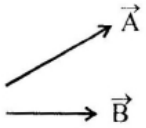
1. Two vectors $\vec{A}$ and $\vec{B}$ have magnitudes 2 and 1 respectively. If the angle between $\vec{A}$ and $\vec{B}$ is 60°, then which of the following vectors may be equal to $\frac{\vec{A}}{2}-\vec{B}$:



(1)  (2)  (3)  (4) 

2. The equation for the position of train starting at x = 0 m is given by $x=\frac{1}{2}at^2+bt^3$, here t is time. The dimensions of b is :

(1) $[T^3]$ (2) $[L^1T^{-3}]$ (3) $[L^1T^{-2}]$ (4) $[L^1T^{-1}]$

3. A point moves in x – y plane according to the law x = 3 cos4t and y = 3 (1 – sin4t). The distance travelled by the particle in 2 sec is (where x and y are in metres) :

(1) 48 m (2) 24 m

(3) $48\sqrt{2}$ m (4) $24\sqrt{2}$ m

4. A particle is projected from level ground. Its kinetic energy K changes due to gravity so that $\frac{K_{max}}{K_{min}}=9$. The ratio of the range to the maximum height attained during its flight is :

(1) $4\sqrt{2}$ (2) 1.5 (3) $\sqrt{2}$ (4) None

5. A man is standing in a lift which goes up and comes down with the same constant acceleration. If the ratio of the apparent weights in the two cases is 2 : 1, then the acceleration of the lift is :

(1) 3.33 m/s^2 (2) 2.50 m/s^2

(3) 2.00 m/s^2 (4) 1.67 m/s^2

6. A body is moving with a velocity of 72 km/h on a rough horizontal surface of coefficient of friction is 0.5. If the acceleration due to gravity is 10m/s^2, find the minimum distance it can be stopped. :

(1) 400 m (2) 40 m (3) 0.40 m (4) 4 m

7. The work done by a force $\vec{F}=(-6x^3\hat{i})N$ in displacing a particle from x = 4m to x = –2m is:

(1) –240 J

(2) 360 J

(3) 420 J

(4) will depend upon the path

8. A disc initially at rest, is rotated about its axis with a uniform angular acceleration. In the first 2 s, it rotates an angle θ. In the next 2 s, the disc will rotate through an angle:

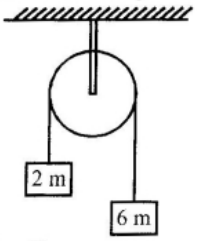
(1) θ (2) 2 θ (3) 3 θ (4) 4 θ

9. A body of mass 2 kg moving with a velocity $(\hat{i}+\hat{j}+\hat{k})$ m/s collides with another body of mass 5 kg moving with velocity $(\hat{i}-2\hat{j}+3\hat{k})$ m/s. If they stick together, the velocity (in m/s) of the composite body is :

(1) $\left(\hat{i}-\frac{8}{7}\hat{j}-\frac{17}{7}\hat{k}\right)$ (2) $\left(\hat{i}-\frac{8}{7}\hat{j}+\frac{17}{7}\hat{k}\right)$

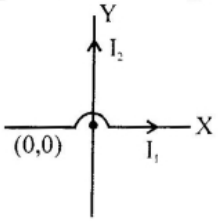
(3) $\left(-\hat{i}-\frac{8}{7}\hat{j}-\frac{17}{7}\hat{k}\right)$ (4) $\left(\hat{i}+\frac{8}{7}\hat{j}+\frac{17}{7}\hat{k}\right)$

10. If the system is released, then the acceleration of the centre of mass of the system is :



(1) g/4 (2) g/2 (3) g (4) 2g

11. Two long straight conductors with currents I_1 and I_2 are placed along X and Y-axes. The equation of locus of points of zero magnetic induction is :-



(1) Y = X (2) $Y=\frac{I_2X}{I_1}$

(3) $Y=\frac{I_1}{I_2}X$ (4) $Y=\frac{X}{I_1I_2}$

12. A copper wire of resistance 10 Ω is in the form of a perfect circle. Two points A and B on it are connected to a battery of emf 5 V and internal resistance 0.5 Ω. The two segments of the circle have lengths in the ratio 2 : 3. The net magnetic induction at the centre of the circle is :-

(1) $\frac{\mu_0}{6\pi}$ (2) zero

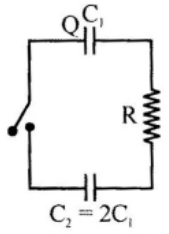
(3) $\frac{\mu_0}{5\pi}$ (4) $\mu_0/4\pi$

13. A charged particle is moving in a circular orbit of radius 6 cm with a uniform speed of 3×10^6 m/s under the action of a uniform magnetic field 2×10^{-4} Wb/m^2 which is at right angles to the plane of the orbit. The charge to mass ratio of the particle is :-

(1) 5×10^9 C/kg (2) 2.5×10^{11} C/kg

(3) 5×10^{11} C/kg (4) 5×10^{12} C/kg

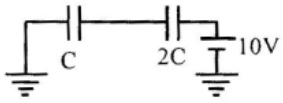
14. Two capacitors C_1 and $C_2 = 2C_1$ are connected in a circuit with a switch between them as shown in the figure. Initially the switch is open and C_1 holds charge Q. The switch is closed. At steady state, the charge on capacitors will be :-



(1) Q, 2Q (2) $\frac{Q}{3}, \frac{2Q}{3}$

(3) $\frac{3Q}{2}, 3Q$ (4) $\frac{2Q}{3}, \frac{4Q}{3}$

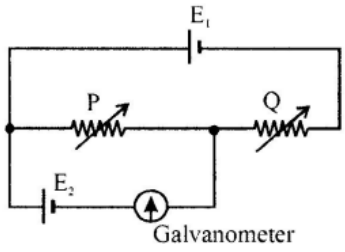
15. In the circuit shown in the figure, C = 6 μF. The charge stored in the capacitor of capacity C is :-



(1) zero (2) 90μC

(3) 40μC (4) 60μC

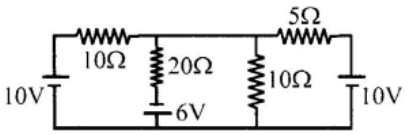
16. Two cells of e.m.f. s E_1 and E_2 and of negligible internal resistances are connected with two variable resistors as shown in Fig. When the galvanometer shows no deflection, the values of the resistances are P and Q. What is the value of the ratio E_2/E_1 ?



(1) $\frac{P}{Q}$ (2) $\frac{P}{P+Q}$

(3) $\frac{Q}{P+Q}$ (4) $\frac{P+Q}{P}$

17. The value of current through 20Ω resistor is :-



(1) 1.2 A (2) 0.3 A

(3) 0.6 A (4) 1.8 A

18. If a metal cube of side 5 cm has a charge of 6 microcoulombs, then the surface charge density is :-

(1) 4×10^2 μC/m^2

(2) 4×10^2 C/m^2

(3) 4×10^3 μC/m^2

(4) 4×10^3 C/m^2

19. If the force between the electron in the first Bohr orbit and the nucleus (proton) in hydrogen atom is F, then the force between them when the electron is in the second orbit is :-

(1) 4F (2) F/4

(3) F/9 (4) F/16

20. In a dc motor, induced e.m.f. will be maximum :-

(1) When motor takes maximum speed

(2) When motor starts rotating

(3) When speed of motor increases

(4) When motor is switched off

21. In a step-up transformer, the turn ratio is 1 : 2. A Leclanche cell (e.m.f. 1.5V) is connected across the primary. The voltage developed in the secondary would be :-

(1) 3.0 V (2) 0.75 V

(3) 1.5 V (4) Zero

22. In the EM wave the amplitude of magnetic field H_0 and the amplitude of electric field E_0 at any place are related as :-

(1) $H_0 = E_0$ (2) $H_0 = \frac{E_0}{c}$

(3) $H_0 = E_0\sqrt{\frac{\mu_0}{\varepsilon_0}}$ (4) $H_0 = E_0\sqrt{\frac{\varepsilon_0}{\mu_0}}$

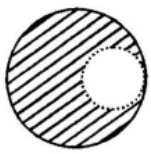
23. Two particles of equal mass 'm' go around a circle of radius R under the action of their mutual gravitational attraction. The speed of each particle with respect to their centre of mass is:-

(1) $\sqrt{\frac{Gm}{R}}$ (2) $\sqrt{\frac{Gm}{4R}}$

(3) $\sqrt{\frac{Gm}{3R}}$ (4) $\sqrt{\frac{Gm}{2R}}$

24. From a solid sphere of mass M and radius R, a spherical portion of radius $\frac{R}{2}$ is removed, as shown in the figure. Taking gravitational potential V = 0 at r = ∞, the potential at the centre of the cavity thus formed is :

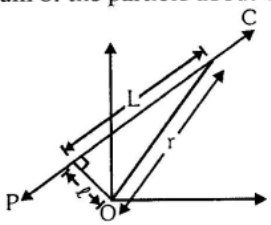
(G = *gravitational constant*)



(1) $\frac{-2GM}{3R}$ (2) $\frac{-2GM}{R}$

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

25. A particle of mass m moves along line PC with velocity v as shown. What is the angular momentum of the particle about O ?



(1) mvL (2) mvℓ (3) mvr (4) zero

26. From a solid sphere of mass M and radius R a cube of maximum possible volume is cut. Moment of inertia of cube about an axis passing through its centre and perpendicular to one of its faces is :-

(1) $\frac{4MR^2}{9\sqrt{3}\pi}$ (2) $\frac{4MR^2}{3\sqrt{3}\pi}$

(3) $\frac{MR^2}{32\sqrt{2}\pi}$ (4) $\frac{MR^2}{16\sqrt{2}\pi}$

27. If S is stress and Y is Young's modulus of material of a wire, the energy stored in the wire per unit volume is-

(1) $2S^2Y$ (2) $\frac{S^2}{2Y}$ (3) $\frac{2Y}{S^2}$ (4) $\frac{S}{2Y}$

28. A 20 cm long capillary tube is dipped in water. The water rises upto 8 cm. If the entire arrangement is put in a freely falling elevator, the length of water column in the capillary tube will be-

(1) 8 cm (2) 10 cm (3) 4 cm (4) 20 cm

29. 50 gm of copper is heated to increase its temperature by 10°C. If the same quantity of heat is given to 10 gm of water, the rise in its temperature is:

(Specific heat of copper =420 Joule $kg^{-1}°C^{-1}$)

(1) 5°C (2) 6°C

(3) 7°C (4) 8°C

30. If the internal energy of n_1 moles of He at temperature 10T is equal to the internal energy of n_2 mole of hydrogen at temperature 6T. The ratio of $\frac{n_1}{n_2}$ is

(1) $\frac{3}{5}$ (2) 2 (3) 1 (4) $\frac{5}{3}$

31. 5.6 liter of helium gas at STP is adiabatically compressed to 0.7 liter. Taking the initial temperature to be T_1, the magnitude work done in the process is

(1) $\frac{9}{8}RT_1$ (2) $\frac{3}{2}RT_1$

(3) $\frac{15}{8}RT_1$ (4) $\frac{9}{2}RT_1$

32. Energy is being emitted from the surface of a black body at 127°C temperature at the rate of 1.0×10^6 J/s–m^2. Temperature of the black body at which the rate of energy emission is 16.0×10^6 J/s–m^2 will be:

(1) 254°C (2) 508°C

(3) 527°C (4) 727°C

33. A body is executing simple Harmonic motion. At a displacement x it's potential energy is E_1 and at a displacement y, its potential energy is E_2. The Potential energy E at a displacement (x + y) is :-

(1) $E_1 + E_2$ (2) $\sqrt{E_1^2 + E_2^2}$

(3) $\sqrt{E_1 E_2}$ (4) $E_1 + E_2 + 2\sqrt{E_1 E_2}$

34. How long after the begining of motion is the displacement of a harmonically oscillating particle equal to one half its amplitude if the period is 12 sec and particle starts from rest :-

(1) 1 s (2) 2 s

(3) 3 s (4) 6 sec

35. Mechanical wave (sound wave) in a gas is :-

(1) Transverse

(2) Longitudinal

(3) Neither transverse nor longitudinal

(4) Either transverse or longitudinal

36. The path Difference between the two waves

$$y_1 = a_1 \sin\left(\omega t - \frac{2\pi x}{\lambda}\right) \text{ and } y_2 = a_2 \cos\left(\omega t - \frac{2\pi x}{\lambda} + \phi\right)$$

is :-

(1) $\frac{\lambda}{2\pi}\phi$ (2) $\frac{\lambda}{2\pi}\left(\phi - \frac{\pi}{2}\right)$

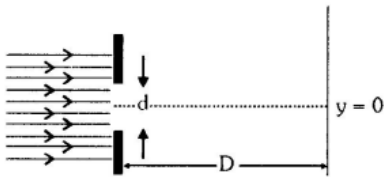
(3) $\frac{\lambda}{2\pi}\left(\phi + \frac{\pi}{2}\right)$ (4) $\frac{2\pi}{\lambda}\phi$

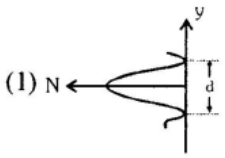
37. Two beams of light having intensities I and $4I$ interfere to produce a fringe pattern on a screen. The phase difference between the beams is $\pi/2$ at point A and π at point B. Then the difference between the resultant intensities at A and B is :

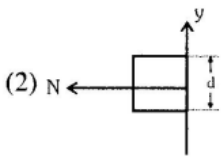
(1) 2I (2) 4I

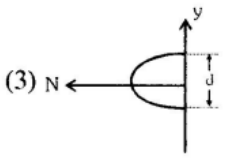
(3) 5I (4) 7I

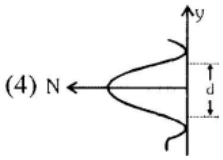
38. In an experiment, electrons are made to pass through a narrow slit of width 'd' comparable to their de-Broglie wavelength. They are detected on a screen at a distance 'D' from the slit (see figure). Which of the following graphs can be expected to represent the number of electrons 'N' detected as a function of the detector position 'y' (y = 0 corresponds to the middle of the slit) ?



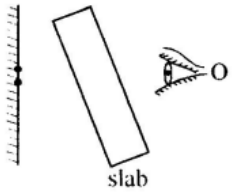
(1) 

(2) 

(3) 

(4) 

39. The observer at O views two closely spaced spots on a vertical wall through an angled glass slab as shown. As seen by observer, the spots appear.



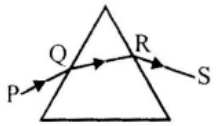
(1) shifted upward

(2) shifted downward

(3) spaced farther apart

(4) spaced closer together

40. A ray of light is incident on an equilateral glass prism placed on a horizontal table. For minimum deviation which of the following is true ?



(1) PQ is horizontal
(2) QR is horizontal
(3) RS is horizontal
(4) Either PQ or RS is horizontal

41. For a CE amplifier, current gain is 69. If the emitter current is 7 mA then the base current and collector current will be -

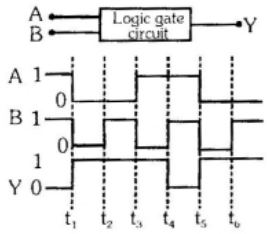
(1) 6.9 mA, 0.1 mA (2) 0.1 mA, 6.9 mA
(3) 0.2 mA, 8.1 mA (4) 0.8 mA, 3.6 mA

42. If λ_{max} is 6563 Å, for Balmer series of a particular atom then wavelength of second line for Balmer series will be

(1) $\lambda = \frac{16}{3R}$ (2) $\lambda = \frac{36}{5R}$

(3) $\lambda = \frac{4}{3R}$ (4) None of the above

43. The following figure shows a logic gate circuit with two inputs A and B and the output Y. The voltage waveforms of A, B, and Y are as given?



The logic gate is :-
(1) OR gate (2) AND gate
(3) NAND gate (4) NOR gate

44. Half-life of radioactive sample, when activity of material initially was 8 counts and after 3 hours it becomes 1 count, is

(1) 2 hours (2) 1 hour (3) 3 hours (4) 4 hours

45. Which of the following is related with characteristic emission of X-ray :–
(1) α-particle emission
(2) electron emission
(3) positron emission
(4) K-eletron capturing

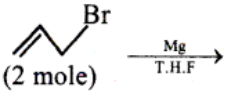
46. What is the value of n-factor of $[Fe(CN)_6]^{-4}$ is the given reaction

$$[Fe(CN)_6]^{-4} \xrightarrow{MnO_4^-/H^+} Fe^{+3} + CO_2 + NO_3^-$$

(1) 18 (2) 31 (3) 61 (4) 28

47. If concentration of a first order reaction is increased by 'x' times, then rate constant (k) becomes :-

(1) $e^{-k/x}$ (2) $\frac{x}{k}$
(3) k (4) $e^{k/x}$

48. 

Find out the major product :

(1)  (2) 
(3)  (4) 

49. Which of the following species is not aromatic :

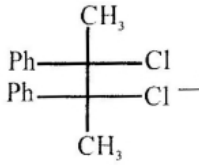
(1)  (2) 
(3)  (4) 

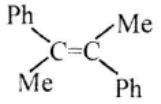
50. Which one of the following complexes will have four isomer :-
(1) $[Co(en)(NH_3)_2Cl_2]Cl$
(2) $[Co(PPh_3)_2(NH_3)_2Cl_2]Cl$
(3) $[Co(en)_3]Cl_3$
(4) $[Co(en)_2Cl_2]Br$

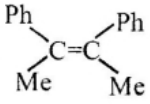
51. The oxidation number of Cr in K_3CrO_8 is +5 how many peroxy linkages are present in this molecule:

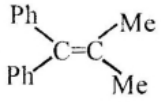
(1) 4 (2) 3 (3) 5 (4) 2

52. A liquid is kept in a closed vessel. If a glass plate (negligible mass) with a small hole is kept on top of the liquid surface, then the vapour pressure of the liquid is the vessel is :-
(1) More than what would be if the glass plate were removed
(2) Same as what would be if the glass plate were removed
(3) Less than what would be if the glass plate were removed
(4) Cannot be predicted

53.  $\xrightarrow{Zn/\Delta}$ Product is :

(1) 

(2) 

(3) 

(4) None

54. Glucose $\xrightarrow{Br_2-H_2O}$ Product; Product is :

(1) glutaric acid (2) gluconic acid
(3) hexanoic acid (4) bromo hexane

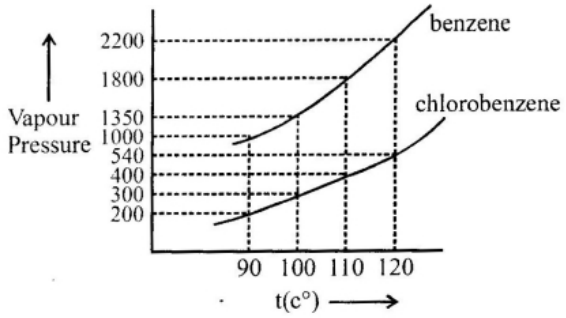
55. Milk of magnesia is :-

(1) $Mg(OH)_2$ (2) $Mg(CO_3)_2$
(3) $CaCO_3$ (4) $Ca(OH)_2$

56. The halide of a metal MX crystalizes as ccp structure (NaCl type). If all the atoms situated at one of the tetrad axis are removed then what will be the simplest molecular formula of halide :

(1) MX (2) M_3X_4 (3) MX_2 (4) MX_3

57. Assuming the formation of an ideal solution, determine the boiling point of a mixture containing 1560 g benzene (molar mass = 78) and 1125 g chlorobenzene (molar mass = 112.5) using the following against an external pressure of 1000 torr:-



(1) 90°C (2) 100°C
(3) 110°C (4) 120°C

58. Glycerol $\xrightarrow{KHSO_4}$ (A) $\xrightarrow{LiAlH_4}$ (B) ;(A) and (B) are respectively :

(1) acrolein, allyl alcohol
(2) glyceryl sulphate, acrylic acid
(3) allyl alcohol, acrolein
(4) none

59. α-D Glucopyranose and β-D Glucopyranose are :

(1) Anomers (2) Epimer
(3) Diasteriomers (4) Meso compound

60. Which of the following order of acidic strength is correct ?

(1) $SO_2 > SO_3 > CO_2$
(2) $Cs_2O > K_2O > Na_2O$
(3) $CO_2 > N_2O_5 > B_2O_3$
(4) $SO_3 > CO_2 > B_2O_3$

61. At what temperature root mean square speed of ozone will be equal to root mean square speed of oxygen at 27°C :

(1) 77°C (2) 177°C
(3) 277°C (4) –77°C

62. The energy of the electron in the first orbit of He^+ is -871.6×10^{-20} J. The energy of the electron in the first orbit of hydrogen would be:-

(1) -871.6×10^{-20} J (2) -435.8×10^{-20} J
(3) -217.9×10^{-20} J (4) -108.9×10^{-20} J

63. Arrange these compounds in decreasing order of reactivity for the nucleophilic addition reactions :

(I) HCHO (II) CH_3CHO

(III) Acetone (IV) Et–C(=O)–Et

(1) I > II > III > IV (2) IV > III > II > I
(3) III > II > I > IV (4) I > IV > II > III

64. Ammonia with excess of Cl_2, forms :-

(1) Nitrogen (2) Nitrosyl chloride
(3) Ammonium chloride (4) Nitrogen trichloride

65. Which among the following attraction is strongest?

(1) HF----H_2O (2) HF----Cl_2
(3) H_2O----Cl_2 (4) Cl_2----Cl_2

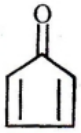
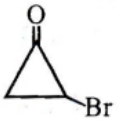
66. 25 g of a solute of molar mass 250 g mol^{-1} is dissolved in 100 ml of water to obtain a solution whose density is 1.25 g ml^{-1}. The molarity and molality of the solution are respectively:-

(1) 0.75 and 1 (2) 0.8 and 1
(3) 1 and 0.8 (4) 1 and 1

67. On addition of one mL solution of 10% NaCl to 10 mL gold sol in presence of 0.025 g of starch, the coagulation is just prevented. The gold number of starch is :–

(1) 25 (2) 2.5 (3) 0.25 (4) 0.025

68. Which carbonyl compound has maximum dipole moment :

(1) 
(2) 
(3) 
(4) 

69. Holme's signals can be obtained by using :-

(1) $CaC_2 + CaCN_2$ (2) $CaC_2 + Ca_3P_2$
(3) $CaC_2 + CaCO_3$ (4) $Ca_3P_2 + CaCN_2$

70. Compare π-bond strength between B & N given in two compounds :-

(I) $(CH_3)_3Si-\underset{\displaystyle Si(CH_3)_3}{\underset{|}{N}}BH_2$ (II) $(CH_3)_3C-\underset{\displaystyle C(CH_3)_3}{\underset{|}{N}}BH_2$

(1) There is no π bond character between B & N
(2) Same in I & II
(3) I > II
(4) II > I

71. Find out the value of K_C for the following reaction from the value of K_P

$2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$

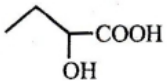
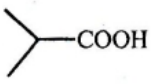
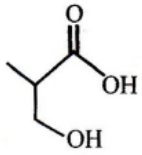
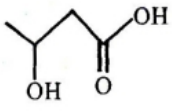
[Given : $K_P = 8 \times 10^{12}$ atm at 500 K
use R = 0.08 L atm mol^{-1} K^{-1}]

(1) 32×10^{13} mol L^{-1} (2) 8×10^{12} mol L^{-1}
(3) 2×10^{11} mol L^{-1} (4) None of these

72. The uncertainity in the location of circulating electron is equal in it's de-Broglie wavelength the minimum percent error in it's measurement of velocity under this cicumstances will be approximately :

(1) 4 (2) 8 (3) 18 (4) 22

73. An optically active compound 'X' having molecular formula $C_4H_8O_3$ it evolves CO_2 with $NaHCO_3$.'x' on treatment with $LiAlH_4$ gives achiral compound then 'x' is :

(1) 
(2) 
(3) 
(4) 

74. Water is oxidised to oxygen by :-

(1) ClO_2 (2) $KMnO_4$
(3) H_2O_2 (4) F_2

75. Consider the following statements for $\dot{C}H_3$=X and $\dot{C}F_3$=Y.

(I) When X dimerises bond angle decreases
(II) When X dimerises bond angle increases
(III) In X-Y molecule C–C bond length is less than that in Y–Y molecule
(IV) Bond angle in X is greater than that in Y

(1) II, III (2) I, II, III
(3) I, IV (4) II, III, IV

76. One litre of an aqueous solution contain 0.15 mole of CH_3COOH ($pK_a = 4.8$) and 0.15 mole of CH_3COONa. After the addition of 0.05 mole of solid NaOH to this solution, the pH will be:

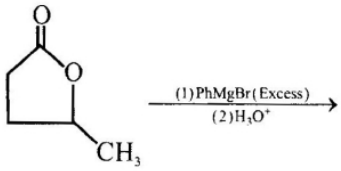
(1) 4.5 (2) 4.8
(3) 5.1 (4) 5.4

77. Different hydrogen in the compound are represented by alphabets :

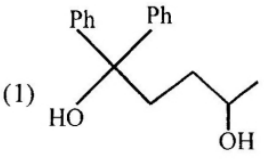
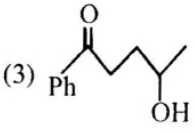
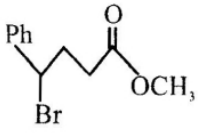
$CH_3-CH = CH - CH_2 - CH_2 - CH(CH_3)_2$
(A) (B) (C) (D) (E) (F)

arrange them in decreasing order of reactivity towards free radical substitution

(1) C > A > E > D > F > B
(2) F > B > A > C > D > E
(3) B > C > A > F > D > E
(4) A > B > C > D > E > F

78. 

The major product formed in the reaction is :

(1) 
(2) 
(3) 
(4) 

79. Which one of the following elements shows maximum number of different oxidation states in its compound :-

(1) Eu (2) La (3) Gd (4) Am

80. When Mg burns in air, it produces :-

(1) MgO, MgO_2

(2) MgO, Mg_3N_2, MgO_2

(3) Mg_3N_2 only

(4) Mg_3N_2 & MgO

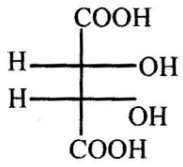
81. A gas present in a cylinder, expands against a constant pressure of 1 atm from a volume of 2 litre to a volume of 6 litre. In doing so, it absorbs 800 joule heat from surrounding. The change in internal energy of process is :

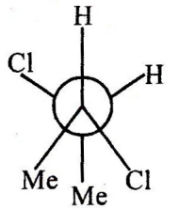
(1) +305.85 joule (2) +796 joule

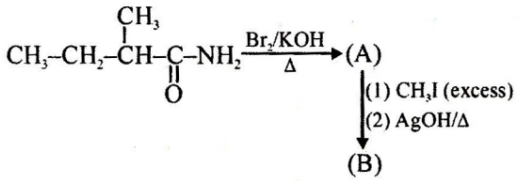
(3) +395 joule (4) –463.28 joule

82. Which of the following will not show optical activity :

(1) Cl-CH=C=CH-Cl (2) Br-CH=C=CH-Br

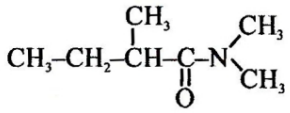
(3) 

(4) 

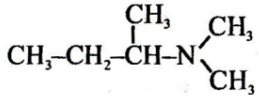
83. 

The major product 'B' is :

(1) $CH_3–CH_2–CH = CH_2$

(2) 

(3) $CH_3–CH = CH – CH_3$

(4) 

84. The colour of $KMnO_4$ is due to :-

(1) Charge transfer from ligand to metal

(2) Charge transfer from metal to ligand

(3) d-d transition

(4) p-d transition

85. Which of the following is producing H_2O_2 on hydrolysis :-

(1) Na_2O_2 (2) PbO_2

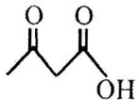
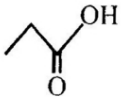
(3) BaO_2 (4) 1 & 3 both

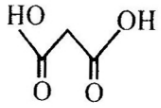
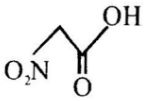
86. For a chemical reaction, $A + 2B \rightarrow C + D$, the rate of reaction increases three times, when concentration of A only is increased nine times. While when concentration of B only is increased 2 times, then rate of reaction also increases 2 times. The order of this reaction is:-

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

(3) $\frac{1}{2}$ (4) None of these

87. Which of the following carboxylic acids is difficult to decarboxylate :

(1)  (2) 

(3)  (4) 

88. Phenol can be converted into salicylic acid by heating with :

(1) CO_2 (under pressure) and alkali

(2) CCl_4 and alkali

(3) $CHCl_3$ and alkali followed by oxidation

(4) All of the above

89. Which among the following complexes has square pyramidal geometry ?

(1) Tetra carbonyl nickel (o)

(2) Hexamine cobalt (II) nitrate

(3) Penta carbonyl iron (o)

(4) Bis(acetylacetonato) oxovandium (IV)

90. If the impurity in a metal has a greater affinity for oxygen and is more easily oxidised than the metal, then the purification of metal may be carried out by :-

(1) Cupellation (2) Electrorefining

(3) Zone refining (4) Poling