

JEE Main – 2020

9th January 2020 (Morning Shift)

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 (1), (2), (3) and (4), out of which **ONLY ONE CHOICE** is correct.
4. **Section 2** contains **5 Numerical Value Type Questions**. The answer to each question is a NUMERICAL VALUE. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places.

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, 0 for all other cases. There is no negative marking.

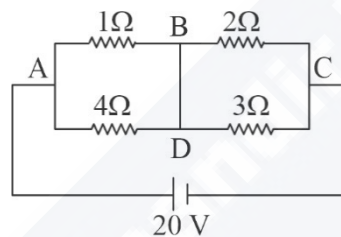
SECTION 1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE CHOICE is correct.

1. A vessel depth $2h$ is half filled with a liquid of refractive index $2\sqrt{2}$ and the upper half with another liquid of refractive index $\sqrt{2}$. The liquids are immiscible. The apparent depth of the inner surface of the bottom of vessel will be:

(1) $\frac{h}{2(\sqrt{2} + 1)}$ (2) $\frac{h}{\sqrt{2}}$ (3) $\frac{3}{4}h\sqrt{2}$ (4) $\frac{h}{3\sqrt{2}}$

2. In the given circuit diagram, a wire is joining points B and D . The current in this wire is:



(1) 4A (2) Zero (3) 0.4A (4) 2A

3. Two particles of equal mass m have respective initial velocities $u\hat{i}$ and $u\left(\frac{\hat{i} + \hat{j}}{2}\right)$. They collide completely inelastically. The energy lost in the process is:

(1) $\sqrt{\frac{2}{3}}\mu^2$ (2) $\frac{1}{8}\mu^2$ (3) $\frac{1}{3}\mu^2$ (4) $\frac{3}{4}\mu^2$

4. The electric fields of two plane electromagnetic plane waves in vacuum are given by:

$$\vec{E}_1 = E_0\hat{j}\cos(\omega t - kx) \text{ and } \vec{E}_2 = E_0\hat{k}\cos(\omega t - ky)$$

At $t = 0$, a particle of charge q is at origin with a velocity $\vec{v} = 0.8c\hat{j}$ (c is the speed of light in vacuum).

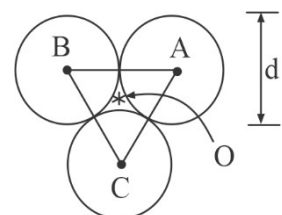
The instantaneous force experienced by the particle is:

(1) $E_{0q}(0.8\hat{i} - \hat{j} + 0.4\hat{k})$ (2) $E_{0q}(0.8\hat{i} + \hat{j} + 0.2\hat{k})$
 (3) $E_{0q}(-0.8\hat{i} + \hat{j} + \hat{k})$ (4) $E_{0q}(0.4\hat{i} - 3\hat{j} + 0.8\hat{k})$

5. A quantity f is given by $f = \sqrt{\frac{hc^5}{G}}$ where c is the speed of light, G universal gravitational constant and h is the Planck's constant. Dimension of f is that of:

(1) volume (2) area (3) momentum (4) energy

6. Three solid spheres each of mass m and diameter d are stuck together such that the lines connecting the centres form an equilateral triangle of side of length d . The ratio I_0 / I_A of moment of inertia I_0 of the system about an axis passing the centroid and about center of any of the spheres I_A and perpendicular to the plane of the triangle is:



(1) $\frac{13}{23}$ (2) $\frac{13}{15}$ (3) $\frac{15}{13}$ (4) $\frac{23}{13}$

7. A particle moving with kinetic energy E has de Broglie wavelength λ . If energy ΔE is added to its energy, the wavelength become $\lambda/2$. Value of ΔE , is :
- (1) $4E$ (2) $3E$ (3) $2E$ (4) E

8. A long, straight wire of radius a carries a current distributed uniformly over its cross-section. The ratio of the magnetic fields due to the wire at distance $\frac{a}{3}$ and $2a$, respectively from the axis of the wire is :
- (1) $2/3$ (2) $1/2$ (3) $3/2$ (4) 2

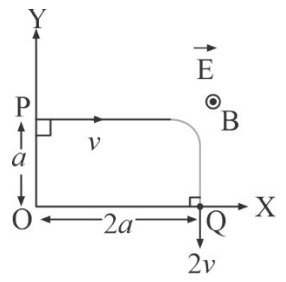
9. Water flows in a horizontal tube (see figure). The pressure of water changes by 700 Nm^{-2} between A and B where the area of cross section are 40 cm^2 and 20 cm^2 , respectively. Find the rate of flow of water through the tube. (density of water 1000 kg m^{-3})



- (1) $2420 \text{ cm}^3/\text{s}$ (2) $2720 \text{ cm}^3/\text{s}$ (3) $3020 \text{ cm}^3/\text{s}$ (4) $1810 \text{ cm}^3/\text{s}$
10. An electric dipole of moment $\vec{p} = (-\hat{i} - 3\hat{j} + 2\hat{k}) \times 10^{-29} \text{ C.m}$ is at the origin $(0,0,0)$. The electric field due to this dipole at $\vec{r} = +\hat{i} + 3\hat{j} + 5\hat{k}$ (note that $\vec{r} \cdot \vec{p} = 0$) is parallel to :
- (1) $(+\hat{i} + 3\hat{j} - 2\hat{k})$ (2) $(-\hat{i} - 3\hat{j} + 2\hat{k})$ (3) $(-\hat{i} + 3\hat{j} - 2\hat{k})$ (4) $(+\hat{i} - 3\hat{j} - 2\hat{k})$

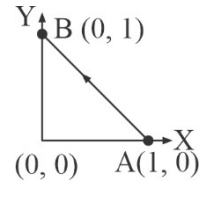
11. Three harmonic waves having equal frequency ν and same intensity I_0 , have phase angles $0, \frac{\pi}{4}$ and $-\frac{\pi}{4}$ respectively. When they are superimposed the intensity of the resultant wave is close to :
- (1) $5.8I_0$ (2) I_0 (3) $0.2I_0$ (4) $3I_0$

12. A charged particle of mass ' m ' and charge ' q ' moving under the influence of uniform electric field $E\hat{i}$ and a uniform magnetic field $B\hat{k}$ follows a trajectory from point P to Q as shown in figure. The velocities at P and Q are respectively, $v\hat{i}$ and $-2v\hat{j}$. Then which of the following statements (A, B, C, D) are the correct? (Trajectory shown is schematic and not to scale)



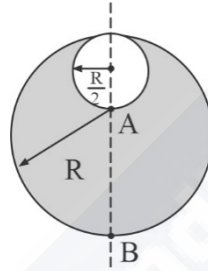
- (1) $E = \frac{3}{4} \left(\frac{mv^2}{qa} \right)$
- (2) Rate of work done by the electric field at P is $\frac{3}{4} \left(\frac{mv^3}{a} \right)$
- (3) Rate of work done by both the fields at Q is zero
- (4) The difference between the magnitude of angular momentum of the particle at P and Q is $2mav$.

13. Consider a force $\vec{F} = -x\hat{i} + y\hat{j}$. The work done by this force in moving a particle from point $A(1,0)$ to $B(0,1)$ along the line segment is: (all quantities are in SI units)
- (1) 2 (2) $\frac{1}{2}$ (3) 1 (4) $\frac{3}{2}$



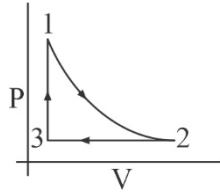
14. The aperture diameter of a telescope is 5 m. The separation between the moon and the earth is 4×10^5 km. With light of wavelength of 5500 \AA , the minimum separation between objects on the surface of moon, so that they are just resolved, is close to :
- (1) 60 m (2) 20 m (3) 600 m (4) 200 m

15. Consider a sphere of radius R which carries a uniform charge density ρ . If a sphere of radius $\frac{R}{2}$ is carved out of it, as shown, the ratio $\frac{|\vec{E}_A|}{|\vec{E}_B|}$ of magnitude of electric field \vec{E}_A and \vec{E}_B , respectively, at points A and B due to the remaining portion is :

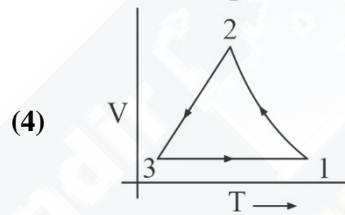
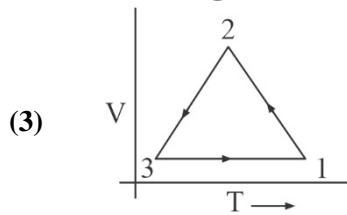
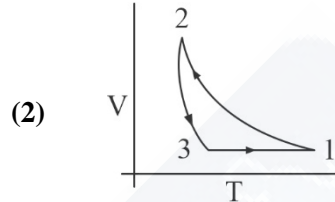
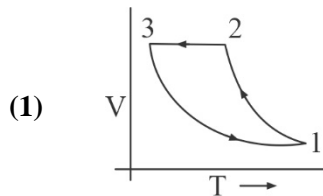


- (1) $\frac{18}{54}$ (2) $\frac{21}{34}$ (3) $\frac{17}{54}$ (4) $\frac{18}{34}$
16. Consider two ideal diatomic gases A and B at some temperature T . Molecules of the gas A are rigid, and have a mass m . Molecules of the gas B have an additional vibrational mode, and have a mass $\frac{m}{4}$. The ratio of the specific heats (C_V^A and C_V^B) of gas A and B , respectively is:
- (1) 3 : 5 (2) 5 : 7 (3) 5 : 9 (4) 7 : 9
17. Radiation, with wavelength 6561 \AA falls on a metal surface to produce photoelectrons. The electrons are made to enter a uniform magnetic field of $3 \times 10^{-4} T$. If the radius of the largest circular path followed by the electrons is 10 mm, the work function of the metal is close to :
- (1) 1.8 eV (2) 1.1 eV (3) 0.8 eV (4) 1.6 eV
18. A body A of mass m is moving in a circular orbit of radius R about a planet. Another body B of mass $\frac{m}{2}$ collides with A with a velocity which is half $\left(\frac{\vec{v}}{2}\right)$ the instantaneous velocity \vec{v} of A . The collision is completely inelastic. Then, the combined body :
- (1) Falls vertically downwards towards the planet
 (2) Continues to move in a circular orbit
 (3) Escapes from the Planet's Gravitational field
 (4) Starts moving in an elliptical orbit around the planet
19. If the screw on a screw gauge is given six rotations, it moves by 3 mm on the main scale. If there are 50 divisions on the circular scale the least count of the screw gauge is :
- (1) 0.01 cm (2) 0.02 mm (3) 0.001 cm (4) 0.001 mm

20. Which of the following is an equivalent cyclic process corresponding to the thermodynamic cyclic given in the figure? Where, $1 \rightarrow 2$ is adiabatic,



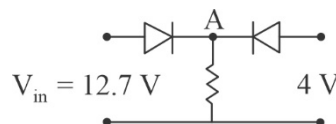
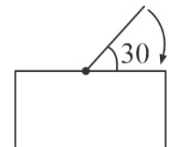
(Graphs are schematic and are not to scale)



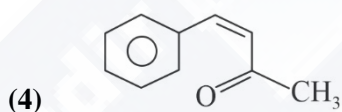
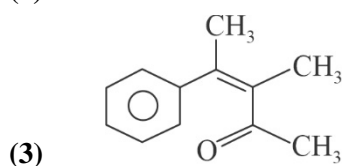
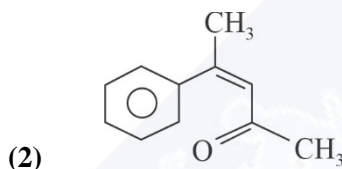
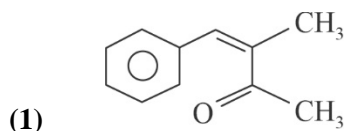
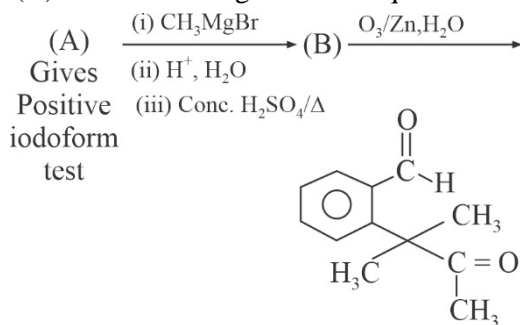
SECTION 2

This section has FIVE (05) Questions. The answer to each question is a NUMERICAL VALUE. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places.

21. One end of a straight uniform 1 m long bar is pivoted on horizontal table. It is released from rest when it makes an angle 30° from the horizontal (see figure). Its angular speed when it hits the table is given as $\sqrt{n} s^{-1}$, where n is an integer. The value of n is _____.
22. The distance x covered by a particle in one dimensional motion varies with time t as $x^2 = at^2 + 2bt + c$. If the acceleration of the particle depends on x as x^{-n} , where n is an integer, the value of n is _____.
23. A body of mass $m = 10$ kg is attached to one end of a wire of length 0.3 m. The maximum angular speed (in rad s^{-1}) with which it can be rotated about its other end in space station is (Breaking stress of wire $= 4.8 \times 10^7 \text{ Nm}^{-2}$ and area of cross section of the wire $= 10^{-2} \text{ cm}^2$) is:
24. In a fluorescent lamp choke (a small transformer) 100 V of reverse voltage is produced when the choke current changes uniformly from 0.25 A to 0 in a duration of 0.025 ms. The self-inductance of the choke (in mH) is estimated to be _____.
25. Both the diodes used in the circuit shown are assumed to be ideal and have negligible resistance when these are forward biased. Built in potential in each diode is 0.7 V. For the input voltages shown in the figure, the voltage (n Volts) at point A is _____.



5. Identify (A) in the following reaction sequence :



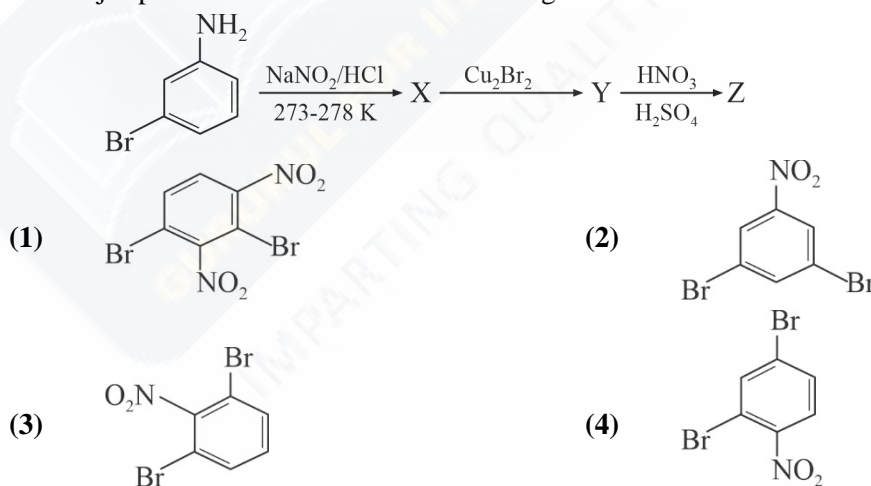
6. The de Broglie wavelength of an electron in the 4th Bohr orbit is:

- (1) $2\pi a_0$ (2) $4\pi a_0$ (3) $8\pi a_0$ (4) $6\pi a_0$

7. Complex X of composition $\text{Cr}(\text{H}_2\text{O})_6\text{Cl}_n$ has a spin only magnetic moment of 3.83 BM. It reacts with AgNO_3 and shows geometrical isomerism. The IUPAC nomenclature of X is :

- (1) Dichloridotetraaqua chromium (IV) chloride dihydrate
 (2) Tetraquadichlorido chromium (III) chloride dihydrate
 (3) Hexaaqua chromium (III) chloride
 (4) Tetraquadichlorido chromium(IV) chloride dihydrate

8. The major product Z obtained in the following reaction scheme is :

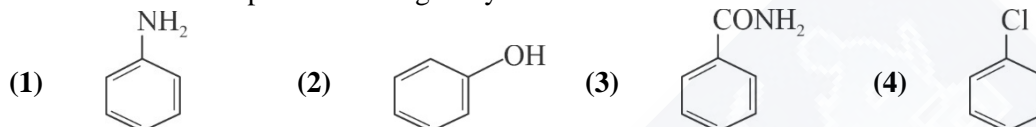


9. If enthalpy of atomisation for $\text{Br}_{2(l)}$ is x kJ/mol and bond enthalpy for Br_2 is y kJ/mol, the relation between them :

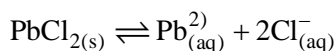
- (1) does not exist (2) is $x = y$ (3) is $x > y$ (4) is $x < y$

10. A chemist has 4 samples of artificial sweetener A, B, C and D. To identify these samples, he performed certain experiments and noted the following observations:
- (i) A and D both form blue-violet colour with ninhydrin.
 - (ii) Lassaigne extract of C gives positive AgNO_3 test and negative $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$ test
 - (iii) Lassaigne extract of B and D gives positive sodium nitroprusside test.
- Based on these observations which option is correct?
- (1) A : Saccharin; B : Alitame; C : Sucralose; D : Aspartame
 - (2) A : Aspartame; B = Alitame; C : Saccharin; D : Sucralose
 - (3) A : Aspartame; B : Saccharin; C : Sucralose; D : Alitame
 - (4) A : Alitame; B = Saccharin; C : Aspartame; D : Sucralose




11. Which of these will produce the highest yield in Friedel Crafts reaction?



12. The K_{sp} for the following dissociation is 1.6×10^{-5}



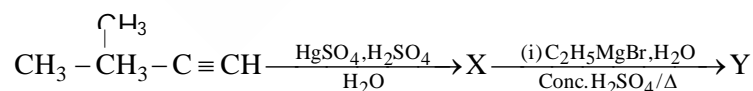
Which of the following choices is correct for a mixture of 300 mL 0.134 M $\text{Pb}(\text{NO}_3)_2$ and 100 mL 0.4 M NaCl?

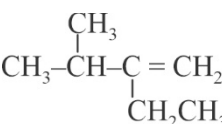
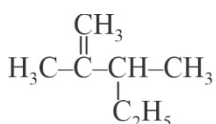
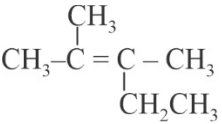
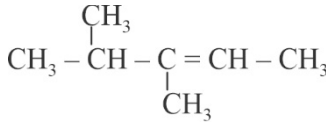
- (1) $Q > K_{sp}$
 - (2) $Q = K_{sp}$
 - (3) Not enough data provided
 - (4) $Q < K_{sp}$
13. The correct order of heat of combustion for following alkadienes is:
- (a)  (b)  (c) 
- (1) (b) < (c) < (a)
 - (2) (a) < (b) < (c)
 - (3) (a) < (c) < (b)
 - (4) (c) < (b) < (a)
14. The compound that cannot act both as oxidising and reducing agent is:
- (1) HNO_2
 - (2) H_2O_2
 - (3) H_3PO_4
 - (4) H_2SO_3
15. The acidic, basic and amphoteric oxides, respectively, are :
- (1) $\text{MgO}, \text{Cl}_2\text{O}, \text{Al}_2\text{O}_3$
 - (2) $\text{Cl}_2\text{O}, \text{CaO}, \text{P}_4\text{O}_{10}$
 - (3) $\text{N}_2\text{O}_3, \text{Li}_2\text{O}, \text{Al}_2\text{O}_3$
 - (4) $\text{Na}_2\text{O}, \text{SO}_3, \text{Al}_2\text{O}_3$

16. 'X' melts at low temperature and is a bad conductor of electricity in both liquid and solid state. X is:

- (1) Carbon tetrachloride
- (2) Silicon carbide
- (3) Zinc sulphide
- (4) Mercury

17. The major product (Y) in the following reactions is:



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

18. If the magnetic moment of a dioxygen species is 1.73 B.M, it may be :
- (1) O_2 or O_2^- (2) O_2, O_2^- or O_2^+
 (3) O_2^- or O_2^+ (4) O_2 or O_2^+
19. The electronic configurations of bivalent europium and trivalent cerium are :
- (1) $[Xe]4f^2$ and $[Xe]4f^7$ (2) $[Xe]4f^7 6s^2$ and $[Xe]4f^2 6s^2$
 (3) $[Xe]4f^7$ and $[Xe]4f^1$ (4) $[Xe]4f^4$ and $[Xe]4f^9$
20. $[Pd(F)(Cl)(Br)(I)]^{2-}$ has n number of geometrical isomers. Then, the spin-only magnetic moment and crystal field stabilisation energy [CFSE] of $[Fe(CN)_6]^{n-6}$, respectively, are:
- (1) 0 BM and $-24\Delta_0$ (2) 2.84 BM and $-1.6\Delta_0$
 (3) 1.73 BM and $-2.0\Delta_0$ (4) 5.92 BM and 0

SECTION 2

This section has FIVE (05) Questions. The answer to each question is a NUMERICAL VALUE. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places.

21. The hardness of a water sample containing 10^{-3} MMgSO₄ expressed as CaCO₃ equivalents (in ppm) is _____.
 (molar mass of MgSO₄ is 120.37 g/mol)
22. The mass percentage of nitrogen in histamine is _____.
23. The molarity of HNO₃ in a sample which has density 1.4 g/mL and mass percentage of 63 % is _____.
 (Molecular Weight of HNO₃ = 63)
24. 108 g of silver (molar mass 108 g mol⁻¹) is deposited at cathode from AgNO₃(aq) solution by a certain quantity of electricity. The volume (in L) of oxygen gas produced at 273 K and 1 bar pressure from water by the same quantity of electricity is _____.
25. How much amount of NaCl should be added to 600 g of water ($\rho = 1.00 \text{ g / mL}$) to decrease the freezing point of water to $-0.2 \text{ }^\circ\text{C}$? _____. (The freezing point depression constant for water = 2 K kg mol^{-1})

SUBJECT III: MATHEMATICS	MARKS: 100
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SECTION 1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE CHOICE** is correct.

1. If for all real triplets (a, b, c) $f(x) = a + bx + cx^2$; then $\int_0^1 f(x) dx$ is equal to :

- | | |
|--|---|
| <p>(1) $\frac{1}{2} \left\{ f(1) + 3f\left(\frac{1}{2}\right) \right\}$</p> <p>(3) $\frac{1}{6} \left\{ f(0) + f(1) + 4f\left(\frac{1}{2}\right) \right\}$</p> | <p>(2) $\frac{1}{3} \left\{ f(0) + f\left(\frac{1}{2}\right) \right\}$</p> <p>(4) $2 \left\{ 3f(1) + 2f\left(\frac{1}{2}\right) \right\}$</p> |
|--|---|

2. If $f(x) = \begin{cases} \frac{\sin(a+2)x + \sin x}{x}; & x < 0 \\ b & x = 0 \\ \frac{(x+3x^2)^{1/3} - x^{1/3}}{x^{4/3}}; & x > 0 \end{cases}$

is continuous at $x=0$, then $a+2b$ is equal to :

- (1) 1 (2) 0 (3) -2 (4) -1

3. Let z be a complex number such that $\left| \frac{z-i}{z+2i} \right| = 1$ and $|z| = \frac{5}{2}$. Then the value of $|z+3i|$ is :

- (1) $\sqrt{10}$ (2) $\frac{15}{4}$ (3) $2\sqrt{3}$ (4) $\frac{7}{2}$

4. The product $2^{\frac{1}{4}} \cdot 4^{\frac{1}{16}} \cdot 8^{\frac{1}{48}} \cdot 16^{\frac{1}{128}} \dots$ to ∞

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

5. If $f'(x) = \tan^{-1}(\sec x + \tan x)$, $-\frac{\pi}{2} < x < \frac{\pi}{2}$, and $f(0) = 0$, then $f(1)$ is equal to :

- (1) $\frac{\pi+2}{4}$ (2) $\frac{\pi-1}{4}$ (3) $\frac{\pi+1}{4}$ (4) $\frac{1}{4}$

6. The integral $\int \frac{dx}{(x+4)^{8/7} (x-3)^{6/7}}$ is equal to :

(where C is a constant of integration)

- | | |
|---|---|
| <p>(1) $\frac{1}{2} \left(\frac{x-3}{x+4} \right)^{3/7} + C$</p> <p>(3) $-\left(\frac{x-3}{x+4} \right)^{-1/7} + C$</p> | <p>(2) $\left(\frac{x-3}{x+4} \right)^{1/7} + C$</p> <p>(4) $-\frac{1}{13} \left(\frac{x-3}{x+4} \right)^{-13/7} + C$</p> |
|---|---|

7. A circle touches the y -axis at the point $(0,4)$ and passes through the point $(2,0)$. Which of the following lines is not a tangent to this circle ?

- | | |
|-----------------------|------------------------|
| (1) $4x + 3y - 8 = 0$ | (2) $3x - 4y - 24 = 0$ |
| (3) $3x + 4y - 6 = 0$ | (4) $4x - 3y + 17 = 0$ |

8. Negation of the statement :” $\sqrt{5}$ is an integer or 5 is irrational” is :
- (1) $\sqrt{5}$ is an integer and 5 is irrational
 (2) $\sqrt{5}$ is not an integer and 5 is not irrational
 (3) $\sqrt{5}$ is not an integer or 5 is not irrational
 (4) $\sqrt{5}$ is irrational or 5 is an integer
9. Let the observations $x_i (1 \leq i \leq 10)$ satisfy the equations, $\sum_{i=1}^{10} (x_i - 5) = 10$ and $\sum_{i=1}^{10} (x_i - 5)^2 = 40$. If μ and λ are the mean and the variance of the observations, $x_1 - 3, x_2 - 3, \dots, x_{10} - 3$, then the ordered pair (μ, λ) is equal to :
- (1) (3, 6) (2) (6, 3) (3) (6, 6) (4) (3, 3)
10. The value of $\cos^3\left(\frac{\pi}{8}\right) \cdot \cos\left(\frac{3\pi}{8}\right) + \sin^3\left(\frac{\pi}{8}\right) \cdot \sin\left(\frac{3\pi}{8}\right)$ is :
- (1) $\frac{1}{\sqrt{2}}$ (2) $\frac{1}{4}$ (3) $\frac{1}{2}$ (4) $\frac{1}{2\sqrt{2}}$
11. Let f be any function continuous on $[a, b]$ and twice differentiable on (a, b) . If for all $x \in (a, b)$, $f'(x) > 0$ and $f''(x) < 0$, then for any $c \in (a, b)$, $\frac{f(c) - f(a)}{f(b) - f(c)}$ is greater than :
- (1) $\frac{b-c}{c-a}$ (2) $\frac{b+a}{b-a}$ (3) $\frac{c-a}{b-c}$ (4) 1
12. If the number of five digit numbers with distinct digits and 2 at the 10^{th} place is $336k$, then k is equal to:
- (1) 7 (2) 4 (3) 8 (4) 6
13. A spherical iron ball of 10 cm radius is coated with a layer of ice of uniform thickness that melts at a rate of $50 \text{ cm}^3 / \text{min}$. When the thickness of ice is 5 cm, then the rate (in cm/min.) at which of the thickness of ice decreases, is :
- (1) $\frac{1}{18\pi}$ (2) $\frac{5}{6\pi}$ (3) $\frac{1}{54\pi}$ (4) $\frac{1}{36\pi}$
14. Let C be the centroid of the triangle with vertices $(3, -1), (1, 3)$ and $(2, 4)$. Let P be the point of intersection of the lines $x + 3y - 1 = 0$ and $3x - y + 1 = 0$. Then the line passing through the points C and P also passes through the point :
- (1) (7, 6) (2) $(-9, -7)$ (3) (9, 7) (4) $(-9, -6)$
15. If e_1 and e_2 are the eccentricities of the ellipse, $\frac{x^2}{18} + \frac{y^2}{4} = 1$ and the hyperbola, $\frac{x^2}{9} - \frac{y^2}{4} = 1$ respectively and (e_1, e_2) is a point on the ellipse, $15x^2 + 3y^2 = k$, then k is equal to :
- (1) 16 (2) 15 (3) 14 (4) 17
16. The number of real roots of the equation, $e^{4x} + e^{3x} - 4e^{2x} + e^x + 1 = 0$ is :
- (1) 1 (2) 3 (3) 2 (4) 4

17. In a box, there are 20 cards, out of which 10 are labelled as A and the remaining 10 are labelled as B . Cards are drawn at random, one after the other and with replacement, till a second A -card is obtained. The probability that the second A -card appears before the third B -card is:
- (1) $\frac{13}{16}$ (2) $\frac{9}{16}$ (3) $\frac{15}{16}$ (4) $\frac{11}{16}$
18. If for some α and β in R , the intersection of the following three planes
- $$x + 4y - 2z = 1$$
- $$x + 7y - 5z = \beta$$
- $$x + 5y + \alpha z = 5$$
- is a line in R^3 , then $\alpha + \beta$ is equal to :
- (1) -10 (2) 0 (3) 2 (4) 10
19. The value of $\int_0^{2\pi} \frac{x \sin^8 x}{\sin^8 x + \cos^8 x} dx$ is equal to :
- (1) 2π (2) $2\pi^2$ (3) 4π (4) π^2
20. If the matrices $A = \begin{bmatrix} 1 & 1 & 2 \\ 1 & 3 & 4 \\ 1 & -1 & 3 \end{bmatrix}$, $B = \text{adj } A$ and $C = 3A$, then $\frac{|\text{adj } B|}{|C|}$ is equal to :
- (1) 72 (2) 8 (3) 16 (4) 2

SECTION 2

This section has FIVE (05) Questions. The answer to each question is a NUMERICAL VALUE. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places.

21. The projection of the line segment joining the points $(1, -1, 3)$ and $(2, -4, 11)$ on the line joining the points $(-1, 2, 3)$ and $(3, -2, 10)$ is _____.
22. The coefficient of x^4 in the expansion of $(1 + x + x^2)^{10}$ is _____.
23. If for $x \geq 0$, $y = y(x)$ is the solution of the differential equation, $(x+1)dy = ((x+1)^2 + y - 3)dx$, $y(2) = 0$, then $y(3)$ is equal to _____.
24. The number of distinct solutions of the equation, $\log_{\frac{1}{2}} |\sin x| = 2 - \log_{\frac{1}{2}} |\cos x|$ in the interval $[0, 2\pi]$, is _____.
25. If the vectors, $\vec{p} = (a+1)\hat{i} + a\hat{j} + a\hat{k}$, $\vec{q} = a\hat{i} + (a+1)\hat{j} + a\hat{k}$ and $\vec{r} = a\hat{i} + a\hat{j} + (a+1)\hat{k}$ ($a \in R$) are coplanar and $3(\vec{p} \cdot \vec{q})^2 - \lambda |\vec{r} \times \vec{q}|^2 = 0$, then the value of λ is _____.