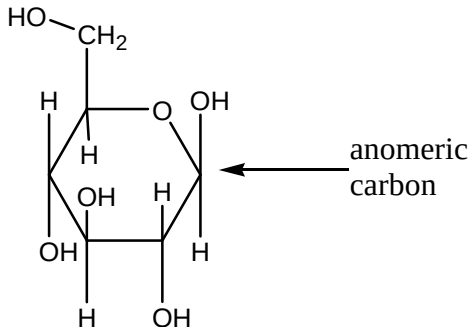
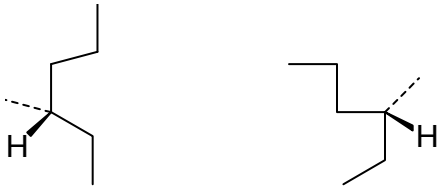
CH1011 Tutorial 4 Answers

1. Draw a **Haworth projection** of an **aldose** sugar in it's hemiacetal β-form and indicate the **anomeric** carbon in this molecule.

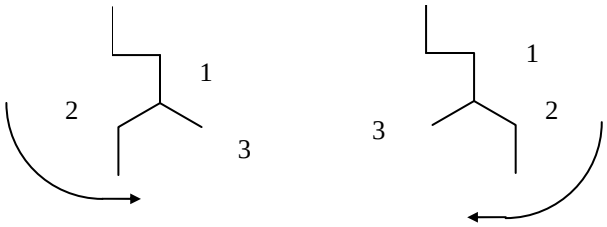


β-D-glucose (an aldose, hexose sugar)

2. Define the term **optical isomers**.
   In the two optical isomers shown which is the **R** and which the **S** form.

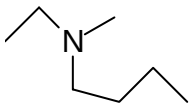


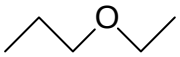
Optical isomers are stereoisomers that exist only in molecules which contain a chiral centre. A chiral centre is typically a carbon which possesses 4 different substituents. There are 2 possible arrangements of these 4 substituents about the chiral carbon, these 2 arrangements are mirror images of each other. The two arrangements of the chiral centre means that there are two different forms of the molecule and these are the optical isomers. The 2 isomers differ only in the way they rotate a beam of plane-polarized light.



S R

3. Provide IUPAC names for the following molecules:





N-ethyl-*N*-methylbutanamine ethoxypropane (or ethyl propyl ether)

4. A 50mL closed vessel contained 500mg of nitrogen gas at 0^oC and $8.13 \times 10^5 Pa$. What mass of $CH_4(g)$ would occupy the same volume at the same temperature and pressure? (assume ideal gas behaviour)

$V_1/n_1 = V_2/n_2$ Avogadro's Law

$50mL / n_{N2} = 50mL / n_{CH4}$ $\therefore$ $n_{N2} = n_{CH4}$
$n_{N2} = 0.500g / MN_2$ $= 0.500g / 28.0 \text{ mol } g^{-1}$ $= 0.0179$ mol
$n_{CH4} = 0.0179$
$m_{CH4} = n_{CH4} \times M_{CH4}$ $= 0.0179 \text{ mol} \times 16.0 \text{ g mol}^{-1}$ $= 0.286g$ (3 significant figures)

5. A 0.34g sample of hydrogen gas (H_2) was added to the 50mL vessel containing the 500mg of N_2 and the vessel was resealed. Calculate the mole-fraction of N_2 that would be present in this system.

$nH_2 = 0.34 \text{ g}/ 2.00 \text{ g mol}^{-1} = 0.17$ mol nN2 $= 0.500g / 28.0 \text{ g mol}^{-1} = 0.0179$ mol
$nH_2 + nN_2 = 0.1879$
$xN_2 = nN_2 / nH_2 + nN_2 = 0.0179 \text{ mol}/ 0.1879 \text{ mol} = 0.095$

6. A 43 mg sample of rat hemoglobin is dissolved in water at 5^oC to make 3.00mL of solution. This solution is placed into an osmometer and the osmotic pressure measured and found to be 3.60 torr. What is the molar mass of this particular type of hemoglobin?
(R =0.0821 atm.L/mol.K; 1 atm = 760 torr)

$\pi = [solute]RT$ $[solute] = n / V = (m / M) / V$
$= (m / M)RT / V$

$M = (m / \pi) RT / V$
$= (43 \times 10^{-3} \text{ g} / (3.60/760)) \times 0.0821 \text{ atm.L mol}^{-1}\text{K}^{-1} \times 278.15 \text{ K} / 3.00 \times 10^{-3} \text{ L}$
$= 6.91 \times 10^4$ g
= 69kDa seems about right for a protein.