FIITJEE

ALL INDIA TEST SERIES

JEE (Advanced)-2025

CONCEPT RECAPITULATION TEST – II

PAPER –2

TEST DATE: 24-04-2025

Time Allotted: 3 Hours **Maximum Marks: 180**

General Instructions:

- The test consists of total 51 questions.
- Each subject (PCM) has 17 questions.
- This question paper contains **Three Parts.**
- **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
- Each **Part** is further divided into **Three Sections**: **Section-A, Section-B & Section-C**.
  Section – A *(01 – 04, 18 – 21, 35 – 38):* This section contains **TWELVE (12)** questions. Each question has **FOUR** options. **ONLY ONE** of these four options is the correct answer.
  Section – A *(05 –07, 22 – 24, 39 – 41):* This section contains **NINE (09)** questions. Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
  Section – B *(08 – 13, 25 – 30, 42 – 47):* This section contains **EIGHTEEN (18)** numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.
  Section – C *(14 –17, 31 – 34, 48 – 51):* This section contains **SIX (06) paragraphs.** Based on each paragraph, there are **TWO (02)** questions of numerical answer type. The answer to each question is a **NUMERICAL VALUE (XXXXX.XX).** If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places.

MARKING SCHEME

Section – A (Single Correct): Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+3	If ONLY the correct option is chosen.
Zero Marks	:	0	If none of the options is chosen (i.e. the question is unanswered);
Negative Marks	:	–1	In all other cases.

Section – A (One or More than One Correct): Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+4	If only (all) the correct option(s) is (are) chosen;
Partial Marks	:	+3	If all the four options are correct but ONLY three options are chosen;
Partial marks	:	+2	If three or more options are correct but ONLY two options are chosen and both of which are correct;
Partial Marks	:	+1	If two or more options are correct but ONLY one option is chosen and it is a correct option;
Zero Marks	:	0	If none of the options is chosen (i.e. the question is unanswered);
Negative Marks	:	–2	In all other cases.

Section – B: Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+4	If ONLY the correct integer is entered;
Zero Marks	:	0	Question is unanswered;
Negative Marks	:	0	In all other cases.

Section – C: Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+3	If ONLY the correct integer is entered;
Zero Marks	:	0	Question is unanswered;
Negative Marks	:	0	In all other cases.

Physics

PART – I

SECTION – A
(One Options Correct Type)

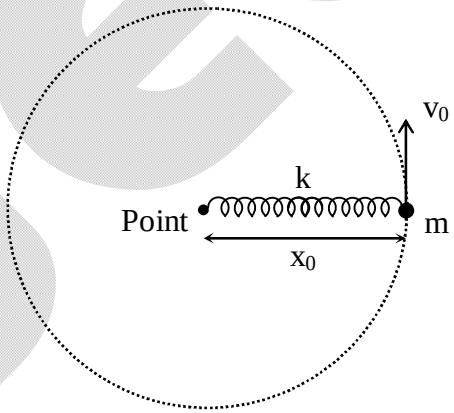
*This section contains **FOUR (04)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.*

1. A uniform rod is kept fixed at one end at rigid wall and placed on smooth horizontal floor. It is pulled by a force under proportionality limit horizontally and released. Assume there is no energy loss and rod performs small oscillations. Then time period of oscillations of rod will be (Take mass m, length ℓ, Young's modulus Y area of cross section.

(A) $2\pi\sqrt{\frac{m\ell}{3AY}}$ (B) $2\pi\sqrt{\frac{m\ell}{AY}}$

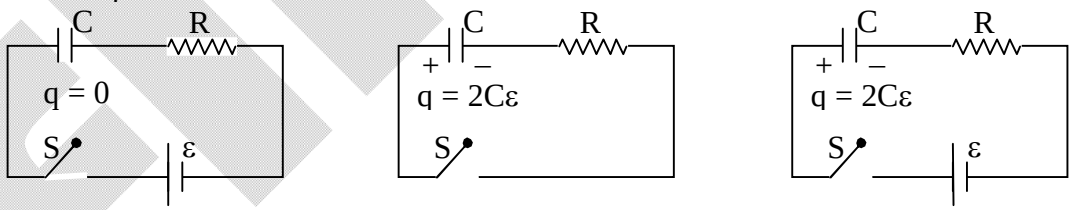
(C) $2\pi\sqrt{\frac{m\ell}{2AY}}$ (D) $2\pi\sqrt{\frac{4m\ell}{3AY}}$

2. A hypothetical massless spring having negligible relaxed length and follows the relation between force F and extension x as $F = cx^{-2}$, where c is constant and x is extension in spring. Spring can only be broken if it stretched upto a very large length. A point mass is performing circular motion with help of spring as shown, with speed v_0. The velocity needed for mass to break the spring is close to:



(A) $2v_0$
(B) $\sqrt{2}v_0$
(C) $3v_0$
(D) $2\sqrt{2}v_0$

3. Three circuits are shown in their initial conditions. In every circuit switch is closed at t = 0. Then currents at time t are observed i_1, i_2 and i_3 in clockwise direction. Choose the correct option.



(A) $i_1 + i_2 = i_3$ (B) $i_1 + i_2 > i_3$

(C) $i_1 + i_2 < i_3$ (D) $i_1 + i_3 = i_2$

4. A stationary source emits sound of frequency f_0 = 492 Hz. The sound is *reflected* by a large car approaching the source with a speed of 2 ms^{-1}. The reflected signal is received by the soruce and superposed with the original. The beat frequency of the resulting signal is (Given that the speed of sound in air is 330 ms^{-1} and the car reflects the sound at the frequency *it* has received).

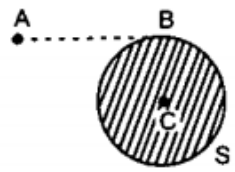
(A) 2 Hz (B) 4 Hz

(C) 6 Hz (D) 8 Hz

SECTION – A
(One or More than one correct type)

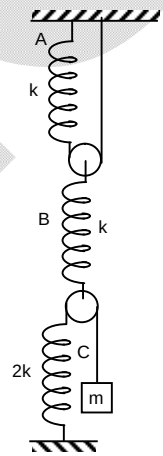
*This section contains **THREE (03)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).*

5. S is solid neutral conducting sphere. A point charge q of 1×10^{-6} C is placed at point A. Point C is the centre of sphere and AB is a tangent. BC = 3m and AB = 4m:



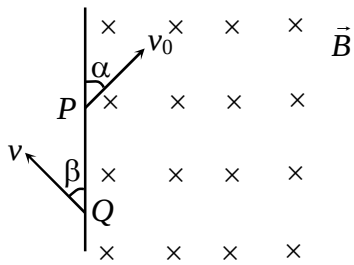
(A) The electric potential of the conductor is 1.8 kV.
(B) The electric potential of the conductor is 2.25 kV.
(C) The electric potential at B due to induced charges on the sphere is –0.45 kV.
(D) The electric potential at B due to induced charges on the sphere is 0.45 kV.

6. In the given figure, the block is attached with a system of three ideal springs A, B, C. The block is displaced by a small distance x from its equilibrium position vertically downwards and released. T represents the time period of small vertical oscillations of the block. Then (pulleys are ideal). Choose the correct alternative(s).



(A) $T = 2\pi\sqrt{\frac{11m}{2k}}$
(B) the deformation of the spring A is (2/11) times the displacement of the block.
(C) the deformation of the spring C is (1/11) times the displacement of the block.
(D) the deformation of the spring B is (4/11) times the displacement of the block.

7. A particle of charge $-q$ and mass m enters a uniform magnetic field $\vec{B}$ (perpendicular to paper inwards) at P with a velocity v_0 at an angle α and leaves the field at Q with velocity v at angle β as shown in the figure. Then



(A) $\alpha = \beta$
(B) $v = v_0$
(C) $PQ = \frac{2mv_0 \sin\alpha}{Bq}$
(D) particle remains in the field for time $t = \frac{2m(\pi - \alpha)}{Bq}$

SECTION – B
(Numerical Answer Type)

*This section contains **SIX (06)** Numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.*

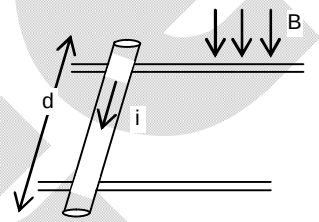
8. If voltage V = (100 ± 5) V and current I = (10 ± 0.2) A, the percentage error in resistance R is

9. A hydrogen-like atom of atomic number Z is in an excited state of quantum number 2n. It can emit a maximum energy photon of 204 eV. If it makes a transition to quantum state n, a photon of energy 40.8 eV is emitted. Ground state energy of hydrogen atom is -13.6 eV. Find the value of n + Z.

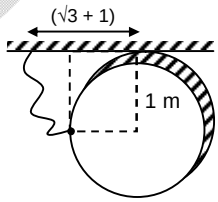
10. Two glass plates are separated by water. If surface tension of water is 75 dynes per cm and area of each plate wetted by water is 8 cm^2 and the distance between the plates is 0.12 mm, then the force (in newton) applied to separate the two plates is

11. Gravitational filed in a region is given by $\vec{E} = \left(3\hat{i} - 4\hat{j}\right)$ N/kg. Find out the work done (in J) in displacing a particle of mass 1 unit by 1m along the line 4y = 3x + 9?

12. A cylindrical uniform rod of mass 0.72 kg and radius 6 cm rests on two parallel rails, that are d = 50 cm apart. The rod caries a current I = 48A (In the direction shown) and rolls along the rails without slipping. If it starts from rest, uniform magnetic field of magnitudes 0.25 T is directed perpendicular to the rod and the rail, then find the friction force (In N) between rod and rails.



13. A disc having radius 1m is held in contact with ceiling. A light rope is tied at circumference of disc and kept the point at same level as centre the other end of rope is tied at ceiling at $(\sqrt{3}+1)$ m distance from contact point disc is released from rest. The rope length is $\sqrt{7}$ m. The rope snaps due to impulse and disc momentarily moves horizontally, just after snapping. The angular velocity of disc after snapping is $k\sqrt{20}$ rad/s. Find the value of k.



SECTION – C
(Numerical Answer Type)

*This section contains **TWO (02) paragraphs.** Based on each paragraph, there are **TWO (02)** questions of numerical answer type. The answer to each question is a **NUMERICAL VALUE (XXXXX.XX).** If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places.*

Paragraph for Question Nos. 14 and 15

The latent heat of fusion of ice is 80 cal/gram and latent heat of steam is 540 cal/gram. Change of state occurs only at melting point or boiling point of the substance. There is no change in temperature during the entire change of state. For rise in temperature (ΔT), heat required, ΔQ = c.m ΔT, where c is specific heat of substance

14. Find Heat required to melt 10g of ice at 0^0C to water at 0^0C (in Kcal).

15. Find Heat required to convert 1gm of ice at -5^0C to water at 0^0C in Cal. (sp. Heat of ice = 0.5 cal/g/^{0}C)

Paragraph for Question Nos. 16 and 17

A brick is thrown at an angle θ with respect to ground. Assume that the long face of brick remains parallel to ground at all times and there is no deformation in the ground or brick when it hits the ground. The coefficient of friction between brick and ground is μ. Ground is perfectly inelastic. The angle of projection to maximize total horizontal distance before coming to rest is X radian, if $\mu = \frac{1}{\sqrt{3}}$ and Y radian, if $\mu = \sqrt{3}$. (take π = 3.14)

16. The value of X is_____.

17. The value of Y is_____.

Chemistry

PART – II

SECTION – A
(One Options Correct Type)

*This section contains **FOUR (04)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.*

18. $LiCl.3NH_{3(s)} \rightleftharpoons LiCl.NH_{3(s)} + 2NH_{3(g)}$

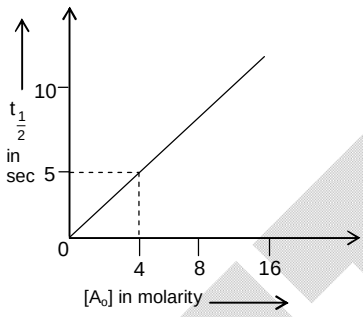
For the above equilibrium, K_p = 9 atm^2 at 37°C. A 5 L vessel contains 0.1 moles of $LiCl.NH_3$. How many moles of NH_3 should be added to the flask at this temperature to drive the backward reaction for completion?

(A) 0.2 (B) 0.79
(C) 0.48 (D) 0.84

19. Which of the following reagents can form an inverted product when reacts with 1-chlorobutan-2-ol.

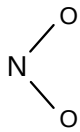
(A) $SOCl_2$ (B) $LiAlH_4$
(C) KCN (D) TsCl

20.



What is the rate constant (k) of the reaction?

(A) 2 x $10^{-1}s^{-1}$ (B) 4 x $10^{-1}s^{-1}$
(C) 4 x 10^{-1} mol L^{-1} s^{-1} (D) 2 x 10^{-1} mol L^{-1} s^{-1}

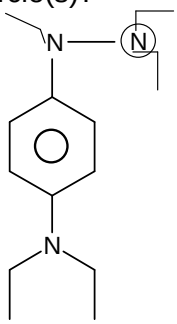
21. In which of the following compounds, the  bond angle has maximum value?

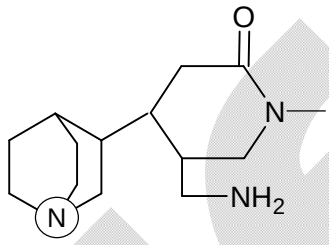
(A) $NaNO_2$ (B) NO_2BF_4
(C) HNO_2 (D) HNO_3

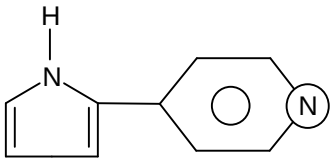
SECTION – A
(One or More than one correct type)

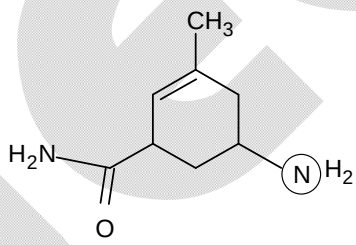
*This section contains **THREE (03)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).*

22. In which of the following molecule(s), the most basic atom(s) is/are represented inside the circle(s)?

(A) 

(B) 

(C) 

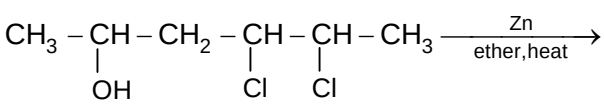
(D) 

23. The degree of hydrolysis of NH_4Cl.
(i) is independent of dilution
(ii) increases with dilution
(iii) decreases with dilution
(iv) increases with addition of an acid
(v) increases with addition of a base
(vi) increases by adding NaCl
Choose the correct statements:
(A) (i), (iii) and (iv) (B) (ii)
(C) (v) (D) (ii) and (iv)

24. In which of the following, the central atoms of both the species, undergo(es) same type of hybridization?
(A) ClO_4^-, BF_4^- (B) NO_3^-, ClO_3^-
(C) BO_2^-, NO_2^- (D) SO_4^{2-}, SO_3^{2-}

SECTION – B
(Numerical Answer Type)

*This section contains **SIX (06)** Numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.*

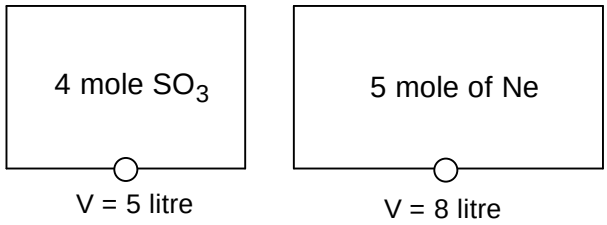
25. 

How many geometrical isomer(s) is/are possible by the major product of above reaction?

26. A nickel electrode of 1M concentration was combined with a hydrogen electrode in acid solution. At what pH of the solution, there exists an equilibrium between the species which undergo redox reaction in the electrochemical cell?

$\left[E^{o}_{Ni^{2+}/Ni} = -0.236\,V \text{ and } P_{H_2} = 1atm\right]$

27. Hydrogen atoms in ground state are excited by monochromatic radiations of photon of energy 12.75 eV. How many spectral line(s) emitted by the atoms is/are observed in the visible region?

28. 

The containers contain the above mentioned ideal gases at constant temperature. If the ratio of the relative rate of effusions through identical orifice is expressed as x : y, what is the value of (x + y)?

29. Thallium forms the most basic anhydride which reacts with water forming TlOH. If the formula of the anhydride is Tl_xO_y and the principal quantum number of the highest energetic inert-pair electrons is z, what is the value of (x + y + z)?

30. $Br - CH_2 - CH_2 - Br \xrightarrow[-KBr]{KCN} Products$

$\downarrow$ -AgBr, AgCN

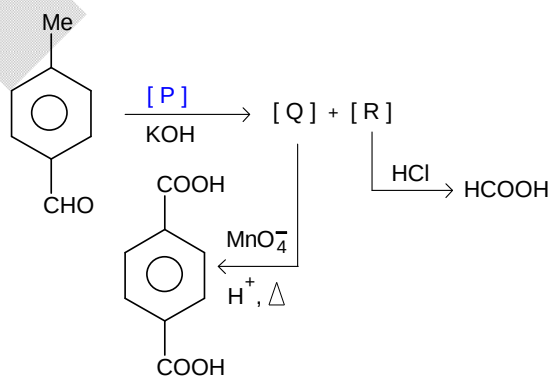
Products

How many different type of products containing four carbon atoms are formed in the above reactions?

SECTION – C
(Numerical Answer Type)

*This section contains **TWO (02) paragraphs.** Based on each paragraph, there are **TWO (02)** questions of numerical answer type. The answer to each question is a **NUMERICAL VALUE (XXXXX.XX).** If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places.*

Paragraph for Question Nos. 31 and 32



Compound [S] responds to Tollen's test.

31. If the molar mass of [P] is x g mol^{-1}, what is the value of $\frac{x}{12}$?

32. How many moles of H_2 gas is produced by reacting one mole of [Q] with sodium metal?

Paragraph for Question Nos. 33 and 34

The colligative properties of solutions have a number of practical applications. The boiling point elevation and freezing point depression are two of them. Ethylene glycol ($HOCH_2 - CH_2OH$) is used in automobile radiators as an antifreeze because of its tendency to lower the freezing point of the coolant. It also helps prevent the coolant from boiling away by increasing the boiling point.

33. The radiator of a car contains 4 Kg water. 620 g of glycol was added to it. If the amount of ice separate out at -6^oC is x g, what is the value of $\frac{x}{80}$? [K_f of water =1.86 K Kg mol^{-1}]

34. One mole of glycol was added to one Kg water at 1 atm pressure and the solution was found to freeze at $-x^oC$. What is the value of x?
[K_f of H_2O = 1.86 K Kg mol^{-1}]

Mathematics

PART – III

SECTION – A
(One Options Correct Type)

*This section contains **FOUR (04)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.*

35. If $\int \frac{\sec^2 x\,dx}{\left(\tan^{101} x + \tan x\right)} = g(x) + c$ where $g\left(\frac{\pi}{4}\right) = -\frac{\ell n 2}{100}$, then $\lim\limits_{x \to \frac{\pi}{2}} g(x)$ is equal to

(A) 0 (B) 1
(C) –1 (D) 2

36. Let a and b be two distinct roots of the equation $x^3 + 3x^2 - 1 = 0$. The equation which has (ab) as its root is equal to:

(A) $x^3 - 3x - 1 = 0$ (B) $x^3 - 3x^2 + 1 = 0$
(C) $x^3 + x^2 - 3x + 1 = 0$ (D) $x^3 + x^2 + 3x - 1 = 0$

37. $f(x) = \int_0^x (e^t - 1)(t-1)(\sin t - \cos t)\sin t\,dt, \forall x \in \left(-\frac{\pi}{2}, 2\pi\right)$, then $f(x)$ is decreasing in:

(A) $\left(-\frac{\pi}{2}, 0\right) \cup \left(\frac{\pi}{4}, 1\right) \cup \left(\pi, \frac{\pi}{4}\right)$ (B) $\left(-\frac{\pi}{2}, \frac{\pi}{4}\right) \cup (1, \pi) \cup \left(\frac{5\pi}{4}, 2\pi\right)$
(C) $\left(\frac{\pi}{4}, 1\right) \cup \left(\pi, \frac{5\pi}{4}\right)$ (D) $\left(0, \frac{\pi}{4}\right) \cup (1, \pi) \cup \left(\frac{5\pi}{4}, 2\pi\right)$

38. If different words are formed using all the letters from the word 'INDIANIDOL' in which 'a' denotes number of words which contains 'INDIA' but not 'INDIAN' and 'b' denotes number of words which contains 'INDIAN' but not 'IDOL' then:

(A) $a + b = 6! + 2$ (B) $a + b = 6! - 2$
(C) $a - b = 4.5! + 2$ (D) $a - b = 4.5! - 2$

SECTION – A
(One or More than one correct type)

*This section contains **THREE (03)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).*

39. Consider, $f(x) = \left(|2x-1| + |x| + |2x+1|\right)\left[\frac{1}{4}\left(x^4 - 2x^2 + 4\right)\right]$, where $[k]$ denotes greatest integer less than or equal to k. Then

(A) number of points where $f(x)$ is discontinuous in $\left[\frac{-3}{2}, \frac{3}{2}\right]$ is 3

(B) number of points where $f(x)$ is discontinuous in $\left[\frac{-3}{2}, \frac{3}{2}\right]$ is 5

(C) number of points where $f(x)$ is non – derivable in $\left(\frac{-3}{2}, \frac{3}{2}\right)$ is 3

(D) number of points where $f(x)$ is non – derivable in $\left(\frac{-3}{2}, \frac{3}{2}\right)$ is 5

40. If the locus of any point $P(z)$ on argand plane is $\arg\left(\frac{z-5i}{z+5i}\right)=\frac{\pi}{4}$ then

(A) The length of the arc described by the locus of $P(z)$ is $\frac{15\pi}{\sqrt{2}}$

(B) Total number of integral points inside the region bounded by the locus of $P(z)$ and imaginary axis on the argand plane is 136

(C) Area of the region bounded by the locus of a complex number 'z' satisfying $\arg\left(\frac{z+5i}{z-5i}\right)=\pm\frac{\pi}{4}$ is $75\pi+50$

(D) Area of the region bounded by the locus of a complex number 'z' satisfying $\arg\left(\frac{z+5i}{z-5i}\right)=\pm\frac{\pi}{4}$ is $75\pi+25$

41. $P_1: x+3y+5z=2, P_2: x-2y+z=5$ are two planes. From a point $P(-4, 7, 11)$ perpendiculars PQ and PR are drawn to plane P_1 and P_2 respectively. Then

(A) The direction ratios of line represented by plane P_1 and P_2 may be equal to <13,4,5>.

(B) Area of triangle $PQR = 2\sqrt{210}$ Sq. unit

(C) Midpoint of $QR = (-2, 3, 13)$

(D) Equation of plane PQR is $13x+4y-5z+79=0$

SECTION – B
(Numerical Answer Type)

*This section contains **SIX (06)** Numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.*

42. If $\sum_{r=0}^{10}\frac{3^r\left(r!\left(3r^2+5r+1\right)\right)}{r^2+3r+2}$ is equal to $\frac{3^m(n!)-12}{12}$ and the value of $\left[\sum_{r=1}^{100}\left(\frac{r^2+3r+1}{(r+2)!}\right)+\frac{103}{102!}\right]\times\frac{8}{3}=k$ then $|m-n+k|$ is:

43. Let $I_n=\int_0^{\frac{3\pi}{2}}\left(\ln|\sin x|\right)\cos(2nx)\,dx$, where $n\in N$.. If $(12I_3-16I_2)$ is $k\pi$ then of k is

44. A tangent is drawn to the parabola $y^2=-ax\,(a>0)$ from a point A (1, 0) which also touches the hyperbola $\frac{x^2}{4}-\frac{y^2}{b^2}=1$ at B such that $|\underline{ASB}=90^\circ$ where S is the focus of hyperbola then $\frac{a+b^2}{14}=$ _____

45. 5 students of a class have an average height 150 cm and variance 18 cm^3. A new student, whose height is 156 cm, joined them. The variance (in cm^2) of the height of these six students is:

46. Let $A=\{1,3,5,7,9\}$ and $B=\{2,4,6,8\}$. An element (a, b) of their cartesian product $A\times B$ is chosen at random. If the probability that $\{a+b=9\}$ is $\frac{p}{q}$ then $\frac{q}{p}$ is

47. Find the sum of all possible integral values of a such that the angle between the pair of tangents drawn from $M(a,a)$ to the circle $x^2+y^2-2x-2y=6$ lies in the range of $\left(\frac{\pi}{3},\pi\right)$.

SECTION – C
(Numerical Answer Type)

*This section contains **TWO (02) paragraphs.** Based on each paragraph, there are **TWO (02)** questions of numerical answer type. The answer to each question is a **NUMERICAL VALUE (XXXXX.XX).** If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places.*

Paragraph for Question Nos. 48 and 49

The curve $y=f(x)$ passes through the point (0, 1) and the curve $y=g(x)=\int_{-\infty}^{x} f(t)dt$ passes through the point $\left(0,\frac{1}{2}\right)$. The tangents drawn to the curves at the point with equal abscissae intersect on the x – axis. Then

48. The area bounded by the x – axis, the tangent and normal to the curve $y=f(x)$ at the point where it cuts the y – axis is _____.

49. $\lim\limits_{x\to 0}\frac{(f(x))^2-1}{x}=$ _____

Paragraph for Question Nos. 50 and 51

Let $A=[a_{ij}]$ be a 2×2 square matrix such that $Tr(A)=5$. If $f(x)=\det(A-xI)$ and $f(A)=A^2+aA+3I$ where I is identity matrix of order 2 then

50. The value of $Tr\left((3A^{-1})^2+(a+1)3A^{-1}+3I\right)$ is

51. If $a_{ij}\in\{1,2,3,4\}$ then number of possible such invertible matrices A is equal to