Practice Paper 2

Question Paper

Course	DP IB Chemistry
Section	Set C
Topic	Practice Paper 2
Difficulty	Medium

Time allowed: 60

Score: /50

Percentage: /100

Question 1a

a)

Nitroglycerin is an oily, colourless liquid and a high explosive, discovered by Alfred Nobel. The unbalanced equation for its explosive decomposition is given below.

$$.....C_3H_5N_3O_9(l) \rightarrow .....N_2(g) + ...CO(g) + ...H_2O(g) + ...O_2(g)$$

Deduce the coefficients required to balance the equation for this reaction and use the equation to suggest why nitroglycerin acts as a high explosive.

[2]

[2 marks]

Question 1b

b)

Nitroglycerin is also used medicinally to treat angina attacks. It comes in the form of tablets, ointments, skin patches and nasal sprays. Nasal sprays vaporise the nitroglycerin, so it is quickly absorbed in the body.

A commercial 11.2 g nasal spray pump delivers a metered dose of exactly 400 micrograms of nitroglycerin. Determine the number of moles present in one dose and how many doses a spray pump can deliver.

[4]

[4 marks]

Question 1c

c)

Suggest a reason why the actual number of doses delivered by the spray pump is less than you have calculated in (b).

[1]

[1 mark]

Question 1d

d)
Describe the changes of state and the energy changes that take place when the spray pump is used.

[1]

[1 mark]

Question 2a

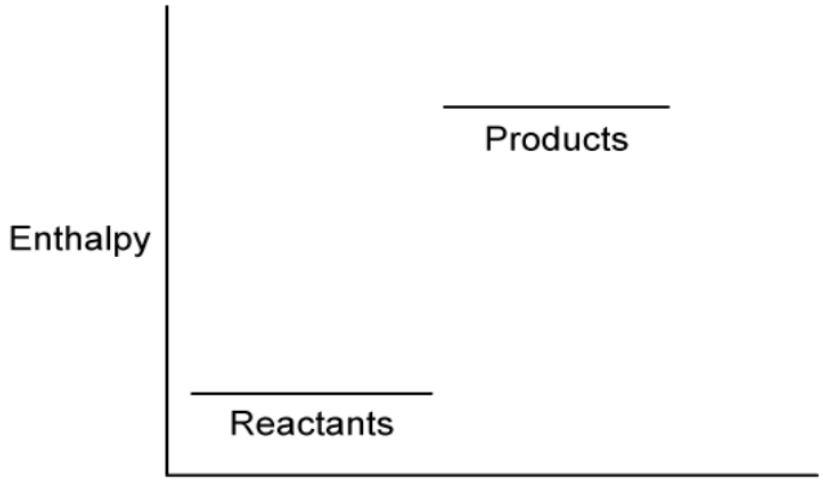
a) Explain what is meant by the *standard enthalpy change of reaction*.

[1 mark]

Question 2b

b) An enthalpy level diagram for the reaction between solid ammonium nitrate and water is shown below.

Figure 1



i) Give the sign of ΔH for the reaction and state whether the reaction is endothermic or exothermic.

ii) State the relative strength of the chemical bonds in the products and in the reactants.

[3 marks]

Question 2c

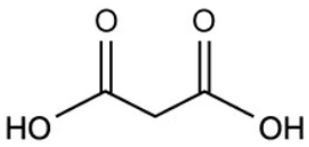
c) The enthalpy of combustion for propanol is, $\Delta H_c^{\ominus}$, is -2021 kJ mol^{-1}. Draw a labelled energy level diagram for this reaction.

[3 marks]

Question 3a

a) Malonic acid is a naturally occurring acid found in fruits and vegetables and is shown in **Figure 1** below.

Figure 1



The first dissociation of malonic acid is:

$$C_3H_4O_4\ (aq) + H_2O\ (l) \rightleftharpoons C_3H_3O_4^-\ (aq) + H_3O^+\ (aq)$$

Identify one conjugate acid-base pair from the equation.

[1 mark]

Question 3b

b) The anion $C_3H_3O_4^-$ may be classified as *amphiprotic*. Explain the meaning of *amphiprotic* and write equations, using $C_3H_3O_4^-$, to illustrate your answer.

[3 marks]

Question 3c

c) Write an equation to show how malonic acid reacts with magnesium.

[1 mark]

Question 3d

d) Under the right conditions, malonic acid can react with ethanol to form diethyl malonate, a diester.

Draw a displayed formula for diethyl malonate showing all the bonds.

[1 mark]

Question 4a

a) Ethene, C_2H_4, can be made into a number of useful compounds. A reaction sequence for this is shown below:

$$C_2H_4 \xrightarrow{\text{step 1}} C_2H_5Cl \xrightarrow{\text{step 2}} C_2H_6O \xrightarrow{\text{step 3}} C_2H_4O$$

i) Name the type of reaction shown in step 1.

ii) Write an equation, using structural formulas, for the reaction in step 2 in which C_2H_5Cl reacts with aqueous NaOH to form C_2H_6O.

[2 marks]

Question 4b

b) The product of step 2 can undergo combustion.

i) Write a balanced equation for the *complete* combustion of the product of step 2.

ii) Write a balanced equation for the *incomplete* combustion of the product of step 2.

[2 marks]

Question 4c

c) Give the reagents and conditions needed to carry out step 3.

[2 marks]

Question 4d

d) The product of step 2 has a higher boiling point than the product of step 3.

State the names of the products of step 2 and 3, and explain the difference in their boiling points.

[3 marks]

Question 5a

a)
State three ways of monitoring concentration changes in a reaction.

[3]

[3 marks]

Question 5b

b)
A reaction is monitored by measuring the volume of a gas produced every 10 seconds. State an appropriate unit to use.

[1]

[1 mark]

Question 5c

c)
Sketch a graph to show the volume of gas produced during the course of an experiment against the time taken.

[4]

[4 marks]

Question 5d

d)
State the effect that increasing concentration has on the rate of a reaction.

[1]

[1 mark]

Question 6a

a)
Tetrafluoroethene, C_2F_4, and tetrafluorohydrazine, N_2F_4, are fluorides of adjacent elements in the Periodic Table.
Draw the Lewis (electron dot) structures for C_2F_4 and N_2F_4 showing all valance electrons.

[2]

[2 marks]

Question 6b

b)
Predict and explain the F-C-F bond angle in tetrafluoroethene and the F-N-F bond angle in tetrafluorohydrazine.

[5]

[5 marks]

Question 6c

c)
Tetrafluorohydrazine is a polar molecule but tetrafluoroethene is not.
Explain the difference in molecular polarity.

[4]

[4 marks]