1.1 Matter, Chemical Change & the Mole Concept

Question Paper

Course	DP IB Chemistry
Section	1. Stoichiometric Relationships
Topic	1.1 Matter, Chemical Change & the Mole Concept
Difficulty	Hard

Time allowed: 50

Score: /37

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)
Carvone is an organic compound containing carbon hydrogen and oxygen.
Complete combustion of 0.1526 g carvone produces 0.4470 g of carbon dioxide and 0.1281 g of water. Determine the empirical formula of carvone, showing your working.

[3]

[3 marks]

Question 2b

b)
0.146 g sample of carvone, when vaporised, had a volume of 0.0341 dm^3 at 150 °C and 100.2 kPa. Calculate its molar mass showing your working.

[2]

[2 marks]

Question 2c

c)
Using your answer to part b), determine the number of molecules of carvone in 0.146 g.

[2]

[2 marks]

Question 3a

a)
Calculate the number of atoms of nitrogen in 38.46 g of ammonium sulfate?

[2]

[2 marks]

Question 3b

b)
Deduce the number of protons in 38.46 g of ammonium sulfate.

[2]

[2 marks]

Question 3c

c)
Using Section 4 of the Data booklet, calculate the mass, in g, of protons in 38.46 g of ammonium sulfate.

[1]

[1 mark]

Question 4a

a)
The coca cola company states that a 12 oz can of coke contains 34 mg of caffeine, $M = 194.19\ g\ mol^{-1}$. Calculate the number of moles of caffeine in a can of coke.

[1]

[1 mark]

Question 4b

b)
The composition by mass of caffeine is 49.48% carbon, 5.20% hydrogen, 28.85% nitrogen and the rest is oxygen. Calculate the empirical formula of caffeine.

[4]

[4 marks]

Question 4c

c)
Calculate the molecular formula of caffeine using your answer from part b).

[1]

[1 mark]

Question 4d

d)
State the type of mixture coca cola is.
Does this change after the can of coke is opened? Justify your answer.

[2]

[2 marks]

Question 5a

a)
Concentrated nitric acid can be made to react with sulfur, and will produce sulfuric acid, nitrogen dioxide and water as the only products. Write a balanced equation for the reaction.

[1]

[1 mark]

Question 5b

b)
Deduce the redox changes taking place in the reaction in part a).

[2]

[2 marks]

Question 5c

c)
Examine the state changes in the reaction in part a) and suggest the relative difference in the energy content of the products and reactants.

[2]

[2 marks]

Question 5d

d)
Identify the ions in part a) and calculate the sum of the relative formula masses of *all* the ions in reaction equation, using section 6 of the Data booklet.

[4]

[4 marks]