

NORMAN HENSILWOOD HIGH SCHOOL EXAMINATIONS



DATE	6 JUNE 2011
GRADE	11
SUBJECT	PHYSICAL SCIENCE PII
TIME	2 hours 30 minutes
MARKS	150
EXAMINER	G M T FEBRUARY
MODERATOR	G JACOBS

D. [Signature] 1.6.2011
Checked

INSTRUCTIONS AND INFORMATION

1. Write your examination number and centre number in the appropriate spaces on the ANSWER BOOK.
2. Answer ALL the questions.
3. This question paper consists of TWO sections:
SECTION A (25)
SECTION B (125)
4. Answer SECTIONS A and B in the ANSWER BOOK.
5. Non-programmable calculators may be used.
6. Appropriate mathematical instruments may be used.
7. Number the answers correctly according to the numbering system used in this question paper.
8. Data sheets and a periodic table are attached for your use.
9. Give brief motivations, discussions, et cetera where required.

SECTION A

Answer this section on the attached ANSWER SHEET.

QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1 – 1.5) on the attached ANSWER SHEET.

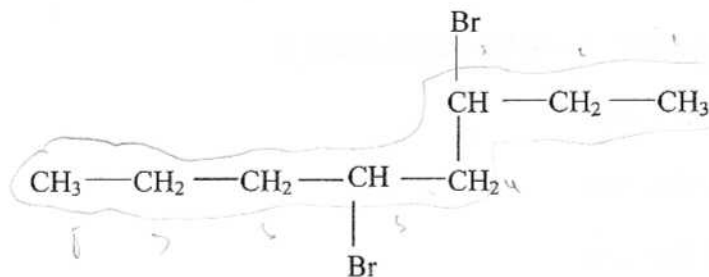
- 1.1 The energy that must be absorbed from the environment by a system to cause the system to react (1)
- 1.2 A molecular formula that shows the simplest possible ratio of elements in a compound (1)
- 1.3 Two or more compounds that have the same molecular formula but different arrangements of atoms (1)
- 1.4 The S.I. unit of temperature (1)
- 1.5 A pair of valence electrons that are not used in bond formation (1)

[5]

QUESTION 2 : MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and make a cross (X) in the block (A – D) next to the question number (2.1 – 2.10) on the attached ANSWER SHEET.

2.1 The condensed structural formula of an organic compound is shown below:



Which ONE of the following is the correct IUPAC name of this compound?

- A 3,5-dibromooctane
 - B 4-bromo-5-bromo-5-propylpentane
 - C 4,6-dibromooctane
 - D 2-bromo-1-bromo-1-propylpentane
- (2)

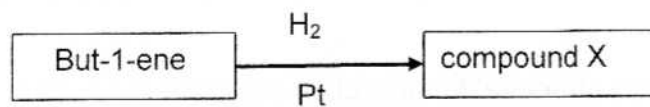
2.2 Which ONE of the following reaction types can be used to prepare ethene from octane?

- A Addition
 - B Cracking
 - C Hydrogenation
 - D Substitution
- (2)

2.3 Which ONE of the following pairs of reactants can be used to prepare the ester ethyl pentanoate in the laboratory ?

- A Ethanol and pentanol
 - B Ethanoic acid and pentanol
 - C Ethanol and pentanoic acid
 - D Ethanal and pentanoic acid
- (2)

2.4 In the flow diagram below

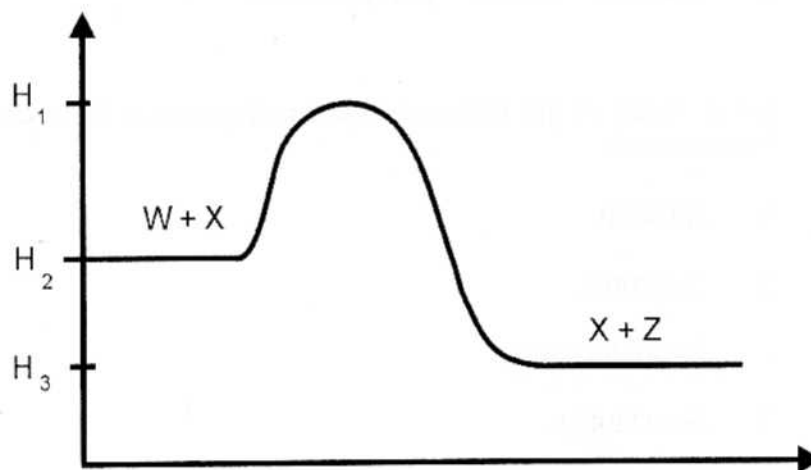
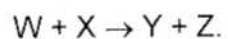


The IUPAC name for compound X is :

- A but-1-yne
- B butan-1-ol
- C butan-2-ol
- D butane

(2)

2.5 The following energy profile diagram represents the reaction :



Which one of the following statements is true?

- A The activation energy is $H_1 - H_2$
- B $\Delta H = H_1 - H_2$
- C $\Delta H = H_3 - H_1$
- D The activation energy is $H_1 - H_3$.

(2)

- 2.6 Under which conditions do real gases behave like ideal gases?
- A low temperature and low pressure
 - B high temperature and high pressure
 - C low temperature and high pressure
 - D high temperature and low pressure
- (2)
- 2.7 An amount of 0,5 mol of nitrogen gas represents ...
- A 14 g nitrogen
 - B 7 g nitrogen
 - C $0,5 \times 14 \times (6,02 \times 10^{23})$ nitrogen atoms
 - D $0,5 \times (6,02 \times 10^{23})$ nitrogen atoms
- (2)
- 2.8 A solution has a concentration of $1,5 \text{ mol. dm}^{-3}$. Which of the following volumes will contain 0,6 moles?
- A 40 cm^3 B 400 cm^3 C 250 cm^3 D 2500 cm^3
- (2)
- 2.9 The gas with the largest volume at STP is
- A 48g of oxygen
 - B 6g of hydrogen
 - C 16g of helium
 - D 28g of nitrogen
- (2)
- 2.10 The volume of a gas is $X \text{ cm}^3$ at 77°C . If the pressure is kept constant, the volume of the gas will be $2X$ at
- A $37,5^\circ\text{C}$ B 154°C C 350°C D 427°C

[20]

SECTION B

INSTRUCTIONS

1. Answer this section in the ANSWER BOOK.
2. The formulae and substitutions must be shown in ALL calculations.
3. Round off your answers to TWO decimal places.

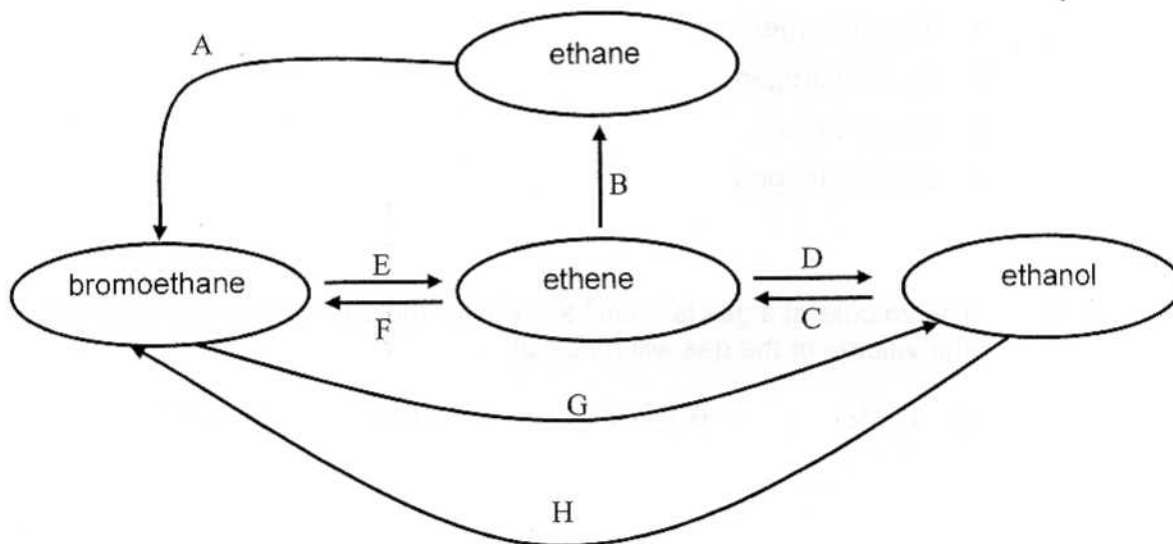
QUESTION 3

Ethene is a gaseous hormone associated with the ripening of fruit. It also contributes to the ageing and distortion of plants. In industry, the artificial ripening of fruit takes place when ethene is passed over the fruit in large rooms. After a while the ripening fruit releases its own ethene.

- 3.1 Write down the structural formula of ethene. (2)
- 3.2 Why is it not advisable to place a banana that has been artificially ripened alongside a cabbage and lettuce? (2)

In industry ethene is also used to synthesise a variety of organic compounds.

The flow diagram below illustrates some of the many reactions ethene undergoes.



- 3.3 Write down the general formula for the homologous series to which ethane belongs. (1)

- 3.4 Name the type of reaction represented by each of the letters A , B , D and H. (4)
- 3.5 Use structural formulae to write down a balanced equation for reaction B. (3)
- 3.6 Apart from ethane , which other reactant is needed for reaction F ? Write down the FORMULA only (2)
- 3.7 Both reactions E and G occur in the presence of a base. Reaction E is an elimination reaction and reaction G is a substitution reaction.
- 3.7.1 How is the base in reaction E different from the base in reaction G ? (2)
- 3.7.1 Name the type of elimination reaction represented by E. (1)

[17]

QUESTION 4

The first six members of the alkanes occur as gases and liquids at normal temperatures. Alkanes are currently our most important fuels, but the use of alcohols as renewable energy source is becoming more and more important. Alcohols are liquids that might be a solution to the energy crisis.

- 4.1 Which chemical property of alkanes and alcohols make them suitable to be used as fuels? (2)
- 4.2 The table shows the boiling points of the first six alkanes and the first six alcohols.

Alkane	Boiling point (°C)	Alcohol	Boiling point (°C)
methane	- 164	methanol	65
ethane	- 89	ethanol	79
propane	- 42	1-propanol	97
butane	- 0,5	1-butanol	117
pentane	36	1-pentanol	138
hexane	69	1-hexanol	156

Draw a graph of boiling points versus number of carbon atoms for the first six ALCOHOLS. Choose 50 °C and 1 carbon atom as origin and use an appropriate scale. Plot the points and draw the best curve through the points.

(6)

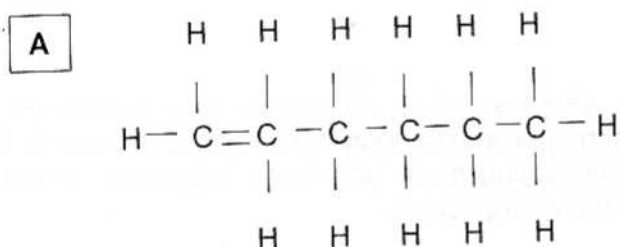
4.3 What trend in boiling point can be observed from the graph ? (2)

4.4 People are always cautioned to keep liquids such as petrol (a mixture of alkanes) out of reach of children. Use the boiling points of alkanes and justify this precaution (2)

[12]

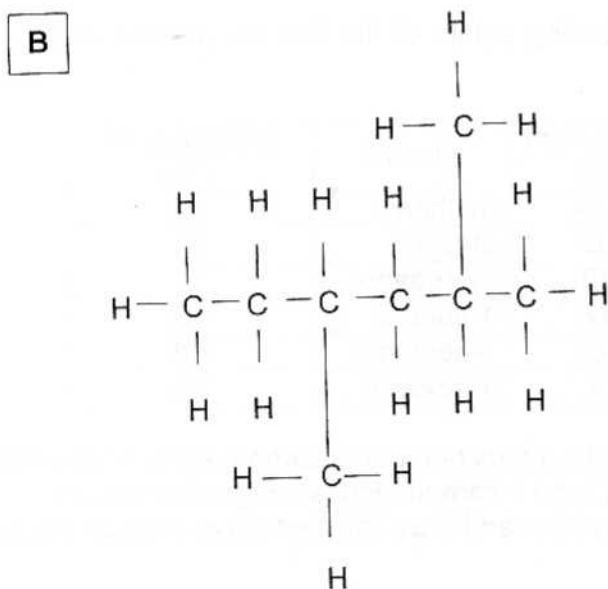
QUESTION 5

The chemical properties of organic compounds are determined by their functional groups. The letters **A** to **E** below represent six organic compounds.



C

Methyl methanoate



D

1,2 - dichlorohexane

E

HCOOH

- 5.1 Write down the LETTER that represents the following :
- 5.1.1 An alkene (1)
- 5.1.2 A haloalkane (1)
- 5.1.3 A carboxylic acid (1)
- 5.1.4 ester (1)
- 5.2 Write down the IUPAC name of the following :
- 5.2.1 Compound A (1)
- 5.2.2 Compound B (1)
- 5.2.3 Compound E (1)
- 5.3 Draw neat structural formula for each of the compounds below :
- 5.3.1 Compound C (2)
- 5.3.2 Compound D (2)
- 5.3.3 Compound E (2)
- 5.4 Compound A reacts with a certain gas to form the product compound D.
- 5.4.1 Give the name of the gas. (1)
- 5.4.2 Name the type of reaction that takes place in 5.4.1. (1)

[15]

QUESTION 6

- 6.1 Define electronegativity. (2)
- 6.2 State whether each of the molecules below are polar or no – polar. Justify your answer by means of sketches :
- 6.2.1 Ammonia (3)
- 6.2.2 Carbon dioxide (3)

6.3 Give the shape of each of the following molecules :

6.3.1 Water

(1)

6.3.2 Methane

(1)

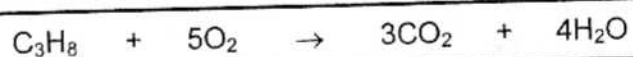
6.3.3 Carbon monoxide

(1)

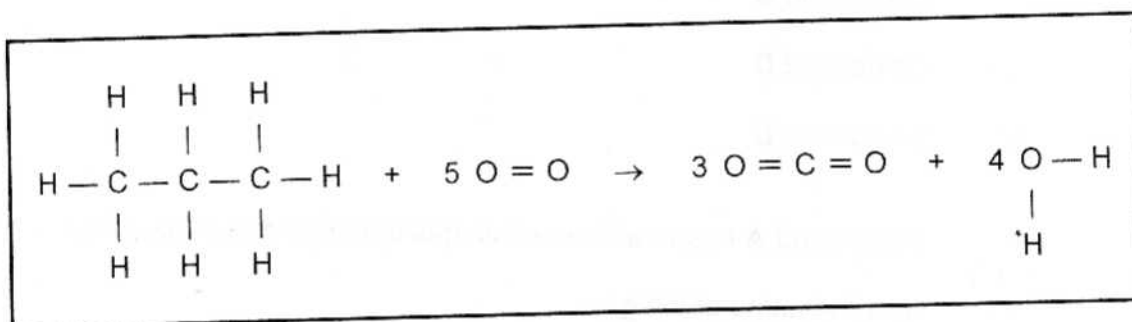
[11]

QUESTION 7

The following equation represents the reaction for the combustion of propane in oxygen.



The following equation represents the structural formula of each substance in the reaction.



7.1 Use the table of average bond energies to calculate the enthalpy change for the combustion of propane.

Bond	Energy ($\text{kJ}\cdot\text{mol}^{-1}$)
H-H	436
C-H	414
O-H	460
C-C	347
C=O	799
O=O	499
N≡N	946

(8)

- 7.2 Decide whether the reaction for the combustion between propane and oxygen is exothermic or endothermic. (1)
- 7.3 Butane is a compound that belongs to the same homologous series of compounds as propane. (1)
- 7.3.1 Write down one of the uses of butane gas. (1)
- 7.3.2 Write a balanced equation for the reaction between butane and oxygen. (4)

[14]

QUESTION 8

- 8.1 Determine the percentage of sulphur in ammonium sulphate (4)
- 8.2 The percentage composition by mass of an unknown compound is given in the following table :

Element	Percentage composition by mass (%)
Na	17,03
S	47,41
O	35,56

- 8.2.1 Determine the empirical formula of the unknown compound. (7)
- 8.2.2 You know that the formula mass of the unknown compound is $270 \text{ g}\cdot\text{mol}^{-1}$. Determine the true formula of the compound (3)

[14]

QUESTION 9

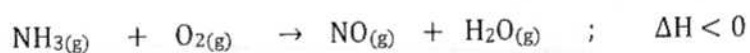
- 9.1 Define Boyle's Law. (3)
- 9.2 Give FOUR statements on which the 'kinetic molecular theory' of gases is based. (4)
- 9.3 Rachel measured the mass of an empty 250 cm^3 flask. She then filled the flask with a gas of unknown molar mass at an atmospheric pressure of 100 kPa and a temperature of $27 \text{ }^\circ\text{C}$. She found that the mass of the flask and contents increased by $0,44 \text{ g}$.

- 9.3.1 Calculate the molar mass of the gas Rachel used to fill the flask. (7)
- 9.3.2 Assume that the gas molecules are only made up of carbon and oxygen. Determine the molecular formula of this gas. (3)
- 9.4 An air bubble on the ocean bed has a volume of $1,5 \text{ cm}^3$. The temperature of the water on the ocean bed is $5 \text{ }^\circ\text{C}$. The air bubble rises towards the surface of the ocean. The temperature of the water at the surface is $15 \text{ }^\circ\text{C}$ and the pressure is $101,3 \text{ kPa}$. The volume of the air bubble increases to $4,5 \text{ cm}^3$ at the instant the bubble reaches the surface of the water .
- Calculate the pressure that the water exerts on the air bubble on the ocean bed. (6)

[23]

QUESTION 10

The following unbalanced chemical equation represents the catalytic oxidation of ammonia :



A sample of 6 g of ammonia reacts with an unknown volume of oxygen at *STP*.

- 10.1 Balance the chemical equation above. (4)
- 10.2 Is the chemical equation exothermic or endothermic ? Justify your answer. (2)
- 10.3 Calculate the volume of $\text{NO}_{(\text{g})}$ at *STP*. (6)
- 10.4 Determine the amount of $\text{H}_2\text{O}_{(\text{g})}$ atoms that is formed. (3)
- 10.5 Determine the oxidation number of nitrogen in $\text{NH}_{3(\text{g})}$. (2)
- 10.6 Is the chemical equation heterogeneous or homogeneous? Justify your answer. (2)

[19]