AITS
ALL INDIA TEST SERIES
SELECTION HOGA YAHIN SE

12th JEE Main

AJLM3/02 **Test- 02**

DURATION : 180 Minutes **DATE : 17/11/2024** **M.MARKS : 300**

Topics Covered

Physics:	Alternating Current, Wave Optics, Dual Nature of Radiation and Matter
Chemistry:	Aldehydes, Ketones and Carboxylic Acids, Amines, Biomolecules, Coordination Compounds, The p-Block Elements, The d and f-Block Elements
Mathematics:	Indefinite Integration, Definite Integration, Application of Integrals, Differential Equation, Vector Algebra, Three Dimensional Geometry

General Instructions:

1. Immediately fill in the particulars on this page of the test booklet.
2. The test is of **3 hours** duration.
3. The test booklet consists of 75 questions. The maximum marks are **300**.
4. There are three Sections in the question paper, Section I, II & III consisting of Section-I **(Physics)**, Section-II **(Chemistry)**, Section-III **(Mathematics)** and having **25 questions** in each part in which first **20** questions are of Objective Type and Last **5 questions** are integers type and all **25 questions are compulsory**.
5. There is only one correct response among 4 alternate choices provided for each objective type question.
6. Each correct answer will give **4** marks while **1** Mark will be deducted for a wrong response.
7. No student 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.
8. 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.
9. **Do not fold or make any stray mark on the Answer Sheet (OMR).**

OMR Instructions:

1. Use blue/black dark ballpoint pens.
2. Darken the bubbles completely. Don't put a tick mark or a cross mark where it is specified that you fill the bubbles completely. Half-filled or over-filled bubbles will not be read by the software.
3. Never use pencils to mark your answers.
4. Never use whiteners to rectify filling errors as they may disrupt the scanning and evaluation process.
5. Writing on the OMR Sheet is permitted on the specified area only and even small marks other than the specified area may create problems during the evaluation.
6. Multiple markings will be treated as invalid responses.
7. **Do not fold or make any stray mark on the Answer Sheet (OMR).**

Name of the Student (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

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

IMPORTANT CONSTANTS

Speed of light in free space,	:	$3.00 \times 10^{8}\ ms^{-1}$
Permeability of free space,	:	$4\pi \times 10^{-7}\ Hm^{-1}$
Permittivity of free space,	:	$8.85 \times 10^{-12}\ Fm^{-1}$
The Planck constant,	:	$6.63 \times 10^{-34}\ Js$
Rest mass of electron,	:	$9.1 \times 10^{-31}\ kg$
Rest mass of proton,	:	$1.67 \times 10^{-27}\ kg$
Molar gas constant,	:	$8.31\ JK^{-1}\ mol^{-1}$
The Avogadro constant,	:	$6.02 \times 10^{23}\ mol^{-1}$
The Boltzmann constant,	:	$1.38 \times 10^{-23}\ JK^{-1}$
Gravitational constant,	:	$6.67 \times 10^{-11}\ N\ m^2kg^{-2}$
Acceleration of free fall	:	$9.8\ ms^{-2}$
Rydberg Constant	:	$1.097 \times 10^{7}\ m^{-1}$
Atomic mass unit	:	$1.67 \times 10^{-27}\ kg$
Charge on proton	:	$1.6 \times 10^{-19}\ C$

IMPORTANT VALUES

$\sqrt{2}$ = 1.414

$\sqrt{3}$ = 1.732

$\sqrt{5}$ = 2.236

π = 3.142

e (Euler's constant) = 2.718

ln 10 = 2.303

$\log_{10}2$ = 0.3010

$\log_{10}3$= 0.4770

$\log_{10}7$ = 0.845

**** Use above values unless otherwise specified in a question.***

❑❑❑

SECTION-I (PHYSICS)

Single Correct Type Questions

1. In a sequentially connected RLC series circuit consisting of a resistor with a resistance of 8kΩ, a capacitor exhibiting a capacitive reactance of 400πΩ, and an unspecified inductor, all connected to an alternating current source of 500 V operating at a frequency of 100 Hz, determine the inductance of inductor necessary to achieve resonance and thereby also find the corresponding maximum rms current in the circuit

(1) 2 H, 62.5 mA (2) 3 H, 31.25 mA
(3) 1.5 H, 37.2 mA (4) 8 H, 68.4 mA

2. An alternating voltage $E = 200\sqrt{2}\sin(100t)$ Volt is connected to a 1μF capacitor through an ideal ac ammeter. The reading of the ammeter is

(1) 20 mA (2) 10 mA
(3) 5 mA (4) 4 mA

3. In a Young's double-slit setup with a slit separation of 1 mm and a screen distance of 2 m, a point is observed on the screen at 5.24 mm from the central maximum using 500 nm light. Calculate the path difference between the light waves reaching this point from the two slits

(1) 1.3 μm (2) 5.24 μm
(3) 2.62 μm (4) 25 μm

4. The potential energy of a particle of mass m is given by $V(x) = \begin{cases} E_0 & ,0 \le x \le 1 \\ 0 & x > 1 \end{cases}$ λ_1 and λ_2 are the de-Broglie wavelengths of the particle, when $0 \le x \le 1$ and $x > 1$ respectively. If the total energy of particle is $2E_0$, then $(\lambda_1/\lambda_2)^2$ is

(1) 1 (2) 2
(3) 3 (4) 4

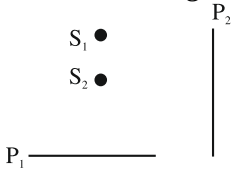
5. The maximum energy electron ejected from a metallic surface has a kinetic energy E due to the photoelectric effect, triggered by electromagnetic radiation having wavelength of λ. If another electromagnetic radiation, which has wavelength of $\frac{\lambda}{3}$, is irradiated on the same metal surface. Determine the corresponding maximum kinetic energy of the emitted electron.

(1) $\frac{2E\lambda + hc}{2\lambda}$ (2) $\frac{E\lambda + 2hc}{\lambda}$
(3) $\frac{E\lambda + 2hc}{3\lambda}$ (4) $\frac{2E\lambda - 3hc}{3\lambda}$

6. In a single slit diffraction experiment using same setup, first maxima of light of unknown wavelength (λ) coincides with first minimum of light of wavelength 540 nm. If it is known that maximas lie exactly in between at middle of adjacent minimas then value of λ is equal to

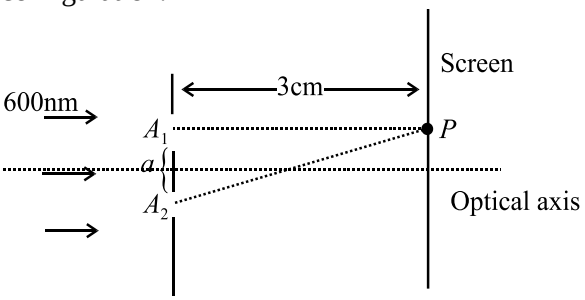
(1) 270 nm (2) 360 nm
(3) 540 nm (4) 810 nm

7. Consider two coherent point sources (S_1 and S_2) separated by a small distance along a vertical line and two screens P_1 and P_2 placed in horizontal and vertical plane respectively, as shown in Figure. Which one of the choices represents most appropriately the shapes of the interference fringe at the central regions on each of the screens?



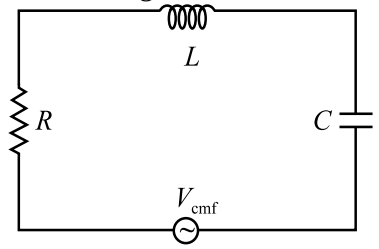
(1) Circular on P_1 and straight lines on P_2
(2) Circular on P_1 and circular on P_2
(3) Straight lines on P_1 and straight lines on P_2
(4) Straight lines on P_1 and circular on P_2

8. In a Young's double-slit experiment utilizing monochromatic light with a wavelength of 600nm, the slits are separated by a distance a, and the projection screen is situated 3cm from the slits, as shown. Consider a point P where the third minimum is observed, positioned exactly infront of the slit A_1, (A_1P line is parallel with the optical axis and perpendicular to the line joining the two slits, A_1 and A_2). Determine the separation a between the slits based on the given configuration.



(1) 0.1 mm (2) 0.5 mm
(3) 0.2 mm (4) 0.3 mm

9. In the *RLC* circuit in the figure, R = 60 Ω, L = 3mH, C = 4mF, and the source of time varying emf has a peak voltage of 120V. What should the angular frequency of the source, ω, be to produce the largest current in the resistor?



(1) 4.2 rad / s (2) 8.3 rad / s
(3) 141.4 rad /s (4) 289 rad /s

10. In a controlled laboratory experiment involving atomic particles with a scanning electron microscope (SEM), electrons traverse with a specific velocity. If alpha particles, possessing an identical velocity, were substituted for the electrons, by what multiplicative factor would the limit-of-resolution of the scanning alpha-particle microscope be altered? (Given the proton-to-electron mass ratio of 1830:1).

(1) $\frac{1}{7320}$ (2) $\frac{1}{3660}$

(3) $\frac{1}{5490}$ (4) $\frac{1}{1830}$

11. Interference fringes were produced by Young's double slit method, the wavelength of light used being 6000 Å. The separation between the two slits is 2mm. The distance between the slits and screen is 1 m. When a transparent plate of thickness 50 μm is placed over one of the slits, the fringe pattern is displaced by 5mm. If μ be the refractive index of the material of the plate, then the value of 10μ.

(1) 10 (2) 12

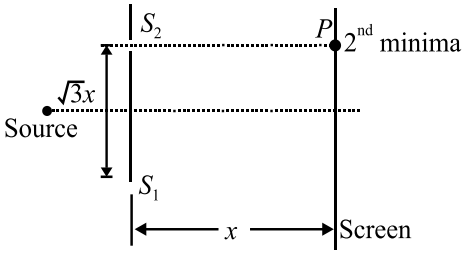
(3) 15 (4) 16

12. In a specially designed PW-laboratory, experiments on the interference of light are conducted. One such experiment is the YDSE. In this experiment, a transparent film of thickness $\frac{d}{2}$ having speed of light in it as $\frac{1}{\mu}$ times the speed of light in vacuum, is positioned in front of one of the slits. While another transparent film of thickness d having speed of light in it as $\frac{1}{2\mu}$ times the speed of light in vacuum, is placed in front of the other slit. The central fringe of the interference pattern exhibits a displacement corresponding to half a fringe width. Given that the wavelength of the incident monochromatic light is λ, calculate the precise value of d.

(1) $\frac{\lambda}{(\mu-1)}$ (2) $\frac{\lambda}{(3\mu-1)}$

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

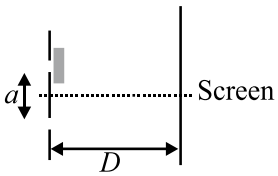
13. International society of scientists (*ISS*) conducted experiments to study the behavior of light, one such experiment is Young's Double-Slit experiment. In the specified YDSE configuration as shown, determine the value of $\frac{x}{\lambda}$ if the required inter-slit distance is $\sqrt{3}x$ for the second minima to be precisely and exactly infront of the slit S_2. Here, λ denotes the wavelength of the monochromatic light used.



(1) 1.5 (2) 0.5

(3) 3 (4) 2.5

14. In a precision optical setup involving a YDSE, a 10 μm thick, optically clear substrate is positioned in front of one of the slits as shown. Utilizing monochromatic light of wavelength 600 nm, the central maximum of the interference pattern exhibits a lateral displacement corresponding to five fringe widths. Determine the refractive index of the optical film.



(1) 1.5 (2) 1.3

(3) 2.5 (4) 1.2

15. Consider a pair of monochromatic radiative sources S_1 and S_2. Source S_1 emitting radiations having one oscillating cycle with wavelength of 2nm, and source S_2 emitting radiations having one oscillating cycle with wavelength of 600 nm. The source S_1 emits radiations with a power three times greater than that of the source S_2. Calculate the ratio of the photons emitted per second for the source S_1 to that of source S_2

(1) 900 (2) $\frac{1}{900}$

(3) 100 (4) $\frac{1}{100}$

16. In an *R-L-C AC* circuit V= 20 sin (314t +5π/6) volt and i =10 sin (314t + 2π/3)Amp. The power factor of the circuit is

(1) 0 .5 and the current lag

(2) 0.866 and the current lead

(3) 0.866 and the current lag

(4) 1 and the current lead

17. What is the maximum kinetic energy of photoelectrons ejected from a metal surface with a work function of 2 eV when illuminated by light composed of two superimposed plane waves with electric fields given by
$E = 300\,[\sin(2 \times 10^{15})\,t + \sin(6 \times 10^{15})\,t]\ \text{Vm}^{-1}$?
Given $h = 4\,\pi/3 \times 10^{-15}$ eV-s.

(1) 1.50 eV
(2) 2.00 eV
(3) 2.50 eV
(4) 4.00 eV

18. Consider a subatomic particle of negative charge moving with constant velocity v and a quantum of electromagnetic radiation propagating at the speed of light c. The de Broglie wavelength of the particle and the wavelength of the quantum of electromagnetic radiation are in the ratio of 3 : 2. Determine the ratio of the particle's kinetic energy E_e to the energy of the quantum of electromagnetic radiation E_{ph}.

(1) $\frac{v}{3c}$ (2) $\frac{3v}{4c}$
(3) $\frac{v}{2c}$ (4) $\frac{3v}{c}$

19. A subatomic particle having mass m and charge e, starting at $t = 0$ with velocity $2v_0\hat{i}$, enters a region with constant electric field described by $\vec{E} = E_0\hat{j}$. Given that its initial de-Broglie wavelength is $\lambda_0 = \frac{h}{m \cdot 2v_0}$, determine the magnitude of fractional change in its de-Broglie wavelength after a time of 2 seconds. Assume the condition $\frac{eE_0}{m \cdot v_0} << 1$.

(1) $\frac{1}{2}\left(\frac{eE_0}{mv_0}\right)^2$
(2) $2\left(\frac{eE_0}{mv_0}\right)^2$
(3) $\frac{1}{2}\left(\frac{eE_0}{2mv_0}\right)^2$
(4) $\left(\frac{eE_0}{mv_0}\right)^2$

20. Considering the phenomena observed in the photoelectric effect, determine the validity of the following statements:

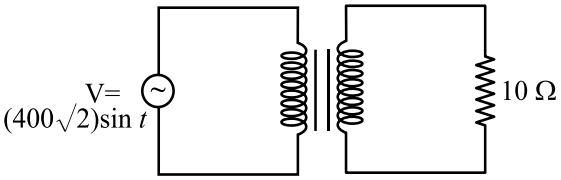
(A) The saturation current exhibits a linear dependence on the frequency of the incident electromagnetic radiation.
(B) The maximum kinetic energy of photoelectrons diminishes as the distance between the light source and the metallic surface increases.
(C) The saturation current diminishes with a reduction in the optical power of a given light-emitting diode (LED) source.
(D) The instantaneous emission of photoelectrons from the metallic surface can be explained by the wave theory of light or electromagnetic wave theory.
(E) The emitted electrons experience a force due to the accumulation of positive charge on the metal surface.

Select the accurate statements from the options provided below.

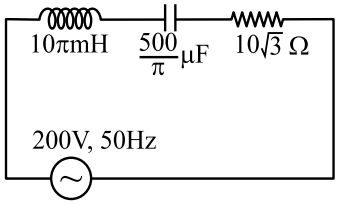
(1) (A) and (B) only
(2) (A) and (E) only
(3) (C) and (E) only
(4) (D) and (E) only

Integer Type Questions

21. A transformer with 80% efficiency is used with an AC source As shown in figure. Turn ratio of primary to secondary coil is 2. If current flowing in primary coil is $I/4$. Find I (in Amperes) (Assume there is no flux leakage in transformer).



22. Determine the approximate magnitude of the current (in amperes) in a series RLC circuit with a resistance of $10\sqrt{3}\ \Omega$, an inductance of 10π mH, and a capacitance of $\frac{500}{\pi}$ μF. The circuit is Powered by an alternating current source with an RMS voltage of 200 V and a frequency of 50 Hz. Assume $\pi^2 = 10$.



23. To examine the interference phenomena of electromagnetic radiation, a 'PW-student' conducts an experiment using a standard YDSE setup with a source of electromagnetic radiation having one wavelength of λ. The optical luminance at a location on the observation screen where the path difference is λ is 100 lumens. Determine the optical luminance (in lumens) at a location where the path difference is $\frac{\lambda}{4}$.

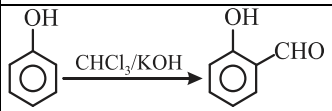
24. To study the transverse nature of electromagnetic radiation, a 'PW-Student' conducts an experiment using a pair of polaroids. Consider a non-polarized electromagnetic radiation with an initial irradiance intensity I_0 incident upon a polarizing optical device. Subsequently, an analyzer, initially aligned with the polarizer, is rotated 53° clockwise. Given that the final irradiance of the transmitted radiation is $\frac{xI_0}{50}$, determine the value of *x*.

25. Maximum *KE* (in eV) of photoelectrons, when a metal surface with work function 2 eV is irradiated with photons of wave length 400 nm is equal to *x*. Value of 10*x* is equal to_____.(*hc* =1240 eV- nm)

SECTION-II (CHEMISTRY)

Single Correct Type Questions

26. Match Column-I with Column-II:

Column-I (Reaction)		Column -II (Name)	
A	$CH_3-\overset{\overset{O}{\|\|}}{C}-CH_3 \xrightarrow[HCl]{Zn(Hg)} CH_3-CH_2-CH_3$	**P**	Rosenmund reduction
B	$R-\overset{\overset{O}{\|\|}}{C}-Cl \xrightarrow[Pd-BaSO_4]{H_2} R-\overset{\overset{O}{\|\|}}{C}-H$	**Q**	Reimer-Tiemann reaction
C	$CH_3-CH_2-CN \xrightarrow[H^+]{SnCl_2/HCl} CH_3-CH_2-CHO$	**R**	Clemmensen Reduction
D		**S**	Stephen Reaction

Choose the correct answer from the options given below

	A	B	C	D
(1)	P	Q	R	S
(2)	Q	P	S	R
(3)	R	P	S	Q
(4)	R	P	Q	S

27. The |CFSE| for $[CoCl_6]^{4-}$ complex is 18000 cm^{-1}. The |CFSE| for $[CoCl_4]^{2-}$ will be

(1) 9000 cm^{-1}
(2) 4000 cm^{-1}
(3) 58000 cm^{-1}
(4) 12000 cm^{-1}

28. Which of the following ions can exhibit optical isomerism

(1) $[Co(NH_3)_4Cl_2]^+$
(2) $[Co(NH_3)_2Cl_4]^-$
(3) Cis–$[CoCl_2(en)_2]^+$
(4) trans-$[CoCl_2(en)_2]^+$

29. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: Fluorine shows –1 oxidation state in its compounds.

Reason R: It can expand its octet due to availability of vacant d-orbital.

In the light of the above statements, choose the most appropriate answer from the options given below.

(1) Both A and R are correct and R is the correct explanation of A.
(2) Both A and R are correct but R is NOT the correct explanation of A.
(3) A is correct but R is not correct.
(4) A is not correct but R is correct.

30. When a polysaccharide 'A' is boiled with dilute HCl at 373 K, it breaks down to produce compound 'B'. Compound B reacts with Fehling's solution, forming a red precipitate. 'A' is known to have only α-glycosidic linkages. Identify compound 'A'

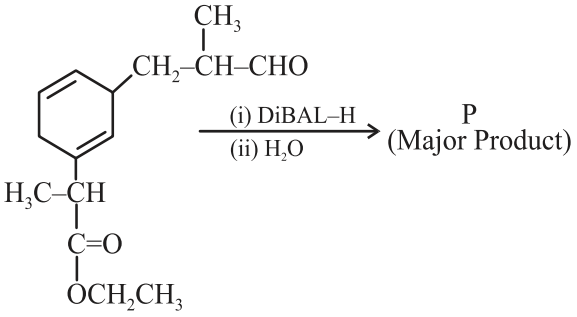
(1) Cellulose
(2) Lactose
(3) Maltose
(4) Amylose

31. The complex with three possible stereoisomers is:

(1) $[Cr(C_2O_4)_3]^{3-}$ (2) $[Co(en)_2Cl_2]$

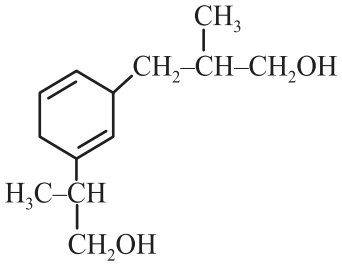
(3) $[CoCl_3(NH_3)_3]$ (4) $[PtCl_4]^{2-}$

32.

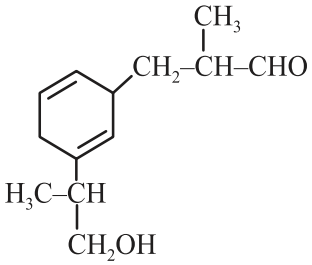


Major product P is_____.

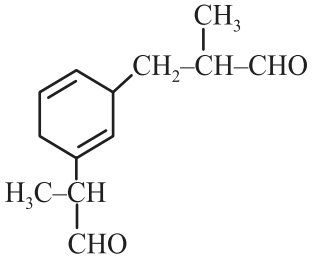
(1)



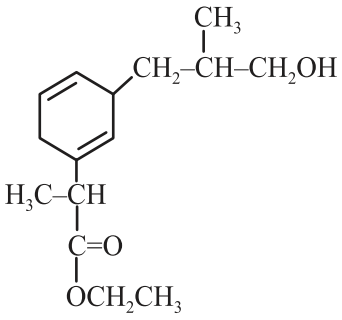
(2)



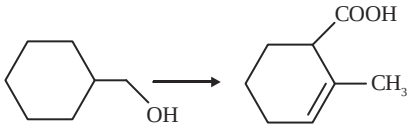
(3)



(4)



33. The correct order of reagents required to bring the following change is:



(1) $H_3O^+; KCN; NBS; K_2Cr_2O_7 / H^+$

(2) $K_2Cr_2O_7 / H^+; Cl_2 / KOH; CH_3MgBr; H_3O^+$

(3) conc. $H_2SO_4, \Delta; NBS; KCN; H_3O^+$

(4) conc. $H_2SO_4, \Delta; NBS; CH_3MgBr; K_2Cr_2O_7 / H^+$

34. Consider the following reaction sequence

$$PhCOOH \xrightarrow{NH_3} [A] \xrightarrow{Heat} [B] \xrightarrow{P_2O_5} [C]$$

$$\xrightarrow[Ni/\Delta]{H_2} [D]$$

$$[B] \xrightarrow[Heat]{Br_2/KOH} [E]$$

Which of the following is false?

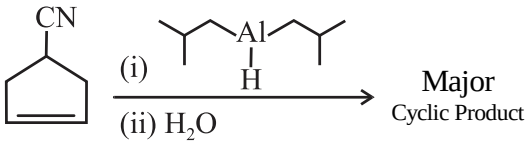
(1) [A] is $PhCONH_2$

(2) [C] is dehydration product of [B]

(3) [B] to [E] is hoffmann bromamide rearrangement

(4) [D] and [E] are homologous

35.



Incorrect statement about the product of above reaction is

(1) Cannot liberate CO_2 with $NaHCO_3$

(2) Gives silver mirror with Tollen's reagent

(3) Degree of unsaturation is three

(4) Cannot show tautomerism

36. The sum of P = O bond in H_3PO_3, $H_4P_2O_6$ and H_3PO_4 will be:

(1) 3 (2) 4

(3) 5 (4) 6

37. Given below are two statements:

Statement-I : An inner orbital complex $[Fe(CN)_6]^{4-}$ with d^2sp^3 hybridisation shows diamagnetism

Statement-II: CN^- is strong field ligand and causes pairing of electrons.

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

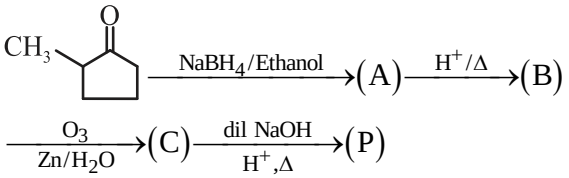
(1) Both Statement-I and Statement-II are true.

(2) Both Statement-I and Statement-II are false.

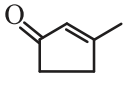
(3) Statement-I is correct but Statement-II is false.

(4) Statement-I is incorrect but Statement-II is true.

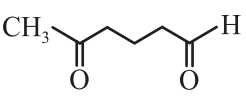
38. Major product (P) in the below reaction is:



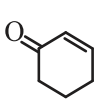
(1)



(2)



(3)



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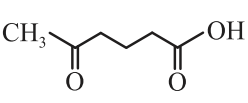
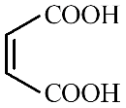
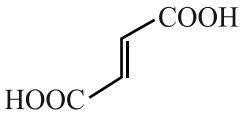
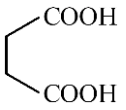
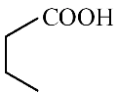


39. Which of the following is most acidic?

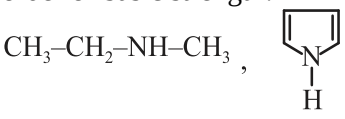
(1) 

(2) 

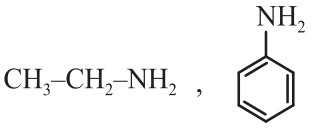
(3) 

(4) 

40. Which of the following is the correct increasing order of basic strength:



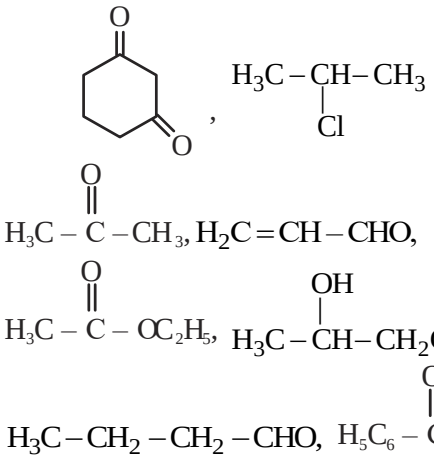
(A) (B)



(C) (D)

(1) B < D < A < C (2) B < D < C < A
(3) D < B < A < C (4) A < B < C < D

41. Consider the following compounds:



How many of these compounds would give positive iodoform test?

(1) 5 (2) 7
(3) 4 (4) 6

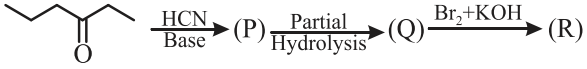
42. The lowest melting solid among the following elements is:

(1) Si (2) Pb
(3) Ge (4) Sn

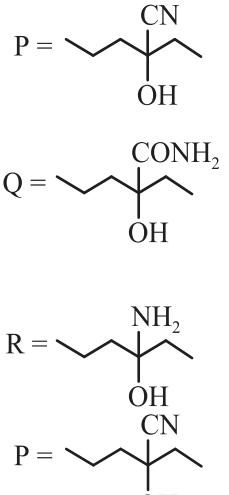
43. Group-15 elements from EH_3 type hydrides. The correct decreasing order of bond enthalpy of E – H bond is: (E = Group 15 element)

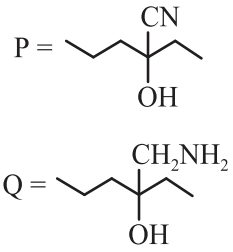
(1) P – H > N – H > As – H > Sb – H
(2) N – H > P – H > As – H > Sb – H
(3) As – H > Sb – H > P – H > N – H
(4) N – H > P – H > Sb – H > As – H

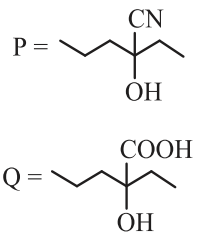
44. In the given reaction sequence;

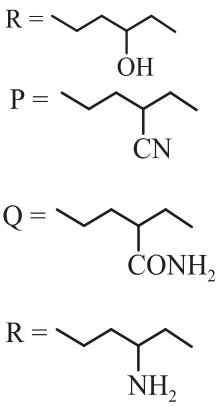


P, Q, R are respectively

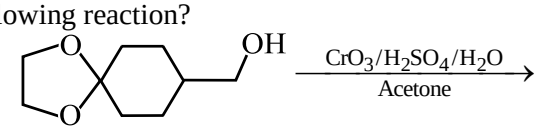
(1) 

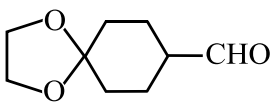
(2) 

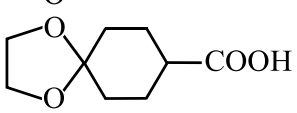
(3) 

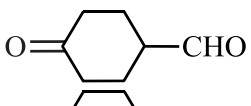
(4) 

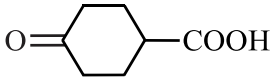
45. What is the major organic product of the following reaction?



(1) 

(2) 

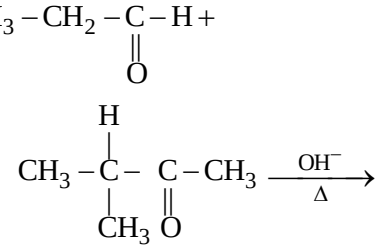
(3) 

(4) 

Integer Type Questions

46. XeF_6 on complete hydrolysis produces a compound XeO_3 and on partial hydrolysis forms $XeOF_4$. The sum of total number of lone pairs of electrons present on both the products is/are:

47. The number of α, β -unsaturated aldehyde/ketone products possible in the below reaction is/are _____.



48. For a given reaction mechanism:

Step I: $MnO_2 + KOH + O_2 \xrightarrow{\text{Heat}} A + H_2O$

Step II: $A + HCl \rightarrow B + MnO_2 + KCl + H_2O$

Step III: $B + H^+ + Fe^{2+} \rightarrow C + Fe^{3+} + H_2O$

Find the number of electrons involved per mole of B in step III. (it is given that B is of pink colour used commonly as an oxidising agent)

49. In how many of the following oxyacids of sulphur, the oxidation state of sulphur atom is +6?

$H_2S_2O_8$, H_2SO_5, H_2SO_3, H_2SO_4, $H_2S_2O_7$, SO_2Cl_2, $SOCl_2$

50. Number of acyclic tripeptides possible by mixing three amino acids A, B and C are _____. (without allowing repetition of amino acids)

SECTION-III (MATHEMATICS)

Single Correct Type Questions

51. Let the solution curve of the differential equation $\frac{xdy - ydx}{xdx} = \frac{\sqrt{(y+4x)^2 - 8xy}}{x}$, be $y = y(x)$. If $y(1) = 0$, then $y(2)$ is equal to:

(1) 15 (2) 6

(3) 13 (4) 7

52. Area bounded by curve $y^2 = \frac{2-x}{x}$ with $x = 0$ is

(1) 2π (2) π

(3) π^2 (4) $\frac{\pi}{2}$

53. If a vector $\vec{r}$ is such that $\vec{r} \times \left(\hat{i} + 2\hat{j} - \hat{k}\right) = \left(\hat{i} + \hat{k}\right)$ then $\vec{r}$ can be

(1) $-2\hat{i} - 5\hat{j} + \hat{k}$ (2) $\hat{i} - \hat{j} + 3\hat{k}$

(3) $2\hat{i} + 5\hat{j} - \hat{k}$ (4) $3\hat{i} + 5\hat{j} - 3\hat{k}$

54. Equation of the curve having $\frac{dy}{dx} = -1$ at a point $A(1, 1)$ and satisfying the differential equation $x\frac{d^2y}{dx^2} + \frac{dy}{dx} = \ln x$, is

(1) $y = x\ln x + x + 3$

(2) $y = x\ln x + 3$

(3) $y = x\ln x + 2x - 3$

(4) $y = x\ln x - 2x + 3$

55. Let $\vec{a} = 4\hat{i} + 3\hat{j} + 10\hat{k}, \vec{b} = p\hat{i} + 13\hat{j} + 4\hat{k}$ and $\vec{c}$ be vectors such that $\vec{a} \times \vec{c} = \vec{a} \times \vec{b}$. If $\vec{a} \cdot \vec{c} = 75, \vec{c} \cdot \left(\hat{i} + 2\hat{j} - 3\hat{k}\right) = 4$ then p is equal to.

(1) $\frac{-36}{205}$ (2) $\frac{266}{41}$

(3) 2727 (4) $-\frac{266}{41}$

56. **Assertion (A):** $\int_1^2 \frac{9x+4}{x^5+3x^2+x}dx = \ln\frac{80}{23}$

Reason (R):

$\int \frac{9x+4}{x^5+3x^2+x}dx = \ln\left(x^4+3x^3+x^2+18x\right) + c$

(1) Both (A) and (R) are true and (R) is correct explanation of (A).

(2) Both (A) and (R) true but (R) is not correct explanation of (A)

(3) (A) is true, (R) is false

(4) (A) is false (R) is true

57. If solution of differential equation $\left(2^x - 1\right)\frac{dy}{dx} + \left(2^x - \frac{2^x}{2^y}\right) = 0$, is $y(x)$ where $x, y > 0, y(1) = 1$, then $y(2)$ is equal to:

(1) $2 + \log_2 3$

(2) $2 + \log_3 2$

(3) $2 - \log_3 2$

(4) $2 - \log_2 3$

58. Let

$$f(x)=\int\frac{a^{3\log_a 2x}+5a^{2\log_a 2x}}{a^{4\log_a x}+5a^{3\log_a x}-7a^{2\log_a x}}dx, x>0.$$

If $f(1)=0$, then value of $f(0)$ is

(1) $4\ln 7$ (2) $4\ln 7+1$

(3) 1 (4) $4\ln 6+1$

59. The value of

$\int_5^{37}\left(\sqrt{x+3-4\sqrt{x-1}}+\sqrt{x+8-6\sqrt{x-1}}\right)dx$ is

(1) 120 (2) 122

(3) 124 (4) 130

60. Let $\vec{a}=\alpha\hat{i}+\hat{j}-\hat{k}$ and $\vec{b}=2\hat{i}+\hat{j}-\alpha\hat{k}$. If the projection of $\vec{b}\times\vec{a}$ on the vector $\hat{i}+\hat{j}+\hat{k}$ is $\sqrt{3}$, then α is equal to:

(1) 0

(2) 3

(3) 2

(4) $-\sqrt{2}$

61. Let $y=y(x)$ be a solution curve of the differential equation, $\left(1+x^2y^2\right)dx=ydx+xdy$. If the line $x=1$ intersects the curve $y=y(x)$ at $y=1$ and the line $x=2$ intersects the curve $y=y(x)$ at $y=\alpha$, then a value of α is

(1) $\frac{\tan\left(1+\frac{\pi}{4}\right)}{2}$ (2) $\frac{\tan\left(1-\frac{\pi}{4}\right)}{2}$

(3) $\frac{\tan\left(\frac{\pi}{4}-1\right)}{3}$ (4) $\frac{\cot\left(1+\frac{\pi}{4}\right)}{3}$

62. Let ABC be a triangle, The points X, Y and Z are on the sides BC, CA and AB respectively such that $\frac{BX}{XC}=\frac{1}{2},\frac{CY}{YA}=\frac{2}{3}\&\frac{AZ}{ZB}=\frac{3}{4}$. Then $\frac{\text{Area}(\Delta ABC)}{\text{Area}(\Delta XYZ)}$ is equal to

(1) 3 (2) $\frac{3}{2}$

(3) $\frac{7}{2}$ (4) $\frac{5}{2}$

63. If

$$\int\left(\left(\frac{x}{e}\right)^{3x}+\left(\frac{e}{x}\right)^{3x}\right)\ln x\,dx=\frac{1}{3}\left(\frac{x}{e}\right)^{ax}-\frac{1}{3}\left(\frac{x}{e}\right)^{bx}+\lambda$$

where e is Euler's number & λ is constant of indefinite integration, then $a+b$ is equal to

(1) 6 (2) 3

(3) -3 (4) 0

64. Solution of the differential equation $\left(x^3\ln x+y-yx^2\right)\frac{dx}{dy}=x^3+x$ is

(1) $y\left(x^2+1\right)=\frac{1}{4}x^3\ln x+\frac{1}{2}x^3+cx$

(2) $y^2\left(x^2-1\right)=\frac{1}{2}x^3\ln x-\frac{1}{4}x^3+cx$

(3) $\frac{y\left(x^2+1\right)}{x}=\frac{1}{2}x^2\ln x-\frac{1}{4}x^2+c$

(4) $\frac{y^2\left(x^2-1\right)}{x}=\frac{1}{2}x^2\ln x+\frac{1}{4}x^2+c$

65. The foot of perpendicular of the point $(-1,0,3)$ on the line $\frac{x+1}{-2}=\frac{y}{3}=\frac{z+1}{-1}$ is (α,β,γ). Then Which of the following is NOT correct?

(1) $\frac{\beta}{\alpha}=2$ (2) $\alpha+\beta+\gamma=-2$

(3) $\frac{\gamma}{\beta}=\frac{5}{6}$ (4) $\frac{\gamma}{\alpha}=\frac{3}{5}$

66. Let a curve $y=y(x)$ pass through the point (2, 4) and the area of the region under this curve, above the x-axis and between y-axis and the abscissa $x(>3)$ be $\left(\frac{y}{x}\right)^2$. If this curve also passes through the point $\left(\alpha,\frac{5}{4}\right)$ in the first quadrant, then α is equal to

(1) 0 (2) 1

(3) 2 (4) 3

67. $\int_0^\infty\frac{3e^{2x}-8e^x+1}{\left(e^x+1\right)\left(e^x-2\right)\left(e^x-3\right)}dx$ equals

(1) $\frac{2}{3}ln2$

(2) $\frac{3}{2}ln3$

(3) $\frac{3}{5}ln2$

(4) $\frac{5}{2}ln2$

68. The shortest distance between the lines $\frac{x+2}{3}=\frac{y+1}{-2}=\frac{z+6}{-2}$ and $\frac{x+6}{-3}=\frac{1+y}{2}=\frac{z+8}{0}$ is D then $\sqrt{13}D$. equals

(1) 2 (2) 4

(3) 6 (4) 8

69. The area of the region enclosed by the curve $y = x^3$ and straight line $y = 3x - 2$ is A. The value of A is

(1) $\frac{27}{4}$ (2) $\frac{25}{2}$

(3) $\frac{23}{2}$ (4) $\frac{23}{4}$

70. If a curve $y = f(x)$ passing through $(4, -2)$ and satisfying the differential equation $(y^3 - x)\,xdy = (x + y^3)\,ydx$ then equation of curve is

(1) $2x + y^2 = 0$ (2) $2x + y = 0$

(3) $2x + y^3 = 0$ (4) $2x^2 + y = 0$

Integer Type Questions

71. If the value of integral

$$25\int_0^{\pi/4} e^{-x}\left(\tan^{24}x + \tan^{26}x\right)dx$$

$$-\int_0^{\pi/4} e^{-x}\tan^{25}x\,dx \text{ is } e^{-\frac{\pi}{\lambda}} \text{ then } \lambda - 4 \text{ is}$$

72. Let the solution curve $y = y(x)$ of the differential equation $y^2dx + xy\left(dy + xydy\right) = 0$ which passes through the point (1, 1). The number of point(s) of intersection of the curve with straight line $y = x$ is

73. Let $I_1 = \int_0^{\pi} f(x)\sin x\,dx$ and $I_2 = \int_0^{\pi} f''(x)\sin x\,dx$ (where $f(x)$ is continuous function in $[0, \pi]$). If $I_1 + I_2 = 5$ and $f(\pi) = 2$, then $10\,f(0)$ is equal to

74. A curve passing through (2, 3) and satisfying $\int_0^x tf(t)dt = x^2 f(x), (x > 0)$. Then the value of $[f(6) + f(8) + f(10)]$ is. {where [ ] denote G.I.F.}

75. Let $P(\alpha, 0, 0)$ be the foot of perpendicular of the point $Q(-1, 2, 6)$ on line $\frac{2-x}{6} = \frac{3-y}{3} = \frac{z+4}{4}$. If $b = \left|\overrightarrow{PQ}\right|$, then $\alpha + b$ is equal to

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