VITEEE 2009 Question Paper

Vellore Institute of Technology Engineering Entrance Examination

SOLVED PAPER

VITEEE 2009

PART - I (PHYSICS)

1. When a wave traverses a medium the displacement of a particle located at x at a time t is given by $y = a \sin (bt - cx)$. Where a, b and c are constants of the wave. Which of the following is a quantity with dimensions?

(a) $\frac{y}{a}$ (b) bt

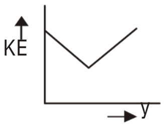
(c) cx (d) $\frac{b}{c}$

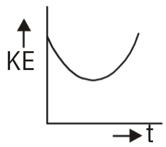
2. A body is projected vertically upwards at time $t = 0$ and it is seen at a height H at time t_1 and t_2 second during its flight. The maximum height attained is (g is acceleration due to gravity)

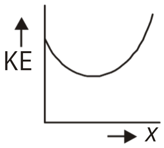
(a) $\frac{g(t_2 - t_1)^2}{8}$ (b) $\frac{g(t_1 + t_2)^2}{4}$

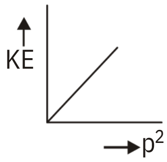
(c) $\frac{g(t_1 \; t_2)^2}{8}$ (d) $\frac{g(t_2 - t_1)^2}{4}$

3. A particle is projected up from a point at an angle with the horizontal direction. At any time t, if p is the linear momentum, y is the vertical displacement, x is horizontal displacement, the graph among the following which does not represent the variation of kinetic energy KE of the particle is

(A) 

(B) 

(C) 

(D) 

(a) graph (A) (b) graph (B)

(c) graph (C) (d) graph (D)

4. Water is flowing in a pipe. A pump delivers water at a certain rate through a given horizontal pipe. To increase the rate of flow of water through the same pipe n times, the power of the motor is increased to P_1. The ratio of P_1 to P_0 is

(a) $n : 1$ (b) $n^2 : 1$

(c) $n^3 : 1$ (d) $n^4 : 1$

5. A body of mass 5 kg makes an elastic collision with another body at rest and continues to move in the original direction after collision with a velocity equal to $\frac{1}{10}$th of its original velocity. Then the mass of the second body is

(a) 4.09 kg (b) 0.5 kg

(c) 5 kg (d) 5.09 kg

6. A particle of mass 4 m explodes into three pieces of masses m, m and 2m. The equal masses move along X-axis and Y-axis with velocities 4 ms^{-1} and 6 ms^{-1} respectively. The magnitude of the velocity of the heavier mass is

(a) $\sqrt{17}$ ms^{-1} (b) $2\sqrt{13}$ ms^{-1}

(c) $\sqrt{13}$ ms^{-1} (d) $\frac{\sqrt{13}}{2}$ ms^{-1}

7. A body is projected vertically upwards from the surface of the earth with a velocity equal to half the escape velocity. If R is the radius of the earth, maximum height attained by the body from the surface of the earth is

(a) $\frac{R}{6}$ (b) $\frac{R}{3}$

(c) $\frac{2R}{3}$ (d) R

8. The displacement of a particle executing SHM is given by

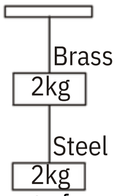
y 5sin 4t 3

If T is the time period and the mass of the particle is 2g, the kinetic energy of the particle when t = T/4 is given by

(a) 0.4 J (b) 0.5 J

(c) 3 J (d) 0.3 J

9. If the ratio of lengths, radii and Young's modulus of steel and brass wires shown in the figure are a, b and c respectively, the ratio between the increase in lengths of brass and steel wires would be



(a) $\frac{b^2 a}{2c}$ (b) $\frac{2a}{b^2 c}$

(c) $\frac{ba}{2c}$ (d) $\frac{a}{2b^2 c}$

10. A soap bubble of radius r is blown up to form a bubble of radius 2r under isothermal conditions. If T is the surface tension of soap solution, the energy spent in the blowing

(a) (c3) TEri2ght spherical (bra) i6n Tdrr2ops of the same mass1 a2n Tdr r2a dius are fal(ldin)g 2 d4o Twr2n with a terminal

11. speed of 6 cm-s–1. If they coalesce to form one big drop, what will be the terminal speed of bigger drop? (Neglect the buoyancy of the air)

(a) (c1) .5A ccmlo-csk– 1pendul(ubm) m6a cdme- so–f 1invar has a perio2d4 o cf m0.-5s –s1, at 20°C(d. I)f t3h2e cmloc-sk– i1s used in a

12. climate where the temperature averages to 30°C, how much time does the clock lose in each oscillation?

(For invar, = 9 × 10–7/°C, g = constan t)

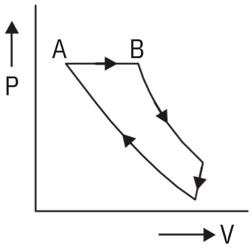
(a) 2.25 × 10–6 s (b) 2.5 × 10–7 s

(c) 5 × 10–7 s (d) 1.125 × 10–6s

13. A piece of metal weighs 45 g in air and 25 g in a liquid of density 1.5 × 103 kg-m–3 kept at 30°C. When the temperature of the liquid is raised to 40° C, the metal piece weights 27 g. the density of liquid of 40°C is 1.25 × 103 kg–m–3. the coefficient of linear expansion of metal is

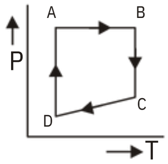
(5a.)2 ×(c1 1). 30A –n×3 /°i1dC0e–a3l /gas i(sb)subjected to a cyclic p0r.2o6ce °×sC s1 20A.–6B3 C×/D° C1 a0s– depi(cdt)ed in the p-V diagram

14. given3 b/e°Clow:

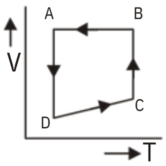


Which of the following curves represents the equivalent cyclic process?

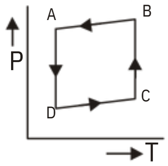
(a)



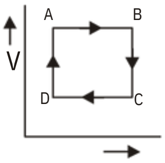
(b)



(c)



(d)



T

15. An ideal gas is subjected to cyclic process involving four thermodynamic states, the amounts of heat (Q) and work (W) involved in each of these states are

Q

Q 14W == 63050000 JJ, Q2 = –5500 J; Q3 = –3000 J;

4== 2x5 J0.0 J; W2 = –1000 J; W3 = –1200 J;

W The ratio of the net work done by the gas to the total heat absorbed by the gas is). The values

of x and respectively are

(a) 500 ; 7.5 % (b) 700; 10.5 %

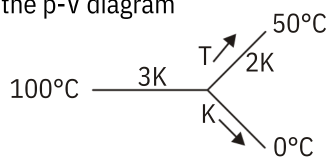
(c) 1000 ; 21 % (d) 1500; 15 %

16. Two cylinders A and B fitted with pistons contain equal number of moles of an ideal monoatomic gas at 400 K. The piston of A is free to move while that of B is held fixed. Same amount of heat energy is given to the gas in each cylinder. If the rise in temperature of the gas in A is 42 K, the rise in temperature of the gas in B is

(a) 21 K (b) 35 K

(c) 42 K (d) 70 K

17. Three rods of same dimensional have thermal conductivity 3 K, 2 K and K. They are arranged as shown in the figure below



Then, the temperature of the junction in steady state is

(a) $\frac{200}{3}$ C (b) $\frac{100}{3}$ C

(c) 75°C (d) $\frac{50}{3}$ C

18. Two sources A and B are sending notes of frequency 680 Hz. A listener moves from A and B with a constant velocity u. If the speed of sound in air is 340 ms−1, what must be the value of u so that he hears 10 beats per second?

(a) (2c.)0 Tmwso– identica(lb)pia2n.5o mwsi–res have a funda1m ent3a.l0 frequency(do)f 610 0 cy3c.l5e per second

19. whenm sk–e1pt under the samse– 1tension. What fractional increase in the tension of one wires will lead to the occurrence of 6 beats per second when both wires vibrate simultaneously?

(a) 0.0 (b) 0.0
(c) 1 (d) 2

20. In the0 .Y0oung's double slit e0x.p0eriment, the inten3s ities at two p aonindt Is21P4 . Iam f2aiInts2 0 loathteesad acrroteen are respectively I 1 cte athte 1 a, centre of a bright fringe and P distance equal to a quarter of fringe width fromP

then $\frac{I_1}{I_2}$ is

(a) 2 (b) $\frac{1}{2}$
(c) 4 (d) 16

21. In Young's double slit experiment, the 10th maximum of wavelength 1 is at a distance of y1, from the central maximum. When the wavelength of the source is changed to2, 5th maximum is at a distance of y2 from its central maximum. The ratio $\frac{y_1}{y_2}$ is

(a) $\frac{2\ _1}{_2}$ (b) $\frac{2\ _2}{_1}$
(c) $2\frac{1}{2}$ (d) $\frac{2}{2\ 1}$

22. Four light sources produce the following four wa ve s:

(i) y1 asin(t 1)
(ii) y2 asin2 t
(iii) y3 asin(t 2)
(iv) y4 asin(3 t)

Superposition of which two waves give rise to i n t er fer en ce?

(a) (i) and (ii) (b) (ii) and (iii)
(c) (i) and (iii) (d) (iii) and (iv)

23. The two lenses of an achromatic doublet should have

(a) equal powers
(b) equal dispersive powers
(c) equal ratio of their power and dispersive power
(d) sum of the product of their powers and dispersive power equal to zero

24. Two bar magnets A and B are placed one over the other and are allowed to vibrate in a vibration magnetometer. They make 20 oscillations per minute when the similar poles of A and B are on the same side, while they make 15 oscillations per minute when their opposite poles lie on the same side. If MA and M AB >a rMeB t,h teh me aragtnioe toicf moments of A and B and if M MA and MB is

(a) 4 : 3 (b) 25 : 7
(c) 7 : 5 (d) 25 : 16

25. A bar magnet is 10 cm long is kept with its north (N)-pole pointing north. A neutral point is formed at a distance of 15 cm from each pole. Given the horizontal component of earth's field is 0.4 Gauss, the pole strength of the magnet is

(a) 9 A-m (b) 6.75 A-m
(c) 27 A-m (d) 1.35 A-m

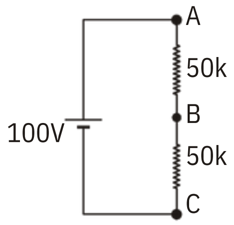
26. An infinitely long thin straight wire has uniform linear charge density of $\frac{1}{3}$ cm−1. Then, the magnitude of the electric intensity at a point 18 cm away is (given 0 = 8.8 × 10−12 CN2m)−2

(a) 0.33 × 1011 NC−1 (b) 3 × 1011 NC−1
(c) 0.66 × 1011 NC−1 (d) 1.32 × 1011 NC−1

27. Two point charges −q and +q are located at points (0, 0, − a) and (0, 0, a) respectively. The electric potential at a point (0, 0, z), where z > a is

(a) $\frac{qa}{4\ _0 z^2}$ (b) $\frac{q}{4\ 0a}$
(c) $\frac{2qa}{4\ 0(z2\ \ a2)}$ (d) $\frac{2qa}{4\ 0(z2\ \ a2)}$

28. In the adjacent shown circuit, a voltmeter of internal resistance R, when connected across B and C reads $\frac{100}{3}$ V. Neglecting the internal resistance of the battery, the value of R is

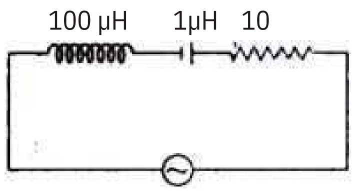


(a) 100 k (b) 75
(c) 50k (d) k

29. A cell in secondary circuit g2i5ves null deflection for 2.5 m length of potentiokmeter having 10 m length of wire. If the length of the potentiometer wire is increased by 1 m without changing the cell in the primary, the position of the null point now is

(a) 3.5 m (b) 3 m
(c) 2.75 m (d) 2.0 m

30. The following series L-C-R circuit, when driven by an emf source of angular frequency 70 kilo-radians per second, the circuit effectively behaves like

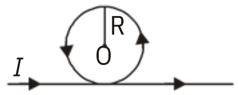


(a) purely resistive circuit
(b) series R-L circuit
(c) series R-C circuit
(d) series L-C circuit with R = 0

31. A wire of length l is bent into a circular loop of radius R and carries a current I. The magnetic field at the centre of the loop is B. The same wire is now bent into a double loop of equal radii. If both loops carry the same current I and it is in the same direction, the magnetic field at the centre of the double loop will be

(a) Zero (b) 2 B
(c) 4 B (d) 8 B

32. An infinitely long straight conductor is bent into the shape as shown below. It carries a current of I ampere and the radius of the circular loop is R metre. Then, the magnitude of magnetic induction at the centre of the circular loop is



(a) $\frac{0I}{2R}$ (b) $\frac{0nI}{2R}$
(c) $\frac{{}_0 I}{2\ R}$ (1) (d) $\frac{{}_0 I}{2R}$ (−1)

33. The work function of a certain metal is 3.31 × 10–19 J. Then, the maximum kinetic energy of photoelectrons emitted by incident radiation of wavelength 5000 Å is (Given, h = 6.62 × 10–34 J-s, c = 3 × 108 ms–1, e = 1.6 × 10–19 C)

(a) 2.48 eV (b) 0.41 eV
(c) 2.07 eV (d) 0.82 eV

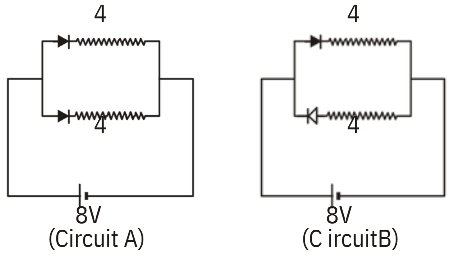
34. A photon of energy E ejects a photoelectron 0fr.om a metal surface whose work function is W. If this electron enters into a uniform magnetic field of induction B in a direction perpendicular to the field and describes a circular path of radius r, then the radius r is given by, (in the usual notation)

(a) $\frac{\sqrt{2m(E\ W)_0}}{eB}$ (b) $\sqrt{2m(E\ W0)eB}$
(c) $\frac{\sqrt{2e(E\ W)_0}}{mB}$ (d) $\frac{\sqrt{2m(E\ W)_0}}{eB}$

35. Two radioactive materials x1 and x2 have decay constants 10 and respectively, if initially they have the same number of nuclei, then the ratio of the number of nuclei of x 1 to that of x2 will be 1/e after a time

(a) (1/10) (b) (1/11)
(c) 11/(10) (d) 1/(9)

36. Current flowing in each of the following circuit A and B respectively are



(Circuit A) (C ircuitB)

(a) 1A, 2A (b) 2 A, 1 A
(c) 4 A, 2 A (d) 2 A, 4 A

37. A bullet of mass 0.02 kg travelling horizontally with velocity 250 ms^{-1} strikes a block of wood of mass 0.23 kg which rests on a rough horizontal surface. After the impact, the block and bullet move together and come to rest after travelling a distance of 40 m. The coefficient of sliding friction of the rough surface is (g = 9.8 ms^{-2})

(a) 0.75 (b) 0.61
(c) 0.51 (d) 0.30

38. Two persons A and B are located in X-Y plane at the points (0, 0) and (0,10) respectively. (The distances are measured in MKS unit). At a time t = 0, they start moving simultaneously with velocities v_a 2ˆ 1 and vb $2i\hat{}ms^{1}$ respectively. The timjem asfter which A and B are at their closest distance is

(a) 2.5s (b) 4s
(c) 1s (d) $\frac{10}{\sqrt{2}}$ s

39. A rod of length l is held vertically stationary with its lower end located at a point P, on the horizontal plane. When the rod is released to topple about P, the velocity of the upper end of the rod with which it hits the ground is

(a) $\sqrt{\frac{g}{l}}$ (b) $\sqrt{3gl}$
(c) $3\sqrt{\frac{g}{l}}$ (d) $\sqrt{\frac{3g}{l}}$

40. A wheel of radius 0.4 m can rotate freely about its axis as shown in the figure. A string is wrapped over its rim and a mass of 4 kg is hung. An angular acceleration of 8 rad-s^{-2} is produced in it due to the torque. Then, moment of inertia of the wheel is (g = 10 ms^{-2})

(a) 2 kg-m2 (b) 1 kg-m2
(c) 4 kg-m2 (d) 8 kg-m2

PART - II (CHEMISTRY)

41. Given that Hf(H) = 218 kJ/mol, express the H—H bond energy in kcal/mol.

(a) 52.15 (b) 911
(c) 104 (d) 52153

42. Identify the alkyne in the following sequence of reactions,

Alkyne $\xrightarrow[\text{Lindlar's catalyst}]{H_2}$ A $\xrightarrow{\text{Ozonolysis}}$ B only $\xrightarrow{\text{Wacker Process}}$ CH 2 CH 2

(a) H3C — C — C C CH3
(b) H2CC — CCHCH2C
(c) H
(d) HCC — CH Fluor2in —e CreCaHcts with dilute NaOH and forms a gaseous product A. The bond angle

43. in the molecule of A is

(a) 104°40' (b) 103°
(c) 107° (d) 109°28'

44. One mole of alkene X on ozonolysis gave one mole of acetaldehyde and one mole of acetone. The IUPAC name of X is

(a) 2-methyl-2-butene (b)2-methyl-1-butene
(c) 2-butene (d) 1-butene

45. The number of p – d ‘pi’ bonds present in XeO_3 and XeO_4 molecules, respectively are

(a) 3, (b) 4,
(c) 4 (d) 2

46. The w2a,velengths of electron3 w,aves in two orbits is 3 :3 5. The ratio of kinetic2 energy of electrons will be

(a) 25 : (b) 5 : 3
(c) 9 9 : (d) 3 : 5

47. Whic2h 5one of the following sets correctly represents the increase in the paramagnetic property of the ions?

(a) $Cu^{2+} > V^{2+} > Cr^{2+} > Mn^{2+}$
(b)$Cu^{2+} < Cr^{2+} < V^{2+} < Mn^{2+}$ (c) (dC)Vu2+< < C Vu 2+ < CCrr22++< < M Mn2n+2+ Electrons with

48 . a kinetic energy of 6.023 × 104 J/ mol are evolved from the surface of a metal, when it is exposed to radiation of wavelength of 600 nm. The minimum amount of energy required to remove an electron from the metal atom is

(a) (2c.)3 12T5h e× 1c0h–e1m9 iJc(abl)e3n in t×it 1ie0s– 1p9r Jesent therm6o.0s2p h×e

49. 1re0 –o1f t9h Je at(md)osp6h.6er2e × a r1e0–34 J

(a) O_2 , O , NO (b) O_3
(c) N_2, O_2, CO_2, H_2O (d) O_3, O_2, O_2

50. The type of bonds present in sulphuric anhydride are
(a) 3 and three $p - d$
(b) 3, one $p-p$ and two $p-d$
(c) 2 and three $p - d$
(d) 2 and two $p-d$

51. In Gattermann reaction, a diazonium group is replaced by X using Y. X and Y are

	X	Y
(a)	Cl^-	Cu/HCl
(b)	Cl_2	$CuCl_2$/HCl
(c)	Cl^-	CuCl/HCl
(d)	Cl_2	Cu_2O/HCl

52. Which pair of oxyacids of phosphorus contains ' P—H' bonds?
(a) H_3PO_4, H_3PO_3
(b) H_3PO_5, $H_4P_2O_7$
(c) H_3PO_3, H_3PO_2
(d) H_3PO_2, HPO_3

53. Dipole moment of HCl = 1.03 D, HI = 0.38 D. Bond length of HC1 = 1.3 Å and HI =1.6 Å. The ratio of fraction of electric charge, , existing on each atom in HCl and HI is
(a) 12 : 1 (b) 2.7 :
(c) 3.3 : 1 (d) 1 1 :

54. $SiCl_4$ on hydrolysis forms 'X'. and HC1. Compound 'X' loses water at 1000°C and gives 'Y'. Compounds 'X' and 'Y' respectively are
(a) H_2SiCl_6 , SiO_2 (b) H_4SiO_4, SiO_2
(c) SiO_2, Si (d) H_4SiO_4, Si

55. 1.5 g of $CdCl_2$ was found to contain 0.9 g of Cd. Calculate the atomic weight of Cd.
(a) 118 (b) 112
(c) 106.5 (d) 53.25

56. Aluminium reacts with NaOH and forms compound 'X'. If the coordination number of aluminium in 'X' is 6, the correct formula of X is
(a) $[Al(H_2O)_4(OH)_2]^+$ (b) $[Al(H_2O)_3(OH)_3]$
(c) $[Al(H_2O)_2(OH)_4]^-$ (d) $[Al(H_2O)_6](OH)_3$

57. The average kinetic energy of one molecule of an ideal gas at 27°C and 1 atm pressure is
(a) (b) (c) (d)

58. Assertion (A): K, Rb and Cs form superoxides.
Reason (R): The stability of the superoxides increases from 'K' to 'Cs' due to decrease in lattice energy.

The correct answer is
(a) Both (A) and (R) are true and (R) is the correct explanation of (A)
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(c) (A) is true but (R) is not true
(d) (A) is not true but (R) is true

59. How many mL of perhydrol is required to produce sufficient oxygen which can be used to completely convert 2 L of SO_2 gas to SO_3 gas?
(a) 10 (b) 5 mL
(c) mL (d) 30 mL

60. pH of a buffer solution decreases by 0.02 units when 0.12 g of acetic acid is added to 250 mL of a buffer solution of acetic acid and potassium acetate at 27°C. The buffer capacity of the solution is
(a) 0.1 (b) 10
(c) 1 (d) 0.4

61. Match the following

List I	List II
(A) Flespar	(I) $[Ag_3Sb_3]$
(B) Asbestos	(II) $Al_2O_3.H_2O$
(C) Pyrargyrite	(III) $MgSO_4.H_2O$
(D) Diaspore	(IV) $KAlSi_3O_8$
	(V) $CaMg_3(SiO_3)_4$

The correct answer is

	(A)	(B)	(C)	(D)
(a)	IV	V	II	I
(b)	IV	V	I	II
(c)	IV	I	III	II
(d)	II	V	IV	I

62. Which one of the following order is correct for the first ionisation energies of the elements?
(a) B < Be < N < O
(b) Be < B < N < O
(c) B < Be < O < N
(d) B < O < Be < N

63. What are X and Y in the following reaction sequence?

$C_2H_5OH \xrightarrow{Cl_2} X \xrightarrow{Cl_2} Y$

(a) C_2H_5Cl, CH_3CHO
(b) CH_3CHO, CH_3CO_2H
(c) CH_3CHO, CCl_3CHO
(d) C_2H_5Cl, CCl_3CHO

64. What are A, B, C in the following reactions?

(i) $(CH_3CO_2)_2Ca \xrightarrow{\Delta} A$
(ii) $CH_3CO_2H \xrightarrow{HI} B$
(iii) $2CH_3CO_2H \xrightarrow{P_4O_{10}} C$

	A	B	C
(a)	C_2H_6	CH_3COCH_3	$C_2H_3H_3CC_6COOOC_2H_2O$
(b)	$(CH_3CO)_2O$ C_2H_2 C_6H_6		
(c)	CH		
(d)	CH		

65. One per cent composition of an organic compound A is, carbon : 85.71% and hydrogen 14.29%. Its vapour density is 14. Consider the following reaction sequence

$$A \xrightarrow{Cl_2/H_2O} B \xrightarrow[(ii)\ H_3O]{(i)\ KCN\ /\ EtOH} C$$

Identify C.

(a) $CH_3-CH(OH)-CO_2H$

(b) $HO-CH_2-CH_2-CO_2H$ (c) $HO-CH_2-CO_2H$ (d) $CH_3-CH_2-CO_2H$

66. How many tripeptides can be prepared by linking the amino acids glycine, alanine and phenyl alanine?

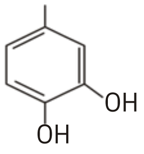
(a) One
(b) Three
(c) Six
(d) Twelve

67. A codon has a sequence of A and specifies a particular B that is to be incorporated into a C. What are A, B, C?

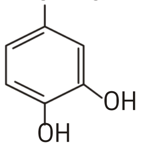
	A	B	C
(a)	3 bases	amino acid	carbohydrate
(b)	3 acids	carbohydrate	protein
(c)	3 bases	protein	amino acid
(d)	3 bases	amino acid	protein

68. Parkinson's disease is linked to abnormalities in the levels of dopamine in the body. The structure of dopamine is

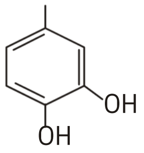
(a) CH_2NH_2



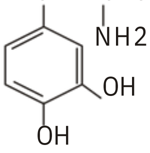
(b) $CH_2CH_2CH_2NH_2$



(c) $CH_2CH_2NH_2$



(d) $CH_2-CH(NH_2)CO_2H$



69. During the depression in freezing point experiment, an equilibrium is established between the molecules of

(a) liquid solvent and solid solvent
(b) liquid solute and solid solvent
(c) liquid solute and solid solute
(d) liquid solvent and solid solute

70. Consider the following reaction,

$$C_2H_5Cl + AgCN \xrightarrow{EtOH/H_2O} X \text{ (major)}$$

Which one of the following statements is true for X?

(I) It gives propionic acid on hydrolysis
(II) It has an ester functional group
(III) It has a nitrogen linked to ethyl carbon
(IV) It has a cyanide group

(a) IV (b) III
(c) II (d) I

71. For the following cell reaction,

$Ag | Ag^+ | AgCl | Cl^- | Cl_2, Pt$

$\Delta G_f(AgCl) = -109 kJ/mol$

$\Delta G_f(Cl^-) = -129 kJ/mol$

$\Delta G_f(Ag^+) = 78 kJ/mol$

E° of the cell is
(a) −0.60 V (b) 0.60 V
(c) 6.0 V (d) None of these

72. The synthesis of crotonaldehyde from acetaldehyde is an example of .... reaction.

(a) nucleophilic addition
(b) elimination
(c) electrophilic addition
(d) nucleophilic addition-elimination

73. At 25°C, the molar conductances at infinite dilution for the strong electrolytes NaOH, NaCl and $BaCl_2$ are 248×10^{-4}, 126×10^{-4} and 280×10^{-4} $Sm^2 mol^{-1}$ respectively, Λ_m $Ba(OH)_2$ in $Sm^2 mol^{-1}$ is

(a) 52.4×10^{-4} (b) 524×10^{-4}
(c) 402×10^{-4} (d) 262×10^{-4}

74. The cubic unit cell of a metal (molar mass = 63.55 g mol^{-1}) has and edge length of 362 pm. Its density is 8.92g cm^{-3}. The type of unit cell is

(a) primitive (b) face centred
(c) body centred (d) end centred

75. The equilibrium constant for the given reaction is 100.

$N_2 (g) + 2O_2(g)$ $2NO_2 (g)$

What is the equilibrium constant for the reaction given below?

$NO_2(g)$ $\frac{1}{2} N_2(g)$ $O_2(g)$

(a) 10 (b) 1
(c) 0.1 (d) 0.01

76. For a first order reaction at 27°C, the ratio of time required for 75% completion to 25% completion of reaction is (a) 3.0
(b) 2.303
(c) 4.8 (d) 0.477

77. The concentration of an organic compound in chloroform is 6.15 g per 100 mL of solution. A portion of this solution in a 5cm polarimeter tube causes an observed rotation of −1.2°. What is the specific rotation of the compound? (a) +12°
(b) −3.9°
(c) −39° (d) +61.5°

78. 20 ml of 0.1 M acetic acid is mixed with 50 mL of potassium acetate. K_a of acetic acid = 1.8×10^{-5} at 27°C. Calculate concentration of potassium acetate if pH of the mixture is 4.8.

(a) 0.1 M (b)0.04 M
(c) 0.4 M (d)0.02 M

79. Calculate H° for the reaction,
$Na_2O(s) + SO_3(g)$ $Na_2SO_4 (g)$
given the following :

(A)$Na(s) + H_2O(l)$ $NaOH(s) + \frac{1}{2}H_2 (g)$
H°= −146 kJ

(B) $Na_2SO_4(s) + H_2O(l)$ $2NaOH(s) + SO_3(g)$
H° = + 418 kJ

(C) $2Na_2O(s) + 2H_2 (g)$ $4Na(s) + 2H_2O(l)$
H° = + 259 kJ

(a) +823 (b) −581
(c) kJ – (d) kJ

80. Which one of the following is most effective in causing the coagulation of an As_2S_3 sol?
(a) KCl (b) $AlCl_3$
(c) $MgSO_4$ (d) $K_3Fe(CN)_6$

PART - III (MATHEMATICS)

81. If $f : [2, 3]$ R is defined by $f(x) = x^3 + 3x - 2$, then the range $f(x)$ is contained in the interval
(a) [1, 12] (b) [12, 34]
(c) [35, 50] (d) [−12, 12]

82. The number of subsets of {1, 2, 3, ..., 9} containing at least one odd number is
(a) 324 (b) 39
(c) 496 (d) 6

83. A binary sequence is an array of 0's and l's. The number of n-digit binary sequences which contain even number of 0's is
(a) (c2) nIf –x1 is numericall(yb)so s2mn a–l1l so that x^2 and highe2r np o–w1–e r1s of x can (bde) ne2gnlected, then

84.

$$1 \quad \frac{2x}{3}^{3/2} .(32 \; 5x)^{-1/5}$$

is approximately equal to

(a) $\frac{32 \; 31x}{64}$ (b) $\frac{31 \; 32x}{64}$

(c) $\frac{31 \; 32x}{64}$ (d) $\frac{1 \quad 2x}{64}$

85. The roots of

$$(x \quad a)(x \quad a \; 1) \quad (x \quad a \; 1)(x \quad a \; 2) \quad (x \quad a)(x \quad a \; 2) \quad 0$$

a R are always
(a) imaginary (b) equal
(c) real and distinct (d) rational and equal

86. Re. If $f(x) = x^2 + ax + b$ has imaginary roots then roots of $f(x) + f'(x) + f''(x) = 0$ are

(a) real and distinct (b) imaginary
(c) equal (d) rational and equal

87. If $f(x) = 2x^4 - 13x^2 + ax + b$ is divisible by $x^2 - 3x + 2$, then (a, b) is equal to
(a) (−9, – 2) (b) (6,
(c) (9, 2) (d) 4)

88. If x, y, z are all positive and are the pth, qth and rth terms of a geometric progression respectively, then the value of the determinant

$$\begin{vmatrix} \log x & p & 1 \\ \log y & q & 1 \\ \log z & r & 1 \end{vmatrix}$$ equals

(a) log xyz (b) (p – 1) (q – 1)(r – 1)
(c) pqr (d) 0

89. The locus of z satisfying the inequality

$\left|\frac{z \quad 2i}{2z \quad i}\right|$ 1, where $z = x + iy$, is

(a) x^2 y^2 1 (b) x^2 y^2 1

(c) x^2 y^2 1 (d) $2x^2$ $3y^2$ 1

90. If n is an integer which leaves remainder one when divided by three, then

$(1 \quad \sqrt{3}i)^n \quad (1-\sqrt{3}i)^n$ equals

(a) −2n + 1 (b) 2n + 1
(c) −(−2)n (d) −2n

91. The period of $\sin 4x \quad \cos 4x$ is

(a) $\frac{4}{2}$ (b) $\frac{2}{2}$ (c) 4 (d) 2

92. If $3\cos x \quad 2\sin x$, then the general solution of

$\sin 2x - \cos 2x \quad 2 \quad \sin 2x$ is

(a) $n \quad (1)^n \frac{}{2}, n \quad Z$

(b) $\frac{n}{2}, n \quad Z$

(c) $(4n \; 1)\frac{}{2}, n \quad Z$

(d) $(2n \; 1) \quad , n \quad Z$

93. $\cos^{1}\frac{1}{2} \quad 2\sin^{1}\frac{1}{2} \quad 3\cos^{1}\frac{1}{\sqrt{2}}$

$4\tan^{1}(\;1)$ equals

(a) $\frac{19}{12}$ (b) $\frac{35}{12}$ (c) $\frac{47}{12}$ (d) $\frac{43}{12}$

94. In a ABC

$\frac{(a \quad b \quad c)(b \quad c \; a)(c \; a \quad b)(a \quad b \quad c)}{4 2 2 \; b \; c}$

equals
(a) cos2A (b) cos2B
(d) sin2 A sin2 B

95. The angle between the lines whose direction cosines satisfy the equations $l + m + n = 0$,

$l^2 \quad m^2 \quad n^2 \quad 0$ is

(a) $\frac{}{6}$ (b) $\frac{}{4}$ (c) $\frac{}{3}$ (d) $\frac{}{2}$

96. If m1, m2, m3 and m4 are respectively the magnitudes of the vectors

$a_1 \quad 2\hat{i} \quad \hat{j} \quad \hat{k}, a_2 \quad 3\hat{} \quad 4\hat{j} \quad 4\hat{k}$,

$a_3 \quad \hat{i} \quad \hat{j} \quad \hat{k}$, and $a_4 \; i \quad -\hat{i} \quad 3\hat{j} \quad \hat{k}$,

then the correct order of m1, m2, m3 and m4 is
(a) m 4mm 14 <<
(b) m3mm2< m2 3 1 m< <
(c) mm 4 <<
(d) m3m1<m 4m 1<

97. If X is a binomial variate with the range {0, 1, 2, 3, 4, 5, 6} and $P(X = 2) = 4P(X = 4)$, then the parameter p of X is

(a) $\frac{1}{3}$ (b) $\frac{1}{2}$ (c) $\frac{2}{3}$ (d) $\frac{3}{4}$

98. The area (in square unit) of the circle which touches the lines $4x + 3y = 15$ and $4x + 3y = 5$ is
(a) 4 (b) 3
(c) 2 (d)

99. The area (in square unit) of the triangle formed by $x + y + 1 = 0$ and the pair of straight lines $x^2 - 3xy + 2y^2 = 0$ is

(a) $\frac{7}{12}$ (b) $\frac{5}{12}$ (c) $\frac{1}{12}$ (d) $\frac{1}{6}$

100. The pairs of straight lines $x^2 - 3xy + 2y^2 = 0$ and $x^2 - 3xy + 2y^2 + x - 2 = 0$ form a
(a) square but not rhombus
(b) rhombus
(c) parallelogram
(d) rectangle but not a square

101. The equations of the circle which pass through the origin and makes intercepts of lengths 4 and 8 on the x and y-axes respectively are
(a) $x^2 + y^2 \pm 4x \pm 8y = 0$
(b) $x^2 + y^2 \pm 2x \pm 4y = 0$
(c) $x^2 + y^2 \pm 8x \pm 16y =$
(d) $0 \; x^2 + y^2 \pm x \pm y = 0$

102. The point (3, −4) lies on both the circles
$x^2 + y^2 - 2x + 8y + 13 = 0$
and $x^2 + y^2 - 4x + 6y + 11 = 0$
Then, the angle between the circles is

(a) 60° (b) $\tan^{1}\frac{1}{2}$

(c) $\tan^{1}\frac{3}{5}$ (d) 135°

103. The equation of the circle which passes through the origin and cuts orthogonally each of the circles $x^2 \quad y^2 \quad 6x \quad 8 \quad 0$ and $x^2 \quad y^2 \quad 2x - 2y \quad 7$ is

(a) (b) (c) (d) The number of normals drawn to the parabola $y^2 = 4x$ from the point (1, 0) is

$3x^2 + 3y^2 - 8x - 13y = 0$ $3x^2 + 3y^2 + 8x + 29y = 0$ $3x^2 + 3y^2 + 8x + 29y = 0$ $3x^2 + 3y^2 - 8x$

(a) 0 (b) 1 (c) 2 (d) 3

104. If the circle $x^2 + y^2 = a^2$ intersects the hyperbola $xy = c^2$ in four points (x_i, y_i) for $i = 1, 2, 3$ and

105. 4, then $y_1 + y_2 + y_3 + y_4$ equals

(a) 0 (b) c (c) a (d) c^4

106. The mid point of the chord $4x - 3y = 5$ of the hyperbola $2x^2 - 3y^2 = 12$ is

(a) $0, \frac{5}{3}$ (b) (2, 1)

(c) $\frac{5}{4}, 0$ (d) $\frac{11}{4}, 2$

107. The perimeter of the triangle with vertices at (1, 0, 0), (0, 1, 0) and (0, 0, 1) is

(a) 3 (b) 2

(c) $2\sqrt{2}$ (d) $3\sqrt{2}$

108. If a line in the space makes angle , and with the coordinate axes, then

$\cos^2 \cos^2 \cos^2 \sin^2 \sin^2 \sin^2$ equals

(a) −1 (b) 0 (c) 1 (d) 2

109. The radius of the sphere $x^2 + y^2 + z^2 = 12x + 4y + 3z$ is

(a) (b) (c) (d) 52

110. $\lim_{x} \frac{x}{x} 5x^2 \; 3$ equals

(a) e (b) e^2 (c) e^3 (d) e^5

111. If $f : R \quad R$ is defined by

$$f(x) = \begin{cases} \frac{2\sin x \quad \sin 2x}{2\,x\cos x}, & if \; x \quad 0 \\ a, & if\, x \quad 0 \end{cases},$$

then the value of a so that f is continuous at 0 is

(a) 2 (b) 1 (c) −1 (d) 0

112. $x \quad \cos^{1} \frac{1}{\sqrt{1 \quad t^2}}$,

$y \quad \sin^1 \frac{t}{\sqrt{1 \quad t^2}} \quad \frac{dy}{dx}$ is equal to

(a) 0 (b) $\tan t$

(c) 1 (d) $\sin t \cos t$

113. $\frac{d}{dx} a\tan^{1} x \quad b\log \frac{x \quad 1}{x \quad 1} \quad \frac{1}{x^4 \quad 1}$

$a - 2b$ is equal to

(a) 1 (b) −1 (c) 0 (d) 2

114. $y \quad e^{a\sin^{1} x} \quad (1 \; x^2) y_{n2} \quad (2n \quad 1) x y_{n1}$ is equal to

(a) $(n^2 \quad a^2) y_n$ (b) $(n^2 - a^2) y_n$

(c) $(n^2 \quad a^2) y$ (d) $(n^2 \quad a^2) y_n$

115. The function $f(x) \quad x^3 \quad 2ax \quad bx \quad ca, ^2 \quad 3b$ has

(a) one maximum value

(b) one minimum value

(c) no extreme value

(d) one maximum and one minimum value

116. $\frac{2 \quad \sin 2x}{1 \; \cos 2x} \; e^x dx$ is equal to

(a) $- e^x \cot x + c$ (b) $e^x \cot x + c$

(c) $2e^x \cot x + c$ (d) $- 2e^x \cot x + c$

117. If $I_n \quad \sin^n x dx$, then $nI_n \quad (n \quad 1) I_{n2}$ equals

(a) $\sin^{n1} x \cos x$ (b) $\cos^{n1} x \sin x$

(c) $\sin^{n1} x \cos x$ (d) $\cos^{n 1} x \sin x$

118. The line $x \quad \frac{}{4}$ divides the area of the region bounded by y = sin x, y = cos x and x-axis

$0 \quad x \quad \frac{}{2}$ into two regions of areas A_1 and A_2. Then $A_1 : A_2$ equals

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

119. The solution of the differential equation $\frac{dy}{dx} \sin(x \quad y)\tan(x \quad y) - 1$ is

cosec (x + y) + tan (x + y) = x + c

(a) x + cosec (x + y) = c

(b) x + tan (x + y) = c

(c) x + sec (x + y) = c

(d)

120. If $p \quad (\sim p \quad q)$ is false, the truth value of p and q are respectively

(a) F, T (b) F, F (c) T, F (d) T, T

SOLUTION S

PART - I (PHYSICS)

1. (d) Here, $y \quad a\sin(bt \quad cx)$

Comparing this equation with geneal wave equation $a\sin \frac{2\ t}{T} \quad \frac{2\ x}{}$ y 2

we get $b \quad \frac{}{T}$, $c \quad 2$

(a) Dimensions of $\frac{y}{a}$ $\frac{[L]}{}$ = Dimensionless

(b) Dimensions of bt $[L] \frac{2}{T} \ t \ \frac{[T]}{}$

= Dimensionless $[T]$

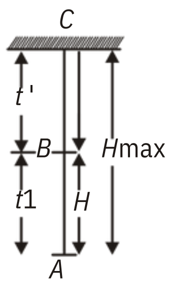
(c) Dimensions of cx $\frac{2}{} \ x \ \frac{[L]}{[L]}$

= Dimensionless

(d) Dimensions of $\frac{b}{c}$ $\frac{\frac{2}{T}}{2} \quad T \quad [LT^{\ 1}]$

2. (b) Let t' be the time taken by the body to fall from point C to B.

Tehn $t_1 \quad 2t' \quad t^2 \quad t' \quad \frac{t_2 \ t_1}{2}$ ...(i)



Total time taken to reach point C

$T \quad t_1 \quad t' \quad t_1 \quad \frac{t_2 \quad t_1}{2}$

$2t1 \quad \frac{t2}{2} \ t_1 \quad \frac{t_1 \ t2}{2}$

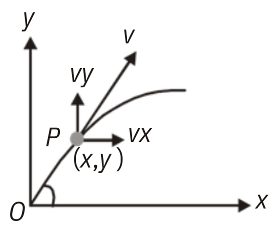
Maximum height attained

$H_{max} \quad \frac{1}{2} g(T)^2 \quad \frac{1}{2} g \left(\frac{t_1 \ t2}{2}\right)^2$

$\frac{1}{2} g \ \frac{(t1 \ t_2)^2}{4}$

Or, $H_{max} \quad \frac{1}{8} g \ (t_1 \quad t2)2m$

3. (a) Momentum, $p \quad m\ v \quad v \quad \frac{p}{m}$



Kinetic energy, KE

$\frac{1}{2}mv2 \quad \frac{1}{2} m \frac{p2}{m2} \quad \frac{1}{2m} p2$

or, KE $\quad p2 \quad \frac{1}{2m}$ constant

Hence, the graph between KE and $p2$ will Nbeo wlin, ekainr.etic

energy KE = $\frac{1}{2}mv2$

The velocity component at point P,

$vy \quad (u\sin \quad gt)$ and $vx \quad u\cos$

Resultant velocity at point P,

$v \quad v_y \ \hat{j} \ v \hat{xi}$

$(u\sin \quad gt)\hat{j} \quad u\cos \ \hat{i}$

$v|| \ \sqrt{(u\cos)2 \quad (u\sin \quad gt)2}$

$\sqrt{^2u\cos2 \quad u2\sin2 \quad g^2t^2 \quad 2ugt\sin}$

$\sqrt{u2(\cos 2 \quad \sin2 \ ) \quad g^2t^2 \quad 2ugt\sin}$

$KE \quad \frac{1}{2}m(u^2 \quad g^2t^2 \quad 2ugt \sin \ )$

i.e., KE

Hence, graph will be parabolic intercept on y -a xi s.

Hence, the graph between KE and t.

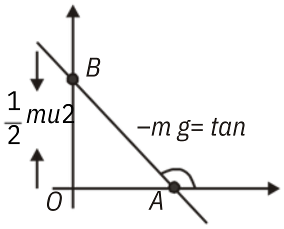
Now, in case of height

$KE \quad \frac{1}{2}m(v^2)$ and $v^2 \quad (u^2 \quad 2gy)$

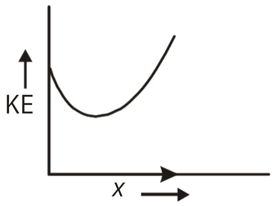
$KE \quad \frac{1}{2}m(u^2 \quad 2gy)$

$KE \quad mgy \quad \frac{1}{2}mu^2$

Intercept on y-axis $= \frac{1}{2}mu^2$



Now, $KE \quad \frac{1}{2}mv^2$



$KE \quad \frac{1}{2} \ m \left(\frac{x}{t}\right)^2$

i.e., KE $\quad x^2$. Thus graph between KE and x will be parabolic.

4. (a) Power of motor initially = P_0

Let, rate of flow of motor = (x)

Since, power,

$P_0 \quad \frac{\text{work}}{\text{time}} \quad \frac{mgy}{t} \quad mg\frac{y}{t}$

$\frac{y}{t} \quad x$ = rate of flow of water = mgx ...(i)

If rate of flow of water is increased by n times, i.e., (nx).

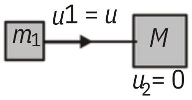
Increased power,

$P_1 \ \frac{mgy'}{t} \quad mg\frac{y'}{t} \quad nmgx$ ...(ii)

The ratio of power,

$\frac{P_1}{P_0} \quad \frac{nmgx}{mgx}$; $P_1 : P_0 \quad n : 1$

5. (a) Mass of the first body m_1 = 5 kg and for elastic collision coefficient of restitution, $e = 1$.



Let initially body m_1 moves with velocity v after collision velocity becomes $\frac{u}{10}$.

Let after collision velocity of M block becomes (v_2).

By conservation of momentum

$m_1u_1 \ m_2u_2 \quad m_1v_1 \ m_2v_2$

or $5u \quad M \ 0 \quad 5 \ \frac{u}{10} \quad Mv_2$

or $5u \quad \frac{u}{2} \quad Mv_2$ ...

Since, $v_1 \quad v_2 \quad e(u_1$ (i)

or $\frac{u}{10} \quad v_2 \quad 1(u)$ or $\frac{u}{10}(u_2) \quad u \quad v_2$

or $\frac{11u}{10} \quad v_2$ ...(ii)

Substituting value of $2v$ in Eq. (i) from Eq. (ii)

$5u \quad \frac{u}{2} \quad M \ \frac{11u}{10}$

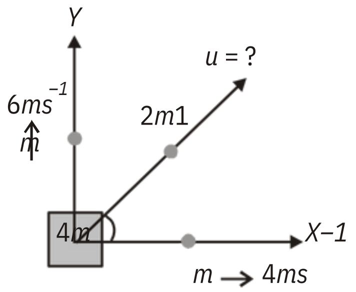
or $5 \ \frac{1}{2} \quad M \ \frac{11}{10} \quad M \quad \frac{9}{2}\ \frac{10}{11} \quad \frac{45}{11}$

$4.09 kg$

6. (c) Let third mass particle $(2m)$ moves making angle with X-axis.

The horizontal component of velocity of $2m$ mass particle = $u \cos$

And vertical component = $u \sin$



From conservation of linear momentum in X-direction

$m1u1m2u2 \quad m1v1\ m2v2$

or 0 $\quad m \quad 4 \quad 2m(u\cos\ )$

.o..r(i) 4 $\quad 2u\cos$ or $\quad 2 \quad u\cos$

Again, applying law of conservation of linear momentum in Y-direction

$0\ m\ 6\ 2m(u\sin\ )$

$\frac{6}{2} \quad u\sin$ or $\quad 3 \quad u\sin$ ...(ii)

Squaring Eqs. (i) and (ii) and adding,

$(4) \quad (9) \quad u\,2\cos^2 \quad u2\sin^2$

$u2\,(\cos^2 \quad \sin2\ )$

or $\quad 13 \quad u2$

$u \quad \sqrt{13}$ ms1

7. (b) Here, maximum height attained by a projectile

$h \quad \frac{v2R}{2gR \quad v2}$ ...(i)

Velocity of body = half the escape velocity

i.e., $v \quad \frac{v_e}{2}$

or $v \quad \frac{\sqrt{2gR}}{2} \quad v2 \quad \frac{2gR}{4} \quad v2 \quad \frac{gR}{2}$

Now, putting value of $v2$ in Eq. (i), we get

Height, $h \quad \frac{\frac{gR}{2}\ R}{2gR \quad \frac{gR}{2}} \quad \frac{\frac{gR^2}{2}}{\frac{3gR}{2}} \quad \frac{R}{3}$

8. (d) Particle executing SHM.

Displacement $y \quad 5\sin 4t \quad \overline{3}$ ...(i)

Velocity of particle

$\frac{dy}{dt} \quad \frac{5d}{dt}$ —$\sin 4t \quad \overline{3}$

$5\cos 4t$

$\overline{3} \quad 4 \quad 20\cos 4t \quad \overline{3}$

Velocity at $t \quad \frac{T}{4}$

$\frac{dy}{dt}_{t\ \frac{T}{4}} \quad 20\cos 4 \quad \frac{T}{4} \quad 3$

or $\quad u \quad 20\cos\ T \quad 3$ ...(ii)

Comparing the given equation with standard equation of SHM.

$y \quad a\sin(\ t \quad)$

We get, = 4

As $\quad \frac{2}{T} \quad T \quad \frac{2}{\ }$

or $T = \frac{2}{4} \quad \overline{2}$

Now, putting value of T in Eq. (ii), we get

$u \quad 20\cos\ \overline{2} \quad \overline{3} \quad 20\sin\ \overline{3}$

$10 \quad \sqrt{3}$

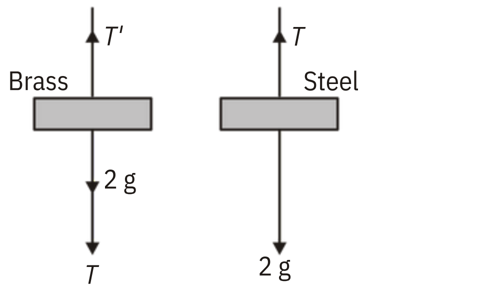
The kinetic energy of particle,

KE $\quad \frac{1}{2}mu2 \quad \frac{1}{2} \quad 2103 \quad (10\sqrt{3})2$

$103 \quad 100 \quad 3 \quad 0.3$J

9. (d) Given, $\frac{l_1}{l_2}\ a, \frac{r_1}{r_2}\ b, \frac{Y_1}{Y_2} \quad c$

Free body diagram of the two blocks brass and steel are



Let Young's modulus of steel is Y_1 and of brass is Y_2.

$$Y_1 \quad \frac{F_1 \; l_1}{A_1 \; l_1} \qquad \text{...(i)}$$

and $$Y_2 \quad \frac{F_2 \; l_2}{A_2 \; l_2} \qquad \text{...(ii)}$$

Dividing Eq. (i) by (ii),

$$\frac{Y_1}{Y_2} \quad \frac{\frac{F_1 l_1}{A_1 l_1}}{\frac{F_2 l_2}{A_2 l_2}}$$

or $$\frac{Y_1}{Y_2} \quad \frac{F_1 \; A_2 \; l_1 \; l_2}{F_2 \; A_1 \; l_2 \; l_1} \qquad \text{...(iii)}$$

Force on steel wire from free body diagram

$T = F_1 = (2g)$ newton

Force on brass wire from free body diagram

$F_2 \quad T' \quad T \quad 2g \quad (4g)$ newton

Now, putting the value of F_1, F_2, in Eq. (iii), we get

$$\frac{Y_1}{Y_2} \quad \frac{2g}{4g} \quad \frac{r_2^2}{r_1^2} \quad \frac{l_1}{l_2} \quad \frac{l_2}{l_1}$$

or $$c \quad \frac{1}{2} \quad \frac{1}{b} \quad \frac{a}{2} \quad \frac{l_2}{l_1}$$

or $$\frac{l_1}{l_2} \quad \frac{a}{2 b^2 c}$$

10. (d) Initially area of soap bubble, $A_1 = 4 \; r^2$

Under isothermal condition radius becomes $2r$.

Area $A_2 \quad 4(2r)^2 \quad 16 r^2$

Increase in surface area

$A \quad 2(A_2 \quad A_1) \quad 2(16 r^2 \quad 4 r^2) \quad 24 r^2$

Energy spent,

$W \quad T \quad A \quad T \; 24 r^2 \quad 24 T r^2$ J

11. (c) Let radius of big drop = R.

$$\frac{4}{3} R^3 \quad \frac{4}{3} \quad r^3 \; 8$$

$R \quad 2r$

Here r = radius of small drops.

Now, terminal velocity of drop in liquid

$$v_T \quad \frac{2}{9} \frac{r^2}{}(\quad)g$$

where is coefficient of viscosity and is density of drop is density of liquid.

Terminal speed drop is 6 cm s−1

$$6 \quad \frac{2}{9} \frac{r^2(}{} \quad)g \qquad \text{...(i)}$$

Let terminal velocity becomes v' after coalesce, then

$$v' \quad \frac{2}{9} \frac{R^2}{}(\quad)g \qquad \text{...(ii)}$$

Dividing Eq. (i) by (ii), we get

$$\frac{6}{v'} \quad \frac{\frac{2}{9} r^2 (\quad)g}{\frac{2}{9} R^2 (\quad)g} \quad \frac{6}{v'} \quad \frac{r^2}{(2r)^2}$$

or v' = 24 cm s−1

12. (a) Time period of oscillation,

$$T \quad 2 \sqrt{\frac{l}{g}} \quad \frac{dT}{T} \quad \frac{1}{2}\frac{dl}{l}$$

As, $$\frac{dl}{l} \quad dt$$

$$\frac{dT}{T} \quad \frac{1}{2} \; dt \quad \frac{1}{2} \quad 9 \quad 10^{7} \quad (30 \quad 20)$$

= 4.5 × 10−6

Loss in time = 4.5 × 10−6 × 0.5

Volume of the m= e2t.2al5 a ×t 310°−C6 s

13. (c)

$$V_{30} \quad \frac{\text{loss of weight}}{\text{specific gravity} \times g}$$

$$\frac{(45 \quad 25)g}{1.5 \quad g} \quad 13.33 \text{ cm}^3$$

Similarly, volume of metal at 40°C

$$V_{40} \quad \frac{(45 \quad 27)g}{1.25\, g} \quad 14.40 \text{ cm3}$$

Now, $V_{40} \quad V_{30}[1 \quad (t_2 \; t_1)]$

or $$\frac{V_{40}}{V_{30}(t_2 \; t_1)} \quad \frac{14.40 \quad 13.33}{13.33(40 \quad 30)}$$

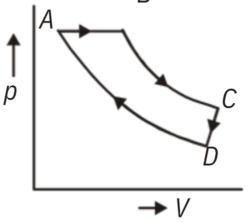
= 8.03 × 10−3/°C

Coefficient of linear expansion of the meta l

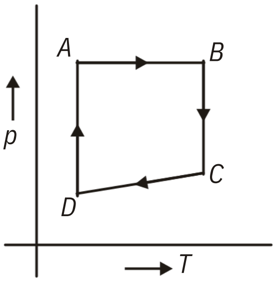
$$\frac{}{3} \quad \frac{8.03\ 10^{3}}{3} \quad 2.6\ 10^{3}/\ C$$

14. (a) Process A B C D A is clockwise.

During A B, pressure is constant and B C, process follows p $\frac{1}{}$ constant. During process C D, both p and V changes and process D A follows p $\frac{1}{V}$ i.e., T is constant.



Hence, equivalent cyclic process is has follows.



15. (b) From first law of thermodynamics

Q U W or U Q W

U_1 Q_1 $W1$ 6000 2500 3500 J

U Q $W2$ 5500 1000 4500 J

2 2 $W3$ 3000 1200 1800 J

U 4 Q 4 $W4$ 3500 x

3 3

For cyclic process U 0

3500 4500 1800 3500 x 0

or x 700J

Efficiency, $\frac{\text{output}}{\text{input}}$ 100

$\frac{W1\ W2\ W3\ W4}{Q1\ \ Q4}$ 100

$\frac{(2500\ 1000\ 1200\ \ 700)}{6000\ 3500}$ 100

$\frac{1000}{9500}$ 100 10.5%

16. (c) From first law of thermodynamics

Q U W

For cylinder A pressure remains constant.

Work done by a system

W $\frac{R}{1}(T1\ \ T_2)$

For monoatomic gases, 1; $\frac{5}{3}$

W $\frac{R}{\frac{5}{3}\ 1}$(442 400) $\frac{3}{2}R$ 42

or W = 63R

But U 0, for cylinder A

Q 0 63R 63R

For cylinder B volume is constant,

W = 0 and Q C_V T

For monoatomic gas

C_V $\frac{3}{2}R$ Q 1 32R T

As heat given on both cylinder is same

63R $\frac{3}{2}R$ T T 42K

17. (a) From figure, $H = H1 + H_2$

$\frac{2\ KA(T)}{l}$ $\frac{3KA(100\ \ T)}{l}$ 50) $\frac{KA(T\ \ 0)}{l}$

300 3T 2T 100 T 6T 400

T $\frac{200}{3}$ C

18. (b) Let listener go from A B with velocity ( ).

And the apparent frequency of sound from source A by listener using Doppler's effect,

$n' \quad n \dfrac{v v_o}{v_s} \qquad n' \quad 680 \dfrac{340 \quad u}{0}$

The apparent frequency of sound from source B by listener

$n'' \quad n \dfrac{v v_o}{v_s} \qquad 680 \dfrac{340 \quad u}{0}$

Listener hear 10 beats per second.
Hence, $n'' - n' = 10$

$\dfrac{680\ 340 \quad u}{340} \qquad \dfrac{680\ 340 \quad u}{340} \qquad 10$

$2(340 \quad u \quad 340 \quad u) \quad 10$

$u \quad 2.5\ \text{ms}^{-1}$

19. (b) When both the wires vibrate simultaneously, beats per second,

$n_1 \quad n_2\ 6$

or $\dfrac{1}{2l}\sqrt{\dfrac{T}{m}} \quad \dfrac{1}{2l}\sqrt{\dfrac{T'}{m}} \quad 6$

$\dfrac{1}{2l}\sqrt{\dfrac{T'}{m}} \quad \dfrac{1}{2l}\sqrt{\dfrac{T}{m}} \quad 6$

$\dfrac{1}{2l}\sqrt{\dfrac{T'}{m}} \quad 6006 \qquad \dfrac{1}{2l}\sqrt{\dfrac{T'}{m}} \quad 606$ ...(i)

Given that fundamental frequency

$\dfrac{1}{2l}\sqrt{\dfrac{T}{m}} \quad 600$ ...(ii)

Dividing Eq. (i) by (ii),

$\dfrac{\dfrac{1}{2l}\sqrt{\dfrac{T'}{m}}}{\dfrac{1}{2l}\sqrt{\dfrac{T}{m}}} \quad \dfrac{60}{6} \quad \dfrac{60}{0}$

$\sqrt{\dfrac{T'}{T}} \quad (1.01) \qquad \dfrac{T'}{T} \quad (1.02)\%$

$T' \quad T(1.02)$

Increase in tension

$T' \quad T\,1.02 \quad T \quad (0.02T)$

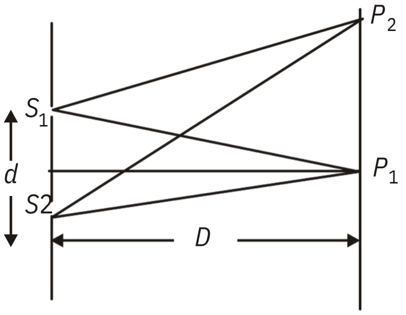
$T = 0.02$

20. (d) Fringe width $\dfrac{D}{d}$

Let be the amplitude of the place where constructive inference takes place.
The position of fringe at $p2$.

$x \quad \dfrac{n \quad D}{d}$

Given, $' \quad \dfrac{}{4}$



$\dfrac{D}{4d} \quad \dfrac{n \quad D}{d}$ or $n \quad \dfrac{1}{4}$

$\dfrac{I_1}{I_2} \quad \dfrac{a^2}{a^2} \quad 16:1$

4

21. (a) Position fringe from central maxima

$y_1 \quad \dfrac{n1D}{d}$

Given, $n = 10$

$y_1 \quad \dfrac{101D}{d}$ ...(i)

For second source

$y_2 \quad \dfrac{52D}{d}$ ...(ii)

$\dfrac{y_1}{y_2} \quad \dfrac{\dfrac{101D}{d}}{\dfrac{52D}{d}} \quad \dfrac{2_1}{_2}$

22. (c) Inteference takes place between two waves having equal frequency and propagate in same direction.

Hence a, 'ysi1n (ta sin(t1)

$y3 \qquad 2)$

will give interference as the two waves have same frequency .

23. (d) The two lenses of an achromatic doublet should have, sum of the product of their powers and dispersive power = zero.

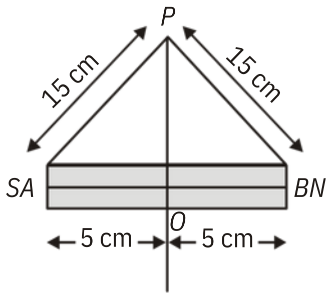
24. (b) Ratio of magnetic moments

$$\frac{M_A}{M_B} = \frac{T_d^2 + T_s^2}{T_d^2 - T_s^2} = \frac{\nu_s^2 + \nu_d^2}{\nu_s^2 - \nu_d^2}$$

$$= \frac{\left(\frac{1}{20}\right)^2 + \left(\frac{1}{15}\right)^2}{\left(\frac{1}{15}\right)^2 - \left(\frac{1}{20}\right)^2} = \frac{400 + 225}{400 - 225}$$

$M_A : M_B = 25 : 7$

25. (d) Here, length of magnet = 10 cm = 10 × 10^{-2} m, r = 15 × 10^{-2} m



$OP = \sqrt{225 - 25} = \sqrt{200}$ cm

Since, at the neutral point, magnetic field due to the magnet is equal to B_H,

$$B_H = \frac{\mu_0}{4\pi} \frac{M}{(OP^2 + AO^2)^{3/2}}$$

$$0.4 \times 10^{-4} = 10^{-7} \frac{M}{(200 \times 10^{-4} + 25 \times 10^{-4})^{3/2}}$$

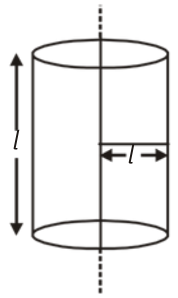
$$\frac{0.4 \times 10^{-4}}{10^{-7}} (225 \times 10^{-4})^{3/2} = M$$

$$0.4 \times 10^{3} \times 10^{-6} (225)^{3/2} = M$$

$M = 1.35$ A-m

26. (a) Charge density or charge per unit length of long wire

$\lambda = \frac{1}{3}$ Cm^{-1} and r = 18 × 10^{-2} m



According to Gauss theorem

$$\oint E \cdot dS = \frac{q}{\varepsilon_0}$$

$$E \oint dS = \frac{q}{\varepsilon_0} \text{ or } E \cdot 2\pi r l = \frac{q}{\varepsilon_0}$$

$$E = \frac{q}{2\pi\varepsilon_0 r l} = \frac{q/l}{2\pi\varepsilon_0 r} = \frac{\lambda}{2\pi\varepsilon_0 r} = \frac{2\lambda}{4\pi\varepsilon_0 r}$$

$$= 9 \times 10^9 \times \frac{1}{3} \times 2 \times \frac{1}{18 \times 10^{-2}}$$

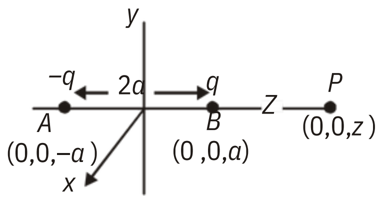
= 0.33 × 10^{11} NC^{-1}

27. (c) Potential at P due to (+q) charge of dipole

$$V_1 = \frac{1}{4\pi\varepsilon_0} \frac{q}{(z - a)}$$

Potential at P due to (−q) charge of dipole

$$V_2 = -\frac{1}{4\pi\varepsilon_0} \frac{q}{(z + a)}$$



Total potential at P due to electric dipole

$$V = V_1 + V_2$$

$$= \frac{1}{4\pi\varepsilon_0} \frac{q}{(z - a)} - \frac{1}{4\pi\varepsilon_0} \frac{q}{(z + a)}$$

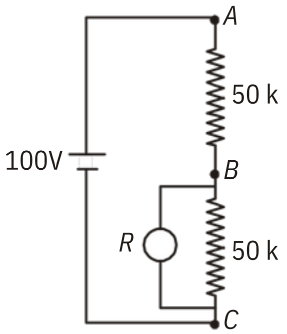
$$= \frac{q}{4\pi\varepsilon_0} \frac{(z + a - z + a)}{(z - a)(z + a)}$$

$$\text{or } V = \frac{2qa}{4\pi\varepsilon_0 (z^2 - a^2)}$$

28. (c) Internal resistance of voltmeter = R. Effective resistance across B and C

$$\frac{1}{R'} = \frac{1}{R} + \frac{1}{50} = \frac{50 + R}{50R}$$

$$\text{or } R' = \frac{50R}{50 + R}$$



According to Ohm's law, $V' \quad IR'$

or $\frac{100}{3} \quad I \quad \frac{50R}{50 \quad R}$

or $\frac{100\ 50 \quad R}{3 \quad 50R} \quad I$ ...(i)

Now, total resistance of circuit

$R'' \quad 50 \quad \frac{50R}{50 \quad R}$

or $R'' \quad \frac{(2500\ 100R)}{(50 \quad R)}$

Now, $V'' \quad IR''$

$100 \quad \frac{100\ 50 \quad R}{3 \quad 50R} \quad \frac{2500\ 100R}{(50 \quad R)}$

$150R \quad 2500\ 100R$ or $R \quad 50\text{k}$

29. (c) Here length of potentiometer wire, l = 10 m

Resistance of potentiometer wire

$R \quad \frac{l}{A}$ or $R \quad \frac{10}{A}$

The value of 2.5 m length wire

$R' \quad \frac{10}{A \quad 10} \quad 2.5 \quad R' \quad \frac{2.5}{A \quad 10}$

Potential, $V' \quad I \quad R' \quad I \quad \frac{2.5}{A \quad 10}$

Again the length of potentiometer wire is increased by 1 m.

Resistance of null position

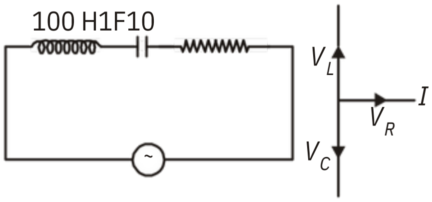
$R'' \quad \frac{l}{11 \quad A}$

$V'' \quad IR''$ and $V \quad V'$

$I \quad \frac{2.5}{A \quad 10} \quad \frac{l}{11 \quad A} \quad I$

or $\frac{2.5\ 11}{10} \quad l \quad 2.75$ m

30. (c)



Impedance, $Z \quad \sqrt{(X_L \sim X_C)^2 \quad R^2}$

or $Z \quad \sqrt{\left(L \sim \frac{1}{C}\right)^2 \quad R^2}$

Inductive reactance

$X_L \quad L \quad 70\ 10^3 \quad 100\ 10^6 \quad 7$

Capacitance reactance

$X_C \quad \frac{1}{C} \quad \frac{1}{70\ 10^3 \quad 1\ 10^6}$

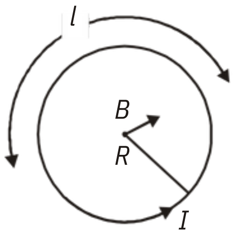
$\frac{1}{7 \quad 10^2} \quad \frac{10^2}{7} \quad \frac{100}{7}$

As $X_C > X_L$

So, circuit behaves like R-C circuit.

31. (c) At the centre of the loop, magnetic field

$B \quad \frac{_0}{4} \quad \frac{I\ 2}{R^2} R$ ...(i)



For the wire which is looped double let radius becomes r

Then, $\frac{l}{2} \quad 2r$ or $\frac{l}{4} \quad (r)$

$B' \quad \frac{_0}{4} \quad \frac{I\ 2\ r \quad 2}{r^2}$

or $B' \quad \frac{_0}{4} \quad \frac{I \frac{l2^2}{2}}{\frac{1}{4}}$

or $B' \quad \frac{{}_0}{4} \frac{Il \quad 16^{2}}{l2}$ ...(ii)

Now, $B \quad \frac{{}_0}{4} \frac{I \quad l}{l \quad {}^2} \quad R \quad \frac{1}{2}$ ...(iii)

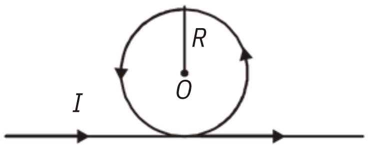
2

Dividing Eq. (ii) by (iii),

$$\frac{B'}{B} \quad \frac{\frac{0}{4} \frac{I\,l\,16^{2}}{l2}}{\frac{0}{4} \frac{Il \quad 4^{2}}{l2}} \quad 4$$

or $B' = 4B$

32. (c) Magnetic field due to long wire at O point



$B_1 \quad 2^{0} \frac{l}{R}$ (upward)

Magnetic field due to loop at O point

$B_2 \quad \frac{0}{4} \frac{I \quad 2 \quad R}{R \quad 2}$

$B_2 \quad \frac{0}{2} \frac{I}{R}$ (in upward direction)

Resultant magnetic field at centre O

$B = B1 + B2$

$B \quad \frac{0 I}{2 \quad R} (\quad 1) T$

33. (b) Work function $W \quad {}_0 \quad 3.31 \; 10 \; 19$ J

Wavelength of incident radiation

$5000 \; 10^{\;10}$ m

According to Einstein's photoelectric equation $E \quad W0 \quad KE$

$\frac{hc}{} \quad 3.31 \, 10^{\;19} \quad$ KE

KE $\quad 3.31 \, 10^{\;19} \quad \frac{6.62 \, 10 \, 34 \quad 3 \, 108}{5000 \, 10^{\;10}}$

$3.31 \quad 10^{\;19} \quad \frac{6.62 \; 3}{5} \quad 10^{\;19}$

$= (-3.31 \times 1.324 \times 3) \times 10^{-19}$

$= (3.972 - 3.31) \times 10-19$

$= 0.662 \times 10-19$ J

or E

$\frac{0.662 \, 10^{\;19}}{1.6 \, 10^{\;19}} \quad 0.41$eV

34. (d) From Einstein's photoelectric equation

$E \quad W0 \quad \frac{1}{2} mv^{2}$ or $\sqrt{\frac{2(E \; W0)}{m}} \quad v$

A charged particle placed in uniform magnetic field experience a force

$F \; evB \; mv \frac{{}^2}{r}$

or $r \quad \frac{mv}{eB}$

or $r \quad \frac{m \sqrt{\frac{2(E \; W0)}{m}}}{eB} \quad r \quad \frac{\sqrt{2m(E \; W0)}}{eB}$

35. (d) Here, $N_1 \quad N0e^{\;10t}$ and $N_2 \quad N0e^{\;\;t}$

$\frac{N1}{N2} \quad \frac{1}{e} \quad e^{\;1} \quad e^{(\quad\quad 10 \quad)t} \quad e^{\;9\;t}$

$t \quad \frac{1}{9}$

36. (c) Here current flows in circuit A as both (p-n) junction diode act as forward biasing. Total resistnace R.

$\frac{1}{R} \quad \frac{1}{4} \quad \frac{1}{4} \quad \frac{2}{4}$ or $R = 2$

According to Ohm's law

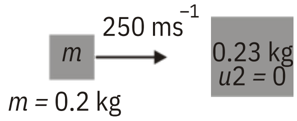
$V \quad IAR$

or 8 = $IA \times 2$ or IA = 4A In circuit B, lower p-n-junction diode is reverse biased. Hence, no current will flow but upper diode is forward biased so current cna flow through it

$V \quad IBR$

or 8 $\quad IB \quad 4$ or $I_{\;B} \quad 2$A

37. (c) After collision the bullet and block move together and comes to rest after covering a distance of 40 m.



By conservation of momentum

$m_1u_1 \; m_2u_2 \quad m_1v_1 \; m_2v_2$

$0.02 \quad 250 \quad 0.23 \; 0 \qquad 0.02v \quad 0.23v$

$5 \quad 0 \quad v(0.25)$ or $v \quad 20 ms^{-1}$

Now, by conservation of energy

or $\frac{1}{2}Mv^2 \qquad Rd$

or $\frac{1}{2} \; 0.25 \; 400 \qquad 0.25 \; 9.8 \; 40$

$\frac{200}{9.8 \; 40} \quad 0.51$

38. (a) Let after the time (t) the position of A is $(0, v_A t)$ and position of $B = (v_B t, 10)$. Distance between them

$y \quad \sqrt{(0 \quad v_B t)^2 \quad (v_A t \quad 10)^2}$

or $y^2 \quad (2t)^2 \quad (2t \; 10)^2$

or $y^2 \quad l \quad 4t^2 \; 4t^2 \quad 100 \; 40t$

$l \quad 8t^2 \; 100 \; 40t$

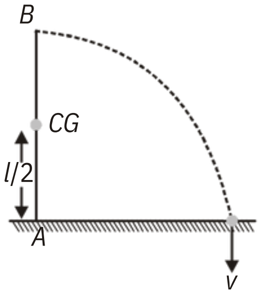
Now, $\frac{dl}{dt} \quad (16t \quad 40) \quad 0$

or

$t \quad \frac{40}{16} \quad 2.5 s \qquad \frac{d^2l}{dt^2} \quad 16 \quad (+ve)$

So, l will be minimum. Here, potential

39. (b) energy of the metre stick will be converted into rotational kinetic energy.



Because centre of gravity of stick lies at the middle of the rod,

PE of metre stick = $\frac{mgl}{2}$

Rotational kinetic energy $E \quad \frac{1}{2} \quad ^2$

I about point $A \quad \frac{ml^2}{3}$.

By law of conservation of energy

$mg \; \frac{l}{2} \quad \frac{1}{2}I \; ^2 \quad \frac{1}{2}\frac{ml^2}{3}\left(\frac{v_B}{l}\right)^2$

By solving, we get $v_B \quad \sqrt{3gl}$

40. (a) Given, $r = 0.4$ m,
 = 8 rad s−1,
$m = 4$ kg, $I = ?$
Torque, $\quad I$
$Imgr$

$4 \; 10 \quad 0.4 \quad I \quad 8$ or $I \quad \frac{16}{8} \quad 2 \; kg.m^2$

PART - II (CHEMISTRY)

41. (c) Given : $H_f(H) = 218$ kJ/mol

i.e., $\frac{1}{2}H_2 \qquad H; \qquad H = 218$ kJ/mol

or $H_2 \qquad 2H; \quad H = 436$ kJ/mol

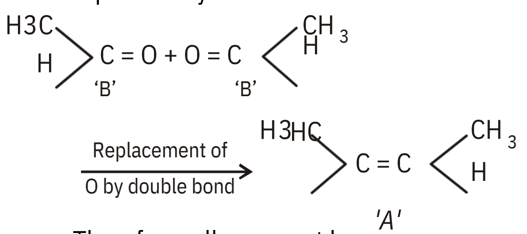
$\frac{436}{4.18} \quad 104.3$ kcal/mol

Hence, H–H bond energy is 104.3 kcal/mol.

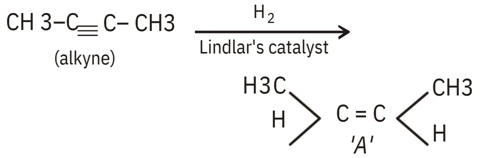
42. (a) In Wacker process, alkene is oxidised into aldehyde.

$CH_2 \; CH_2 \qquad \frac{1}{2}O_2 \xrightarrow[H_2O]{PdCl_2 \; CuCl_2} CH_3CHO$ (B)

Since only alkenes produce aldehydes, on ozonolysis hence 'A' must be an alkene. Now to find the structure of alkene we should add two molecules of aldehyde and replace O by double bond

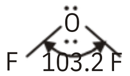


Therefore, alkyne must be



43. (b) $2F_2$ 2 NaOH (dilute) 2NaF OF_2 (A) H_2O

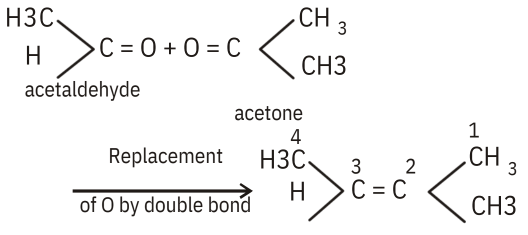
The structure of '*A*' (OF_2) is as



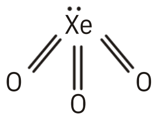
bonds made by O = 2

Due to repulsion between two lone pairs of electrons, its shape gets distorted. Therefore, the bond angle in the molecule is 103°.

44. (a) To decide the structure of alkene that undergoes ozonolysis, add the products and replace O by double (=) bond. Thus,

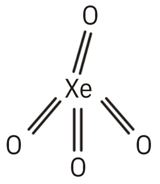


45. (a) Structure of XeO_3



3*p*-d pi bonds.

Structure of XeO_4



4*p-d* bonds.

46. (a) According to de-Broglie's equation.

$\frac{h}{mv}$ ^{2} $\frac{h2}{m2v2}$

or $mv2$ $\frac{h^2}{m\ ^2}$

KE(*K*) $\frac{1}{2}mv2$

KE(*K*) $\frac{1}{2}\frac{h^2}{m\ ^2}$

$\frac{K1}{K_2}$ $\frac{2}{1}$ ^{2} $\frac{52}{3}$ 25:9

*K*1 : *K*2

47. (c) Paramagnetic nature depends upon the number of unpaired electrons. Higher the number of unpaired electrons, higher the paramagnetic property will be.

Cu^{2+} = [Ar] 3*d*9, no. of unpaired electrons = 1

V^{2+} = [Ar] 3*d*3, no. of unpaired electrons = 3

Cr^{2+} = [Ar] 3*d*4, no. of unpaired electrons = 4

Mn^{2+} = [Ar] 3*d*5, no. of unpaired electrons = 5

Hence, correct order is Cu2 V2 Cr2 Mn2

48. (a) 1 mol = 6.023 × 1023 atoms

KE of 1 mol = 6.023 × 104 J

or KE of 6.023 × 1023 atoms = 6.023 × 104 J

KE of 1 atom = $\frac{6.023\ 104}{6.023\ 1023}$

= 1.0 × 10−19 J

hv_{energy} $\frac{hc}{}$ $\frac{6.626\ 10\ 34\quad 3\ 108}{600\ 10\ ^9}$

= 3.313 × 10−19 J

Now since Threshold energy

hv KE

3.313 10 19 1.0 10 19

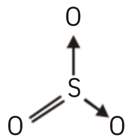
= 2.313 × 10−19 J Hence minimum amount of energy required to remove an electron from the metal ion will be 2.313 × 10−19J.

49. (a) The earth's thermosphere also includes the region of the atmosphere, called the *ionosphere*. The ionosphere is the region of the atmosphere that is filled with charged particles such as O, O+, NO+. The high

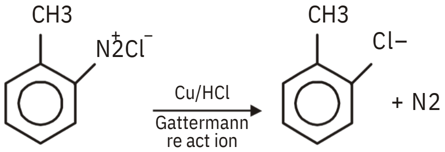
2

temperature in the thermosphere can cause molecules to ionize.

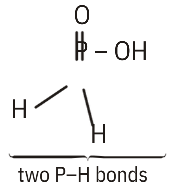
50. (b) The formula of sulphuric anhydride is SO_3 and its structure is as follows :



3 , 1*p-p*, 2 *p-d* bonds are present.

51. (a) 

52. (c) H_3PO_3 H – O – P – O – H} P–H bonds
H
O

H_3PO_2 

53. (c) Dipole moment,
( ) d
where, = magnitude of electric charge
d = distance between particles (or bond length)

d
or HCl/HI HCl/dHCl dHI/HI

1.03 1.6 / 1.3 0.38 3.3 : 1

54. (d) $SiCl_4$ 4H 2O H_4SiO_4 4HCl
H_4SiO_4 1000 C SiO_2 2H 2O

55. (c) Mass percent of Cd in $CdCl_2$
= 0.9/1.5 100 60%
Mass percent of Cl_2 in $CdCl_2$
= 100 – 60 = 40%
40% part (Cl_2) has atomic weight
= 2 × 35.5 = 71.0
60% part (Cd) has atomic weight
71.0 60 / 40 106.5

56. (c) 2Al 2NaOH $2H_2O$ 2 $NaAlO_2$ $3H_2$
sodium meta aluminate
Sodiummetaaluminate, thus formed, is soluble in water and changes into the complex $[Al(HO)_2]^-$
coordination number of Al is 6.

57. (b) Average kinetic energy per molecule
$\frac{3}{2}kT$
or $\frac{3}{2}\frac{R}{N_0}T$ $\frac{3}{2}$ $\frac{8.314}{6.023\ 10^{23}}$ 300
The speci=es 6 h.2a1vi n×g 1 a0n– 2O1– OJK b–o1n dm aonledc

58. (c) an oxidation state of $\frac{1}{2}$ are super oxides and is represented as O_2^-. Usually these are formed by active metals such as KO_2, RbO_2 and CsO_2. For the salts of larger anions (like O_2), lattice energy increases in a group. Since, lattice energy is the driving force for the formation of an ionic compound and its stability, the stability of the superoxides from 'K' to 'Cs' also increases.

59. (a) 30% solution of H_2O_2 is known as perhydrol .
H_2O_2 decomposes as
$2H_2O_2$ $2H_2O$ O_2
2VQol2u msoel ustiroenn gisth of 30% H
100 i.e., 1 mL of this solution on decomposition gives 100 mL oxygen.

SO_2 $\frac{1}{2}O_2$ SO_3
1L $\frac{1}{2}$L 1L
2L 1L 2L

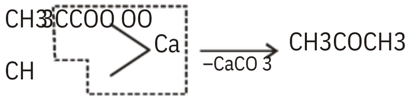
Since, 100 mL of oxygen is obtained by = 1 mL of H_2O_2
1000 mL of oxygen will be obtained by
$\frac{1}{100}$ 1000 mL of H_2O_2 = 10 mL of H_2O_2

60. (d) Buffer capacity, $\frac{dC_{HA}}{dpH}$,
where, dC_{HA} = no. of moles of acid added per litre
*d*pH = change in pH
dC_{HA} = moles of acetic acid / volume
= $\frac{0.12/60}{250/1000}$ $\frac{1}{125}$
$\frac{1/125}{0.02}$ $\frac{1}{2.5}$ 0.4

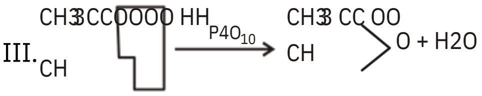
61. (b) (A) Felspar (orthoclase) ($KAlSi_3O_8$) (B) Asbestos {$CaMg_3(SiO_3)_4$} (C) Pyrargyrite (Ruby silver) (Ag_3SbS_3) (D) Diaspore ($Al_2O_3 \cdot H_2O$)

62. (c) Along a period first ionisation energy increases. Thus, the first IE of the elements of the second period should follow the order Be < B < N < O But in practice. The first IE of these elements follows the order B < Be < O < N The lower IE of B than that of Be is because in B ($1s^2, 2s^2 2p^1$), electron is to be removed from 2p which is easy while in Be ($1s^2, 2s^2$), electron is to be removed from 2s which is difficult. The low IE of O than that of N is because of the half-filled 2p orbitals in N ($1s^2, 2s^2 2p^3$).

63. (c) $CH_3CH_2OH + Cl_2 \xrightarrow{-2HCl} \underset{\text{Acetaldehyde}}{\underset{X}{CH_3CHO}} \xrightarrow[-3HCl]{3Cl_2} \underset{\text{chloral}}{\underset{Y}{CCl_3CHO}}$

64. (c) I. 

II. $CH_3COOH + 6HI \xrightarrow{\text{Red P}} CH_3CH_3 + 3I_2 + 2H_2O$

III. 

65. (b) C = 85.71% $\frac{85.71}{12} = 7.14$; $\frac{7.14}{7.14} = 1$

H = 14.29% = $\frac{14.29}{1} = 14.29$; $\frac{14.29}{7.14} = 2$

Empirical formula = CH_2
and, empirical formula weight = 12 + 2 = 14
Now since molecular formula weight
= 2 × vapour density
= 2 × 14 = 28

$n = \frac{28}{14} = 2$

Molecular formula = $(CH_2)_2 = C_2H_4$

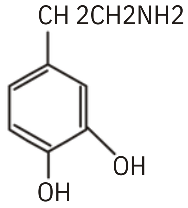
$\underset{(A)}{CH_2{=}CH_2} + HOCl \rightarrow \underset{(B)}{\underset{OH}{CH_2}-CH_2-Cl} \xrightarrow[EtOH]{KCN} \underset{OH}{CH_2}-CH_2-CN \xrightarrow{H_3O^+} \underset{(C)}{\underset{OH}{CH_2}-CH_2-COOH}$

66. (c) Tripeptides are amino acids polymers in which three individual amino acid units, called residues, are linked together by amide bonds.
glycine (NH_2-CH_2-COOH), alanine ($CH_3-\underset{NH_2}{CH}-COOH$) and phenylalanine

$C_6H_5-CH_2-\underset{NH_2}{CH}COOH$ can be linked in six different ways.

67. (d) A codon is a specific sequence of three adjacent bases on a strand of DNA or RNA that provides genetic code information for a particular amino acid.

68. (c) The IUPAC name of dopamine is 2-(3,4-dihydroxyphenyl) ethylamine and its structure is as follows :



69. (a) Freezing point of a substance is the temperature at which the solid and the liquid forms of the substance are in equilibrium.

70. (b) $C_2H_5Cl + AgCN \xrightarrow{EtOH/H_2O} C_2H_5-NC + AgCl$

(N-linked to ethyl carbon)

71. (a) For the given cell,
$Ag \mid Ag^+ \mid AgCl \mid Cl^- \mid Cl_2, Pt$
The cell reactions are as follows

At anode : $Ag \rightarrow Ag^+ + e^-$

At cathode : $AgCl + e^- \rightarrow Ag(s) + Cl^-$

Net cell reaction : $AgCl \rightarrow Ag^+ + Cl^-$

$\Delta G^o_{reaction} = \Delta G^o_P - \Delta G^o_R$

= (78 – 129) – (–109)

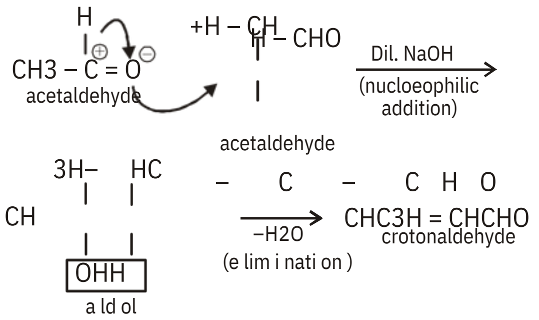
= + 58 kJ/mol

$\Delta G^o = -nFE^o$

$58 \times 10^3 \text{ J} = -1 \times 96500 \times E^o_{cell}$

$E^o_{cell} = -\frac{58 \times 1000}{96500} = -0.6\text{V}$

72. (d) Crotonaldehyde is produced by the aldol condensation of acetaldehyde.



73. (b) $BaCl_2 + 2NaOH \rightarrow Ba(OH)_2 + 2NaCl$

$\Lambda^\infty_{m\,Ba(OH)_2} = \Lambda^\infty_{m\,BaCl_2} + 2\Lambda^\infty_{m\,NaOH} - 2\Lambda^\infty_{m\,NaCl}$

$= 280 \times 10^{-4} + 2 \times 248 \times 10^{-4} - 2 \times 126 \times 10^{-4}$

$= (280 + 496 - 252) \times 10^{-4}$

$= 524 \times 10^{-4}$ S m^2 mol^{-1}

74. (b) Density, $d = \frac{MZ}{N_0 a^3}$

where, Z = number of atoms in unit cell

$Z = \frac{dN_0 a^3}{M}$

$= \frac{8.92 \times 6.023 \times 10^{23} \times (362 \times 10^{-10})^3}{63.55}$

= 4.0

Thus, metal has face centred unit cell.

75. (c) $N_2 + 2O_2 \rightleftharpoons 2NO_2$

$K_1 = \frac{[NO_2]^2}{[N_2][O_2]^2}$

or $100 = \frac{[NO_2]^2}{[N_2][O_2]^2}$ ..(i)

Again, $[NO_2] \rightleftharpoons \frac{1}{2}N_2 + O_2$

$K_2 = \frac{[N_2]^{1/2}[O_2]}{[NO_2]}$

or $K_2^2 = \frac{[N_2][O_2]^2}{[NO_2]^2}$ ...(ii)

Eqs. (i) × (ii), we get $100 \times K_2^2 = 1$

$K_2^2 = \frac{1}{100}$ or $K_2 = \frac{1}{10} = 0.1$

76. (c) For a first order reaction,

$t = \frac{2.303}{k}\log_{10}\frac{a}{a-x}$

Let initial amount of reactant is 100.

$\frac{t_1}{t_2} = \frac{\log\frac{100}{100-75}}{\log\frac{100}{100-25}}$ [$\because$ k remains constant]

$= \frac{\log\frac{100}{25}}{\log\frac{100}{75}} = \frac{\log 4}{\log 4/3}$

$= \frac{\log 4}{\log 4 - \log 3}$

$= \frac{2 \times 0.3010}{2 \times 0.3010 - 0.4771}$

$= \frac{0.6020}{0.1249} = 4.81$

77. (c) $[\alpha] = \frac{[\alpha]_{observed}}{l \times C} = \frac{1.2}{5 \times \frac{6.15}{1000}} = 39$

78. (a) Let the concentration of potassium acetate is x. According to Henderson's equation,

$pH = pKa + \log\frac{[salt]}{[acid]}$

$4.8 = -\log(1.8 \times 10^{-5}) + \log\frac{x \times 50}{20 \times 0.1M}$

$4.8 = 4.74 + \log 25x$

or $\log 25x = 0.06$

$25x \quad 1.148$

$x \quad 0.045M$

79. (b) By '$2A \overset{C}{\underset{2}{—}} B$', we get

$Na_2O \quad SO_3 \qquad Na_2SO_4$

$H \quad \frac{2 \; 146 \; 259 \; 418}{2}$

$H \quad 580.5 \; 581kJ$

80. (a) According to Hardy Schulze rule, greater the valency of the coagulating ion, greater is its coagulating power. Thus, out of the given, $AlCl_3 (Al^3)$ is most effective for causing coagulation of As_2S_3 sol.

PART - III (MATHEMATICS)

81. (b) Given, $f(x) \quad x^3 \; 3x \; 2$

$f'(x) \quad 3x^2 \quad 3$

Put $f'(x) \quad 0 \quad 3x^2 \quad 3 \quad 0$

$x^2 \quad 1$

$f(x)$ is either increasing or decreasing.

At $x = 2$, $f(2) = 2^3 + 3(2) - 2 = 12$

At $x = 3$, $f(3) = 3^3 + 3(3) - 2 = 34$

$f(x) \quad [12, 34]$.

82. (c) The total number of subsets of given set is $2^9 = 512$

Even numbers are {2, 4, 6, 8}.

Case I : When selecting only one even number = ${}^4C_1 = 4$

Case II : When selecting only two even numbers = ${}^4C_2 = 6$

Case III : When selecting only three even numbers = ${}^4C_3 = 4$

Case IV : When selecting only four even numbers = ${}^4C_4 = 1$

Required number of ways

= 512 − (4 + 6 + 4 + 1) − 1 = 496

[Here, we subtract 1 for due to the null set]

83. (a) The required number of ways = The even number of 0's i.e., {0, 2, 4, 6, ...}

$\frac{n}{!} \quad \frac{n!}{2!(n \; 2)!} \quad \frac{n!}{4!(n \quad 4)!}$

$\frac{n}{!} \quad {}^nC_0 \quad {}^nC_2 \quad {}^nC_4 \quad ... \quad 2^{n \; 1}$

84. (a) $1 \quad \frac{2x}{3}^{\,3/2} \quad (32 \; 5x)^{1/5}$

$1 \quad \frac{3}{2} \frac{2x}{3} \quad (32)^{1/5} \; 1 \quad \frac{5}{32} x^{\;1/5}$

(neglecting higher powers of x)

$[1 \quad x] 2^{\;1} \; 1 \quad \frac{1}{5} \; \frac{5}{3} \; \frac{x}{2}$

(neglecting higher powers of x)

$\frac{1}{2}(1 \quad x) 1 \quad \frac{x}{32}$

$\frac{(1 \quad x)(32 \quad x)}{64} \quad \frac{32 \quad 31x}{64}$

(neglecting x^2 term)

85. (c) $(x \quad a)(x \quad a \quad 1) \quad (x \quad a \; 1)(x \quad a \quad 2)$

$(x \quad a)(x \quad a \quad 2) \quad 0$

Let $x - a = t$, then

$t(t \quad 1) \quad (t \quad 1)(t \quad 2) \quad t(t \quad 2) \quad 0$

$t^2 \quad t \quad t^2 \quad 3t \quad 2 \quad t^3 \quad 2t \quad 0$

$3t^2 \quad 6t \quad 2 \quad 0$

$t \quad \frac{6 \quad \sqrt{36 \quad 24}}{2(3)} \quad \frac{6 \quad 2\sqrt{3}}{2(3)}$

$x \quad a \quad \frac{3 \quad \sqrt{3}}{3}$

$x \quad a \quad \frac{3 \quad \sqrt{3}}{3}$

Hence, x is real and distinct.

86. (b) $f(x) \quad x^2 \quad ax \quad b$ has imaginary roots.

Discriminant, $D \quad 0 \quad a^2 \quad 4b \quad 0$

$f'(x) \quad 2x \quad a$

$f''(x) \quad 2$

Also, $f(x) \quad f'(x) \quad f''(x) \quad 0$ ...(i)

$x^2 \quad ax \quad b \quad 2x \quad a \quad 2 \quad 0$

$x^2 \quad (a \quad 2)x \quad b \quad a \quad 2 \quad 0$

$x \quad \frac{(a \quad 2) \quad \sqrt{(a \; 2)^2 \; 4(a \quad b \quad 2)}}{2}$

$\frac{(a \quad 2) \quad \sqrt{a^2 \quad 4b \quad 4}}{2}$

Since, $a2 \quad 4b \quad 0$

$a2 \quad 4b \quad 4 \quad 0$

Hence, Eq. (i) has imaginary roots.

87. (c) $f(x) \quad 2x4\ 13x2\ ax \quad b$ is divisible by $(x \quad 2)(x\ 1)$.

$f(2) \quad 2(2)4\ 13(2)2\ a(2) \quad b \quad 0$

$2a \quad b \quad 20$ ...(i)

and $f(1) \quad 2(1)4\ 13(1)2\ a \quad b \quad 0$

$a \quad b \quad 11$ ...(ii)

On solving Eqs. (i) and (ii), we get

$a = 9,\ b = 2$

88. (d) Let a and R be the first term and common ratio of a GP respectively.

So, $T_p \quad aRp1 \quad x$

$T_q \quad aRq1 \quad y$ and $T_r \quad aRr1 \quad z$

$\log x \quad \log a \quad (p\ 1)\log R$

$\log y \quad \log a \quad (q\ 1)\log R$

and $\log z \quad \log a \quad (r \quad 1)\log R$

$$\begin{vmatrix} \log x & p & 1 \\ \log y & q & 1 \\ \log z & r & 1 \end{vmatrix} \quad \begin{vmatrix} \log a\ (p \quad 1)\log R & p & 1 \\ \log a\ (q \quad 1)\log R & q & 1 \\ \log a\ (r \quad 1)\log R & r & 1 \end{vmatrix}$$

$$\begin{vmatrix} \log a & p & 1 \\ \log a & q & 1 \\ \log a & r & 1 \end{vmatrix} \quad \begin{vmatrix} (p \quad 1)\log R & p & 1 \\ (q \quad 1)\log R & q & 1 \\ (r \quad 1)\log R & r & 1 \end{vmatrix}$$

$$\log a \begin{vmatrix} 1 & p & 1 \\ 1 & q & 1 \\ 1 & r & 1 \end{vmatrix} \quad \log R \begin{vmatrix} p & 1p & 1 \\ q & 1\ q & 1 \\ r & 1r & 1 \end{vmatrix} \quad \begin{matrix} 1 \\ 1 \\ 1 \end{matrix}$$

$(C2 \quad C2 \quad C3)$

= 0 + 0 = 0 (two columns are identical)

89. (c) Let $z = x + iy$

Given : $\left|\dfrac{z \quad 2i}{2z \quad i}\right| \quad 1$

$$\frac{\sqrt{(x)^2 \quad (y \quad 2)^2}}{\sqrt{(2x)^2 \quad (2y\ 1)^2}} \quad 1$$

$x^2 \quad y^2 \quad 4 \quad 4y \quad 4x2 \quad 4y2 \quad 1 \quad 4y$

$3x2\ 3y2 \quad 3 \quad x2 \quad y^2 \quad 1$

90. (c) $(1 \quad \sqrt{3}i)n \quad (1 \quad \sqrt{3}i)n$

$$2\ \frac{1 \quad \sqrt{3}i}{2}^{n} \quad 21\frac{\quad \sqrt{3}i}{2}^{n}$$

$(\ 2 \quad 2)n \quad (\ 2 \quad)n$

$(\ 2)n[(\ 2)3\ r1 \quad (\ )3\ r1]$

($n = 3r + 1$, where r is an integer)

$(\ 2)n(\quad 2 \quad) \quad (\ 2)n$

91. (d) Let $f\ (x) \quad \sin4 x \cos4 x$

$(\sin 2x \quad \cos2 x)2 \quad 2 \sin 2x\cos2x$

$1\ 1\overline{4}\ 2(\sin2x)2$

$$1 \quad \frac{1}{4}(1 \quad \cos4x) \quad \frac{3}{4} \quad \frac{\cos4x}{4}$$

$$\text{Period of } f(\ x) \quad \frac{2}{4} \quad \overline{2}$$

92. (c) $\sin2 x \cos2x \quad 2 \quad \sin2x$

$1 \cos x^2 \quad (\ 2 \cos^2 \ 1) \quad 2\ 2\sin x\cos x$

$3\cos2 x\ 2\sin x\cos x \quad 0$

$\cos x(2\sin x \quad 3\cos x) \quad 0$

$\cos x \quad 0, \quad (\quad 2\sin x \quad 3\cos x \quad 0)$

$$x \quad 2n \quad \overline{2}$$

$$x \quad (4n\ 1)\ \overline{2},n \quad Z$$

93. (d) $\cos^{1} \dfrac{1}{2} \quad 2\sin^{1}\dfrac{1}{2} \quad 3\cos^{1}\dfrac{1}{\sqrt{2}}$

$4\tan^{1}(\ 1)$

$$\cos^{1}\frac{1}{2} \quad 2\ \overline{6} \quad 3 \quad \cos^{1}\frac{1}{\sqrt{2}}$$

$4\tan^{1}(1)$

$$\overline{3}\ \overline{3} \quad 3 \quad \overline{4} \quad 4\ \overline{4}$$

$$3 \quad 3 \quad 43$$

$$3 \quad 4 \quad 12$$

94. (c) We know that, $2s = a + b + c$

$(a \quad b \quad c)(b \quad c \quad a)(c \quad a \quad b)(a \quad b \quad c)$

$4b2c2$

$2s(2s \quad 2a)(2s \quad 2b)(2s \quad 2c)$

$4 \ 2 \ 2$
$b \ c$

$\frac{4s(s \quad a)}{bc} \quad \frac{(s \quad b)(s \quad c)}{bc}$

$4\cos 2\frac{A}{2} \quad \sin 2\frac{A}{2} \quad \sin 2A$

95. (c) $lmn0, l \quad m \quad n$

and $l2m2n2 \quad 0$

$(\frac{m}{m2} \ n)_2 \ ^2m \quad n2 \quad 0$

$2 \quad 2mn \ 0$

$2m(m \ n) \quad 0$

$m \quad 0 or m \quad n \quad 0$

If $m = 0$, then $l = -n$

$\frac{l1}{1} \quad \frac{m1}{0} \quad \frac{n}{1}$

and if $m + n = 0 \quad m \quad n$, then $l = 0$

$\frac{l2}{0} \quad \frac{m2}{1} \quad \frac{n2}{1}$

ie., $(l1, m1, n1) \quad (1, 0, 1)$
and $(l\ 2, m2, n2) \quad (0, \quad 1, 1)$

$\cos \quad \frac{0 \quad 0 \quad 1}{\sqrt{1 \quad 0 \quad 1}\sqrt{0 \quad 1 \quad 1}} \quad \frac{1}{2}$

3

96. (a) $m \quad |a1| \quad \sqrt{22 \quad (1)2 \quad (1)2} \quad \sqrt{6}$

$1 \quad |a2| \quad \sqrt{32(4)2 \quad (4)2} \quad \sqrt{41}$

$m \quad |a3| \quad \sqrt{1212\,(1)2} \quad \sqrt{3}$

2 and $m_4 \quad |a4| \quad \sqrt{(1)2 \quad (3)2 \quad (1)2} \quad \sqrt{11}$

$m\,m3 \quad m1 \quad m4 \quad m2$

3

97. (a) Here, $n = 6$
According to the question

$^6C_2\,p^2 q^4 \quad 4 \ ^6C_4\,p^4 q^2$

$q2 \quad 4p2 \quad (1 \quad p)2 \quad 4p2$

$3p2 \quad 2p \quad 1 \quad 0$

$(p \quad 1)(3p \quad 1) \quad 0$

$p \quad \frac{1}{3} \quad$ (p cannot be negative)

98. (d) Given lines are parallel.

$d \quad \frac{15 \quad 5}{\sqrt{42 \quad 32}} \quad \frac{10}{5}$

$d \quad 2$ diameter of the circle
Radius of circle = 1
Area of circle = r2 = sq unit

99. (c) $x^2 \quad 2xy \quad xy \quad 2y^2 \quad 0$

$(x \quad 2y)(x \quad y) \quad 0$

$x \quad 2y, x \quad y$ ...(i)

Also, $x + y + 1 = 0$ ...(ii)
On solving Eqs. (i) and (ii), we get

$A \quad \frac{2}{3}, \frac{1}{3}, B \quad \frac{1}{2}, \frac{1}{2}, C(0, 0)$

Area of $ABC \quad \frac{1}{2}\begin{vmatrix} \frac{2}{3} & \frac{1}{3} & 1 \\ \frac{1}{2} & \frac{1}{2} & 1 \\ 0 & 0 & 1 \end{vmatrix}$

$\frac{1}{2} \ \frac{1}{3} \ \frac{1}{6} \quad \frac{1}{2} \ \frac{1}{6} \quad \frac{1}{12}$

100. (c) Given pair of lines are

$x^2 \quad 3xy \quad 2y^2 \quad 0$

and $x^2 \quad 3xy \quad 2y2 \quad x \quad 2 \quad 0$

$(x \quad 2y)(x \quad)y \quad 0$

and $(x \quad 2y \quad 2)(x \quad y \quad 1) \quad 0$

$x \quad 2y \quad 0, x \quad y \quad 0$

and $x \quad 2y \quad 2 \quad 0, x \quad y \quad 1 \quad 0$

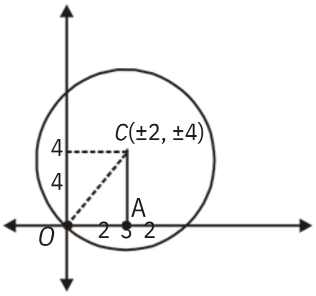
The lines $x \quad 2y \quad 0, x \quad 2y \quad 2 \quad 0$ and

$x \quad y \quad 0, x \quad y \quad 1 \quad 0$ are parallel.

Also, angle between $x - 2y = 0$ and $x - y = 0$ is not 90°.

It is a parallelogram.

101. (a) In OAC, $OC^2 = 22 + 42 = 20$



Required equation of circle is

$(x \quad 2)2 \quad (y \quad 4)^2 \quad 20$

$x2 \quad y2 \quad 4x \quad 8y \quad 0$

102. (d) Given circles are

$x^2 \quad y^2 \quad 2x \quad 8y \quad 13 \quad 0$

and $x^2 \quad y2 \quad 4x \quad 6y \quad 11 \quad 0$

Here $C_1 \quad (1, \quad 4), C2 \quad (2, \quad 3)$

$r_1 \quad \sqrt{1\ 16\ 13} \quad 2$

and $r_2 \quad \sqrt{4 \quad 9 \quad 11} \quad \sqrt{2}$

So, d

$C1C2 \quad \sqrt{(2\ 1)2 \quad (\quad 3 \quad 4)2} \quad \sqrt{2}$

$\cos \quad \frac{d^2 \quad r_1^2 \quad r22}{2r_1r_2} \quad \frac{2 \quad 4 \quad 2}{2 \quad 2 \quad \sqrt{2}} \quad \frac{1}{\sqrt{2}}$

135

103. (b) Let the required equation of circle be

$x2 \quad y2 \quad 2gx \quad 2fy \quad 0$

The above circle cuts the given circles orthogonally.

2

$2(3g) \quad f(0) \quad 8 \quad 2g \quad \frac{8}{3}$

and $2g \quad 2f \quad 7$

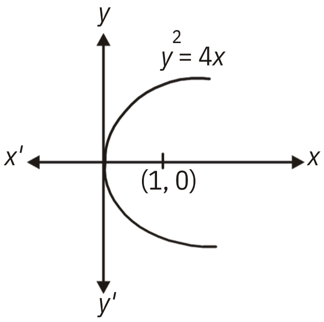
$2f \quad 7 \quad \frac{8}{3} \quad \frac{29}{3}$

Required equation of circle is

$x^2 \quad y^2 \quad \frac{8}{3}x \quad \frac{29}{3}y \quad 0$

or $3x2 \quad 3y2 \quad 8x \quad 29y \quad 0$

104. (b) Given curve is $y2 = 4x$.



Also, point (1, 0) is the focus of the p ar abola .
It is clear from the graph that only one normal is possible.

105. (a) $x4y2$

$y2(a2 \quad y2) \quad c4$

$y4 \quad a2y2 \quad c4 \quad 0$

Let $y1, y2, y3$ and $y4$ are the roots.

$y1 \quad y2 \quad y3 \quad y4 \quad 0$

106. (b) Solving $4x \quad 3y \quad 5$ and $2x2 \quad 3y2 \quad 12$

$2 \quad \frac{5 \quad 3y}{4}^2 \quad 3y2 \quad 12$

$\frac{(25 \quad 9y2 \quad 30y)}{8} \quad 3y2 \quad 12$

$15y2 \quad 30y \quad 71 \quad 0$

$y \quad \frac{30 \quad \sqrt{900 \quad 4260}}{30} \quad 1 \quad \frac{\sqrt{3360}}{30}$

Also, $2x2 \quad 3 \quad \frac{4x \quad 5}{3}^2 \quad 12$

$10x2 \quad 40x \quad 61 \quad 0$

$x \quad \frac{40 \quad \sqrt{1600 \quad 4\ 10 \quad 61}}{2 \quad 10}$

$\frac{40 \quad \sqrt{840}}{20} \quad 2 \quad \frac{\sqrt{840}}{20}$

Points are $A \quad 2 \quad \frac{\sqrt{840}}{20}, 1 \quad \frac{\sqrt{3360}}{30}$

and $B \quad 2 \quad \frac{\sqrt{840}}{20}, 1 \quad \frac{\sqrt{3360}}{30}$.

Mid point of AB is (2, 1).

107. (d) Let $A = (1, 0, 0)$, $B = (0, 1, 0)$ and $C = (0, 0, 1)$

So, $AB \quad \sqrt{(0 \quad 1)^2 \quad (1 \quad 0)^2 \quad 0^2} \quad \sqrt{2}$

$BC \quad \sqrt{0^2 \quad (0\ 1)^2 \quad (1\ 0)^2} \quad \sqrt{2}$

and $CA \quad \sqrt{(1 \quad 0)^2 \quad 0^2 \quad (0 \quad 1)^2} \quad \sqrt{2}$

Perimeter of triangle

$= AB + BC + CA \quad \sqrt{2} \quad \sqrt{2} \quad \sqrt{2} \quad 3\sqrt{2}$

108. (c) $\cos^2 \quad \cos^2 \quad \cos^2$

$+ \sin^2 \quad \sin^2 \quad \sin^2$

$(\cos^2 \quad \sin^2) \quad (\cos^2 \quad \sin^2 \quad)$

$(\cos^2 \quad \sin^2 \quad) \quad \sin^2 \quad \sin^2 \quad \sin^2$

$\cos^2 \quad \cos^2 \quad \cos^2 \quad 1$

109. (a) Given equation of sphere is

$x^2 \quad y^2 \quad z^2 \quad 12x \quad 4y \quad 3z \quad 0$

Centre of sphere is $6, 2, \frac{3}{2}$.

Radius of sphere $\sqrt{(6)^2 \quad (2)^2 \quad \left(\frac{3}{2}\right)^2}$

$\sqrt{36 \quad 4 \quad \frac{9}{4}} \quad \sqrt{\frac{169}{4}} \quad \frac{13}{2}$

110. (c) $\lim_{x} \left(\frac{x \quad 5}{x \quad 2}\right)^{x \quad 3} \quad \lim_{x} \left(1 \quad \frac{3}{x \quad 2}\right)^{x \quad 3}$

$\lim_{x} \left[\left(1 \quad \frac{3}{x \quad 2}\right)^{\frac{x \quad 2}{3}}\right]^{\frac{3(x \quad 3)}{x \quad 2}}$

$e^{\lim_{x} 3 \frac{1 \quad \frac{3}{x}}{1 \quad \frac{2}{x}}} \quad e^3$

111. (d) $f(x) \quad \begin{cases} \frac{2\sin x \quad \sin 2x}{2x\cos x}, & \text{if } x \quad 0 \\ a, & \text{if } x \quad 0 \end{cases}$

$\lim_{x\ 0} f(x) \quad \lim_{x\ 0} \frac{2\sin x \quad \sin 2x}{2x\cos x} \quad \frac{0}{0}$ form

$\lim_{x\ 0} \frac{2\cos x \quad 2\cos 2x}{2(\cos x \quad x\sin x)}$

$\lim_{x\ 0} \frac{2 \quad 2}{2(1 \quad 0)} \quad 0$

Since, $f(x)$ is contineous at $x = 0$

$f(0) = \lim_{x\ 0} f(x) \quad a \quad 0$

112. (c) We have, $x \quad \cos^{1} \frac{1}{\sqrt{1 \quad t^2}}$

and $y \quad \sin^{1} \frac{t}{\sqrt{1 \quad t^2}}$

$x \quad \tan^{1} t$ and $y \quad \tan^{1} t$

$y \quad x \quad \frac{dy}{dx} \quad 1$

113. (b) $\frac{d}{dx}\left(a\tan^{1} x \quad b\log \frac{x \quad 1}{x \quad 1}\right) \quad \frac{1}{x^4 \quad 1}$

On integrating both sides, we get

$a\tan^{1} x \quad b\log \frac{x \quad 1}{}$

$\frac{1}{2} \left(\frac{1}{x^2 \quad 1} \quad \frac{1}{x^2 \quad 1}\right) dx$

$a\tan^{1} x \ b\log \frac{x \quad 1}{x \quad 1}$

$\frac{1}{4} \log \frac{x \quad 1}{x \quad 1} \quad \frac{1}{2} \tan^{1} x$

$a \quad \frac{1}{2}, b \quad \frac{1}{4}$

$a \quad 2b \quad \frac{1}{2} \quad 2 \quad \frac{1}{4} \quad 1$

114. (c) $y \quad e^{a\sin^{1} x}$

On differentiating w.r.t. x, we get

$y_1 \quad e^{a\sin^{1} x} a \frac{1}{\sqrt{1 \quad x^2}}$

$y_1\sqrt{1 \quad x^2} \quad ay$

$(1 \quad x^2)\ y_1^2 \quad a^2y^2$

Again differentiating w.r.t. x, we get

$(1 \quad x^2) 2y_1y_2 \quad 2xy_1^2 \quad a^2 2yy_1$

$(1 \quad x^2) y_2 \quad xy_1 \quad a^2 \quad 0$

Using Leibnitz's rule,

$(1 \; x^2)y_{n\;2} \quad {}^nC_1 y_{n\;1}(2x) \quad {}^nC_2 y_n(\;\; 2)$

$xy_{n\;1} \quad {}^nC_1 y_n \; 1 \;\; n(\;2\;a^2) \; y_n \; 0$

$(1 \; x^2)y_{n\;2} \quad xy \qquad 1)$

$y_n[\; n(n \quad 1) \quad n \quad a^2] \quad 0$

$(1 \; x^2)y_{n\;2} \quad (2n\;1)xy_{n\;1} \quad (n^2 \quad a^2)y_n$

115. (c) Given, $f(x) \quad x^3 \quad ax^2 \; bx \quad c, a^2 \quad 3b$

$f'(x) \quad 3x^2 \quad 2ax \quad b$

Put $f'(x) \quad 0$

$3x^2 \quad 2ax \; b \quad 0$

$$x \; \frac{2a \quad \sqrt{4a^2 \quad 12b}}{2 \;\; 3}$$

$$\frac{2a \quad 2\sqrt{a^2 \quad 3b}}{3}$$

Since, $a^2 \quad 3b$,

x has an imaginary value.

Hence, no extreme value of x exists.

116. (a) Let $I \quad \frac{2 \; \sin 2x}{1 \; \cos 2x} e^x \, dx$

$$\frac{2 \quad 2\sin x \cos x}{2 \sin^2 x} e^x dx$$

$\text{co sec}^2 \; x \quad \cot \; x$

$\cot x e^x \quad e^x \frac{d}{dx}(\cot x) \; e^x \; dx$

$\cot x e^x \; dx \; c$

$\cot x e^x \quad c$

117. (c) We know that, if

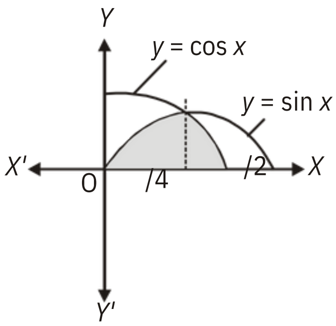
$I_n \quad \sin^n x dx$, then

$$I_n \quad \frac{\sin^{n\;1} x \cos x}{n} \quad \frac{n \quad 1}{n} I_{n\;2}$$

where n is a positive integer.

$nI_n \quad (n\;1)I_{n\;2} \quad \sin^{n\;1} x \cos x$

118. (d)



Area, $A_1 \; \int_0^{/4} \sin x dx$

$[\cos x]_0^{/4} \quad 1 \quad \frac{1}{\sqrt{2}}$

$\frac{\sqrt{2} \quad 1}{\sqrt{2}}$

and area, $A_2 \; \int_{/4}^{/2} \cos x dx$

$[\sin x]_{/4}^{/2} \quad 1 \quad \frac{1}{\sqrt{2}} \quad \frac{\sqrt{2} \quad 1}{\sqrt{2}}$

$A_1 : A_2 \quad \frac{\sqrt{2} \quad 1}{\sqrt{2}} : \frac{\sqrt{2} \quad 1}{\sqrt{2}} \quad 1:1$

119. (b) $\frac{dy}{dx} \quad \sin(x \quad y)\tan(x \quad y) \quad 1$

Put $x + y = z$

$1 \quad \frac{dy}{dx} \quad \frac{dz}{dx}$

$\frac{dz}{dx} \; 1 \; 1 \quad \sin z \tan z \quad 1$

$\frac{\cos z}{\sin^2 z} dz \quad dx$

Putting $\sin z \quad t \quad \cos z dz \quad dt$, we have

$\frac{1}{t^2} dt \quad x \quad c \qquad \frac{1}{t} \quad x \quad c$

$\text{cosec } z \quad x \quad c \qquad \text{cosec } (x \quad y) \quad x \quad c$

120. (c) $p \quad (\sim p \quad q)$ is false means p is true and $\sim p \quad q$ is false.

p is true and both $\sim p$ and q are false.

p is true and q is false.