Year 12 Chemistry

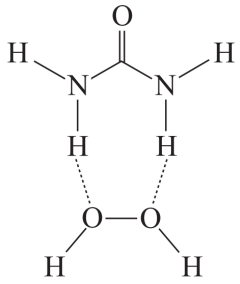
Test: Elemental Chemistry

1. Compounds of phosphorus can be used to soften water.
   (a) Write the electron configuration of phosphorus, using subshell notation. /2

   (b) Phosphorus commonly displays an oxidation state of +5 in its compounds.
      (i) Explain why an oxidation state of +5 is possible for phosphorus. Refer to the electron configuration of phosphorus in your answer. /2
      (ii) Identify the other positive oxidation state that phosphorus commonly displays in its compounds. /1

   (c) Draw the structural formula of the phosphate ion PO_4^{3-}. /2

2. Adhesive plastic strips containing hydrogen peroxide in a gel can be used to whiten teeth. In the gel, molecules of urea and hydrogen peroxide are held together by secondary interactions, as shown in the diagram below:



   (a)
      (i) On the diagram above, show the polarity of an O–H bond in the hydrogen peroxide molecule. /1
      (ii) State what causes this O–H bond to be polar. /1

   (b)
      (i) Name the type of secondary interaction shown holding these molecules of urea and hydrogen peroxide together. /1
      (ii) Explain why this secondary interaction occurs. /2

3. The elements titanium and zinc make important contributions to modern society.
   (a) Identify the block of the periodic table in which titanium and zinc are found. /1
   (b) Write the electronic configuration of the Zn^{2+} ion, using subshell notation. /2
   (c) The element titanium occurs naturally as the mineral titanium dioxide, TiO_2.
      (i) Predict and explain whether or not TiO_2 is likely to be molecular. /2
      (ii) TiO_2 reacts with sodium hydroxide to form the ion TiO_3^{2-}. Write an equation for the reaction of TiO_2 with sodium hydroxide. /2
      (iii) Explain how this reaction indicates that titanium has some non-metallic properties. /2

4. Oxides of sulfur and nitrogen are major pollutants that contribute to the formation of acid rain in industrialised countries.
   (a) State whether sulfur has a high, intermediate or low electronegativity. /1
   (b) Draw a diagram to show the bonding and shape of a molecule of SO_2. /2
   (c) Bonds between S and O are polar. State why the molecule of SO_2 is polar. /1
   (d) State why SO_2 is a gas at room temperature. /1