

## Paper - II

- Radial force  $= \frac{mv^2}{r} = \frac{m}{r} \left( \frac{p}{m} \right)^2 = \frac{p^2}{mr}$   
 ....[ $\because p = mv$ ]
- As the volume is continuously increasing and the work of expansion is always positive, so the work done by the system continuously increases.
- Angular spread of central maxima is  $\theta = 2\lambda/a$
- When particle moves undeflected, magnetic force and electric force on particle exactly balance each other, i.e.,  $F_m = F_e$   
 $qvB = qE \Rightarrow v = \frac{E}{B}$
- $\phi = BA \cos \theta = 4 \times 10^{-2} \times 0.4 \times \cos 60^\circ$   
 $= 8 \times 10^{-3} \text{ Wb}$

- Magnetic field energy  $\left( \frac{1}{2} LI^2 \right)$  changes from max. to zero, when current changes from  $I_0$  to zero i.e. in  $T/4$  sec.  
 $\therefore \frac{T}{4} = 10 \text{ ms}, T = 40 \text{ ms} = 40 \times 10^{-3} \text{ s}$   
 $f = \frac{1}{T} = \frac{1}{40 \times 10^{-3}} = \frac{10^3}{40} = 25 \text{ Hz}$
- $g = \frac{GM}{R^2} \Rightarrow g \propto \frac{M}{R^2}$
- $I_E = I_B + I_C \Rightarrow I_C = I_E - I_B$
- New amplitude  $= 0.09 \times \frac{2}{3} = 0.06$   
 Direction is reversed.  
 Thus required equation will be  
 $-0.06 \sin 8\pi \left( t + \frac{x}{20} \right)$
- Spring constant,  $k = \frac{F}{x} = \text{Slope of curve}$   
 $\therefore k = \frac{800 - 200}{15}$   
 $= 40 \text{ g/cm} = 0.04 \text{ kg/cm}$
- The frictional force between tyres and road provides necessary c.p.f., but this force also has a moment about centre of mass of cyclist, which causes the cyclist to topple.
- The bridge is balanced because  
 $\frac{P}{Q} = \frac{R}{S} \quad \left( \because \frac{10 \Omega}{2 \Omega} = \frac{25 \Omega}{5 \Omega} \right)$   
 Hence, there will be no current through the  $10 \Omega$  resistance and galvanometer. Let the current through arm ABC be  $I$ . Then current through the arm ADC will be  $(1.4 - I)$ .  
 Hence,  
 $(10 + 2)I = (25 + 5)(1.4 - I)$   
 $\therefore 12I = 30 \times 1.4 - 30I$   
 $\therefore 42I = 30 \times 1.4$   
 $\therefore I = \frac{30 \times 1.4}{42} = 1 \text{ A}$
- $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE}}$   
 $\therefore \lambda \propto \frac{1}{\sqrt{E}} \quad (h \text{ and } m = \text{constant})$
- $W = \int_{x=0}^{x=4} F dx = \int_{x=0}^{x=4} \left( \frac{x}{2} + 15 \right) dx$   
 $= \int_{x=0}^{x=4} \frac{x}{2} dx + \int_{x=0}^{x=4} 15 dx$

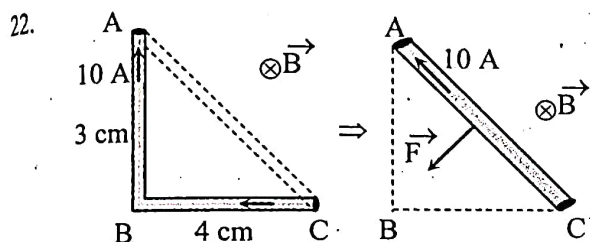
$$= \frac{1}{2} \left[ \frac{x^2}{2} \right]_{x=0}^{x=4} + 15 \left[ x \right]_{x=0}^{x=4}$$

$$= \frac{1}{2} \left[ \frac{4^2 - 0}{2} \right] + 15[4 - 0]$$

$$W = 4 + 60 = 64 \text{ J}$$

19.  $P = \frac{4T}{r} = \frac{4 \times 15}{2 \times 10^{-1}} = 300 \text{ dyne/cm}^2$

21. In adiabatic process, exchange of heat  $\Delta Q = 0$



Force on the conductor ABC

= Force on the conductor AC

$$F = I l B \sin \theta$$

$$= I l B \quad \dots (\because \theta = 90^\circ)$$

$$\therefore F = 15 \times (5 \times 10^{-2}) \times 8 = 6 \text{ N}$$

23.  $\mu_r < 1$  and  $\epsilon_r > 1$

24. As  $I$  increases in outer loop,  $\phi$  increases

$\therefore$  Current in the inner loop is such that it opposes the increase in  $\phi$ . Hence  $\phi$  decreases (By Right Hand Rule). The induced current will be counter clockwise.

25. For inductor,

$$I \propto \frac{1}{X_L} \propto \frac{1}{f}$$

Hence, as frequency increases, current decreases.

For capacitor,

$$I \propto \frac{1}{X_C} \propto f$$

Hence, as frequency increases, current increases.

26. For  $r_1 > R$  and  $r_2 > R$ ,

Potential at  $r$  is,

$$V = \frac{GM}{r}$$

$$\text{here, } M = \frac{4}{3} \pi R^3 \rho$$

$$\therefore V_1 = \frac{\frac{4}{3} \pi R^3 \rho G}{r_1} \text{ and } V_2 = \frac{\frac{4}{3} \pi R^3 \rho G}{r_2}$$

$$\therefore \frac{V_1}{V_2} = \frac{r_2}{r_1}$$

For  $r_1 < R$  and  $r_2 < R$ ,

The gravitational potential inside the earth is only due to the mass of the earth that lies within a solid sphere of radius  $r$ .

$$\therefore M = \frac{4}{3} \pi r^3 \rho$$

$$\therefore V_1 = \frac{\frac{4}{3} \pi r_1^3 \rho G}{r_1} = \frac{4}{3} \pi r_1^2 \rho G$$

$$V_2 = \frac{\frac{4}{3} \pi r_2^3 \rho G}{r_2} = \frac{4}{3} \pi r_2^2 \rho G$$

$$\therefore \frac{V_1}{V_2} = \frac{r_1^2}{r_2^2}$$

$$27. \alpha = \frac{\text{Change in collector current}}{\text{Change in emitter current}}$$

$$\therefore \beta = \frac{\alpha}{1 - \alpha} = \frac{0.95}{1 - 0.95} = 19$$

$$\therefore \Delta I_C = \beta(\Delta I_B) = 19 \times 0.4 = 7.6 \text{ mA}$$

$$28. \text{ Frequency of vibration of string, } n = \frac{P}{2l} \sqrt{\frac{T}{m}}$$

Where  $m$  is linear mass density

Case I:

Number of loops ( $P_1$ ) = Number of antinodes  
= 5

$$\therefore n_1 = \frac{5}{2l} \sqrt{\frac{T_1}{m}}$$

$$\therefore n_1 = \frac{5}{2l} \sqrt{\frac{9g}{m}} \quad \dots (i)$$

Case II:

Number of loop ( $P_2$ ) = Number of antinodes  
= 3

$$\therefore n_2 = \frac{3}{2l} \sqrt{\frac{T_2}{m}}$$

$$\therefore n_2 = \frac{3}{2l} \sqrt{\frac{Mg}{m}} \quad \dots (ii)$$

Dividing equation (i) and (ii),

$$\frac{n_1}{n_2} = \frac{5 \times \sqrt{9}}{3 \times \sqrt{M}}$$

Since  $n_1 = n_2$

$$\therefore 9 \times M = 25 \times 9$$

$$\therefore M = 25 \text{ kg}$$

$$29. \text{ M.I. of rod about one end} = \frac{ML^2}{3}$$

$$= \frac{1}{2} \times \frac{(l)^2}{3} = \frac{1}{6}$$

$$\therefore \text{K.E. of the rod} = \frac{1}{2} I \omega^2 = \frac{1}{2} \times \frac{1}{6} \times (6)^2 = 3 \text{ joule.}$$

$$30. E_{\text{medium}} = \frac{E_{\text{air}}}{k} = \frac{E}{2}$$

31. For small dipole,  
At  $2r$ :

$$E_{\text{equator}} = \frac{1}{4\pi\epsilon_0} \frac{p}{(2r)^3} = \frac{1}{4\pi\epsilon_0} \frac{p}{8r^3} = E_2$$

At r:

$$E_{\text{axis}} = \frac{1}{4\pi\epsilon_0} \frac{2p}{r^3} = E_1$$

$$\therefore \frac{E_2}{E_1} = \frac{(1/4\pi\epsilon_0) \times (p/8r^3)}{(1/4\pi\epsilon_0) \times (2p/r^3)} = \frac{1}{16}$$

32. According to the balance condition of Wheatstone bridge,

$$\frac{X}{10} = \frac{(52+1)}{(48+2)}$$

$$\therefore X = 10.6 \Omega$$

$$34. K.E_{\text{max}} = hv - \phi = hv - hv_0 = h(v - v_0)$$

$$36. F = \eta A \frac{dv}{dx}$$

$$\therefore \text{shearing stress} = \frac{F}{A} = \eta \frac{dv}{dx}$$

$$\therefore \text{shearing stress} = 10^{-2} \times \frac{8 \times \frac{5}{18}}{12} = 1.85 \times 10^{-3} \text{ N/m}^2$$

37. Pressure exerted by the gas on wall of container is given by,

$$P = \frac{1}{3} \rho v^2 \quad \dots (v \equiv \text{r.m.s. speed})$$

$$\therefore P = \frac{1}{3} \left( \frac{M}{V} \right) v^2$$

$$P = \frac{2}{3} \cdot \frac{1}{2} \left( \frac{M}{V} \right) v^2$$

$$\therefore P = \frac{2}{3} \left( \frac{K.E}{V} \right) \quad \dots (\because K.E. = \frac{1}{2} Mv^2)$$

38. For interference, phase difference must be constant.

$$39. B = \mu_0 n I \Rightarrow B \text{ does not depend upon radius.}$$

$$40. \text{Magnetization is given by, } M_Z = \frac{CB_{\text{ext}}}{T}$$

41. The reactance of the circuit is zero either when the circuit contains only resistor or the circuit contains an inductor and capacitor connected in such a way that their individual reactance cancel out.

42. At constant pressure,

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\text{Here } T_1 = 27^\circ\text{C} = 300 \text{ K}$$

$$T_2 = 127^\circ\text{C} = 400 \text{ K}$$

$$\therefore \frac{1}{300} = \frac{V_2}{400}$$

$$V_2 = 1.3 \text{ litre}$$

44. Time interval between a maxima and consecutive minima,

$$\Delta t = \frac{1}{2(n_1 - n_2)} = \frac{1}{2 \times 4} = \frac{1}{8} \text{ s}$$

45. We know that, frequency of oscillations is,

$$n = \frac{1}{2\pi} \sqrt{\frac{g}{l}}$$

$$\therefore n \propto \frac{1}{\sqrt{l}}$$

For given pendulums,

$$n_1 = \frac{1}{2\pi} \sqrt{\frac{g}{1.44}}$$

$$\text{and } n_2 = \frac{1}{2\pi} \sqrt{\frac{g}{1.96}}$$

$$\therefore \frac{n_1}{n_2} = \sqrt{\frac{1.96}{1.44}} = \frac{7}{6}$$

$$\therefore n_2 = \frac{6n_1}{7}$$

Hence, for  $n_2$  to be integer, minimum value of  $n_1$  should be 7.

$$\therefore n_2 = 6$$

i.e., after 6 oscillations of bigger pendulum, both will be in phase.

$$46. \text{M.I. of 1 about } YY' = \frac{MR^2}{2} + MR^2 = \frac{3MR^2}{2}$$

$$\text{M.I. of 2 about } YY' = \frac{3MR^2}{2}$$

$$\text{M.I. of 3 about } YY' = \frac{MR^2}{2}$$

$$\therefore I = \frac{3MR^2}{2} + \frac{3MR^2}{2} + \frac{MR^2}{2} = \frac{7MR^2}{2} = \frac{7PQ^2}{2}$$

$$48. n = \frac{q}{e} = \frac{1 \times 10^{-9}}{1.6 \times 10^{-19}} = 6.25 \times 10^9$$

$$49. R_{AB} = 2 \times 10 = 20 \Omega$$

$$I = \frac{3}{10+20} = \frac{3}{30} = \frac{1}{10} \text{ A}$$

$$\text{So, } V = I R_{AB} = \frac{1}{10} \times 20 = 2 \text{ V}$$

$$\frac{V}{L} = \frac{2}{10} = 0.2 \text{ V/m.}$$

$$50. \frac{1}{\lambda_{\text{Balmer}}} = R_{\text{H}} \left[ \frac{1}{2^2} - \frac{1}{3^2} \right] = \frac{5R_{\text{H}}}{36}$$

$$\therefore \frac{1}{\lambda_{\text{Lyman}}} = R_{\text{H}} \left[ \frac{1}{1^2} - \frac{1}{2^2} \right] = \frac{3R_{\text{H}}}{4}$$

$$\therefore \lambda_{\text{Lyman}} = \lambda_{\text{Balmer}} \times \frac{5}{27} = 1215.4 \text{ \AA}$$

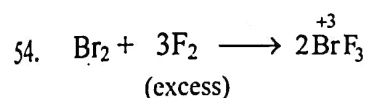
51. (A)  $\text{Cl}^-$  is a Bronsted base.  
 (B) All Lewis acids are not Bronsted acids.  
 (D)  $\text{H}_2\text{O}$  acts as an acid towards  $\text{NH}_3$  and as a base towards  $\text{HCl}$ .

52. The pairs  $\text{CH}_3\text{CH}_2\text{OH}$ ,  $\text{CH}_3\text{OCH}_2\text{CH}_3$  and  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ ,  $\text{CH}_3\text{CH}_2\text{CHO}$  have different compounds because the compounds of each pair have different functional groups. The compounds in the pair  $\text{CH}_3\text{CH}_2\text{OCH}_3$ ,  $\text{CH}_3\text{OCH}_2\text{CH}_3$  are same. The pair  $\text{CH}_3\text{OCH}_3$ ,  $\text{CH}_3\text{OCH}_2\text{CH}_3$  belongs to homologous series as the compounds differ by  $-\text{CH}_2$  unit and they have same functional group.

53. 
$$E = E^\circ - \frac{0.0592}{2} \log_{10} \frac{[\text{H}^+]^2}{P_{\text{H}_2}}$$
  

$$= 0 - \frac{0.0592}{2} \log_{10} \frac{(0.1)^2}{1} = - \frac{0.0592}{2} \times (-2)$$
  

$$= 0.0592 \text{ V}$$



55. The nucleophile attacks the carbon undergoing substitution from the side opposite to that of the leaving group.

56. N-H bonds in amines are less polar than O-H bond in alcohols. Thus, water solubilities of alcohols, amines and alkanes of comparable molar mass in water decreases in the order: alcohols > amines > alkanes.

57. The average rate of a reaction is the change in concentration of reactant or product divided by time interval over which the change occurs.

58. The molecular formula of Raffinose is  $\text{C}_{18}\text{H}_{32}\text{O}_{16}$  (Trisaccharide), Sucrose is  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$  (Disaccharide) and Stachyose is  $\text{C}_{24}\text{H}_{42}\text{O}_{21}$  (Tetrasaccharide).

59. 
$$\text{CO} + \frac{1}{2}\text{O}_2 \rightarrow \text{CO}_2$$
  

$$\Delta H = \Delta_f H^\circ(\text{CO}_2) - \left[ \Delta_f H^\circ(\text{CO}) + \frac{1}{2} \Delta_f H^\circ(\text{O}_2) \right]$$
  

$$= -94.0 \text{ kcal} - (-26.4 \text{ kcal}) \quad [\because \Delta_f H^\circ(\text{O}_2) = 0]$$
  

$$= -67.6 \text{ kcal}$$

61. Chlorine is 2-5 times heavier than air.

64. Alkyl groups have electron donating inductive effect (+I) which makes carbonyl carbon less electrophilic.

68. 
$$\Delta U = \Delta H \text{ when } \Delta n = 0$$
  
 In the equation (C),  

$$\text{H}_{2(g)} + \text{Cl}_{2(g)} \rightleftharpoons 2\text{HCl}_{(g)}$$
  

$$\Delta n = 0, \therefore \Delta U = \Delta H$$

69. Percent dissociation =  $\alpha \times 100$

$$\therefore \alpha = \frac{1.1}{100} = 1.1 \times 10^{-2}$$

Equilibrium concentration of  $\text{H}^+$  ions  

$$= \alpha \times c$$
  

$$= 1.1 \times 10^{-2} \times 0.1$$
  

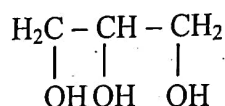
$$= 1.1 \times 10^{-3} \text{ mol L}^{-1}$$

71. One-eighth of each corner atom (X) and one half of each face centred atom (Y) are contained within the unit cell of the compound. Thus, the number of X atoms per unit cell =  $8 \times \frac{1}{8} = 1$  and the number of Y atoms per unit cell

$$= 6 \times \frac{1}{2} = 3.$$

The formula of the compound is  $\text{XY}_3$ .

73. Propylene glycerol is a trihydric alcohol.



It has -OH groups attached to two primary C-atoms and one secondary C-atom.

74. Repeating units of a condensation polymer do not have the same elemental composition as that of original monomer.

75. Reactivity of aldehydes and ketones is due to the polarity of carbonyl group which results in electrophilicity of carbon. In general, aldehydes are more reactive than ketones toward nucleophilic attack due to greater +I effect of alkyl group and greater steric hindrance of alkyl group.

76. Electronic configuration of  $\text{X}^{3+}$ :  $[\text{Ar}] 3d^4$   
 Electronic configuration of X:  $[\text{Ar}] 3d^5 4s^2$   
 Atomic number of X =  $18 + 5 + 2 = 25$

77. For first order kinetics, the integrated rate law is,

$$k = \frac{2.303}{t} \log \frac{[\text{A}]_0}{[\text{A}]_t}$$

where,  $k$  = rate constant =  $6 \text{ min}^{-1}$ ,  $t$  = time,  
 $[\text{A}]_0$  = initial concentration =  $0.5 \text{ mol dm}^{-3}$ , and  
 $[\text{A}]_t$  = concentration at time  $t = 0.05 \text{ mol dm}^{-3}$ ,

$$6 = \frac{2.303}{t} \log \frac{0.5}{0.05}$$

or 
$$t = \frac{2.303}{6 \text{ min}^{-1}} \log \frac{0.5}{0.05}$$

$$= \frac{2.303}{6 \text{ min}^{-1}}$$

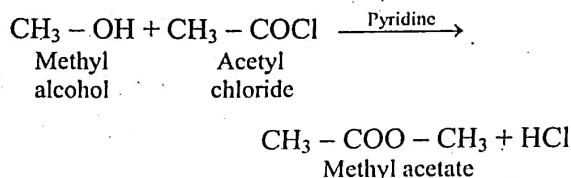
$$= 0.384 \text{ min}$$



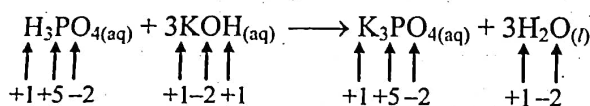
78. Only aliphatic aldehydes show reducing property with Fehling's solution and not the aromatic aldehydes and ketones. Thus only butanal will give red precipitate with Fehling's solution, among the given options.

79. Sunscreen contains nanoparticles of zinc oxide (ZnO) and titanium dioxide (TiO<sub>2</sub>).

80. Methyl alcohol reacts with acetyl chloride to give methyl acetate.



81. Given reaction:



This is acid-base reaction. The oxidation numbers of all the species remain same thus; the given reaction is NOT a redox reaction.

82.  $\Delta T_b = 100 - 94 = 6^\circ\text{C} = 6\text{ K}$

$$\Delta T_b = i K_b m$$

$$\therefore m = \frac{\Delta T_b}{K_b} = \frac{6\text{ K}}{0.52\text{ K kg mol}^{-1}} = 11.54\text{ mol kg}^{-1}$$

Therefore, 1 kg or 1000 g water contain  
 = 11.54 mol nonvolatile solute  
 = 11.54 mol  $\times$  60 g mol<sup>-1</sup>  
 = 692 g

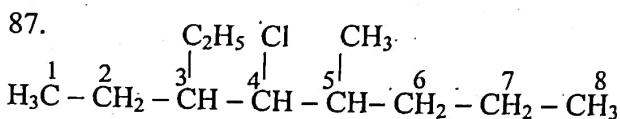
83.  $P_1 V_1 = P_2 V_2$

$$P_2 = \frac{P_1 V_1}{V_2} = \frac{1\text{ atm} \times 10\text{ L}}{20\text{ L}} = 0.5\text{ atm}$$

84. Enthalpy is an extensive property.

85. Potassium bicarbonate (KHCO<sub>3</sub>) is fairly soluble in water so it does not get precipitated in water while NaHCO<sub>3</sub> being sparingly soluble in water gets precipitated. Therefore, Solvay process is used to prepare Na<sub>2</sub>CO<sub>3</sub> but not K<sub>2</sub>CO<sub>3</sub>.

86. In NICAD cell, cathode is made by nickel(IV) oxide i.e., NiO<sub>2</sub> supported on Ni.



89. The vapour pressure of pure solvent =  $p_1^\circ$

$$= 120\text{ mm Hg}$$

$$\text{The vapour pressure of solution} = p$$

$$= 108\text{ mm Hg}$$

$$\text{Mole fraction of solute} = x_2$$

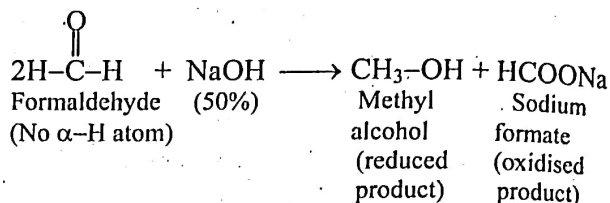
$$\text{According to Raoult's law, } \frac{p_1^\circ - p}{p_1^\circ} = x_2$$

$$\frac{120\text{ mm Hg} - 108\text{ mm Hg}}{120\text{ mm Hg}} = x_2 = 0.1$$

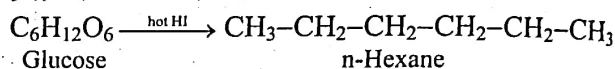
$$\text{Mole fraction of solvent} = 1 - x_2 = 1 - 0.1 = 0.9$$

$$90. \alpha = \frac{\wedge}{\wedge_0} = \frac{50}{250} = \frac{1}{5} = 0.2$$

93. In Cannizzaro's reaction, the oxidised and reduced forms of the same aldehyde are formed. It is disproportionation reaction.

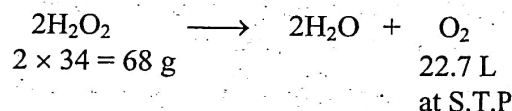


- 94.



96. 10 volume H<sub>2</sub>O<sub>2</sub> solution means that 1 L of this solution will liberate 10 L of oxygen at S.T.P. Let us calculate the amount of H<sub>2</sub>O<sub>2</sub> (in grams) which gives 10 L of oxygen at S.T.P. This amount will be present in 1 L of 10 volume solution of H<sub>2</sub>O<sub>2</sub>.

Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) decomposes as:

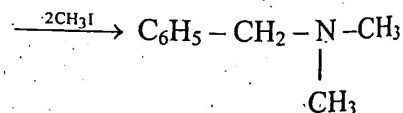
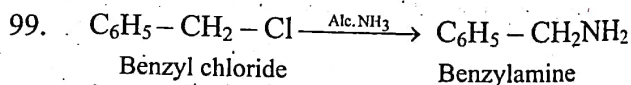


22.7 L of O<sub>2</sub> at S.T.P. is produced from H<sub>2</sub>O<sub>2</sub>

$$= 68\text{ g}$$

10 L of O<sub>2</sub> at S.T.P. is produced from H<sub>2</sub>O<sub>2</sub>

$$= \frac{68}{22.7} \times 10 = 29.96\text{ g} = 29.96\text{ g/litre}$$



100. The molecular weight of substance =  $M_2$   
 Molal elevation constant =  $K_b = 2.16\text{ K kg mol}^{-1}$   
 Mass of solute =  $W_2 = 0.11\text{ g} = 0.11\text{ g}$   
 Mass of solvent =  $W_1 = 15\text{ g} = 15\text{ g}$   
 Elevation in boiling point =  $\Delta T_b = 0.1^\circ\text{C}$   
 $= 0.1\text{ K}$   

$$M_2 = \frac{K_b \times W_2}{\Delta T_b \times W_1} = \frac{2.16\text{ K kg mol}^{-1} \times 0.11\text{ g}}{0.1\text{ K} \times 15\text{ g}}$$

$$= 0.158\text{ kg mol}^{-1}$$

$$= 158\text{ g mol}^{-1}$$