

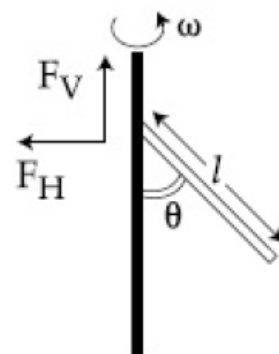
# FITJEE

## Solutions to JEE (Main)-2020


JEE–Main–2020 –Sept–3–Second–Shift  
PHYSICS, CHEMISTRY & MATHEMATICS

### PART –A (PHYSICS)

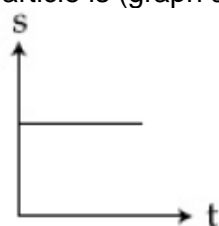
1. The electric field of a plane electromagnetic wave propagating along the x direction in vacuum is  $\vec{E} = E_0 \hat{j} \cos(\omega t - kx)$ . The magnetic field  $\vec{B}$ , at the moment  $t = 0$  is:
- (A)  $\vec{B} = E_0 \sqrt{\mu_0 \epsilon_0} \cos(kx) \hat{j}$                       (B)  $\vec{B} = E_0 \sqrt{\mu_0 \epsilon_0} \cos(kx) \hat{k}$   
(C)  $\vec{B} = \frac{E_0}{\sqrt{\mu_0 \epsilon_0}} \cos(kx) \hat{k}$                       (D)  $\vec{B} = \frac{E_0}{\sqrt{\mu_0 \epsilon_0}} \cos(kx) \hat{j}$
2. A block of mass 1.9 kg is at rest at the edge of a table, of height 1 m. A bullet of mass 0.1 kg collides with the block and sticks to it. If the velocity of the bullet is 20 m/s in the horizontal direction just before the combined system strikes the floor, is [Take  $g = 10 \text{ m/s}^2$ . Assume there is no rotational motion and loss of energy after the collision is negligible.]
- (A) 21 J    (B) 20 J  
(C) 23 J    (D) 19 J
3. Hydrogen ion and singly ionized helium atom are accelerated, from rest, through the same potential difference. The ratio of final speeds of hydrogen and helium ions is close to:
- (A) 1 : 2    (B) 10 : 7  
(C) 5 : 7    (D) 2 : 1
4. A uniform rod of length 'l' is pivoted at one of its ends on a vertical shaft of negligible radius. When the shaft rotates at angular speed  $\omega$  the rod makes an angle  $\theta$  with it (see figure). To find  $\theta$  equate the rate of change of angular momentum (direction going into the paper)  $\frac{ml^2}{12} \omega^2 \sin\theta \cos\theta$  about the centre of mass (CM) to the torque provided by the horizontal and vertical forces  $F_H$  and  $F_V$  about the CM. The value of  $\theta$  is then such that:
- (A)  $\cos\theta = \frac{g}{l\omega^2}$                                       (B)  $\cos\theta = \frac{2g}{3l\omega^2}$   
(C)  $\cos\theta = \frac{3g}{2l\omega^2}$                                       (D)  $\cos\theta = \frac{g}{2l\omega^2}$
5. Amount of solar energy received on the earth's surface per unit area per unit time is defined a solar constant. Dimension of solar constant is:
- (A)  $M^2L^0T^{-1}$                                       (B)  $ML^2T^{-2}$   
(C)  $ML^0T^{-3}$                                       (D)  $MLT^{-2}$



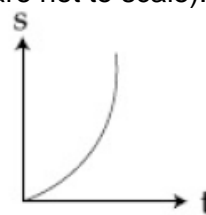
6. A calorimeter of water equivalent 20 g contains 180 g of water at  $25^{\circ}\text{C}$ , 'm' grams of steam at  $100^{\circ}\text{C}$  is mixed in it till the temperature of the mixture is  $31^{\circ}\text{C}$ . The value of 'm' is close to (Latent heat of water =  $540\text{ cal g}^{-1}$ , specific heat of water =  $1\text{ cal g}^{-1}\text{ }^{\circ}\text{C}^{-1}$ )  
 (A) 2.6 (B) 4 (C) 2 (D) 3.2
7. Which of the following will NOT be observed when a multimeter (operating in resistance measuring mode) probes connected across a component, are just reversed?  
 (A) Multimeter shows a deflection, accompanied by a splash light out of connected component in one direction and NO deflection on reversing the probes if the chosen component is LED.  
 (B) Multimeter shows NO deflection in both cases i.e. before and after reversing the probes if the chosen component is metal wire.  
 (C) Multimeter shows NO deflection in both case i.e. before and after reversing the probes if the chosen component is capacitor.  
 (D) Multimeter shows an equal deflection in both cases i.e. before and after reversing the probes if the chosen component is resistor.
8. Two sources of light emit X – rays of wavelength 1 nm and visible light of wavelength 500 nm, respectively. Both the sources emit light of the same power 200 W. The ratio of the number density of photons of X – rays to the number density of photons of the visible light of the given wavelengths is:  
 (A)  $\frac{1}{500}$  (B) 500 (C) 250 (D)  $\frac{1}{250}$
9. Concentric metallic hollow spheres of radii R and 4R hold charges  $Q_1$  and  $Q_2$  respectively. Given that surface charge densities of the concentric spheres are equal, the potential difference  $V(R) - V(4R)$  is:  
 (A)  $\frac{3Q_2}{4\pi\epsilon_0 R}$  (B)  $\frac{Q_2}{4\pi\epsilon_0 R}$  (C)  $\frac{3Q_1}{16\pi\epsilon_0 R}$  (D)  $\frac{3Q_1}{4\pi\epsilon_0 R}$
10. A block of mass m attached to a massless spring is performing oscillatory motion of amplitude 'A' on a frictionless horizontal plane. If half of the mass of the block breaks off when it is passing through its equilibrium point, the amplitude of oscillation for the remaining system become fA . The value of f is:  
 (A)  $\frac{1}{2}$  (B)  $\frac{1}{\sqrt{2}}$  (C)  $\sqrt{2}$  (D) 1
11. Two light waves having the same wavelength  $\lambda$  in vacuum are in phase initially. Then the first wave travels path  $L_1$  through a medium of refractive index  $n_1$  while the second wave travels a path of length  $L_2$  through a medium of refractive index  $n_2$  . After this the phase difference between the two waves is:  
 (A)  $\frac{2\pi}{\lambda}\left(\frac{L_2}{n_1} - \frac{L_1}{n_2}\right)$  (B)  $\frac{2\pi}{\lambda}\left(\frac{L_1}{n_1} - \frac{L_2}{n_2}\right)$   
 (C)  $\frac{2\pi}{\lambda}(n_1L_1 - n_2L_2)$  (D)  $\frac{2\pi}{\lambda}(n_2L_1 - n_1L_2)$
12. A metallic sphere cools from  $50^{\circ}\text{C}$  to  $40^{\circ}$  in 300s. If atmospheric temperature around is  $20^{\circ}\text{C}$ , then the sphere's temperature after the next 5 minutes will be close to:  
 (A)  $35^{\circ}\text{C}$  (B)  $31^{\circ}\text{C}$   
 (C)  $33^{\circ}\text{C}$  (D)  $28^{\circ}\text{C}$

13. If a semiconductor photodiode can detect a photon with a maximum wavelength of 400 nm, then its band gap energy is:  
 Planck's constant  $h = 6.63 \times 10^{-34}$  J.s.  
 Speed of light  $c = 3 \times 10^8$  m/s  
 (A) 3.1eV (B) 1.5eV  
 (C) 2.0eV (D) 1.1eV
14. To raise the temperature of a certain mass of gas by  $50^\circ$  C at a constant pressure, 160 calories of heat is required. When the same mass of gas is cooled by  $100^\circ$  C at constant volume, 240 calories of heat is released. How many degrees of freedom does each molecule of this gas have (assume gas to be ideal)?  
 (A) 7 (B) 5  
 (C) 3 (D) 6
15. A perfectly diamagnetic sphere has a small spherical cavity at its centre, which is filled with a paramagnetic substance. The whole system is placed in a uniform magnetic field  $\vec{B}$ . Then the field inside the paramagnetic substance is:  
 (A) zero  
 (B) much large than  $|\vec{B}|$  but opposite to  $\vec{B}$   
 (C)  $\vec{B}$   
 (D) much large than  $|\vec{B}|$  and parallel to  $\vec{B}$
- 
16. The radius  $R$  of a nucleus of mass number  $A$  can be estimated by the formula  $R = (1.3 \times 10^{-15}) A^{1/3}$  m. It follows that the mass density of a nucleus is of the order of:  
 ( $M_{\text{prot}} = M_{\text{neut.}} \approx 1.67 \times 10^{-27}$  kg)  
 (A)  $10^3 \text{ kg m}^{-3}$  (B)  $10^{17} \text{ kg m}^{-3}$   
 (C)  $10^{10} \text{ kg m}^{-3}$  (D)  $10^{24} \text{ kg m}^{-3}$
17. The mass density of a planet of radius  $R$  varies with the distance  $r$  from its centre as  $\rho(r) = \rho_0 \left(1 - \frac{r^2}{R^2}\right)$ . Then the gravitational field is maximum at:  
 (A)  $r = \frac{1}{\sqrt{3}}R$  (B)  $r = R$   
 (C)  $r = \sqrt{\frac{5}{9}}R$  (D)  $r = \sqrt{\frac{3}{4}}R$
18. A uniform magnetic field  $B$  exists in a direction perpendicular to the plane of a square loop made of a metal wire. The wire has a diameter of 4 mm and a total length of 30 cm. The magnetic field changes with time at a steady rate  $\frac{dB}{dt} = 0.032 \text{ Ts}^{-1}$ . The induced current in the loop is close to (Resistivity of the metal wire is  $1.23 \times 10^{-8} \Omega \text{ m}$ )  
 (A) 0.61A (B) 0.43A  
 (C) 0.53A (D) 0.34A

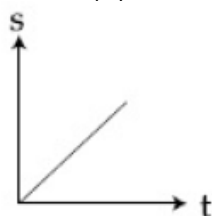
19. A particle is moving unidirectionally on a horizontal plane under the action of a constant power supplying energy source. The displacement(s) – time (t) graph that describes the motion of the particle is (graph are drawn schematically and are not to scale):



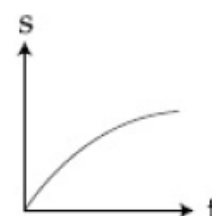
(A)



(B)



(C)



(D)

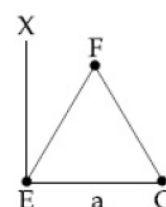
20. Two resistors  $400\Omega$  and  $800\Omega$  are connected in series across a 6 V battery. The potential difference measured by a voltmeter of  $10k\Omega$  across  $400\Omega$  resistor is close to:  
 (A) 2 V (B) 2.05V  
 (C) 1.95 V (D) 1.8 V

21. A block starts moving up an inclined plane of inclination  $30^\circ$  with an initial velocity of  $v_0$ . It comes back to its initial position with velocity  $\frac{v_0}{2}$ . The value of the coefficient of kinetic friction between the block and the inclined plane is close to  $\frac{l}{1000}$ , The nearest integer to l is

22. A galvanometer coil has 500 turns and each turn has an average area of  $3 \times 10^{-4} m^2$ . If a torque of 1.5 Nm is required to keep this coil parallel to a magnetic field when a current of 0.5 A is flowing through it, the strength of the field (in T) is \_\_\_\_\_.

23. If minimum possible work is done by a refrigerator in converting 100 grams of water at  $0^\circ C$  to ice, how much heat (in calories) is released to the surroundings at temperature  $27^\circ C$  (Latent heat of ice = 80 Cal/gram) to the nearest integer?

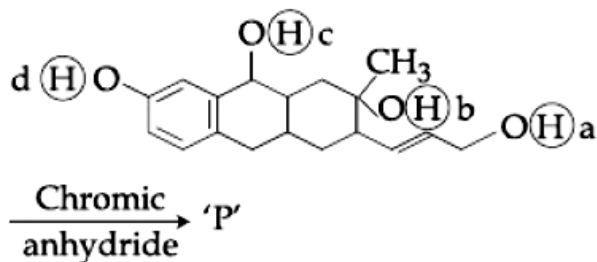
24. A massless equilateral triangle EFG of side 'a' (As shown in figure) has three particles of mass m situated at its vertices. The moment of inertia of the system about the line EX perpendicular to EG in the plane of EFG is  $\frac{N}{20} ma^2$  where N is an integer. The value of N is \_\_\_\_\_.



25. When an object is kept at a distance of 30 cm from a concave mirror, the image is formed at a distance of 10 cm from the mirror. If the object is moved with a speed of  $9 \text{ cm s}^{-1}$ , the speed (in  $\text{cm s}^{-1}$ ) with which image moves at that instant is \_\_\_\_\_.

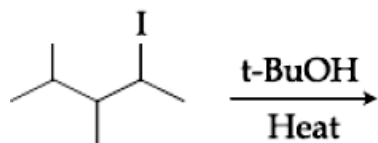
## PART – B (CHEMISTRY)

26. Consider the following reaction:



The product 'P' gives positive ceric ammonium nitrate test. This is because of the presence of which of these – OH group(s)?

- (A) (d) only (B) (b) and (d)  
 (C) (b) only (D) (c) and (d)
27. The major product in the following reaction is:



- (A) (B)
- (C) (D)

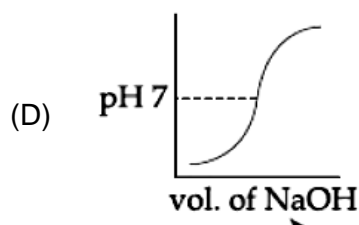
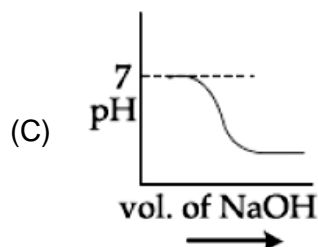
28. An ionic micelles is formed on the addition of:

- (A)  $\text{SO}_4^-$  (B) sodium stearate to pure toluene
- (C) liquid diethyl ether to aqueous NaCl solution (D)  $\text{PF}_6^-$
- excess water to liquid**

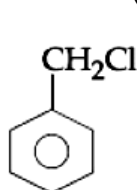
29. The five successive ionization enthalpies of an element are 800, 2427, 3658, 25024 and 32824 kJ mol<sup>-1</sup>. The number of valence electrons in the element is:

- (A) 4 (B) 2  
 (C) 5 (D) 3

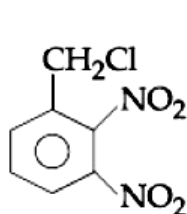




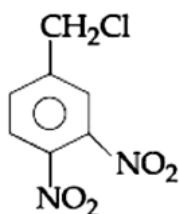
34. The incorrect statement(s) among (a) – (d) regarding acid rain is (are):  
 (a) It can corrode water pipes.  
 (b) It can damage structures made up of stone.  
 (c) It cannot cause respiratory ailments in animals  
 (d) It is not harmful for trees  
 (A) (a), (b) and (d) (B) (c) and (d)  
 (C) (a), (c) and (d) (D) (c) only
35. The increasing order of the reactivity of the following compounds in nucleophilic addition reaction is:  
 Propanal, Benzaldehyde, Propanone, Butanone  
 (A) Benzaldehyde < Propanal < Propanone < Butanone  
 (B) Butanone < Propanone < Benzaldehyde < Propanal  
 (C) Propanal < Propanone < Butanone < Benzaldehyde  
 (D) Benzaldehyde < Butanone < Propanone < Propanal
36. Complex A has a composition of  $H_{12}O_6Cl_3Cr$ . If the complex on treatment with conc.  $H_2SO_4$  loses 13.5% of its original mass, the correct molecular formula of A is:  
 [Given : atomic mass of Cr = 52 amu and Cl = 35 amu]  
 (A)  $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$  (B)  $[Cr(H_2O)_6]Cl_3$   
 (C)  $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$  (D)  $[Cr(H_2O)_3Cl_3] \cdot 3H_2O$
37. The incorrect statement is  
 (A) In manganate and permanganate ions, the  $\pi$  - bonding takes place by overlap of p-orbitals of oxygen and d-orbitals of manganese  
 (B) Manganate ion is green in colour and permanganate ion is purple in colour  
 (C) Manganate and permanganate ions are paramagnetic  
 (D) Manganate and permanganate ions are tetrahedral
38. The decreasing order of reactivity of the following compounds towards nucleophilic substitution ( $S_N2$ ) is:



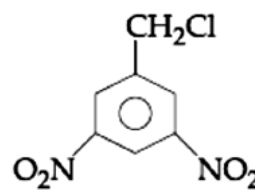
(I)



(II)



(III)



(IV)

- (A) (II) > (III) > (I) > (IV) (B) (III) > (II) > (IV) > (I)  
 (C) (II) > (III) > (IV) > (I) (D) (IV) > (II) > (III) > (I)

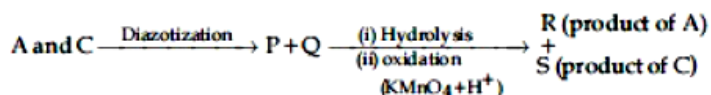
39. A mixture of one mole each of  $H_2$ , He and  $O_2$  each are enclosed in a cylinder of volume V at temperature T. If the partial pressure of  $H_2$  is 2 atm, the total pressure of the gases in the cylinder is:

- (A) 14 atm (B) 6 atm  
(C) 22 atm (D) 38 atm

40. Among the statements (I – IV), the correct ones are:

- (I) Be has smaller atomic radius compared to Mg.  
(II) Be has higher ionization enthalpy than Al.  
(III) Charge/radius ratio of Be is greater than that of Al.  
(IV) Both Be and Al form mainly covalent compounds.  
(A) (I), (III) and (IV) (B) (II), (III) and (IV)  
(C) (I), (II) and (III) (D) (I), (II) and (IV)

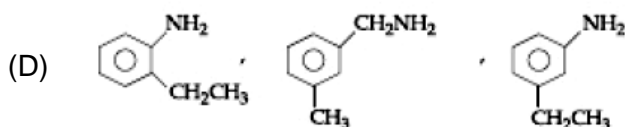
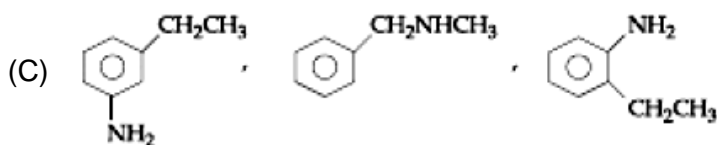
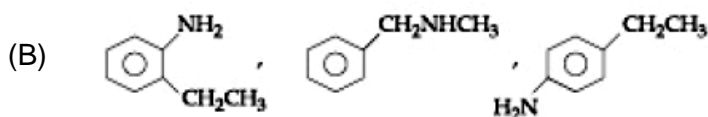
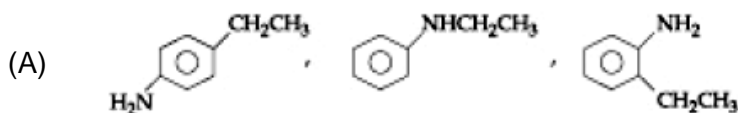
41. Three isomers A, B and C (mol. formula  $C_8H_{11}N$ ) give the following results:



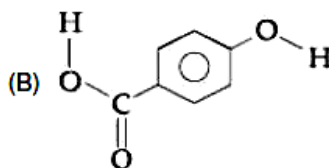
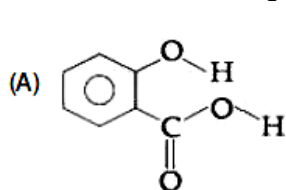
R has lower boiling point than S



A, B and C, respectively are:



42. Consider the following molecules and statements related to them:



- (a) (B) is more likely to be crystalline  
(b) (B) has higher boiling point than (A)  
(c) (B) dissolves more readily than (A) in water

Identify the correct option from below:

- (A) (a) and (c) are true (B) (b) and (c) are true  
(C) (a) and (b) are true (D) only (a) is true



43. For the reaction  $2A + 3B + \frac{3}{2}C \rightarrow 3P$ , which statement is correct?

(A)  $\frac{dn_A}{dt} = \frac{2}{3} \frac{dn_B}{dt} = \frac{3}{4} \frac{dn_C}{dt}$

(B)  $\frac{dn_A}{dt} = \frac{dn_B}{dt} = \frac{dn_C}{dt}$

(C)  $\frac{dn_A}{dt} = \frac{3}{2} \frac{dn_B}{dt} = \frac{3}{4} \frac{dn_C}{dt}$

(D)  $\frac{dn_A}{dt} = \frac{2}{3} \frac{dn_B}{dt} = \frac{4}{3} \frac{dn_C}{dt}$

44. The d – electron configuration of  $[\text{Ru}(\text{en})_3]\text{Cl}_2$  and  $[\text{Fe}(\text{H}_2\text{O})_6]\text{Cl}_2$ , respectively are:

(A)  $t_{2g}^6 e_g^0$  and  $t_{2g}^4 e_g^2$

(B)  $t_{2g}^4 e_g^2$  and  $t_{2g}^4 e_g^2$

(C)  $t_{2g}^6 e_g^0$  and  $t_{2g}^6 e_g^0$

(D)  $t_{2g}^4 e_g^2$  and  $t_{2g}^6 e_g^0$

45. Match the following drugs with their therapeutic actions:

Column-I		Column-II	
(i)	Ranitidine	(a)	Antidepressant
(ii)	Nardil (Phenelzine)	(b)	Antibiotic
(iii)	Chloramphenicol	(c)	Antihistamine
(iv)	Dimetane (Brompheniramine)	(d)	Antacid
		(e)	Analgesic

(A) (i) – (e); (ii) – (a); (iii) – (c); (iv) – (d)

(B) (i) – (a); (ii) – (c); (iii) – (b); (iv) – (e)

(C) (i) – (d); (ii) – (c); (iii) – (a); (iv) – (e)

(D) (i) – (d); (ii) – (a); (iii) – (b); (iv) – (c)

46. The volume (in mL) of 0.1 N NaOH required to neutralise 10 mL of 0.1 N phosphinic acid is \_\_\_\_\_.

47. The number of  $\text{>C=O}$  groups present in a tripeptide Asp – Glu – Lys is \_\_\_\_\_.

48. If 250 cm<sup>3</sup> of an aqueous solution containing 0.73 g of a protein A is isotonic with one litre of another aqueous solution containing 1.65 g of a protein B, at 298 K, the ratio of the molecular masses of A and B is \_\_\_\_\_  $\times 10^{-2}$  (to the nearest integer).

49. An acidic solution of dichromate is electrolyzed for 8 minutes using 2A current. As per the following equation  $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$ . The amount of  $\text{Cr}^{3+}$  obtained was 0.104 g. The efficiency of the process (in %) is (Take:  $F = 96000 \text{ C}$ , At. Mass of chromium = 52) \_\_\_\_\_.

50.  $6.023 \times 10^{22}$  molecules are present in 10 g of a substance 'x'. The molarity of a solution containing 5 g of substance 'x' in 2 L solution is \_\_\_\_\_  $\times 10^{-3}$ .

## PART-C (MATHEMATICS)

51. If the sum of the series  $20 + 19\frac{3}{5} + 19\frac{1}{5} + 18\frac{4}{5} + \dots$  upto  $n^{\text{th}}$  term is 488 and the  $n^{\text{th}}$  term is negative, then:
- (A)  $n^{\text{th}}$  term is  $-4\frac{2}{5}$  (B)  $n = 41$   
 (C)  $n^{\text{th}}$  term is  $-4$  (D)  $n = 60$
52. If  $z_1, z_2$  are complex numbers such that  $\text{Re}(z_1) = |z_1 - 1|, \text{Re}(z_2) = |z_2 - 1|$  and  $\arg(z_1 - z_2) = \frac{\pi}{6}$ , then  $\text{Im}(z_1 + z_2)$  is equal to:
- (A)  $2\sqrt{3}$  (B)  $\frac{\sqrt{3}}{2}$   
 (C)  $\frac{1}{\sqrt{3}}$  (D)  $\frac{2}{\sqrt{3}}$
53. Let  $a, b, c \in \mathbb{R}$  be such that  $a^2 + b^2 + c^2 = 1$ . If  $a \cos \theta = b \cos\left(\theta + \frac{2\pi}{3}\right) = c \cos\left(\theta + \frac{4\pi}{3}\right)$ , where  $\theta = \frac{\pi}{9}$ , then the angle between the vectors  $a\hat{i} + b\hat{j} + c\hat{k}$  and  $b\hat{i} + c\hat{j} + a\hat{k}$  is:
- (A)  $\frac{\pi}{9}$  (B)  $\frac{2\pi}{3}$   
 (C) 0 (D)  $\frac{\pi}{2}$
54. Let the latus rectum of the parabola  $y^2 = 4x$  be the common chord to the circles  $C_1$  and  $C_2$  each of them having radius  $2\sqrt{5}$ . Then, the distance between the centres of the circles  $C_1$  and  $C_2$  is:
- (A)  $4\sqrt{5}$  (B)  $8\sqrt{5}$   
 (C) 8 (D) 12
55. Let  $R_1$  and  $R_2$  be two relations defined as follows:  
 $R_1 = \{(a, b) \in \mathbb{R}^2 : a^2 + b^2 \in \mathbb{Q}\}$  and  
 $R_2 = \{(a, b) \in \mathbb{R}^2 : a^2 + b^2 \notin \mathbb{Q}\}$ , where  $\mathbb{Q}$  is the set of all rational numbers. Then:
- (A) Neither  $R_1$  nor  $R_2$  is transitive.  
 (B)  $R_1$  is transitive but  $R_2$  is not transitive.  
 (C)  $R_1$  and  $R_2$  are both transitive  
 (D)  $R_2$  is transitive but  $R_1$  is not transitive.

56. If the value of the integral  $\int_0^{1/2} \frac{x^2}{(1-x^2)^{3/2}} dx$  is  $\frac{k}{6}$ , then k is equal to:
- (A)  $2\sqrt{3} + \pi$  (B)  $3\sqrt{2} - \pi$   
 (C)  $2\sqrt{3} - \pi$  (D)  $3\sqrt{2} + \pi$
57. If  $x^3 dy + xy dx = x^2 dy + 2y dx$ ;  $y(2) = e$  and  $x > 1$ , then  $y(4)$  is equal to:
- (A)  $\frac{\sqrt{e}}{2}$  (B)  $\frac{1}{2} + \sqrt{e}$   
 (C)  $\frac{3}{2}\sqrt{e}$  (D)  $\frac{3}{2} + \sqrt{e}$
58. The probability that a randomly chosen 5 – digit number is made from exactly two digits is:
- (A)  $\frac{134}{10^4}$  (B)  $\frac{121}{10^4}$   
 (C)  $\frac{150}{10^4}$  (D)  $\frac{135}{10^4}$
59. If the surface area of a cube is increasing at a rate of  $3.6 \text{ cm}^2/\text{sec}$ , retaining its shape; then the rate of change of its volume (in  $\text{cm}^3/\text{sec}$ ), when the length of a side of the cube is 10 cm, is:
- (A) 9 (B) 18  
 (C) 10 (D) 20
60. The set of all real values of  $\lambda$  for which the quadratic equations,  $(\lambda^2 + 1)x^2 - 4\lambda x + 2 = 0$  always have exactly one root in the interval (0, 1) is:
- (A) (0, 2) (B) (2, 4]  
 (C) (-3, -1) (D) (1, 3]
61. If a  $\Delta ABC$  have vertices A (-1, 7), B (-7, 1) and C (5, -5), then its orthocenter has coordinates:
- (A)  $\left(\frac{3}{5}, -\frac{3}{5}\right)$  (B) (-3, 3)  
 (C) (3, -3) (D)  $\left(-\frac{3}{5}, \frac{3}{5}\right)$
62. Let p, q, r be three statements such that the truth value of  $(p \wedge q) \rightarrow (\sim q \vee r)$  is F. Then the truth values of p, q, r are respectively:
- (A) T, F, T (B) T, T, F  
 (C) F, T, F (D) T, T, T
63. The plane which bisects the line joining the points (4, -2, 3) and (2, 4, -1) at right angles also passes through the point:
- (A) (0, -1, 1) (B) (4, 0, 1)  
 (C) (4, 0, -1) (D) (0, 1, -1)

64. Let  $e_1$  and  $e_2$  be the eccentricities of the ellipse,  $\frac{x^2}{25} + \frac{y^2}{b^2} = 1 (b < 5)$  and the hyperbola,  $\frac{x^2}{16} - \frac{y^2}{b^2} = 1$  respectively satisfying  $e_1 e_2 = 1$ . If  $\alpha$  and  $\beta$  are the distances between the foci of the ellipse and the foci of the hyperbola respectively, then the ordered pair  $(\alpha, \beta)$  is equal to :
- (A) (8, 10) (B)  $\left(\frac{24}{5}, 10\right)$   
 (C)  $\left(\frac{20}{3}, 12\right)$  (D) (8, 12)
65. Let A be a  $3 \times 3$  matrix such that  $\text{adj} A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 0 & 2 \\ 1 & -2 & -1 \end{bmatrix}$  and  $B = \text{adj}(\text{adj} A)$ .  
 If  $|A| = \lambda$  and  $|(B^{-1})^T| = \mu$ , then the ordered pair,  $(|\lambda|, \mu)$  is equal to:
- (A)  $\left(9, \frac{1}{9}\right)$  (B) (3, 81)  
 (C)  $\left(9, \frac{1}{81}\right)$  (D)  $\left(3, \frac{1}{81}\right)$
66. If  $\int \sin^{-1}\left(\sqrt{\frac{x}{1+x}}\right) dx = A(x) \tan^{-1}(\sqrt{x}) + B(x) + C$ , where C is a constant of integration, then the ordered pair  $(A(x), B(x))$  can be:
- (A)  $(x-1, -\sqrt{x})$  (B)  $(x-1, \sqrt{x})$   
 (C)  $(x+1, -\sqrt{x})$  (D)  $(x+1, \sqrt{x})$
67. Let  $x_i (1 \leq i \leq 10)$  be ten observations of a random variable X. If  $\sum_{i=1}^{10} (x_i - p) = 3$  and  $\sum_{i=1}^{10} (x_i - p)^2 = 9$  where  $0 \neq p \in \mathbb{R}$ , then the standard deviation of these observations is:
- (A)  $\sqrt{\frac{3}{5}}$  (B)  $\frac{4}{5}$   
 (C)  $\frac{7}{10}$  (D)  $\frac{9}{10}$
68. If the term independent of x in the expansion of  $\left(\frac{3}{2}x^2 - \frac{1}{3x}\right)^9$  is k, then 18k is equal to:
- (A) 9 (B) 5  
 (C) 7 (D) 11

69. Suppose  $f(x)$  is a polynomial of degree four, having critical points at  $-1, 0, 1$ . If  $T = \{x \in \mathbb{R} \mid f(x) = f(0)\}$ , then the sum of squares of all the elements of  $T$  is:  
 (A) 8 (B) 6  
 (C) 2 (D) 4
70.  $\lim_{x \rightarrow a} \frac{(a+2x)^{\frac{1}{3}} - (3x)^{\frac{1}{3}}}{(3a+x)^{\frac{1}{3}} - (4x)^{\frac{1}{3}}}$  ( $a \neq 0$ ) is equal to:  
 (A)  $\left(\frac{2}{3}\right)^{\frac{4}{3}}$  (B)  $\left(\frac{2}{9}\right)^{\frac{4}{3}}$   
 (C)  $\left(\frac{2}{9}\right)\left(\frac{2}{3}\right)^{\frac{1}{3}}$  (D)  $\left(\frac{2}{3}\right)\left(\frac{2}{9}\right)^{\frac{1}{3}}$
71. If the tangent to the curve,  $y = e^x$  at a point  $(c, e^c)$  and the normal to the parabola,  $y^2 = 4x$  at the point  $(1, 2)$  intersect at the same point on the  $x$  – axis, then the value of  $c$  is \_\_\_\_\_.
72. The total number of 3 – digit numbers, whose sum of digits is 10, is \_\_\_\_\_.
73. Let  $S$  be the set of all integer solutions,  $(x, y, z)$ , of the system of equation  
 $x - 2y + 5z = 0$   
 $-2x + 4y + z = 0$   
 $-7x + 14y + 9z = 0$   
 such that  $15 \leq x^2 + y^2 + z^2 \leq 150$ . Then, the number of elements in the set  $S$  is equal to \_\_\_\_\_.
74. Let a plane  $P$  contain two lines  $\vec{r} = \hat{i} + \lambda(\hat{i} + \hat{j}), \lambda \in \mathbb{R}$  and  $\vec{r} = -\hat{j} + \mu(\hat{j} - \hat{k}), \mu \in \mathbb{R}$ . If  $Q(\alpha, \beta, \gamma)$  is the foot of the perpendicular drawn from the point  $M(1, 0, 1)$  to  $P$ , then  $3(\alpha + \beta + \gamma)$  equals \_\_\_\_\_.
75. If  $m$  arithmetic means (A.Ms) and three geometric means (G.Ms) are inserted between 3 and 243 such that 4<sup>th</sup> A.M. is equal to 2<sup>nd</sup> G.M., then  $m$  is equal to \_\_\_\_\_.