

# JEE Main

## MOCK TEST - 1

### Instructions:

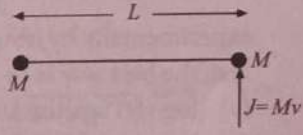
- I. The JEE Main Test Paper consists of one paper containing 60 objective questions (four options with single correct answer) and 30 numerical value type questions from the syllabus of Physics, Chemistry and Mathematics.
- II. The duration of paper would be 3 hours (180 minutes).
- III. There will be total 90 questions : Physics - 30, Chemistry - 30, Mathematics - 30.
- IV. Each question will carry 4 marks. For each correct response the applicant will be awarded four marks. For each incorrect answer there will be deduction of one mark.
- V. There will be no negative marking for unattended questions. More than one answer of single question will also be considered as incorrect response and will be negatively marked.

Max. Marks : 300

Time : 180 minutes

### PHYSICS

#### Section-A (Multiple Choice Questions)

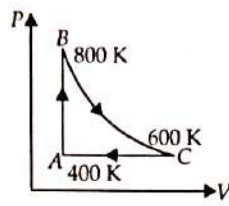
1. A point source of light is kept below the surface of water ( $n_w = \frac{4}{3}$ ) at a depth of  $\sqrt{7}$  m. The radius of the circular bright patch of light noticed on the surface of water is ... m.  
(a)  $\frac{3}{\sqrt{7}}$  (b) 3 (c)  $\frac{\sqrt{7}}{3}$  (d)  $\sqrt{7}$
2. Two identical induction coils each of inductance  $L$  joined in series are placed very close to each other such that the winding direction of one is exactly opposite of that of the other, what is the net inductance?  
(a) zero (b)  $L/2$  (c)  $2L$  (d)  $L^2$
3. Consider a body, shown in figure, consisting of two identical balls, each of mass  $M$  connected by a light rigid rod. If an impulse  $J = Mv$  is imparted to the body at one of its ends, what would be its angular velocity?  

4. Dipole is placed parallel to the electric field. If  $W$  is the work done in rotating the dipole by  $60^\circ$ , then work done in rotating it by  $180^\circ$  is  
(a)  $2W$  (b)  $3W$  (c)  $4W$  (d)  $W/2$
5. A particle of mass  $m$  and charge  $q$  moves with a constant velocity  $v$  along the positive  $x$  direction. It enters a region containing a uniform magnetic field  $B$  directed along the negative  $z$  direction, extending from  $x = a$  to  $x = b$ . The minimum value of  $v$  required so that the particle can just enter the region  $x > b$  is  
(a)  $\frac{qbB}{m}$  (b)  $\frac{q(b-a)B}{m}$   
(c)  $\frac{qaB}{m}$  (d)  $\frac{q(b+a)B}{2m}$
6. Assuming the sun to have a spherical outer surface of radius  $r$ , radiating like a black body at temperature  $t^\circ\text{C}$ , the power received by a unit surface, (normal to the incident rays) at a distance  $R$  from the centre of the sun is  
(a)  $\frac{r^2\sigma(t+273)^4}{R^2}$  (b)  $\frac{16\pi^2r^2\sigma t^4}{R^2}$



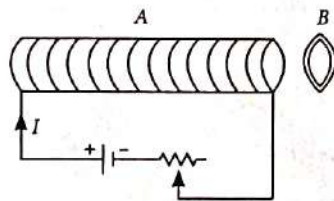
(c)  $\frac{16\pi^2 r^2 \sigma t^4}{R^2}$

(d)  $\frac{4\pi r^2 \sigma t^4}{R^2}$

7. One mole of diatomic ideal gas undergoes a cyclic process ABC as shown in figure. The process BC is adiabatic. The temperatures at A, B and C are 400 K, 800 K and 600 K respectively. Choose the correct statement.



- (a) The change in internal energy in the process BC is  $-500R$ .  
 (b) The change in internal energy in whole cyclic process is  $250R$ .  
 (c) The change in internal energy in the process CA is  $700R$ .  
 (d) The change in internal energy in the process AB is  $-350R$ .
8. An aluminium ring B faces an electromagnet A. The current  $I$  through A can be altered. Then which of the following statements is correct?



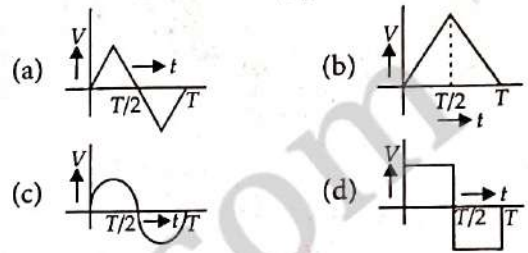
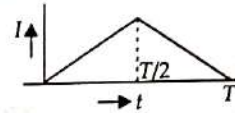
- (a) If  $I$  decreases, A will repel B.  
 (b) Whether  $I$  increases or decreases, B will not experience any force.  
 (c) If  $I$  increases, A will repel B.  
 (d) If  $I$  increases, A will attract B.
9. A signal of frequency 20 kHz and peak voltage of 5 volts is used to modulate a carrier wave of frequency 1.2 MHz and peak voltage 25 volts. Choose the correct statement.
- (a) Modulation index = 5, side frequency bands are at 1400 kHz and 1000 kHz  
 (b) Modulation index = 0.2, side frequency bands are at 1220 kHz and 1180 kHz  
 (c) Modulation index = 0.8, side frequency bands are at 1180 kHz and 1220 kHz  
 (d) Modulation index = 5, side frequency bands are at 21.2 kHz and 18.8 kHz

10. A quantity  $X$  is given by  $\epsilon_0 L \frac{\Delta V}{\Delta t}$ , where  $\epsilon_0$  is the permittivity of free space,  $L$  is a length,  $\Delta V$  is a potential difference and  $\Delta t$  is a time interval. The dimensional formula for  $X$  is the same as that of
- (a) electrical resistance (b) electric charge  
 (c) electric voltage (d) electric current

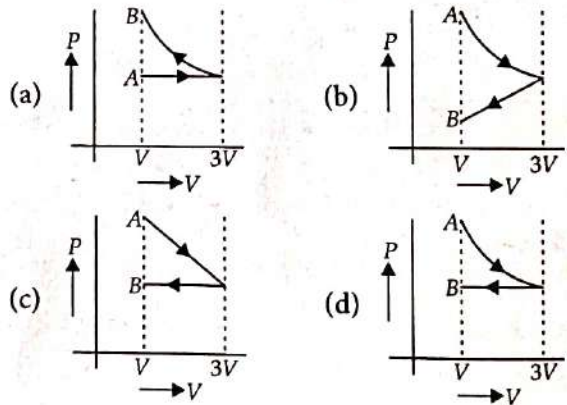
11. If an earth satellite of mass  $m$  orbiting at a distance  $2R$  from the centre of earth has to be transferred into the orbit of radius  $3R$ , the amount of energy required is ( $R$  : radius of earth)

(a)  $mgR$  (b)  $\frac{mgR}{3}$  (c)  $\frac{mgR}{2}$  (d)  $\frac{mgR}{12}$

12. The current ( $I$ ) in the inductance is varying with time according to the plot shown in figure. Which one of the following is the correct variation of voltage with time in the coil?



13. One mole of an ideal gas goes from an initial state A to final state B via two processes : It first undergoes isothermal expansion from volume  $V$  to  $3V$  and then its volume is reduced from  $3V$  to  $V$  at constant pressure. The correct  $P$ - $V$  diagram representing the two processes is



14. Two metal spheres are falling through a liquid of density  $2 \times 10^3 \text{ kg/m}^3$  with the same uniform speed. The material density of sphere 1 and sphere 2 are  $8 \times 10^3 \text{ kg/m}^3$  and  $11 \times 10^3 \text{ kg/m}^3$  respectively. The ratio of their radii is

(a)  $\frac{11}{8}$  (b)  $\sqrt{\frac{11}{8}}$  (c)  $\frac{3}{2}$  (d)  $\sqrt{\frac{3}{2}}$

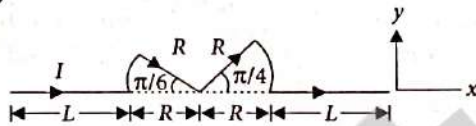
15. A particle of mass  $m$  is acted upon by a force  $F$  given by the empirical law  $F = \frac{R}{t^2} v(t)$ . If this law is to be tested experimentally by observing the motion starting from rest, the best way is to plot
- (a)  $\log v(t)$  against  $1/t$  (b)  $v(t)$  against  $t^2$   
 (c)  $\log v(t)$  against  $1/t^2$  (d)  $\log v(t)$  against  $t$



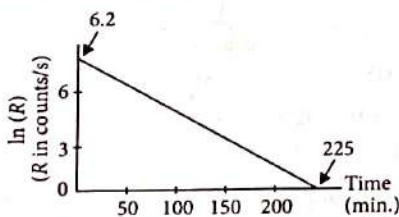
### Section-B (Numerical Value Type)

Attempt any 5 questions out of 10

16. A ball is dropped from a height of 20 m above the surface of water in a lake. The refractive index of water is  $4/3$ . A fish inside the lake, in the line of fall of the ball, is looking at the ball. At an instant, when the ball is 12.8 m above the water surface, the fish sees the speed of ball as (Take  $g = 10 \text{ m/s}^2$ )  
 (a) 9 m/s (b) 12 m/s  
 (c) 16 m/s (d) 21.33 m/s
17. The electric field in an em wave is given by  $E = \left(\frac{50 \text{ N}}{\text{C}}\right) \cdot \sin\left[\omega\left(t - \frac{x}{c}\right)\right]$ . Then the energy contained in a cylinder of cross-section  $10 \text{ mm}^2$  and length 50 m along the X-axis is  
 (a)  $4.5 \times 10^{-12} \text{ J}$  (b)  $5.5 \times 10^{-12} \text{ J}$   
 (c)  $6.5 \times 10^{-12} \text{ J}$  (d)  $7.5 \times 10^{-12} \text{ J}$
18. A conductor (shown in the figure) carrying constant current  $I$  is kept in the  $x$ - $y$  plane in a uniform magnetic field  $\vec{B}$ . If  $F$  is the magnitude of the total magnetic force acting on the conductor, then the correct statement(s) is(are)

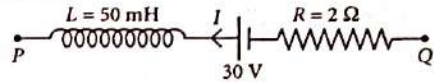


- (a) If  $\vec{B}$  is along  $\hat{z}$ ,  $F = 0$   
 (b) If  $\vec{B}$  is along  $\hat{x}$ ,  $F \propto (L + R)$   
 (c) If  $\vec{B}$  is along  $\hat{y}$ ,  $F \propto (L + R)$   
 (d) If  $\vec{B}$  is along  $\hat{y}$ ,  $F = 0$
19. A 9 V battery with internal resistance of  $0.5 \Omega$  is connected across an infinite network as shown in the figure. All ammeters  $A_1, A_2, A_3$  and voltmeter  $V$  are ideal. Choose correct statement.  
 (a) Reading of  $V$  is 9 V. (b) Reading of  $A_1$  is 2 A.  
 (c) Reading of  $V$  is 7 V. (d) Reading of  $A_1$  is 18 A.
20. The graph shows some measurements of the decay rate of a sample of radio active nuclei  $^{128}\text{I}$ . Find the half-life for this radioactive nucleus.

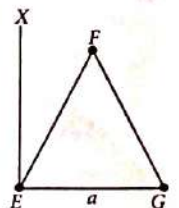


- (a) 20 min (b) 25 min (c) 15 min (d) 75 s

21. A 0.5 kg ball moving with a speed of 12 m/s strikes a hard wall at an angle of  $30^\circ$  with the wall. It is reflected with the same speed at the same angle. If the ball is in contact with the wall for 0.25 seconds, then the average force acting on the wall in newton is \_\_\_\_\_.
22. An ideal gas is filled in a closed rigid and thermally insulated container. A coil of  $100 \Omega$  resistor carrying current 1 A for 5 minute supplies heat to the gas. The change in internal energy of gas (in kJ), is \_\_\_\_\_.
23. A non-isotropic solid metal cube has coefficients of linear expansion as  $5 \times 10^{-5} \text{ }^\circ\text{C}^{-1}$  along the  $x$ -axis and  $5 \times 10^{-6} \text{ }^\circ\text{C}^{-1}$  along the  $y$  and the  $z$ -axis. If the coefficient of volume expansion of the solid is  $C \times 10^{-6} \text{ }^\circ\text{C}^{-1}$  then the value of  $C$  is \_\_\_\_\_.
24. A part of a complete circuit is shown in the figure. At some instant, the value of current  $I$  is 1 A and it is decreasing at a rate of  $10^2 \text{ A s}^{-1}$ . The value of the potential difference  $V_P - V_Q$ , (in volts) at that instant, is \_\_\_\_\_.



25. Two beams of light having intensities  $I$  and  $4I$  interfere to produce a fringe pattern on a screen. The phase difference between the beams is  $\pi/2$  at point  $A$  and  $2\pi$  at point  $B$ . Then, the difference between the resultant intensity between  $A$  and  $B$  is  $nI$  where the value of  $n$  is \_\_\_\_\_.
26. In order to be transmitted over a communication system, a speech signal with frequencies in the range 0.2-5 kHz is amplitude modulated over a carrier wave of frequency 1000 kHz. The maximum transmitted frequency (in kHz) is \_\_\_\_\_.
27. One end of a horizontal thick copper wire of length  $2L$  and radius  $2R$  is welded to an end of another horizontal thin copper wire of length  $L$  and radius  $R$ . When the arrangement is stretched by applying forces at two ends, the ratio of the elongation in the thin wire to that in the thick wire is found to be  $x : 1$ . Then the value of  $x$  is \_\_\_\_\_.
28. An massless equilateral triangle  $EFG$  of side ' $a$ ' (As shown in figure) has three particles of mass  $m$  situated at its vertices. The moment of inertia of the system about the line  $EX$  perpendicular to  $EG$  in the plane of  $EFG$  is  $\frac{N}{20} ma^2$  where  $N$  is an integer. The value of  $N$  is \_\_\_\_\_.





29. A cricket ball of mass 0.15 kg is thrown vertically up by a bowling machine so that it rises to a maximum height of 20 m after leaving the machine. If the part pushing the ball applies a constant force  $F$  on the ball and moves horizontally a distance of 0.2 m while launching the ball, the value of  $F$  (in N) is ( $g = 10 \text{ m s}^{-2}$ ) \_\_\_\_\_.

30. The radii and Young's moduli of two uniform wires A and B are in the ratio 2 : 1 and 1 : 2 respectively. Both wires are subjected to the same longitudinal force. If the increase in length of the wire A is one percent, the percentage increase in length of the wire B is \_\_\_\_\_.

## CHEMISTRY

### Section-A (Multiple Choice Questions)

31. Time taken for an electron to complete one revolution in the Bohr orbit of hydrogen atom is

- (a)  $\frac{4\pi^2mr^2}{nh}$  (b)  $\frac{nh}{4\pi^2mr}$   
 (c)  $\frac{2\pi mr}{n^2h^2}$  (d)  $\frac{h}{2\pi mr}$

32. Two statements are given below:

**Statement I :** The melting point of monocarboxylic acid with even number of carbon atoms is higher than that of with odd number of carbon atoms acid immediately below and above it in the series.

**Statement II :** The solubility of monocarboxylic acids in water decreases with increase in molar mass.

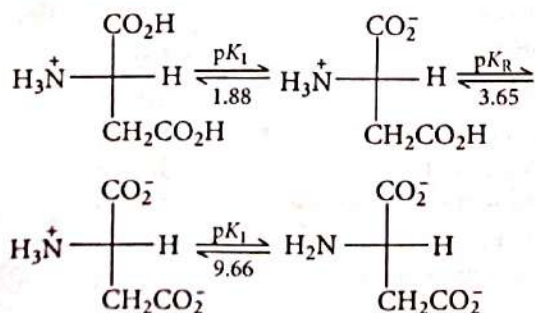
Choose the most appropriate option.

- (a) Both Statement I and Statement II are correct.  
 (b) Both Statement I and Statement II are incorrect.  
 (c) Statement I is correct but Statement II is incorrect.  
 (d) Statement I is incorrect but Statement II is correct.

33. The dipole moment of HBr is  $0.78 \times 10^{-18}$  esu cm and interatomic spacing is 1.41 Å. The % ionic character of HBr is

- (a) 7.5 (b) 11.5 (c) 15 (d) 27

34. Consider the following sequence for aspartic acid :



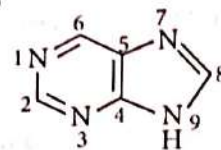
The pI (isoelectric point) of aspartic acid is

- (a) 3.65 (b) 2.77 (c) 5.74 (d) 1.88

35. For an adiabatic change in a system, the condition which is applicable will be

- (a)  $w = 0$  (b)  $q = -w$  (c)  $q = w$  (d)  $q = 0$

36. The "N" which does not contribute to the basicity for the compound is



- (a) N 9 (b) N 3 (c) N 1 (d) N 7

37. In aqueous alkaline solution, two electron reduction of  $\text{HO}_2^-$  gives

- (a)  $\text{HO}^-$  (b)  $\text{H}_2\text{O}$  (c)  $\text{O}_2$  (d)  $\text{O}_2^-$

38. Vulcanization of rubber is carried out by heating a mixture of

- (a) isoprene and styrene (b) neoprene and sulphur  
 (c) isoprene and sulphur (d) neoprene and styrene.

39. Among LiCl, RbCl, BeCl<sub>2</sub>, MgCl<sub>2</sub> the compounds with greatest and least ionic character respectively are

- (a) LiCl and RbCl (b) RbCl and BeCl<sub>2</sub>  
 (c) RbCl and MgCl<sub>2</sub> (d) MgCl<sub>2</sub> and BeCl<sub>2</sub>

40. Dettol contains

- (a) chloroxylenol  
 (b) terpineol  
 (c) 1% iodine  
 (d) both chloroxylenol and terpineol.

41. The hydrides of group 14 elements with maximum and minimum reducing character respectively are

- (a)  $\text{CH}_4$ ,  $\text{PbH}_4$  (b)  $\text{CH}_4$ ,  $\text{SnH}_4$   
 (c)  $\text{PbH}_4$ ,  $\text{SiH}_4$  (d)  $\text{PbH}_4$ ,  $\text{CH}_4$ .

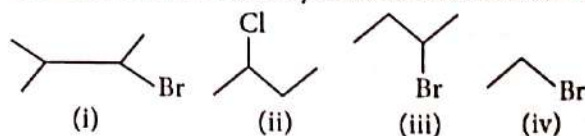
42. The molecular formula of phenoxy benzene is

- (a)  $\text{C}_6\text{H}_5\text{C}_6\text{H}_5$  (b)  $\text{C}_6\text{H}_5-\text{O}-\text{C}_6\text{H}_5$   
 (c)  $\text{C}_6\text{H}_5-\text{O}-\text{C}_3\text{H}_7$  (d) none of these.

43. In Lassaigne's test for nitrogen, the blue colour is due to the formation of

- (a) ferric ferrocyanide  
 (b) potassium ferrocyanide  
 (c) sodium ferrocyanide  
 (d) sodium cyanide.

44. Correct order of reactivity towards alcoholic KOH is



- (a)  $i > ii > iii > iv$  (b)  $i > iii > ii > iv$   
 (c)  $iv > ii > iii > i$  (d)  $i > iv > ii > iii$

45. Number of possible alkynes with formula  $\text{C}_5\text{H}_8$  is

- (a) 3 (b) 5 (c) 2 (d) 4



46. Which one of the following cyano complexes would exhibit the lowest value of paramagnetic behaviour?  
 (a)  $[\text{Cr}(\text{CN})_6]^{3-}$  (b)  $[\text{Mn}(\text{CN})_6]^{3-}$   
 (c)  $[\text{Fe}(\text{CN})_6]^{3-}$  (d)  $[\text{Co}(\text{CN})_6]^{3-}$
47. Green Chemistry in day-to-day life is in the use of  
 (a) large amount of water alone for washing clothes  
 (b) liquified  $\text{CO}_2$  for dry cleaning of clothes  
 (c) chlorine for bleaching of paper  
 (d) tetrachloroethene for laundry
48. Which metallurgy does not involve leaching?  
 (a) Au (b) Ag (c) Al (d) Fe
49. Henry's law constant for molality of methane in benzene at 298 K is  $4.27 \times 10^5$  mm Hg. The mole fraction of methane in benzene at 298 K under 760 mm Hg is  
 (a)  $1.78 \times 10^{-3}$  (b)  $17.43 \times 10^{-3}$   
 (c) 0.114 (d) 2.814
50. For the reaction,  
 $[\text{Cu}(\text{NH}_3)_4]^{2+} + \text{H}_2\text{O} \rightleftharpoons [\text{Cu}(\text{NH}_3)_3\text{H}_2\text{O}]^{2+} + \text{NH}_3$   
 the net rate of reaction at any time is given by:  
 Net rate =  $2.0 \times 10^{-4} [[\text{Cu}(\text{NH}_3)_4]^{2+}] - 3.0 \times 10^5 [[\text{Cu}(\text{NH}_3)_3\text{H}_2\text{O}]^{2+}][\text{NH}_3]$

Then correct statement is

- (a) rate constant for forward reaction =  $2 \times 10^{-4}$   
 (b) rate constant for backward reaction =  $3 \times 10^5$   
 (c) equilibrium constant for the reaction =  $6.6 \times 10^{-10}$   
 (d) all of these.

### Section-B (Numerical Value Type)

Attempt any 5 questions out of 10

51. Methylation of 10 g of benzene gave 8.2 g of toluene. The percentage yield of toluene is \_\_\_\_\_.
52. For octahedral complex  $[\text{Cu}(\text{en})_2(\text{SCN})_2]$ , how many number of relatively more stable isomer(s) are possible?
53. The atomic number of the element having maximum number of unpaired  $2p$  electrons is  $x$ . The group to which this element belongs is  $y$ . The sum of  $x$  and  $y$  is \_\_\_\_\_.
54. The number of P—O—H bonds present in pyrophosphoric acid is \_\_\_\_\_.
55. At 400 K, the root mean square (r.m.s.) speed of a gas X (molecular weight = 40) is equal to the most probable speed of gas Y at 60 K. The molecular weight of the gas Y is \_\_\_\_\_.
56. 100 mL of 0.0018% (w/v) solution of  $\text{Cl}^-$  ion has the minimum concentration of  $\text{Cl}^-$  required to precipitate a negative sol. The coagulating value of  $\text{Cl}^-$  ion is \_\_\_\_\_. (Nearest integer)

57. The solubility of  $\text{AgCl}_{(s)}$  with solubility product  $1.6 \times 10^{-10}$  in 0.1 M NaCl solution is  $1.6 \times 10^{-x}$ . The value of  $x$  is \_\_\_\_\_.
58. The same quantity of electricity that liberated 2.158 g of Ag was passed through a gold salt, and 1.314 g of gold was deposited. The equivalent mass of Ag is 107.9. The oxidation state of Au in the salt is \_\_\_\_\_. (At. mass of Au = 197 u)
59. 1 mL of  $\text{H}_2\text{O}_2$  solution gives 10 mL of  $\text{O}_2$  at NTP. It is \_\_\_\_\_ volume of  $\text{H}_2\text{O}_2$ .
60. Aluminium crystallizes in a cubic close packed structure. Its metallic radius is 125 pm. The length of the side of unit cell (in pm) will be \_\_\_\_\_.

## MATHEMATICS

### Section-A (Multiple Choice Questions)

61. Let  $R = \{(P, Q) \mid P \text{ and } Q \text{ are at the same distance from the origin}\}$  be a relation, then the equivalence class of  $(5, 5)$  is the set  $S =$   
 (a)  $\{(x, y) \mid x^2 + y^2 = 1\}$   
 (b)  $\{(x, y) \mid x^2 + y^2 = 50\}$   
 (c)  $\{(x, y) \mid x^2 + y^2 = 4\}$   
 (d)  $\{(x, y) \mid x^2 + y^2 = \sqrt{2}\}$
62. If  $z_1, z_2$  are complex numbers such that  $\text{Re}(z_1) = |z_1 - 2|$ ,  $\text{Re}(z_2) = |z_2 - 2|$  and  $\arg(z_1 - z_2) = \frac{\pi}{6}$ , then  $\text{Im}(z_1 + z_2)$  is equal to  
 (a)  $\frac{4}{\sqrt{3}}$  (b)  $4\sqrt{3}$  (c)  $\frac{\sqrt{3}}{2}$  (d)  $\frac{1}{\sqrt{3}}$
63. The homogeneous system of equations  

$$\begin{bmatrix} 2 & a+b+c+d & ab+cd \\ a+b+c+d & 2(a+b)(c+d) & ab(c+d)+cd(a+b) \\ ab+cd & ab(c+d)+cd(a+b) & 2abcd \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = 0$$
  
 has non trivial solutions only if  
 (a)  $a + b + c + d = 0$   
 (b)  $ab + cd = 0$   
 (c)  $ab(c + d) + cd(a + b) = 0$   
 (d) for any  $a, b, c, d$
64. A man writes letter to his six friends and addresses the corresponding envelopes. The total number of ways in which letters can be placed in the envelopes so that at least four of them are in the wrong envelopes, is  
 (a) 626 (b) 678  
 (c) 664 (d) 692
65. The coefficient of  $t^{20}$  in  $(1 + t^2)^{10} (1 + t^{10}) (1 + t^{20})$  is  
 (a)  ${}^{10}C_5 + 3$  (b)  ${}^{10}C_5 + 1$   
 (c)  ${}^{10}C_5$  (d)  ${}^{10}C_5 + 2$



66. If  $x_1, x_2, \dots, x_n$  are  $n$  non-zero real numbers such that  $(x_1^2 + x_2^2 + x_3^2 + \dots + x_{n+1}^2)(x_2^2 + x_3^2 + x_4^2 + \dots + x_n^2) \geq (x_1x_2 + x_2x_3 + \dots + x_{n-1}x_n)^2$  then  $x_1, x_2, \dots, x_n$  are in  
 (a) A.P. (b) G.P. (c) A.G.P. (d) None of these
67. If  $f(x) = |x - 2|$  and  $g(x) = f(f(x))$ , then  $\sum_{r=0}^3 g'(2r - 1)$  is equal to  
 (a) 0 (b) 1 (c) -1 (d) 2
68. Evaluate:  $\int_2^4 \frac{\sqrt{x^2 - 4}}{x^4} dx$   
 (a)  $\frac{\sqrt{3}}{32}$  (b)  $\frac{\sqrt{3}}{16}$  (c)  $\frac{\sqrt{3}}{8}$  (d)  $\frac{2\sqrt{3}}{15}$
69. The general solution of the differential equation  $(1 + y^2) + (x - e^{\tan^{-1}y}) \frac{dy}{dx} = 0$  is  $2xe^{f(y)} = e^{2f(y)} + c$ , then the area of the region bounded by the curves  $x = f(y)$ ,  $y = \pm\sqrt{3}$  and  $y$ -axis is  
 (a)  $\frac{\pi}{\sqrt{3}} - \log 2$  (b)  $\frac{2\pi}{\sqrt{3}} - \log 4$   
 (c)  $\frac{\pi}{\sqrt{3}} + \log 2$  (d)  $\frac{2\pi}{\sqrt{3}}$
70. One possible condition for the three points  $(a, b)$ ,  $(b, a)$  and  $(a^2, -b^2)$  to be collinear is  
 (a)  $a - b = 2$  (b)  $a + b = 2$   
 (c)  $a = 1 + b$  (d)  $a = 1 - b$
71. The equation of the plane perpendicular to the  $xy$ -plane and passing through the points  $(1, -2, 4)$  and  $(3, -4, 5)$  is  
 (a)  $y + 2x = 5$  (b)  $2x + 3y = 6$   
 (c)  $x + y + 1 = 0$  (d)  $2y + x = 6$
72. The set of vectors  $\vec{a}, \vec{b}, \vec{c}$  are reciprocal to the set  $\vec{a} = 4\hat{i} + 6\hat{j} - 2\hat{k}$ ,  $\vec{b} = 2\hat{i} - 2\hat{j} - 4\hat{k}$ ,  $\vec{c} = -2\hat{i} + 4\hat{j} + 4\hat{k}$ , then  $\vec{a}' + \vec{b}' + \vec{c}'$  is  
 (a)  $\frac{13\hat{i} + 6\hat{j} + 11\hat{k}}{6}$  (b)  $\frac{13\hat{i} - 6\hat{j} + 11\hat{k}}{6}$   
 (c)  $\frac{13\hat{i} - 6\hat{j} - 11\hat{k}}{6}$  (d)  $\frac{-13\hat{i} + 6\hat{j} - 11\hat{k}}{6}$
73. For three numbers  $a, b, c$  product of the average of the numbers  $a^2, b^2, c^2$  and  $\frac{1}{a^2}, \frac{1}{b^2}, \frac{1}{c^2}$  cannot be less than  
 (a) 1 (b) 3 (c) 9 (d) None of these
74. If  $x, y, z \in [-1, 1]$  such that  $\sin^{-1}x + \sin^{-1}y + \sin^{-1}z = -\frac{3\pi}{2}$ , then the value of  $\frac{x^2 + y^2 + z^2}{3}$  is  
 (a) 0 (b) 1 (c) 2 (d) 3
75. The logical statement  $(p \Rightarrow q) \wedge (q \Rightarrow \sim p)$  is equivalent to  
 (a)  $\sim p$  (b)  $p$  (c)  $q$  (d)  $\sim q$
76. If  $|z_1| = 2, |z_2| = 3, |z_3| = 4$ , and  $|16z_1z_2 + 9z_1z_3 + 4z_2z_3| = 144$ , then  $|z_1 + z_2 + z_3|$  equals  
 (a) 12 (b) 8 (c) 6 (d) 4
77. The number of ways of selecting 6 books from a library which has 8 books, each on History, Civics, Economics and Geography, is  
 (a) 36 (b) 84 (c) 66 (d) None of these
78. Let  $k$  be a positive real number and  $A = \begin{bmatrix} 2k-1 & 2\sqrt{k} & 2\sqrt{k} \\ 2\sqrt{k} & 1 & -2k \\ -2\sqrt{k} & 2k & -1 \end{bmatrix}, B = \begin{bmatrix} 0 & 2k-1 & \sqrt{k} \\ 1-2k & 0 & 2\sqrt{k} \\ -\sqrt{k} & -2\sqrt{k} & 0 \end{bmatrix}$   
 If  $\det(\text{adj } A) + \det(\text{adj } B) = 10^6$ , then  $[k]$  is  
 (a) 1 (b) 4 (c) 2 (d) 3
79. A bag contains  $n$  yellow balls and 3 black balls. Balls are drawn one by one without replacement till all the black balls are drawn. The probability that this procedure for drawing ball will come to an end at the  $r^{\text{th}}$  draw is  
 (a)  $\frac{{}^nC_{r-3}}{{}^{n+3}C_r}$  (b)  $\frac{{}^3C_1 \times {}^nC_r}{n-r+4}$   
 (c)  $\frac{3(r-1)(r-2)}{(n+1)(n+2)(n+3)}$  (d)  $\frac{3r(r-1)(r-2)}{(n+1)(n+2)(n+3)}$
80.  $\frac{1}{5^4} \times \frac{1}{25^8} \times \frac{1}{125^{16}} \times \dots \infty$  is equal to  
 (a) 1 (b) 25 (c) 5 (d)  $\sqrt{5}$

### Section-B (Numerical Value Type)

Attempt any 5 questions out of 10

81. A square matrix  $P$  satisfies  $P^2 = I - P$ , where  $I$  is an identity matrix of order as order of  $P$ . If  $P^n = 5I - 8P$ , then  $n =$  \_\_\_\_\_.
82. Number of solutions of the equation  $z^3 + \frac{3(\bar{z})^2}{|z|} = 0$ , where  $z$  is a complex number is \_\_\_\_\_.
83. The largest term in the expansion of  $(3 + 2x)^{50}$ , where  $x = 1/5$ , is \_\_\_\_\_.
84. For the curve  $C: (x^2 + y^2 - 3) + (x^2 - y^2 - 1)^5 = 0$ , the value of  $3y' - y^3y''$ , at the point  $(\alpha, \alpha)$ ,  $\alpha > 0$ , on  $C$ , is equal to \_\_\_\_\_.

85. Area of the region enclosed between the curves

$x = y^2 - 1$  and  $x = |y|\sqrt{1 - y^2}$ ,  $x \geq 0$ , is \_\_\_\_\_.

86. The equation  $3(\log_3 x)^2 - 2|\log_3 x| + k = 0$  has four solutions. The interval in which  $k$  lies in the interval

$\left(0, \frac{1}{N}\right)$ , then  $N =$  \_\_\_\_\_.

87. If  $e^{f(x)} = \frac{10+x}{10-x}$ ,  $x \in (-10, 10)$  and

$f(x) = kf\left(\frac{200x}{100+x^2}\right)$ , then  $k =$  \_\_\_\_\_.

88. The value of  $\int_{-\pi/4}^{\pi/4} [(x^9 - 3x^5 + 7x^3 - x + 1) / \cos^2 x] dx$  is \_\_\_\_\_.

89. If plane  $ax - by + cz = 0$  contains the line

$\frac{x-a}{a} = \frac{y-2d}{b} = \frac{z-c}{c}$ , then  $\frac{b}{d} =$  \_\_\_\_\_.

90. The number of elements in the set  $S = \{\theta \in [-4\pi, 4\pi] : 3\cos^2 2\theta + 6\cos 2\theta - 10\cos^2 \theta + 5 = 0\}$  is \_\_\_\_\_.

SPACE FOR ROUGH WORK

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