JEE Mains (Dropper)

Sample Paper – V

DURATION : 180 Minutes **M. MARKS : 300**

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 **90** questions **(75 to attempt)**. The maximum marks are **300**.
4. There are three subjects in the question paper, Subject I, II and III consisting of Section-I (**Physics),** Section-II **(Chemistry)**, Section-III **(Mathematics)**, and having **30 questions** in each part.
5. There will be a total of **20 MCQs** and **10 Numerical** Value Based Questions **(attempt any 5)**.
6. Each correct answer will give 4 marks while 1 Marks 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).**

Name of the Student (In CAPITALS): _____

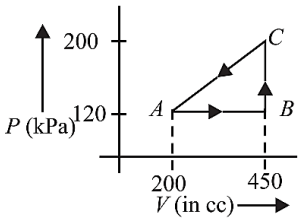
Roll Number: _____

Candidate's Signature: _____

Section-I (PHYSICS)

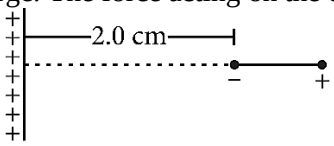
Section-A

1. The *PV* diagram of a cyclic process is shown, the work done by the gas during *ABCA* as shown in figure is



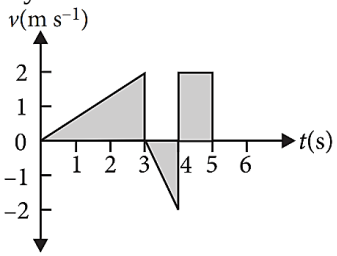
(1) 20 J
(2) –20 J
(3) –10 J
(4) 10 J

2. An electric dipole consists of charges $\pm 2.0 \times 10^{-8}$ C separated by a distance of 2.0×10^{-3} m. It is placed near a long line charge of linear charge density 4.0×10^{-4} C m^{-1} as shown in the figure, such that the negative charge is at a distance of 2.0 cm from the line charge. The force acting on the dipole will be



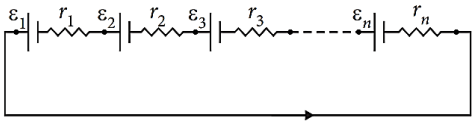
(1) 7.2 N towards the line charge
(2) 6.6 N away from the line charge
(3) 0.6 N away from the line charge
(4) 0.6 N towards the line charge.

3. The velocity versus time graph of a body moving in a straight line is shown in figure. The displacement of the body in 5 s is



(1) 3 m (2) 5 m
(3) 4 m (4) 2 m

4. *n* batteries are connected to form a circuit as shown in the figure. The resistances denote the internal resistances of the batteries which are related to the emf 's as $r_i = k\varepsilon_i$ constant with proper SI units. The solid dots represent the terminals of the batteries. Then

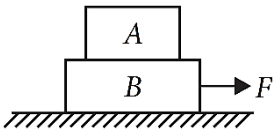


(1) the current through the circuit is $\frac{n}{k}$.
(2) the potential difference between the terminals of the i^{th} battery is zero.
(3) the current through the circuit is $\frac{n^2}{k}$.
(4) the potential difference between the terminals of the i^{th} battery is $\frac{\varepsilon}{k}$.

5. A body of mass 0.5 kg travels in a straight line with velocity $v = ax^{3/2}$ where a = 5 $m^{-1/2}$ s^{-1}. The work done by the net force during its displacement from $x = 0$ to $x = 2$ m is

(1) 1.5 J (2) 50 J
(3) 10 J (4) 100 J

6. In figure, the coefficient of friction between the floor and the block *B* is 0.1. The coefficient of friction between the blocks *B* and *A* is 0.2. The mass of *A* is *m*/2 and that of *B* is m. What is the maximum horizontal force *F* can be applied to the block *B* so that two blocks move together?



(1) 0.15 *mg*
(2) 0.05 *mg*
(3) 0.1 *mg*
(4) 0.45 *mg*

7. A vertical circular coil of radius 0.1 m and having 10 turns carries a steady current. When the plane of the coil is normal to magnetic meridian, a neutral point is observed at the centre of the coil. If $B_H = 0.314 \times 10^{-4}$ T, then current in the coil is

(1) 0.25 A (2) 0.5 A
(3) 1 A (4) 2 A

8. A straight horizontal conducting rod of length 50 cm and mass 50 g is suspended by two vertical wires at its ends. A current of 5.0 A is set up in the rod through the wires. What magnetic field should be set up normal to the conductor in order that the tension in the wires is zero? (Take g = 10 m s^{-2})

(1) 0.05 T (2) 0.1 T
(3) 0.2 T (4) 0.5 T

9. A uniform disc of radius *R* lies in *x-y* plane with its centre at origin. Its moment of inertia about the axis $x = 2R$ and $y = 0$ is equal to the moment of inertia about the axis $y = d$ and $z = 0$, where *d* is equal to

(1) $\frac{4}{3}R$ (2) $\frac{\sqrt{17}}{2}R$
(3) $3R$ (4) $\frac{\sqrt{15}}{2}R$

10. A uniform magnetic field B exists in a direction perpendicular to the plane of a square frame made of copper wire. The wire has a diameter of 2 mm and a total length of 40 cm. The magnetic field changes with time at a steady rate $dB/dt = 0.02$ T s^{-1}. What will be the current induced in the frame?

(Resistivity of copper = 1.7×10^{-8} Ω)

(1) 0.1 A (2) 0.2 A

(3) 0.3 A (4) 0.4 A

11. In the expression for torque $\tau = a \times L + b \times I/\omega$, L represents angular momentum, I is moment of inertia and ω is angular velocity. The dimensions of $a \times b$ are

(1) $[M^0 L^0 T^{-4}]$ (2) $[M^0 L^0 T^{-2}]$

(3) $[M^0 L^0 T^{-1}]$ (4) $[M^0 L^0 T^{-3}]$

12. The electric field in a region is radially outward with magnitude $E = Ar$. What will be the charge contained in a sphere of radius a centred at the origin? Take $A = 100$ V m^{-2} and a = 20.0 cm.

(1) 8.89×10^{-11} C

(2) 4.47×10^{-11} C

(3) 8.89×10^{-9} C

(4) 4.47×10^{-9} C

13. Water drops fall at regular intervals from a tap which is 5.0 m above the ground. The third drop is leaving the tap at the instant the first drop reaches the ground. How far above the ground is the second drop at that instant?

(1) 1.25 m (2) 2.50 m

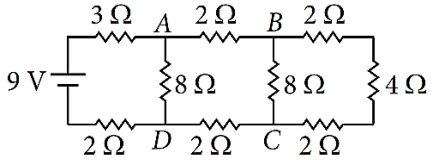
(3) 3.75 m (4) 5.00 m

14. A spring balance has a scale that reads from 0 to 60 kg. The length of the scale is 30 cm. A body suspended from this balance and when displaced and released, oscillates with a period of 0.8 s, what is the weight of the body when oscillating?

(1) 350.67 N (2) 540.11 N

(3) 311.64 N (4) 300.5 N

15. Refer to the circuit shown in the figure.



The current through the

(1) 3 Ω resistor is 0.50 A

(2) 3 Ω resistor is 0.25 A

(3) 4 Ω resistor is 0.50 A

(4) 4 Ω resistor is 0.25 A

16. A block of mass m = 1 kg moving on a horizontal surface with speed $v_i = 2$ ms^{-1} enters a rough patch ranging from $x = 0.10$ m to $x = 2.01$ m. The retarding force F_r on the block in this range is inversely proportional to x over this range,

$F_r = -\frac{k}{x}$ for $0.1 < x < 2.01$ m

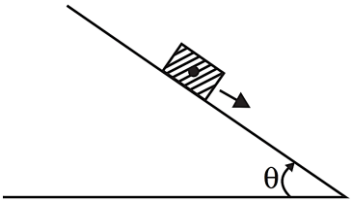
= 0 for $x < 0.1$ m and $x > 2.01$ m

where k = 0.5 J. What is the final kinetic energy of the block as it crosses this patch?

(1) 0.5 J (2) 1.5 J

(3) 2.0 J (4) 2.5 J

17. A plank with a box on it at one end is gradually raised about the other end. As the angle of inclination with the horizontal reaches 30°, the box starts to slip and slides 4.0 m down the plank in 4.0 s. The coefficients of static and kinetic friction between the box and the plank will be, respectively



(Take g = 10 m s^{-2})

(1) 0.5 and 0.6

(2) 0.4 and 0.3

(3) 0.6 and 0.6

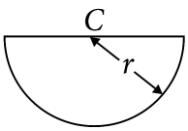
(4) 0.6 and 0.5

18. A vibration magnetometer placed in magnetic meridian has a small bar magnet. The magnet executes oscillations with a time period of 2 s in earth's horizontal magnetic field of 24 μT. When a horizontal field of 18 μT is produced opposite to the earth's field by placing a current carrying wire, the new time period of the magnet will be

(1) 1 s (2) 2 s

(3) 3 s (4) 4 s

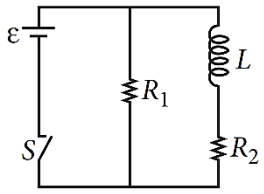
19. A semicircular lamina of mass m, radius r and centre at C is shown in the figure. Its centre of mass is at a distance x from C. Its moment of inertia about an axis through its centre of mass and perpendicular to its plane is



(1) $\frac{1}{2}mr^2$ (2) $\frac{1}{4}mr^2$

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

20. An inductor of inductance $L = 400$ mH and resistors of resistances $R_1 = 2\ \Omega$ and $R_2 = 2\ \Omega$ are connected to a battery of emf 12 V as shown in figure. The internal resistance of the battery is negligible. The switch S is closed at $t = 0$. The potential drop across L as a function of time is



(1) $6e^{-5t}V$ (2) $\frac{12}{t}e^{-3t}V$

(3) $6(1-e^{-t/0.2})V$ (4) $12e^{-5t}V$

Section-B

21. A particle is projected at an angle of 60° above the horizontal with a speed of 10 m s–1. After some time, the direction of its velocity makes an angle of 30° above the horizontal. The speed of the particle at this instant is $\frac{2n}{\sqrt{3}}$ m s–1. The value of n is _____.

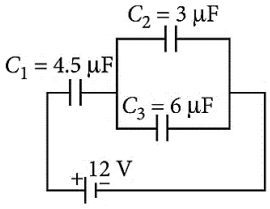
22. A bus is moving with a velocity of 5 m s^{-1} towards a huge wall. The driver sounds a horn of frequency 165 Hz. If the speed of sound in air in 335 m s^{-1}, the number of beats per second heard by the passengers in the bus would be _____.

23. The ground state energy of hydrogen atom is –13.6 eV. The photon emitted during the transition of electron from $n = 3$ to $n = 1$ state, is incident on a photosensitive material of unknown work function. The photoelectrons are emitted from the materials with a maximum kinetic energy of 9 eV. The threshold wavelength of the material used is $N \times 1000$Å then N is _____.

24. There is a stream of neutrons with a kinetic energy of 0.0327 eV. If the half life period of neutrons is 700 s, the fraction of neutrons decay before they travel a distance of 5 m is $x \times 10^{-8}$. The value of x is _____.

25. Two bodies are in equilibrium when suspended in water from the arms of a balance. The mass of one body is 36 g and its density is 9 g cm^{-3}. If the mass of the other is 48 g, its density is_____ g cm^{-3}.

26. The potential difference across the 4.5 mF capacitor is _____ V.



27. A boat of 90 kg is floating in still water. A boy of mass 30 kg walks from the stern to the bow. The length of the boat is 3 m. The distance moved by the boat is $N/100$ then N is _____.

28. Two soap bubbles A and B are kept in a closed chamber where the air is maintained at pressure a of 8 N m^{-2}. The radii of bubbles A and B are 2 cm and 4 cm respectively. Surface tension of soap water used to make bubbles is 0.04 Nm^{-1}. If n_A and n_B are the number of moles of air in bubbles A and B respectively. Then the value of is $\frac{n_B}{n_A}$_____.

(Neglect effect of gravity).

29. An electric drill of output 0.2 hp is used to drill a hole in 100 g of iron. It takes 20 s to drill the hole. Assuming that all the energy spent is absorbed by the iron, its rise in temperature is $\frac{3000}{N}$ °C then N is _____.

(Given specific heat of iron = 450 J kg^{-1} $°C^{-1}$)

30. Monochromatic radiation of wavelength 640.2 nm from a neon lamp irradiates photosensitive material made of cesium. The stopping voltage is measured to be 0.54 V. The source is replaced by another source of wavelength 427.2 nm which irradiates the same photocell. The new stopping voltage is $\frac{N}{10}V$ then N is _____.

Section-II (CHEMISTRY)

Section - A

31. The reason for almost doubling the rate of reaction on increasing the temperature of the reaction system by 10° C is:

(1) The value of threshold energy increases

(2) Collision frequency increases

(3) The fraction of the molecule having energy equal to threshold energy or more increases

(4) Activation energy decreases

32. Which of the following factors may be regarded as the main cause of lanthanoid contraction?

(1) Greater shielding of 5d electrons by 4f electrons

(2) Poorer shielding of 5d electrons by 4f electrons

(3) Effective shielding of one of 4f electrons by another in the subshell.

(4) Poor shielding of one of 4f electron by another in the subshell.

33. Isobutyl magnesium bromide with dry ether and ethyl alcohol gives:

(1) $CH_3\underset{\underset{CH_3}{|}}{C}HCH_2OH$ & CH_2MgBr

(2) $CH_3\underset{\underset{CH_3}{|}}{C}HCH_3$ & $MgBr(OC_2H_5)$

(3) $CH_3\underset{\underset{CH_3}{|}}{C}HCH=CH_2$ & $Mg(OH)Br$

(4) $CH_3\underset{\underset{CH_3}{|}}{C}HCH_3$ & CH_3OMgBr

34. The K_p/K_c ratio will be highest in case of:

(1) $CO(g)+\frac{1}{2}O_2(g)\rightleftharpoons CO_2(g)$

(2) $H_2(g)+I_2(g)\rightleftharpoons 2HI(g)$

(3) $PCl_5(g)\rightleftharpoons PCl_3(g)+Cl_2(g)$

(4) $7H_2(g)+2NO_2(g)\rightleftharpoons 2NH_3(g)+4H_2O(g)$

35. Which of the following substances has the greatest ionic character?

(1) Cl_2O (2) NCl_3

(3) $PbCl_2$ (4) $BaCl_2$

36. An organic compound contains 49.3% carbon, 6.84% hydrogen and its vapour density is 73. Molecular formula of the compound is:

(1) $C_3H_5O_2$ (2) $C_4H_{10}O_2$

(3) $C_6H_{10}O_4$ (4) $C_3H_{10}O_2$

37. Consider the following transformations: $CH_3COOH\xrightarrow{CaCO_3}A\xrightarrow{heat}B\xrightarrow[NaOH]{I_2}C$.

The molecular formula of C is:

(1) $CH_3-\underset{\underset{I}{|}}{\overset{\overset{OH}{|}}{C}}-CH_3$ (2) ICH_2-COCH_3

(3) CHI_3 (4) CH_3I

38. The values of ΔH and ΔS for the reaction, $C(graphite)+CO_2(g)\rightarrow 2CO(g)$ are 170 kJ and 170 JK^{-1}, respectively. This reaction will be spontaneous at:

(1) 910 K (2) 1110 K

(3) 510 K (4) 710 K

39. Containers A and B have same gases, Pressure, volume and temperature of A are all twice that of B, then the ratio of number of molecules of A and B are:

(1) 1:2 (2) 2:1

(3) 1:4 (4) 4:1

40. The stability of $+1$ oxidation state among Al, Ga, In and Tl increases in the sequence:

(1) $Ga<In<Al<Tl$ (2) $Al<Ga<In<Tl$

(3) $Tl<In<Ga<Al$ (4) $In<Tl<Ga<Al$

41. Among the following four structures I to IV,

$C_2H_5-\underset{(I)}{\underset{\underset{CH_3}{|}}{CH}-C_3H_7}$, $CH_3-\underset{(II)}{\overset{\overset{O}{\|}}{C}-\underset{\underset{CH_3}{|}}{CH}-C_2H_5}$,

$\underset{(III)}{H-\overset{\overset{H}{|}}{\overset{|}{C^+}}-H}$, $\underset{(IV)}{C_2H_5-\underset{\underset{CH_3}{|}}{CH}-C_2H_5}$

it is true that:

(1) only I and II are chiral compounds

(2) only III is a chiral compound

(3) only II and IV are chiral compounds

(4) all four are chiral compounds

42. Which is a dangerous radiological pollutant?

(1) C^{14} (2) S^{35}

(3) Sr^{90} (4) p^{32}

43. A compound of formula A_2B_3 has the hcp lattice. Which atom forms the hcp lattice and what fraction of tetrahedral voids is occupied by the other atoms:

(1) hcp lattice $-A$, $\frac{2}{3}$ Tetrahedral voids $-B$

(2) hcp lattice $-A$, $\frac{1}{3}$ Tetrahedral voids $-B$

(3) hcp lattice $-B$, $\frac{2}{3}$ Tetrahedral voids $-A$

(4) hcp lattice $-B$, $\frac{1}{3}$ Tetrahedral voids $-A$

44. Of the four isomeric hexanes, the isomer which can give two monochlorinated structural compounds is:

(1) $2-$methylpentane

(2) 2,2-dimethylbutane

(3) 2,3-dimethylbutane

(4) n-hexane

45. The solubility product of $PbCl_2$ is 1.7×10^{-5} . The solubility in moles per litre would be:

(1) 1.62×10^{-4} (2) 1.62×10^{-8}

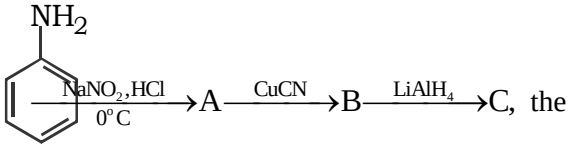
(3) 1.62×10^{-2} (4) 1.62×10^{-6}

46. Crystal field stabilization energy for high spin d^4 octahedral complex is:

(1) $-1.8\Delta_0$ (2) $-1.6\Delta_0+P$

(3) $-1.2\Delta_0$ (4) $-0.6\Delta_0$

47. In the reaction sequence:



the product 'C' is:

(1) benzonitrile (2) benzaldehyde
(3) benzoic acid (4) benzylamine

48. Nylon threads are made of:

(1) polyester polymer
(2) polyamide polymer
(3) benzoic acid
(4) polyvinyl polymer

49. In the reaction of oxalate with permanganate in acid medium, the number of electrons involved in producing one molecule of CO_2 is

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

50. Momentum of radiations of wavelength 0.33 nm is:

(1) $2.01\times10^{-21}\,kg\,msec^{-1}$

(2) $2.01\times10^{-24}\,g\,msec^{-1}$

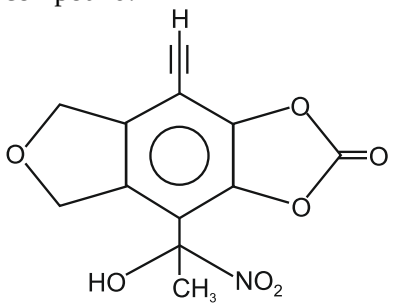
(3) $2.01\times10^{-21}\,g\,msec^{-1}$

(4) $2.01\times10^{-24}\,kg\,msec^{-1}$

[Section - B]

51. Calculate the difference in the heat of formation (in calories) of carbon monoxide at constant pressure and at constant volume at 27^oC.

52. Calculate number of molecules of Grignard reagent consumed by 1 molecule of following compound.



53. In a metal oxide, there is 20% oxygen by weight. What is its equivalent weight?

54. Find the total number of possible isomers for the complex compound $[Cu^{II}(NH_3)_4][Pt^{II}Cl_4]$.

55. Calculate the strength in % w/v of 10 volume H_2O_2 solution.

56. The hardness of a water sample (in terms of ppm of $CaCO_3$) containing 10^{-3} M $CaSO_4$ is: (molar mass of $CaSO_4$ = 136g/mol).

57. In the following reaction sequence, the mass percentage of carbon in the major product P is_____.

$$2C_6H_5CHO + CH_3COCH_3 \xrightarrow[\text{Heat}]{OH^-} P$$

58. The enthalpy changes of the following reactions at 27°C are

$$Na(s) + \frac{1}{2}Cl_2\,(g) \longrightarrow NaCl\,(s)$$

$$\Delta_rH = -411\ kJ/mol$$

$$H_2(g) + S\,(s) + 2O_2\,(g) \longrightarrow H_2SO_4\,(l)$$

$$\Delta_rH = -811\ kJ/mol$$

$$2Na(s) + S(s) + 2O_2\,(g) \longrightarrow Na_2SO_4\,(s)$$

$$\Delta_rH = -1382\ kJ/mol$$

$$\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \longrightarrow HCl\,(g)$$

Δ_rH = –92 kJ/mol; R = 8.3 J/K-mol

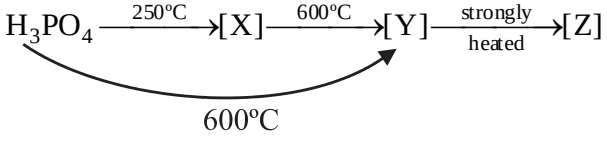
from these data, the heat change of reaction at constant volume (in kJ/mol) at 27°C for the process

$2NaCl\,(s) + H_2SO_4\,(l) \longrightarrow Na_2SO_4\,(s) + 2HCl\,(g)$ is

59. How many of these bicarbonate that can exist in solid state?

(1) $LiHCO_3$ (2) $Mg(HCO_3)_2$
(3) NH_4HCO_3 (4) $Ba(HCO_3)_2$
(5) $NaHCO_3$ (6) $KHCO_3$

60. In the following reaction how many phosphorus atom present in product [Z] is



Section-III (MATHEMATICS)

Section - A

61. The value of $\int_0^{\pi} |\cos x|^3\,dx$ is

(1) 0 (2) $\frac{4}{3}$

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

62. For $x^2 \neq n\pi+1, n \in N$ (the set of natural numbers), the integral

$\int x \cdot \sqrt{\frac{2\sin\left(x^2-1\right)-\sin 2\left(x^2-1\right)}{2\sin\left(x^2-1\right)+\sin 2\left(x^2-1\right)}}dx$ is

(1) $\log_e\left|\frac{1}{2}\sec^2\left(x^2-1\right)\right|+c$

(2) $\frac{1}{2}\log_e\left|\sec\left(x^2-1\right)\right|+c$

(3) $\frac{1}{2}\log_e\left|\sec^2\left(\frac{x^2-1}{2}\right)\right|+c$

(4) $\log_e\left|\sec\left(\frac{x^2-1}{2}\right)\right|+c$

63. Axis of a parabola lies along *x*-axis. If its vertex and focus are at distance 2 and 4 respectively from the origin, on the positive *x*-axis then which of the following points does not lie on it?

(1) $(5, 2\sqrt{6})$ (2) $(8, 6)$

(3) $(6, 4\sqrt{2})$ (4) $(4, -4)$

64. Let $0<\theta<\frac{\pi}{2}$. If the eccentricity of the hyperbola $\frac{x^2}{\cos^2\theta}-\frac{y^2}{\sin^2\theta}=1$ is greater than 2, then the length of its latus rectum lies in the interval:

(1) $(3, \infty)$ (2) $\left(\frac{3}{2}, 2\right]$

(3) $(2, 3]$ (4) $\left(1, \frac{3}{2}\right]$

65. For $x \in R-[0,1]$, let $f_1(x)=\frac{1}{x}, f_2(x)=1-x$ and $f_3(x)=\frac{1}{1-x}$ be three given functions. If a function, $J(x)$ satisfies $\left(f_2 o J o f_1\right)(x)=f_3(x)$ then $J(x)$ is equal to:

(1) $f_3(x)$ (2) $\frac{1}{x}f_3(x)$

(3) $f_2(x)$ (4) $f_1(x)$

66. The solution of $\frac{dy}{dx}=\frac{y}{2y\log y+y+x}$ is given by

(1) $x=y\log y+\frac{c}{y}$ (2) $y=x\log y+\frac{c}{y}$

(3) $x=y\log x+\frac{c}{y^2}$ (4) None

67. If *a*, *b* and *c* be three distinct numbers in G.P. and $a + b + c = xb$ then *x* cannot be

(1) -2 (2) -3

(3) 4 (4) 2

68. If $\cos^{-1}\left(\frac{2}{3x}\right)+\cos^{-1}\left(\frac{3}{4x}\right)=\frac{\pi}{2}, x>\frac{3}{4}$ then *x* is equal to:

(1) $\frac{\sqrt{145}}{12}$ (2) $\frac{\sqrt{145}}{10}$

(3) $\frac{\sqrt{146}}{12}$ (4) $\frac{\sqrt{145}}{11}$

69. Equation of a common tangent to the circle, $x^2+y^2-6x=0$ and the parabola $y^2=4x$, is:

(1) $2\sqrt{3}y=12x+1$ (2) $\sqrt{3}y=x+3$

(3) $2\sqrt{3}y=-x-12$ (4) $\sqrt{3}y=3x+1$

70. The system of linear equation $x+y+z=2$, $2x+3y+2z=5$, $2x+3y+(a^2-1)z=a+1$ then

(1) is inconsistent when $a = 4$

(2) has a unique solution for $|a|=\sqrt{3}$

(3) has infinitely many solutions for $a = 4$

(4) inconsistent when $|a|=\sqrt{3}$

71. The equation of line passing through (– 4, 3, 1), parallel to the plane $x + 2y - z - 5 = 0$ and intersecting the line $\frac{x+1}{-3}=\frac{y-3}{2}=\frac{z-2}{-1}$ is:

(1) $\frac{x+4}{2}=\frac{y+3}{1}=\frac{z+1}{4}$

(2) $\frac{x+4}{1}=\frac{y-3}{1}=\frac{z-1}{3}$

(3) $\frac{x+4}{3}=\frac{y-3}{-1}=\frac{z-1}{1}$

(4) $\frac{x+4}{-1}=\frac{y-3}{1}=\frac{z-1}{1}$

72. Consider the set of all lines $px + qy + r = 0$ such that $3p + 2q + 4r = 0$. Which one of the following statements is true?

(1) The line are concurrent at the point $\left(\frac{3}{4}, \frac{1}{2}\right)$.

(2) Each line passes through the origin.

(3) The lines are all parallel

(4) The lines are not concurrent

73. $\lim_{y\to 0}\frac{\sqrt{1+\sqrt{1+y^4}}-\sqrt{2}}{y^4}=$

(1) exists and equal $\frac{1}{4\sqrt{2}}$

(2) exists and equal to $\frac{1}{2\sqrt{2}\left(\sqrt{2}+1\right)}$

(3) exists and equals $\frac{1}{2\sqrt{2}}$

(4) Does not exist

74. The plane through the intersection of the plane $x + y + z = 1$ and $2x + 3y - z + 4 = 0$ and parallel to y-axis also pass through the point:

(1) $(-3, 0, -1)$

(2) $(-3, 1, 1)$

(3) $(3, 3, -1)$

(4) $(3, 2, 1)$

75. If $A=\begin{bmatrix}\cos\theta & -\sin\theta \\ \sin\theta & \cos\theta\end{bmatrix}$, then the matrix A^{-50} when $\theta=\frac{\pi}{12}$, is equal to

(1) $\begin{bmatrix}\frac{1}{2} & -\frac{\sqrt{3}}{2} \\ \frac{\sqrt{3}}{2} & \frac{1}{2}\end{bmatrix}$ (2) $\begin{bmatrix}\frac{\sqrt{3}}{2} & -\frac{1}{2} \\ \frac{1}{2} & \frac{\sqrt{3}}{2}\end{bmatrix}$

(3) $\begin{bmatrix}\frac{\sqrt{3}}{2} & \frac{1}{2} \\ -\frac{1}{2} & \frac{\sqrt{3}}{2}\end{bmatrix}$ (4) $\begin{bmatrix}\frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{\sqrt{3}}{2} & \frac{1}{2}\end{bmatrix}$

76. If the Boolean expression $(p \oplus q) \wedge (\sim p \Theta q)$ is equivalent to $p \wedge q$, where $\oplus, \Theta \in \{\wedge, \vee\}$, then the ordered pair $(\oplus, \Theta)$ is:

(1) $(\wedge, \vee)$

(2) $(\vee, \vee)$

(3) $(\wedge, \vee)$

(4) $(\wedge, \wedge)$

77. For any $\theta \in \left(\frac{\pi}{4}, \frac{\pi}{2}\right)$, the expression $3(\sin\theta - \cos\theta)^4 + 6(\sin\theta + \cos\theta)^2 + 4\sin^6\theta$ equals:

(1) $13 - 4\cos^2\theta + 6\sin^2\theta\cos^2\theta$

(2) $13 - 4\cos^6\theta$

(3) $13 - 4\cos^2\theta + 6\cos^4\theta$

(4) $13 - 4\cos^4\theta + 2\sin^2\theta\cos^2\theta$

78. Let $f : R \to R$ be a function defined as $f(x)=\begin{cases}5, & \text{if } x \le 1 \\ a+bx, & \text{if } 1 < x < 3 \\ b+5x, & \text{if } 3 \le x < 5 \\ 30, & \text{if } x \ge 5\end{cases}$. Then f is:

(1) continuous if $a = 5$ and $b = 5$

(2) continuous if $a = 5$ and $b = 10$

(3) continuous if $a = 0$ and $b = 5$

(4) not continuous for any values of a and b

79. Let $A=\left\{\theta \in \left(-\frac{\pi}{2}, \pi\right) : \frac{3+2i\sin\theta}{1-2i\sin\theta} \text{ purely imaginary}\right\}$. Then, the sum of the elements in A is

(1) $\frac{5\pi}{6}$ (2) π

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

80. Three circles of radii a, b, c $(a < b < c)$ touch each other externally. If they have x-axis as a common tangent, then:

(1) $\frac{1}{\sqrt{a}} = \frac{1}{\sqrt{b}} + \frac{1}{\sqrt{c}}$

(2) $\frac{1}{\sqrt{b}} = \frac{1}{\sqrt{a}} + \frac{1}{\sqrt{c}}$

(3) a, b, c are in A.P.

(4) $\sqrt{a}, \sqrt{b}, \sqrt{c}$ are in A.P

Section - B

81. Let $\vec{a} = \hat{i} - \hat{j}, \vec{b} = \hat{i} + \hat{j} + \hat{k}$ and $\vec{c}$ be a vector such that $\vec{a} \times \vec{c} + \vec{b} = 0$ and $\vec{a} \cdot \vec{c} = 4$, $|\vec{c}|^2$ is k then $2k$ is

82. If $y = y(x)$ is solution of the differential equation $x\frac{dy}{dx} + 2y = x^2$ satisfying $y(1) = 1$, then $y\left(\frac{1}{2}\right)$ is α then 16α is equal to

83. If the fractional part of the number $\frac{2^{403}}{15}$ is $\frac{k}{15}$, then k is equal to:

84. If θ denotes the acute angle between the curves, $y = 10 - x^2$ and $y = 2 + x^2$ at a point of their intersection, then $|\tan\theta|$ is α then 15α is equal to

85. 5 students of a class have an average height 150 cm and variance 18 cm^2. A new student, whose height is 156 cm, joined them. The variance (in cm^2) of the height of these six students is:

86. The area (in sq. units) bounded by the parabola $y = x^2 - 1$, the tangent at the point (2, 3) to it and the y-axis is λ then 3λ is

87. Let $a_1, a_2, \ldots\ldots, a_{30}$ be an A.P., $S = \sum_{i=1}^{30} a_i$ and $T = \sum_{i=1}^{15} a_{2i-1}$. If $a_5 = 27$ and $S - 2T = 75$, then a_{10} is equal to

88. Consider a class of 5 girls and 7 boys. The number of different teams consisting of 2 girls and 3 boys that can be formed from this class, if there are two specific boys *A* and *B*, who refuse to be the members of the same team, is:

89. Let α and β be two roots of the equation $x^2+2x+2=0$, then $\alpha^{15}+\beta^{15}$ is k then $-k$ is equal to

90. Two cards are drawn successively with replacement from a well shuffled deck of 52 cards. Let X denote the random variable of number of aces obtained in the two drawn cards. Then $P(X = 1) + P(X = 2)$ is α then 169α is equal to

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