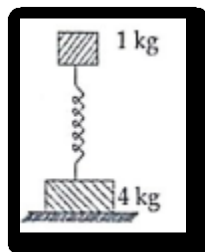


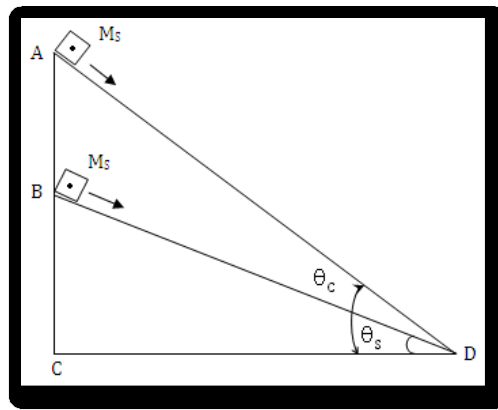
## JEE Main Online Paper 2014

### Part A - Physics

1. An experiment is performed to obtain the value of acceleration due to gravity  $g$  by using a simple pendulum of length  $L$ . In this experiment time for 100 oscillations is measured by using a watch of 1 second least count and the value is 90.0 seconds. The length  $L$  is measured by using a meter scale of least count 1 mm and the value is 20.0 cm. The error in the determination of  $g$  would be :  
(a) 1.7%                      (b) 2.7%                      (c) 4.4%                      (d) 2.27%
2. The position of a projectile launched from the origin at  $t = 0$  is given by  $\vec{r} = (40\hat{i} + 30\hat{j})$  m at  $t = 2$  s. If the projectile was launched at an angle  $\theta$  from the horizontal, then  $\theta$  is (take  $g = 10 \text{ ms}^{-2}$ ).  
(a)  $\tan^{-1} 2/3$               (b)  $\tan^{-1} 3/2$               (c)  $\tan^{-1} 7/4$               (d)  $\tan^{-1} 4/5$
3. Water is flowing at a speed of  $1.5 \text{ ms}^{-1}$  through a horizontal tube of cross-sectional area  $10^{-2} \text{ m}^2$  and you are trying to stop the flow by your palm. Assuming that the water stops immediately after hitting the palm, the minimum force that you must exert should be (density of water =  $10^3 \text{ kgm}^{-3}$ ).  
(a) 15 N                      (b) 22.5 N                      (c) 33.7 N                      (d) 45 N
4. A block A of mass 4 kg is placed on another block B of mass 5 kg, and the block B rests on a smooth horizontal table. If the minimum force that can be applied on A so that both the blocks move together is 12 N, the maximum force that can be applied on B for the blocks to move together will be :  
(a) 30 N                      (b) 25 N                      (c) 27 N                      (d) 48 N
5. Two bodies of masses 1 kg and 4 kg are connected to a vertical spring, as shown in the figure. The smaller mass executes simple harmonic motion of angular frequency  $25 \text{ rad/s}$ , and amplitude 1.6 cm while the bigger mass remains stationary on the ground. The maximum force exerted by the system on the floor is (take  $g = 10 \text{ ms}^{-2}$ )



- (a) 20 N                      (b) 10 N                      (c) 60 N                      (d) 40 N
6. A cylinder of mass  $M_c$  and sphere of mass  $M_s$  are placed at points A and B of two inclines, respectively. (See Figure). If they roll on the incline without slipping such that their accelerations are the same, then the ratio  $\frac{\sin \theta_c}{\sin \theta_s}$  is :



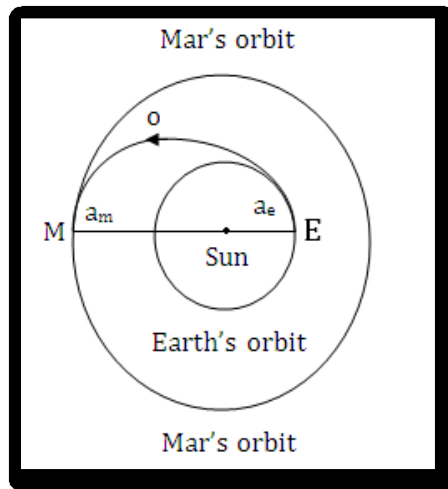
(a)  $\sqrt{\frac{8}{7}}$

(b)  $\sqrt{\frac{15}{14}}$

(c)  $\frac{8}{7}$

(d)  $\frac{15}{14}$

7. India's Mangalyan was sent to the Mars by launching it into a transfer orbit EOM around the sun. It leaves the earth at E and meets Mars at M. If the semi-major axis of Earth's orbit is  $a_e = 1.5 \times 10^{11}$  m, that of Mar's orbit  $a_m = 2.28 \times 10^{11}$  m, taken Kepler's laws give the estimate of time for Mangalyan to reach Mars from Earth to be close to :



(a) 500 days

(b) 320 days

(c) 260 days

(d) 220 days

8. In materials like aluminium and copper, the correct order of magnitude of various elastic moduli is :

(a) Young's moduli < shear moduli < bulk moduli.

(b) Bulk moduli < shear moduli < Young's moduli.

(c) Shear moduli < Young's moduli < bulk moduli.

(d) Bulk moduli < Young's moduli < shear moduli.

9. The amplitude of a simple pendulum, oscillating in air with a small spherical bob, decreases from 10 cm to 8 cm in 40 seconds. Assuming that Stokes law is valid, and ratio of the coefficient of viscosity of air to that of carbon dioxide is 1.3, the time in which amplitude of this pendulum will reduce from 10 cm to 5 cm in carbondioxide will be close to ( $\ln 5 = 1.601$ ,  $\ln 2 = 0.693$ ).

(a) 231

(b) 208 s

(c) 161 s

(d) 142 s

10. A capillary tube is immersed vertically in water and the height of the water column is  $x$ . When this arrangement is taken into a mine of depth  $d$ , the height of the water column is

y. If R is the radius of earth, the ratio  $\frac{x}{y}$  is :

- (a)  $\left(1 - \frac{d}{R}\right)$       (b)  $\left(1 - \frac{2d}{R}\right)$       (c)  $\left(\frac{R-d}{R+d}\right)$       (d)  $\left(\frac{R+d}{R-d}\right)$

11. Water of volume 2 L in a closed container is heated with a coil of 1 kW. While water is heated, the container loses energy at a rate of 160 J/s. In how much time will the temperature of water rise from 27°C to 77°C ? (Specific heat of water is 4.2 kJ/kg and that of the container is negligible).

- (a) 8 min 20 s      (b) 6 min 2 s      (c) 7 min      (d) 14 min

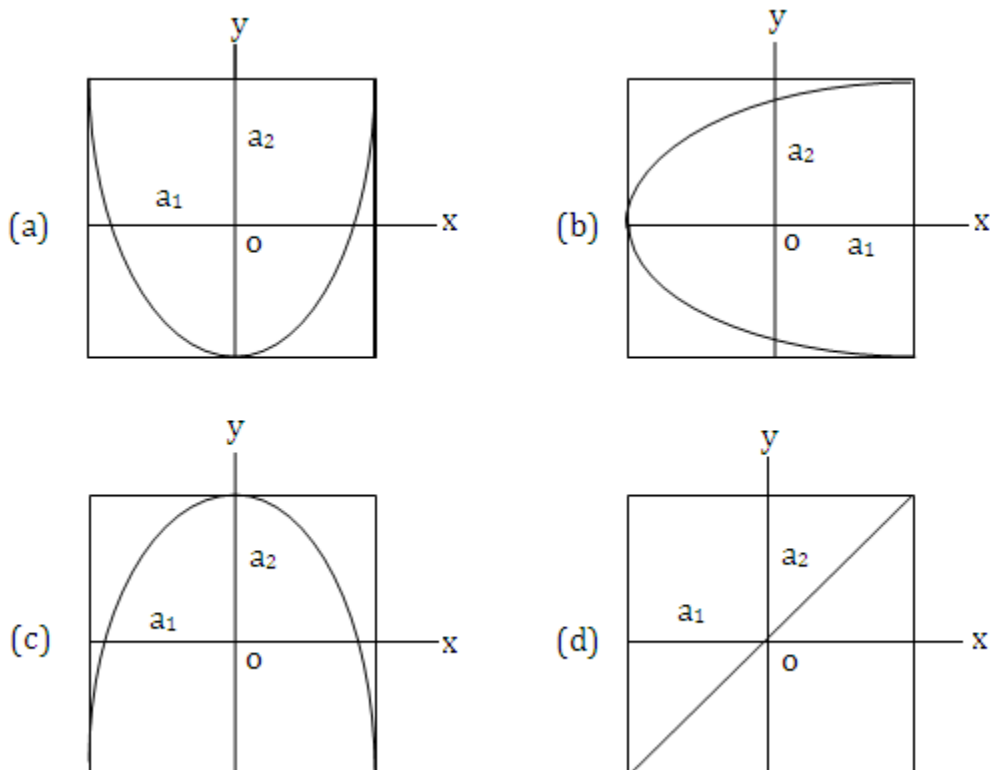
12. The equation of state for a gas is given by  $PV = nRT + \alpha V$ , where n is the number of moles and  $\alpha$  is a positive constant. The initial temperature and pressure of one mole of the gas contained in a cylinder are  $T_0$  and  $P_0$  respectively. The work done by the gas when its temperature doubles isobarically will be :

- (a)  $\frac{P_0 T_0 R}{P_0 - \alpha}$       (b)  $\frac{P_0 T_0 R}{P_0 + \alpha}$       (c)  $P_0 T_0 R \ln 2$       (d)  $P_0 T_0 R$

13. Modern vacuum pumps can evacuate a vessel down to a pressure of  $4.0 \times 10^{-15}$  atm. at room temperature (300 K). Taking  $R = 8.3 \text{ JK}^{-1} \text{ mole}^{-1}$ ,  $1 \text{ atm} = 10^5 \text{ Pa}$  and  $N_{\text{Avogadro}} = 6 \times 10^{23} \text{ mole}^{-1}$ , the mean distance between molecules of gas in an evacuated vessel will be of the order of :

- (a)  $0.2 \mu\text{m}$       (b)  $0.2 \text{ mm}$       (c)  $0.2 \text{ cm}$       (d)  $0.2 \text{ nm}$

14. A particle which is simultaneously subjected to two perpendicular simple harmonic motions represented by ;  $x = a_1 \omega t$  and  $y = a_2 \cos 2\omega t$  traces a curve given by :



15. A transverse wave is represented by :  $y = \frac{10}{\pi} \sin \left( \frac{2\pi}{T}t - \frac{2\pi}{\lambda}x \right)$

For what value of the wavelength the wave velocity is twice the maximum particle velocity ?

- (a) 40 cm                      (b) 20 cm                      (c) 10 cm                      (d) 60 cm

16. The magnitude of the average electric field normally present in the atmosphere just above the surface of the Earth is about 150 N/C, directed inward towards the center of the Earth. This gives the total net surface charge carried by the Earth to be :

[Given  $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 / \text{N-m}^2$ ,  $R_E = 6.37 \times 10^6 \text{ m}$ ]

- (a) + 670 kC                      (b) - 670 kC                      (c) -680 kC                      (d) + 680 kC

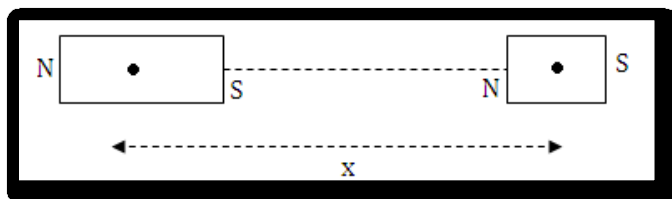
17. Three capacitances, each of 3  $\mu\text{F}$ , are provided. These cannot be combined to provide the resultant capacitance of :

- (a) 1  $\mu\text{F}$                       (b) 2  $\mu\text{F}$                       (c) 4.5  $\mu\text{F}$                       (d) 6  $\mu\text{F}$

18. A d. c. main supply of e. m. f. 220 V is connected across a storage battery of e. m. f. 200 V through a resistance of 1  $\Omega$ . The battery terminals are connected to an external resistance 'R'. The minimum value of 'R', so that a current passes through the battery to charge it is :

- (a) 7  $\Omega$                       (b) 9  $\Omega$                       (c) 11  $\Omega$                       (d) Zero

19. The mid points of two small magnetic dipoles of length d in end-on positions, are separated by a distance x, ( $x \gg d$ ). The force between them is proportional to  $x^{-n}$  where n is :



- (a) 1                      (b) 2                      (c) 3                      (d) 4

20. The magnetic field of earth of the equator is approximately  $4 \times 10^{-5} \text{ T}$ . The radius of earth is  $6.4 \times 10^6 \text{ m}$ . Then the dipole moment of the earth will be nearly of the order of :

- (a)  $10^{23} \text{ A m}^2$                       (b)  $10^{20} \text{ A m}^2$                       (c)  $10^{16} \text{ A m}^2$                       (d)  $10^{10} \text{ A m}^2$

21. When the rms voltages  $V_L$ ,  $V_C$  and  $V_R$  are measured respectively across the inductor L, the capacitor C and the resistor R in a series LCR circuit connected to an AC source it is found that the ratio  $V_L : V_C : V_R = 1 : 2 : 3$ . If the rms voltage of the AC source is 100 V, then  $V_R$  is close to :

- (a) 50 V                      (b) 70 V                      (c) 90 V                      (d) 100 V

22. Match List I (Wavelength range of electromagnetic spectrum) with List II. (Method of production of these waves) and select the correct option from the options given below the lists.

List I		List II	
(a)	700 nm to 1 mm	(i)	Vibration of

			atoms and molecules.
(b)	1 nm to 400 nm		Inner shell electrons in a atom moving from one energy level to a lower level.
(c)	$< 10^{-3}$ nm	(iii)	Radioactive decay of the nucleus.
(d)	1 mm to 0.1 m	(iv)	Magnetron valve.

(a) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

(b) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

(c) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

(d) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

**23.** A driver looking up through the water sees the outside world contained in a circular horizon. The refractive index of water is  $\frac{4}{3}$ , and the diver's eyes are 15 cm below the surface of water. Then the radius of the circle is :

(a)  $15 \times 3 \times \sqrt{5}$  cm

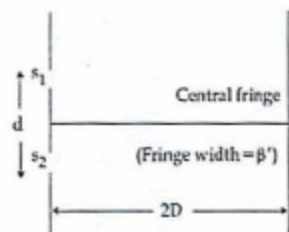
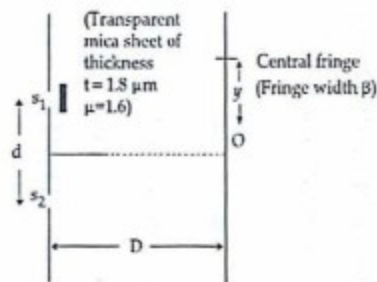
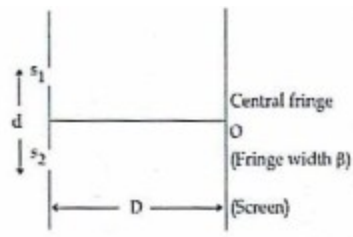
(b)  $15 \times 3\sqrt{7}$  cm

(c)  $\frac{15 \times \sqrt{7}}{3}$  cm

(d)  $\frac{15 \times 3}{\sqrt{7}}$  cm

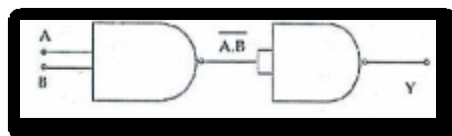
**24.** Using monochromatic light of wavelength  $\lambda$ , an experimentalist sets up the Young's double slit experiment in three ways as shown.

If she observes that  $y = \beta'$ , the wavelength of light used is :



- (a) 520 nm      (b) 540 nm      (c) 560 nm      (d) 580 nm

25. The focal lengths of objective lens and eye lens of a Galileian Telescope are respectively 30 cm and 3.0 cm. Telescope produces virtual, erect image of an object situated far away from it at least distance of distinct vision from the eye lens. In this condition, the Magnifying Power of the Galileian Telescope should be :
- (a) + 11.2      (b) - 11.2      (c) - 8.8      (d) +8.8
26. For which of the following particles will it be most difficult to experimentally verify the de-Broglie relationship ?
- (a) an electron      (b) a proton      (c) an  $\alpha$ -particle      (d) a dust particle
27. If the binding energy of the electron in a hydrogen atom is 13.6 eV, the energy required to remove the electron from the first excited state of  $\text{Li}^{++}$  is :
- (a) 122.4 eV      (b) 30.6 eV      (c) 13.6 eV      (d) 3.4 eV
28. Identify the gate and Match A, B, Y in bracket to check



- (a) AND (A = 1, B = 1, Y = 1)  
 (b) OR (A = 1, B = 1, Y = 0)  
 (c) NOT (A = 1, B = 1, Y = 1)  
 (d) XOR (A = 0, B = 0, Y = 0)
29. A transmitting antenna at the top of a tower has a height 32 m and the height of the receiving antenna is 50 m. What is the maximum distance between them for satisfactory

communication in line of sight (LOS) mode ?

- (a) 55.4 km            (b) 45.5 km            (c) 54.5 km            (d) 455 km

30. An n-p-n transistor has three leads A, B and C. Connecting B and C by moist fingers, A to the positive lead of an ammeter, and C to the negative lead of the ammeter, one finds large deflection. Then, A, B and C refer respectively to :

- (a) Emitter, base and collector            (b) Base, emitter and collector  
(c) Base, collector and emitter            (d) Collector, emitter and base.

### Part B – Chemistry

31. In a face centered cubic lattice atoms A are at the corner points and atoms B at the face centered points. If atoms B is missing from one of the face centered points, the formula of the ionic compound is :

- (a) AB<sub>2</sub>            (b) A<sub>5</sub>B<sub>2</sub>            (c) A<sub>2</sub>B<sub>3</sub>            (d) A<sub>2</sub>B<sub>5</sub>

32. Van der Waal's equation for a gas is stated as,

$$p = \frac{nRT}{V - nb} - a \left( \frac{n}{V} \right)^2.$$

This equation reduces to the perfect gas equation,  $p = \frac{nRT}{V}$  when,

- (a) temperature is sufficiently high and pressure is low.  
(b) temperature is sufficiently low and pressure is high.  
(c) both temperature and pressure are very high.  
(d) both temperature and pressure are very low.

33. The standard electrode potentials ( $E_{M^+/M}^0$ ) of four metals A, B, C and D are -1.2 V, 0.6 V, 0.85 V and - 0.76 V, respectively. The sequence of deposition of metals on applying potential is :

- (a) A, C, B, D            (b) B, D, C, A            (c) C, B, D, A            (d) D, A, B, C

34. At a certain temperature, only 50% HI is dissociated into H<sub>2</sub> and I<sub>2</sub> at equilibrium. The equilibrium constant is :

- (a) 1.0            (b) 3.0            (c) 0.5            (d) 0.25

35. Dissolving 120 g of a compound of (mol. wt. 60) in 1000 g of water gave a solution of density 1.12 g/mL. The molarity of the solution is :

- (a) 1.00 M            (b) 2.00 M            (c) 2.50 M            (d) 4.00 M

36. The half-life period of a first order reaction is 15 minutes. The amount of substance left after one hour will be :

- (a) 1/4 of the original amount  
(b) 1/8 of the original amount  
(c) 1/16 of the original amount  
(d) 1/32 of the original amount

37. A current of 10.0 A flows for 2.00 h through an electrolyte cell containing a molten salt of metal X. This results in the decomposition of 0.250 mol of metal X at the cathode. The

oxidation state of X in the molten salt is : (F = 96, 500 C)

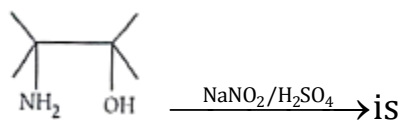
- (a) 1 +                      (b) 2 +                      (c) 3 +                      (d) 4 +

38. The energy of an electron in first Bohr orbit of H-atoms is  $-13.6$  eV. The energy value of electron in the excited state of  $\text{Li}^{2+}$  is :
- (a)  $-27.2$  eV              (b)  $30.6$  eV                      (c)  $-30.6$  eV                      (d)  $27.2$  eV
39. The temperature at which oxygen molecules have the same root mean square speed as helium atoms have at  $300$  K is :
- (Atomic masses : He =  $4$  u, O =  $16$  u)
- (a)  $300$  K                      (b)  $600$  K                      (c)  $1200$  K                      (d)  $2400$  K
40. The standard enthalpy of formation of  $\text{NH}_3$  is  $-46.0$  kJ/mol. If enthalpy of formation of  $\text{H}_2$  from its atoms is  $-436$  kJ/mol and that of  $\text{N}_2$  is  $-712$  kJ/mol, the average bond enthalpy of N-H bond in  $\text{NH}_3$  is :
- (a)  $-1102$  kJ/mol   (b)  $-964$  kJ/mol                      (c)  $+352$  kJ/mol                      (d)  $+1056$  kJ/mol
41. The amount of oxygen in  $3.6$  moles of water is :
- (a)  $115.2$  g                      (b)  $57.6$  g                      (c)  $28.8$  g                      (d)  $18.4$  g
42. The gas evolved on heating  $\text{CaF}_2$  and  $\text{SiO}_2$  with concentrated  $\text{H}_2\text{SO}_4$ , on hydrolysis gives a white gelatinous precipitate. The precipitate is ;
- (a) hydrofluosilicic acid  
(b) silica gel  
(c) silicic acid  
(d) calciumfluorosilicate
43. Chloro compound of Vanadium has only spin magnetic moment of  $1.73$  BM. This Vanadium chloride has the formula :
- (at. no. of V =  $23$ )
- (a)  $\text{VCl}_2$                       (b)  $\text{VCl}_4$                       (c)  $\text{VCl}_3$                       (d)  $\text{VCl}_5$
44. An octahedral complex of  $\text{Co}^{3+}$  is diamagnetic. The hybridisation involved in the formation of the complex is :
- (a)  $\text{sp}^3\text{d}^2$                       (b)  $\text{dsp}^2$                       (c)  $\text{d}^2\text{sp}^3$                       (d)  $\text{dsp}^3\text{d}$
45. Which of the following is not formed when  $\text{H}_2\text{S}$  reacts with acidic  $\text{K}_2\text{Cr}_2\text{O}_7$  solution ?
- (a)  $\text{CrSO}_4$                       (b)  $\text{Cr}_2(\text{SO}_4)_3$                       (c)  $\text{K}_2\text{SO}_4$                       (d) S
46. Which of the following has unpaired electrons (s) ?
- (a)  $\text{N}_2$                       (b)  $\text{O}_2^-$                       (c)  $\text{N}_2^{2+}$                       (d)  $\text{O}_2^{2-}$
47. In the following sets of reactants which two sets best exhibit the amphoteric character of  $\text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ ?
- Set 1 :  $\text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O}(\text{s})$  and  $\text{OH}^- (\text{aq})$   
Set 2 :  $\text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O} (\text{s})$  and  $\text{H}_2\text{O}(\text{l})$   
Set 3 :  $\text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O} (\text{s})$  and  $\text{H}^+ (\text{aq})$   
Set 4 :  $\text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O} (\text{s})$  and  $\text{NH}_3 (\text{aq})$
- (a) 1 and 2                      (b) 1 and 3                      (c) 2 and 4                      (d) 3 and 4



48. The number and type of bonds in  $C_2^{2-}$  ion in  $CaC_2$  are :
- One  $\alpha$  bond and one  $\pi$ -bond
  - One  $\sigma$  bond and two  $\pi$ -bonds
  - Two  $\sigma$  bonds and two  $\pi$ -bonds
  - Two  $\sigma$  bonds and one  $\pi$ -bonds
49. The form of iron obtained from blast furnace is :
- Steel
  - Cast Iron
  - Pig Iron
  - Wrought Iron
50. The correct statement about the magnetic properties of  $[Fe(CN)_6]^{3-}$  and  $[FeF_6]^{3-}$  is :  
(Z = 26).
- both are paramagnetic.
  - both are diamagnetic.
  - $[Fe(CN)_6]^{3-}$  is paramagnetic,  $[FeF_6]^{3-}$  is paramagnetic.
  - $[Fe(CN)_6]^{3-}$  is paramagnetic,  $[FeF_6]^{3-}$  is diamagnetic.
51. Which one of the following reactions will not result in the formation of carbon-carbon bond ?
- Reimer-Tieman reaction
  - Friedel Craft's acylation
  - Wurtz reaction
  - Cannizzaro reaction
52. In the hydroboration - oxidation reaction of propene with diborane,  $H_2O_2$  and  $NaOH$ , the organic compound formed is :
- $CH_3CH_2OH$
  - $CH_3CHOHCH_3$
  - $CH_3CH_2CH_2OH$
  - $(CH_3)_3COH$

53. The major product of the reaction



- (a)
- (b)
- (c)
- (d)

54. For the compounds  $CH_3Cl$ ,  $CH_3Br$ ,  $CH_3I$  and  $CH_3F$ , the correct order of increasing C-halogen bond length is :

- (a)  $\text{CH}_3\text{F} < \text{CH}_3\text{Cl} < \text{CH}_3\text{Br} < \text{CH}_3\text{I}$   
 (b)  $\text{CH}_3\text{F} < \text{CH}_3\text{Br} < \text{CH}_3\text{Cl} < \text{CH}_3\text{I}$   
 (c)  $\text{CH}_3\text{F} < \text{CH}_3\text{I} < \text{CH}_3\text{Br} < \text{CH}_3\text{Cl}$   
 (d)  $\text{CH}_3\text{Cl} < \text{CH}_3\text{Br} < \text{CH}_3\text{F} < \text{CH}_3\text{I}$

55. Allyl phenyl ether can be prepared by heating:

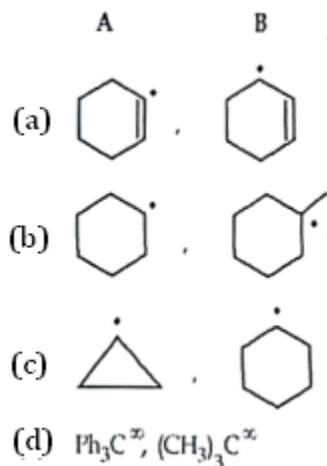
- (a)  $\text{C}_6\text{H}_5\text{Br} + \text{CH}_2=\text{CH}-\text{CH}_2-\text{ONa}$   
 (b)  $\text{CH}_2=\text{CH}-\text{CH}_2-\text{Br} + \text{C}_6\text{H}_5\text{ONa}$   
 (c)  $\text{C}_6\text{H}_5-\text{CH}=\text{CH}-\text{Br} + \text{CH}_3-\text{ONa}$   
 (d)  $\text{CH}_2=\text{CH}-\text{Br} + \text{C}_6\text{H}_5-\text{CH}_2-\text{ONa}$

56. In a nucleophilic substitution reaction :

$\text{R}-\text{Br} + \text{Cl} \xrightarrow{\text{DMF}} \text{R}-\text{Cl} + \text{Br}^-$ , which one of the following undergoes complete inversion of configuration ?

- (a)  $\text{C}_6\text{H}_5\text{CHC}_6\text{H}_5\text{Br}$       (b)  $\text{C}_6\text{H}_5\text{CH}_2\text{Br}$   
 (c)  $\text{C}_6\text{H}_5\text{CHCH}_3\text{Br}$       (d)  $\text{C}_6\text{H}_5\text{CCH}_3\text{C}_6\text{H}_5\text{Br}$

57. In which of the following pairs A is more stable than B ?



58. Structure of some important polymers are given. Which one represents Buna-S ?

- (a)  $(-\text{CH}_2-\overset{\text{CH}_3}{\underset{|}{\text{C}}}=\text{CH}-\text{CH}_2-)_n$   
 (b)  $(-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\underset{\text{C}_6\text{H}_5}{\underset{|}{\text{CH}}}-\text{CH}_2-)_n$   
 (c)  $(-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\underset{\text{CN}}{\underset{|}{\text{CH}}}-\text{CH}_2-)_n$   
 (d)  $(-\text{CH}_2-\overset{\text{Cl}}{\underset{|}{\text{C}}}=\text{CH}-\text{CH}_2-)_n$

59. Which is the major product formed when acetone is heated with iodine and potassium hydroxide ?

- (a) Iodoacetone      (b) Acetic acid      (c) Iodoform      (d) Acetophenone

60. Which one of the following class of compounds is obtained by polymerization of acetylene ?  
 (a) Poly-yne      (b) Poly-ene      (c) Poly-ester      (d) Poly-amide

**Part C – Mathematics**

61. Let P be the relation defined on the set of all real numbers such that  $P = \{(a, b) : \sec^2 a - \tan^2 b = 1\}$ . Then P is :  
 (a) reflexive and symmetric but not transitive.  
 (b) reflexive and transitive but not symmetric.  
 (c) symmetric and transitive but not reflexive.  
 (d) an equivalence relation.
62. Let  $w$  ( $\text{Im } w \neq 0$ ) be a complex number. Then the set of all complex numbers  $z$  satisfying the equation  $w - \bar{w}z = k(1 - z)$ , for some real number  $k$ , is :  
 (a)  $\{z : |z| = 1\}$       (b)  $\{z : z = \bar{z}\}$       (c)  $\{z : z \neq 1\}$       (d)  $\{z : |z| = 1, z \neq 1\}$
63. If equation  $ax^2 + bx + c = 0$ , ( $a, b, c \in \mathbb{R}, a \neq 0$ ) and  $2x^2 + 3x + 4 = 0$  have a common root, then  $a : b : c$  equals :  
 (a)  $1 : 2 : 3$       (b)  $2 : 3 : 4$       (c)  $4 : 3 : 2$       (d)  $3 : 2 : 1$
64. If  $\frac{1}{\sqrt{\alpha}}$  and  $\frac{1}{\sqrt{\beta}}$  are the roots of the equation,  $ax^2 + bx + 1$  ( $a \neq 0, a, b \in \mathbb{R}$ ), then the equation,  $x(x + b^3) + (a^3 - 3abx) = 0$  has roots:  
 (a)  $\alpha^{\frac{3}{2}}$  and  $\beta^{\frac{3}{2}}$       (b)  $\alpha \beta^{\frac{1}{2}}$  and  $\alpha^{\frac{1}{2}} \alpha \beta^{\frac{1}{2}}$       (c)  $\sqrt{\alpha\beta}$  and  $\alpha\beta$       (d)  $\alpha^{\frac{3}{2}}$  and  $\beta^{\frac{3}{2}}$
65. If  $a, b, c$  are non-zero real numbers and if the system of equations  
 $(a - 1)x = y = z,$   
 $(b - 1)y = z + x$   
 $(c - 1)z = x + y,$   
 has a non-trivial solution, then  $ab + bx + ca$  equals :  
 (a)  $a + b + c$   
 (b)  $abc$   
 (c)  $1$   
 (d)  $-1$
66. If  $B$  is a  $3 \times 3$  matrix such that  $B^2 = 0$ , then  $\det. [(I + B)^{50} - 50B]$  is equal to :  
 (a)  $1$       (b)  $2$       (c)  $3$       (d)  $50$
67. The number of terms of the expansion of  $(1 + x)^{101} (1 + x^2 - x)^{100}$  in powers of  $x$  is :  
 (a)  $302$       (b)  $301$       (c)  $202$       (d)  $101$
68. The sum of the digits in the unit's place of all the 4-digit numbers formed by using the numbers 3, 4, 5 and 6, without repetition, is :  
 (a)  $432$       (b)  $108$       (c)  $36$       (d)  $18$

69. Given an A. P. whose terms are all positive integers. The sum of its first nine terms is greater than 200 and less than 220. If the second term in it is 12, then its 4<sup>th</sup> term is :  
 (a) 8 (b) 16 (c) 20 (d) 24
70. If the sum  $\frac{3}{1^2} + \frac{5}{1^2+2^2} + \frac{7}{1^2+2^2+3^2} + \dots$  upto 20 terms is equal to  $\frac{k}{21}$ , then k is equal to :  
 (a) 120 (b) 180 (c) 240 (d) 60
71. If  $f(x)$  is continuous and  $f\left(\frac{9}{2}\right) = \frac{2}{9}$ , then  $\lim_{x \rightarrow 0} f\left(\frac{1 - \cos 3x}{x^2}\right)$  is equal to :  
 (a)  $9/2$  (b)  $2/9$  (c) 0 (d)  $8/9$
72. If  $y = e^{nx}$ , then  $\left(\frac{d^2y}{dx^2}\right)\left(\frac{d^2x}{dy^2}\right)$  is equal to :  
 (a)  $n e^{nx}$  (b)  $n e^{-nx}$  (c) 1 (d)  $-n e^{-nx}$
73. If the Rolle's theorem holds for the function  $f(x) = 2x^3 + ax^2 + bx$  in the interval  $[-1, 1]$  for the point  $c = \frac{1}{2}$ , then the value of  $2a + b$  is :  
 (a) 1 (b) -1 (c) 2 (d) -2
74. If  $f(x) = \left(\frac{3}{5}\right)^x + \left(\frac{4}{5}\right)^x - 1$ ,  $x \in \mathbb{R}$ , then the equation  $f(x) = 0$  has :  
 (a) no solution (b) one solution  
 (c) two solutions (d) more than two solutions
75.  $\int \frac{\sin^8 x - \cos^8 x}{(1 - 2 \sin^2 x \cos^2 x)} dx$  is equal to :  
 (a)  $\frac{1}{2} \sin 2x + c$  (b)  $-\frac{1}{2} \sin 2x + c$  (c)  $-\frac{1}{2} \sin x + c$  (d)  $-\sin^2 x + c$
76. The integral  $\int_0^{\frac{1}{2}} \frac{\ln(1+2x)}{1+4x^2} dx$ , equals :  
 (a)  $\frac{\pi}{4} \ln 2$  (b)  $\frac{\pi}{8} \ln 2$  (c)  $\frac{\pi}{16} \ln 2$  (d)  $\frac{\pi}{32} \ln 2$
77. Let  $A = \{(x, y) : y^2 \leq 4x, y - 2x \geq -4\}$ . The area (in square units) of the region A is ;  
 (a) 8 (b) 9 (c) 10 (d) 11
78. If the differential equation representing the family of all circles touching x-axis at the origin is  $(x^2 - y^2) \frac{dy}{dx} = g(x)y$ , then  $g(x)$  equals :  
 (a)  $\frac{1}{2}x$  (b)  $2x^2$  (c)  $2x$  (d)  $\frac{1}{2}x^2$

79. Let a and b be any two numbers satisfying  $\frac{1}{a^2} + \frac{1}{b^2} = \frac{1}{4}$ . Then, the foot of perpendicular from the origin on the variable line,  $\frac{x}{a} + \frac{y}{b} = 1$ , lies on :
- (a) a hyperbola with each semi-axis =  $\sqrt{2}$ .  
 (b) a hyperbola with each semi-axis = 2.  
 (c) a circle of radius = 2  
 (d) a circle of radius =  $\sqrt{2}$
80. Given three points P, Q, R with P(5, 3) and R lies on the x-axis. If equation of RQ is  $x - 2y = 2$  and PQ is parallel to the x-axis, then the centroid of  $\Delta PQR$  lies on the line :
- (a)  $2x + y - 9 = 0$                       (b)  $x - 2y + 1 = 0$   
 (c)  $5x - 2y = 0$                         (d)  $2x - 5y = 0$
81. If the point (1, 4) lies inside the circle  $x^2 + y^2 - 6x - 10y + p = 0$  and the circle does not touch or intersect the coordinate axes, then the set of all possible values of p is the interval :
- (a) (0, 25)                      (b) (25, 39)                      (c) (9, 25)                      (d) (25, 29)
82. If OB is the semi-minor axis of an ellipse,  $F_1$  and  $F_2$  are its foci and the angle between  $F_1B$  and  $F_2B$  is a right angle, then the square of the eccentricity of the ellipse is :
- (a)  $\frac{1}{2}$                       (b)  $\frac{1}{\sqrt{2}}$                       (c)  $\frac{1}{2\sqrt{2}}$                       (d)  $\frac{1}{4}$
83. Equation of the plane which passes through the point of intersection of lines  $\frac{x-1}{3} = \frac{y-2}{1} = \frac{z-3}{2}$  and  $\frac{x-3}{1} = \frac{y-1}{2} = \frac{z-2}{3}$  and has the largest distance from the origin is :
- (a)  $7x + 2y + 4z = 54$                       (b)  $3x + 4y + 5z = 49$   
 (c)  $4x + 3y + 5z = 50$                       (d)  $5x + 4y + 3z = 57$
84. A line in the 3-dimensional space makes an angle  $\theta$  ( $0 < \theta \leq \frac{\pi}{2}$ ) with both the x and y-axis. Then the set of all values of  $\theta$  is the interval :
- (a)  $\left(0, \frac{\pi}{4}\right]$                       (b)  $\left[\frac{\pi}{6}, \frac{\pi}{3}\right]$                       (c)  $\left[\frac{\pi}{4}, \frac{\pi}{2}\right]$                       (d)  $\left(\frac{\pi}{3}, \frac{\pi}{2}\right]$
85. If  $|\vec{a}| = 2$ ,  $|\vec{b}| = 3$  and  $|2\vec{a} - \vec{b}| = 5$ , then  $|2\vec{a} + \vec{b}|$  equals :
- (a) 17                      (b) 7                      (c) 5                      (d) 1
86. In a set of  $2n$  distinct observations, each of the observation below the median of all the observations is increased by 5 and each of the remaining observations is decreased by 3. Then the mean of the new set of observations :
- (a) increases by 1.                      (b) decreases by 1.  
 (c) decreases by 2                      (d) increases by 2.

- 87.** If A and B are two events such that  $P(A \cap B) = P(A \cap B)$ , then the incorrect statement amongst the following statements is :
- (a) A and B are equally likely
  - (b)  $P(A \cap B') = 0$
  - (c)  $P(A' \cap B) = 0$
  - (d)  $P(A) + P(B) = 1$
- 88.** The number of values of  $\alpha$  in  $[0, 2\pi]$  for which  $2 \sin^3 \alpha - 7 \sin^2 \alpha + 7 \sin \alpha = 2$ , is :
- (a) 6
  - (b) 4
  - (c) 3
  - (d) 1
- 89.** If  $\operatorname{cosec} \theta = \frac{p+q}{p-q}$  ( $p \neq q \neq 0$ ), then  $\left| \cot \left( \frac{\pi}{4} + \frac{\theta}{2} \right) \right|$  is equal to :
- (a)  $\sqrt{\frac{p}{q}}$
  - (b)  $\sqrt{\frac{q}{p}}$
  - (c)  $\sqrt{pq}$
  - (d)  $pq$
- 90.** The contrapositive of the statement "I go to school if it does not rain" is :
- (a) If it rains, I do not go to school.
  - (b) If I do not go to school, it rains.
  - (c) If it rains, I go to school.
  - (d) If I go to school, it rains.