Thymine

(A) I – P ; II – Q ; III – S ; IV – R

(B) I – P ; II – R ; III – Q ; IV – S

(C) I – P ; II – R ; III – S ; IV – R

(D) I – R ; II – P ; III – Q ; IV – S

SPACE FOR ROUGH WORK

17. The descending order of acidity for the following carboxylic acid is:

I. CH_3COOH II. F_3CCOOH

III. $ClCH_2COOH$ IV. FCH_2COOH

V. $BrCH_2COOH$

Choose the correct answer from the options given below :

(A) IV > II > I > V > III **(B)** V > IV > II > I > III

(C) II > III > IV > V > I **(D)** II > IV > III > V > I

18. Cerium (Z = 58) is an important member of the lanthanides. Which of the following statements about cerium is incorrect?

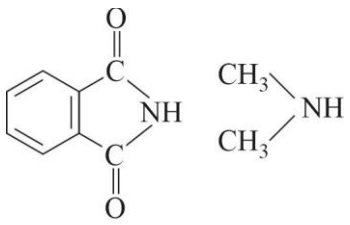
(A) The common oxidation states of cerium are + 3 and + 4

(B) The + 3 oxidation state of cerium is more stable than + 4 oxidation state

(C) The + 4 oxidation state of cerium is not known in solutions

(D) Cerium (IV) acts as an oxidizing agent

19. Which of the following statement is correct organic compound I and II.



(i) (ii)

(A) Both I and II are less basic than ammonia

(B) Both I and II are more basic than ammonia

(C) I is less basic than ammonia while II is more basic than ammonia

(D) I is more basic than ammonia while II is less basic than ammonia

20. The magnetic moment of a transition metal compound has been calculated to be 3.87 B.M. The metal ion is:

(A) Cr^{2+} **(B)** Mn^{2+} **(C)** V^{2+} **(D)** Ti^{2+}

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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. How many moles of KOH will be consumed for conversion of 1 mole of benzamide into aniline following Hoffmann bromamide process?

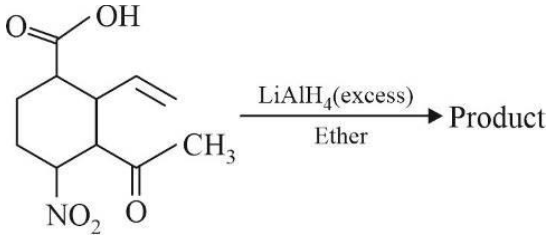
2. Total number of moles of AgCl precipitated on addition of excess of $AgNO_3$ to one mole each of the following complexes $[Co(NH_3)_4Cl_2]Cl$, $[Ni(H_2O)_6]Cl_2$, $[Pt(NH_3)_2Cl_2]$ and $[Pd(NH_3)_4]Cl_2$ is _____.

3. The number of bridging carbonyl groups in $Mn_2(CO)_{10}$ is _____.

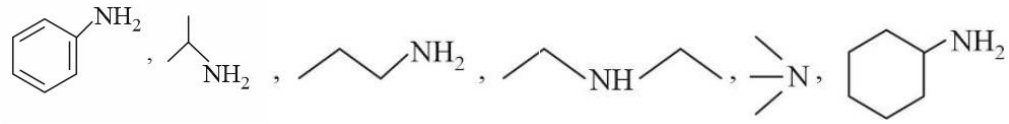
4. The spin only magnetic moment of $[Mn(H_2O)_6]^{2+}$ complexes is _____B.M. (Nearest integer)

(Given : Atomic number of Mn is 25)

5. The number of π bonds in the major product will be _____.



6. How many of these compounds reacts with Hinsberg reagent?



SPACE FOR ROUGH WORK

7. The sum of the total number of bonds between chromium and oxygen atoms in chromate and dichromate ions is _____.

8. How many of the following statements are correct?

Statement – I: Aniline is an IUPAC name

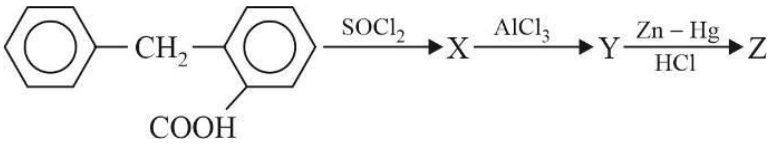
Statement – II: Aniline is a common name

Statement – III: Benzenediazonium fluoroborate is stable at room temperature.

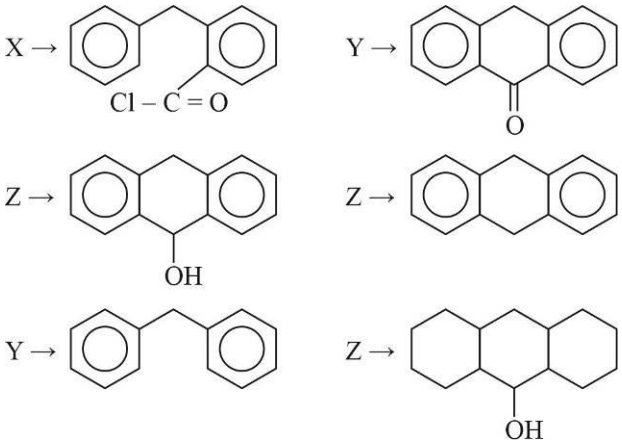
Statement – IV: Cyanobenzene can be prepared by nucleophilic substitution of chlorine in chlorobenzene

Statement – V: Aniline on Friedel-Crafts Methylation form p-Toluidine as major product.

9.



How many are correct product for above reaction?



10. In an oligopeptide named Alanylglycylphenylalanylisoleucine, the number of sp^2 hybridized carbons is _____.

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PART III : MATHEMATICS	MARKS: 100

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. The general solution of the differential equation $\frac{xdx+ydy}{ydx-xdy}=x^2+2y^2+\frac{y^4}{x^2}$, is:

(A) $\frac{2x}{y}+\frac{1}{\left(x^2+y^2\right)}=C$ **(B)** $\frac{2y}{x}+\frac{1}{\left(x^2+y^2\right)}=C$

(C) $\frac{2x}{y}-\frac{1}{\left(x^2+y^2\right)}=C$ **(D)** $\frac{2y}{x}-\frac{1}{\left(x^2+y^2\right)}=C$

2. $\int\left(\sin(101x).\sin^{99}x\right)dx$ equals:

(A) $\frac{\sin(100x)(\sin x)^{100}}{100}+C$ **(B)** $\frac{\cos(100x)(\sin x)^{100}}{100}+C$

(C) $\frac{\cos(100x)(\cos x)^{100}}{100}+C$ **(D)** $\frac{\sin(100x)(\cos x)^{100}}{100}+C$

3. If r satisfies the equation $\vec{r}\times\left(\hat{i}+2j+k\right)=\hat{i}-k$, then for any scalar $\alpha, \vec{r}$ is equal to:

(A) $\hat{i}+\alpha\left(\hat{i}+2j+k\right)$ **(B)** $j+\alpha\left(\hat{i}+2j+k\right)$

(C) $k+\alpha\left(\hat{i}+2j+k\right)$ **(D)** $\hat{i}-k+\alpha\left(\hat{i}+2j+k\right)$

4. Let $I_n=\int\tan^n xdx,(n>1)$. If $I_4+I_6=a\tan^5x+bx^5+C$, where C is a constant of integration, then the ordered pair (a,b) is equal to:

(A) $\left(\frac{1}{5},0\right)$ **(B)** $\left(\frac{1}{5},-1\right)$ **(C)** $\left(\frac{-1}{5},0\right)$ **(D)** $\left(\frac{-1}{5},1\right)$

SPACE FOR ROUGH WORK

5. If $\vec{a}=\frac{1}{\sqrt{10}}\left(3\hat{i}+\hat{k}\right)$ and $\vec{b}=\frac{1}{7}(2\hat{i}+3\hat{j}-6\hat{k})$, then the value of $(2\vec{a}-\vec{b})\cdot\left[\left(\vec{a}\times\vec{b}\right)\times\left(\vec{a}+2\vec{b}\right)\right]$.

(A) 5 **(B)** 3 **(C)** -5 **(D)** -3

6. Let $\vec{a}=\hat{j}-\hat{k}$ and $\vec{c}=\hat{i}-\hat{j}-\hat{k}$. Then vector $\vec{b}$ satisfying $\vec{a}\times\vec{b}+\vec{c}=\vec{0}$ and $\vec{a}\cdot\vec{b}=3$ is:

(A) $2\hat{i}-\hat{j}+2\hat{k}$ **(B)** $\hat{i}-\hat{j}-2\hat{k}$ **(C)** $\hat{i}+\hat{j}-2\hat{k}$ **(D)** $-\hat{i}+\hat{j}-2\hat{k}$

7. If $\vec{u},\vec{v},\vec{w}$ are non-coplanar vectors and *p*, *q* are real numbers, then the equality

$\left[3\vec{u}\ p\vec{v}\ p\vec{w}\right]-\left[p\vec{v}\ \vec{w}\ q\vec{u}\right]-\left[2\vec{w}\ q\vec{v}\ q\vec{u}\right]=0$ holds for:

(A) exactly one value of (p, q)

(B) exactly two values of (p, q)

(C) more than two but not all values of (p, q)

(D) all values of (p, q)

8. Let *a*, *b* and *c* be distinct non-negative numbers. If the vectors $a\hat{i}+a\hat{j}+c\hat{k}, \hat{i}+\hat{k}$ and $c\hat{i}+c\hat{j}+b\hat{k}$ lie in a plane, then *c* is:

(A) the Geometric Mean of *a* and *b*

(B) the Arithmetic Mean of *a* and *b*

(C) equal to zero

(D) the Harmonic Mean of *a* and *b*

9. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three non-zero vectors such that no two of these are collinear. If the vector $\vec{a}+2\vec{b}$ is collinear with $\vec{c}$ and $\vec{b}+3\vec{c}$ is collinear with $\vec{a}$ (λ being some non-zero scalar) then $\vec{a}+2\vec{b}+6\vec{c}$ equals:

(A) $\lambda\vec{a}$ **(B)** $\lambda\vec{b}$ **(C)** $\lambda\vec{c}$ **(D)** 0

SPACE FOR ROUGH WORK

10. The differential equation which represents the family of curves $y = c_1 e^{c_2 x}$, where c_1 and c_2 are arbitrary constants, is:

(A) $yy'' = y'$ **(B)** $yy'' = (y')^2$ **(C)** $y' = y^2$ **(D)** $y'' = y'y$

11. $\vec{a} = 3\hat{i} - 5\hat{j}$ and $\vec{b} = 6\hat{i} + 3\hat{j}$ are two vectors and $\vec{c}$ is a vector such that $\vec{c} = \vec{a} \times \vec{b}$ then $|\vec{a}| : |\vec{b}| : |\vec{c}|$

(A) $\sqrt{34} : \sqrt{45} : \sqrt{39}$ **(B)** $\sqrt{34} : \sqrt{45} : 39$

(C) 34 : 39 : 45 **(D)** 39 : 35 : 34

12. $\int_{-4}^{3} |x^2 - 4| dx =$

(A) $\frac{7}{3}$ **(B)** $\frac{71}{3}$ **(C)** $\frac{80}{3}$ **(D)** $\frac{57}{3}$

13. The value of $\int_{-\pi}^{\pi} \frac{2x(1+\sin x)}{1+\cos^2 x} dx$ is:

(A) π^2 **(B)** $2\pi^2$ **(C)** $4\pi^2$ **(D)** 0

14. If $\vec{a}, \vec{b}, \vec{c}$ are vectors such that $\vec{a} + \vec{b} + \vec{c} = 0$ and $|\vec{a}| = 7, |\vec{b}| = 5, |\vec{c}| = 3$ then angle between vector $\vec{b}$ and $\vec{c}$ is:

(A) 60° **(B)** 30° **(C)** 45° **(D)** 90°

15. The value of $\int_{0}^{1} \frac{(x^6 - x^3)}{(2x^3 + 1)^3} dx$ is equal to:

(A) $-\frac{1}{6}$ **(B)** $-\frac{1}{12}$ **(C)** $-\frac{1}{18}$ **(D)** $-\frac{1}{36}$

SPACE FOR ROUGH WORK

16. $2\int_0^{\frac{1}{\sqrt{2}}} \frac{\sin^{-1}x}{x}dx - \int_0^1 \frac{\tan^{-1}x}{x}dx =$

(A) $\frac{\pi}{8}\ln 2$ **(B)** $\frac{\pi}{4}\ln 2$ **(C)** $\frac{\pi}{2\sqrt{2}}\ln 2$ **(D)** $\frac{\pi}{2}\ln 2$

17. If $\vec{a},\vec{b},\vec{c}$ are vectors such that $\vec{a}\cdot\left(\vec{b}\times\vec{c}\right)=4$ then $\left(\vec{a}\times\vec{b}\right)\cdot\left(\left(\vec{b}\times\vec{c}\right)\times\left(\vec{c}\times\vec{a}\right)\right)=$

(A) 16 **(B)** 64 **(C)** 4 **(D)** 8

18. If a curve $y=f(x)$ passes through the point $(1,-1)$ and satisfies the differential equation, $y(1+xy)dx=xdy$, then $f\left(-\frac{1}{2}\right)$ is equal to:

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

19. Let $y(x)$ be the solution of the differential equation $(x\log x)\frac{dy}{dx}+y=2x\log x,\ (x\geq 1)$. Then $y(e)$ is equal to:

(A) 2 **(B)** 2*e* **(C)** *e* **(D)** 0

20. $(2+\sin x)\frac{dy}{dx}+(y+1)\cos x=0$ and $y(0)=1$, then $y\left(\frac{\pi}{2}\right)$ is equal to:

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

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 $\int_0^1 \frac{4x^3(1+(x^4)^{2010})}{(1+x^4)^{2012}}\,dx = \frac{\lambda}{\mu}$

Where λ and μ are relatively prime positive integers. Find unit digit of μ.

2. Let $\int_1^{\sqrt{3}} \left(x^{2x^2+1} + \ln(x^{2x^{2x^2+1}}) \right) dx = N.$ Find the value of $(N-6).$

3. Find the value of $|a|$ for which the area of triangle included between the coordinate axes and any tangent to the curve $x^a y = \lambda^a$ is constant (where λ is constant)

4. Let $I = \int_0^{\pi} x^6(\pi - x)^8\,dx,$ then $\frac{\pi^{15}}{({}^{15}C_9)I} =$

5. Let $\vec{u} = \hat{i} + \hat{j}, \vec{v} = \hat{i} - \hat{j}$ and $\vec{w} = \hat{i} + 2\hat{j} + 3\hat{k}.$ If $\hat{n}$ is unit vector such that $\vec{u}\cdot\hat{n} = 0$ and $\vec{v}\cdot\hat{n} = 0$ then $|\vec{w}\cdot\hat{n}|$ is equal to _____.

SPACE FOR ROUGH WORK

6. The integral $\int_2^4 \frac{\log x^2}{\log x^2 + \log(36 - 12x + x^2)} dx$ is equal to _____.

7. If solution of the differential equation $\cos x dy = y(\sin x - y)dx,\ y(0) = 1$ is $y = f(x)$. Then $f\left(\frac{\pi}{2}\right)$ is _____.

8. If $\frac{dy}{dx} = y + 3 > 0$ and $y(0) = 2$, then $y(\ln 2)$ is equal to _____.

9. Let [.] denote the greatest integer function then the value of $4 \times \int_0^{1.5} x[x^2]dx$ is _____.

10. If the value of $\int_0^1 \frac{8\log(1+x)}{1+x^2} dx$ is $\pi \ln k$, then 'k' is _____.

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