BAULKHAM HILLS HIGH SCHOOL

YEARLY EXAMINATION

2009

YEAR 11

CHEMISTRY

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Data Sheet and Period Table is provided on the back of this paper.

Total Marks: 75

Part A – 15 marks
15 Multiple Choice questions worth 1 mark each

Part B – 60 marks
- All questions are compulsory
- Answer in the allocated spaces

PART A

Multiple Choice – 15 marks
Select the most correct response, A, B, C or D and write your answer on the Multiple Choice Answer Sheet.

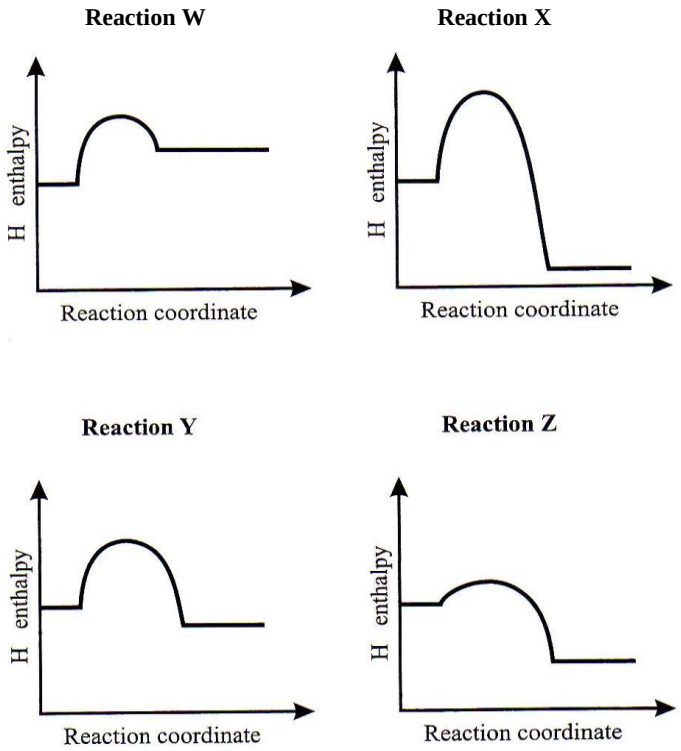
1. A mixture of hexane, pentane, octane and heptane is prepared and fractionally distilled. Four distillate samples are collected. Select the correct answer.

   a) Hexane will be the first fraction to be collected
   b) Four fractions containing samples of the four pure hydrocarbons will be obtained
   c) The first samples collected will be richer in the most volatile component
   d) The last sample collected will be pure octane

2. Identify the element which is found in solder, bronze alloys and steel cans.

   a) aluminium
   b) copper
   c) tin
   d) zinc

3. The figure below shows the energy profile diagram for four different chemical reactions (W,X,Y and Z).



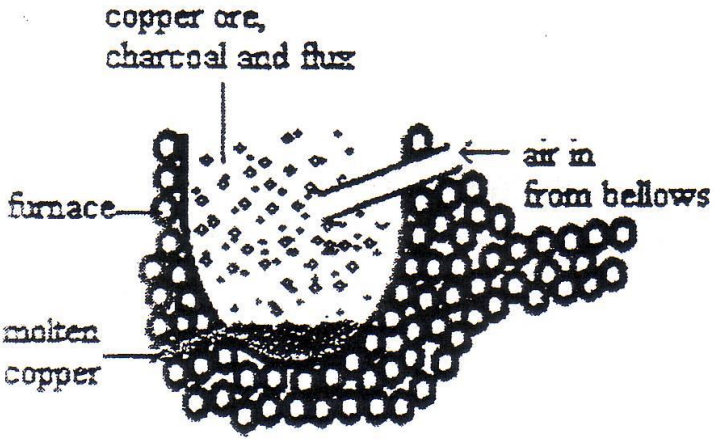
   Select the correct statement about these reactions.

   a) All four reactions are exothermic
   b) Reaction Z requires the greatest amount of heating to initiate the reaction
   c) The activation energies for the forward reactions decrease in the order X,Y,W,Z.
   d) Reactions X and Y are exothermic and W and Z are endothermic.

4. If two electrons are transferred from an atom of *X* to an atom of *Y* to form a compound, then

   a) the formula of the compound will be X_2Y_2
   b) the compound will be composed of X^{2+} and Y^{2-} ions
   c) the solid compound will conduct electricity
   d) the compound will be composed of Y^{2+} and X^{2-} ions

5. The diagram shows how copper was obtained in ancient Egyptian times. The contents of the smelting furnace were set on fire and the copper ran off as it was produced.



   Which world equation describes a possible reaction in this ancient Egyptian furnace?

   a) copper + oxygen → copper oxide
   b) copper sulphide + carbon → carbon disulfide + copper sulphate
   c) copper + carbon + oxygen → copper oxide + carbon dioxide
   d) copper sulfide + carbon + oxygen → copper + sulfur dioxide + carbon dioxide

6. A 10mL volume of 0.15 mol L^{-1} aluminium chloride solution is diluted to a final volume of 50mL. What is the chloride ion concentration in the diluted solution?

   a) 9.0×10^{-2} mol L^{-1}
   b) 4.5×10^{-2} mol L^{-1}
   c) 3.0×10^{-2} mol L^{-1}
   d) 1.5×10^{-2} mol L^{-1}

7. White precipitates are formed when sodium hydroxide is added to magnesium chloride solution and when sulfuric acid is added to barium nitrate solution.
   Predict the *result* of adding together equal volumes of 0.05 mol L^{-1} barium hydroxide and magnesium sulfate solutions.

   a) no reaction
   b) a precipitate of barium sulfate only
   c) a precipitate of magnesium hydroxide only
   d) a mixed precipitate of barium sulfate and magnesium hydroxide

8. A beaker contains 50mL of sodium carbonate (Na_2CO_3) solution at a concentration of 1.0×10^{-2} mol L^{-1}.

   What is the number of moles of sodium ions in the beaker?

   a) 5.0×10^{-4} mol
   b) 1.0×10^{-3} mol
   c) 2.0×10^{-2} mol
   d) 5.0×10^{-1} mol

9. A solution is made by dissolving 0.5 mol of potassium iodide and 1.0 mol of calcium iodine in water to a volume of 500mL of solution.

   What are the *ionic concentrations*, in mol L^{-1} in this solution?

	$[K^+]$	$[Ca^{2+}]$	$[I^-]$
a)	0.5	1.0	1.5
b)	1.0	2.0	3.0
c)	0.5	1.0	2.5
d)	1.0	2.0	5.0

10. Which statement best explains why iodine does not dissolve in water?

    a) Iodine is a dense brown liquid
    b) Iodine has a macromolecular structure
    c) Iodine has low chemical reactivity
    d) Iodine consists of non-polar molecules

11. Which one of the following gases would occupy 22.71 litres at 0^oC and 100 kPa?

    a) 60g of NO
    b) 1g of H_2
    c) 44g of CO_2
    d) 48g of C_4H_{10}

12. Which one of the following statements about the Periodic Table is correct?

    a) Electronegativity increases both across a period and down a group
    b) Atomic radius increases as the atomic number increases
    c) The trends in melting points for metals and non metals down a group are opposite to each other
    d) The reactivity of an element is directly related to its electronegativity.

13. Joseph Gay-Lussac put forward the law combining volumes of gases.
Which one of the following statements bests illustrates this law?

a) 200mL of hydrogen gas + 100mL of oxygen gas → 200mL of steam
b) 100g of hydrogen gas + 100g of chlorine gas → 200g of hydrogen chloride
c) The percentage of oxygen in water is always 89% by mass
d) 1 mole of hydrogen gas is formed when 65.38g of zinc is reacted with excess hydrochloric acid

14. A 4.44g mass of ice was pushed down so as to be fully submerged in a measuring cylinder containing water. The volume of water increased from 26.60mL to 31.43mL.

The density of the ice must be

a) 4.44g/mL
b) 1.00g/mL
c) 0.98g/mL
d) 0.92g/mL

15. A certain hydrocarbon has the molecular formula C_3H_6.

This hydrocarbon belongs to the homologous series of

a) alkanes
b) alkenes
c) alkynes
d) alkanols

Student's Name: …… Teacher's Name: …….

BAULKHAM HILLS HIGH SCHOOL

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2009

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CHEMISTRY

MULTIPLE CHOICE ANSWER SHEET

Select the most correct response, A,B,C or D and circle the corresponding letter below.

1	**A**	**B**	**C**	**D**
2	**A**	**B**	**C**	**D**
3	**A**	**B**	**C**	**D**
4	**A**	**B**	**C**	**D**
5	**A**	**B**	**C**	**D**
6	**A**	**B**	**C**	**D**
7	**A**	**B**	**C**	**D**
8	**A**	**B**	**C**	**D**
9	**A**	**B**	**C**	**D**
10	**A**	**B**	**C**	**D**
11	**A**	**B**	**C**	**D**
12	**A**	**B**	**C**	**D**
13	**A**	**B**	**C**	**D**
14	**A**	**B**	**C**	**D**
15	**A**	**B**	**C**	**D**

PART B

60 marks
Attempt all questions
Write your answers in the spaces provided.

Marks

Question 16 (6 marks)

a) Construct *net ionic equations* for the dissolving of lead nitrate in water AND the precipitation of lead iodide when lead nitrate solution is added to sodium iodide solution. **2**

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b) Calculate the mass of sodium iodide present in 200mL of 0.50 mol L^{-1} sodium iodide solution. **2**

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c) Predict the mass of lead iodide precipitate formed if the sodium iodide solution from b) is added to 200mL of 0.50 mol L^{-1} lead nitrate solution. **2**

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Marks

Question 17 (4 marks)

a) Describe the *structure* of BOTH diamond and graphite. **2**

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b) Describe uses for BOTH diamond and graphite AND relate these uses to their physical properties. **2**

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Marks

Question 18 (5 marks)

Although aluminium is the most abundant metal in Earth's crust it was once more valuable than silver.

a) Distinguish between a mineral and an ore. **2**

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b) Assess the energy requirements for the extraction of aluminium. **2**

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c) Justify the practice of recycling aluminium containers and construction materials. **1**

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Question 19 (6 marks)

a) Compare the bonding within AND between *water molecules* in the liquid state. **3**

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Marks

Question 19 (continued)

b) i) Relate the bonding in water to its ability to dissolve a large range of substances. **2**

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ii) Account for the inability of water to dissolve hydrocarbons. **1**

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Question 20 (4 marks)

Photosynthesis is one of the most important chemical processes to the existence of life on Earth.

a) Write a chemical equation to represent photosynthesis. **1**

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b) Outline the role of photosynthesis to explain its importance to life on Earth. **3**

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Marks

Question 21 (3 marks)

Heat energy is released when anhydrous calcium chloride is dissolved in water.

$$CaCl_{2(s)} \rightarrow CaCl_{2(aq)} + 83kJ$$

Calculate the final temperature when 0.01 mol of calcium chloride is dissolved into 100 mL of water, initially at a temperature of 18.0°C. **3**

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Question 22 (2 marks)

Solder is an alloy which is used to join two metal surfaces together.
The solder is melted and on cooling, solidifies to make a join between the metallic surfaces.

Soft solder is one type of solder that contains varying amounts of lead and tin.
It is commonly used in electrical circuitry.

Describe two properties which this type of solder has, to allow it to be used in this manner. **2**

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Marks

Question 23 (6 marks)

The table below gives information about two covalent molecular substances.

Molecule	Molar Mass [$gmol^{-1}$]	Shape	Melting Point (ºC)	Boiling Point (ºC)
hydrogen sulfide	34.1	bent	-86	-60
ammonia	17.0	trigonal pyramid	-78	-33

a) Draw a Lewis electron dot diagram of each molecule. **2**

i) Hydrogen sulphide	ii) ammonia

b) Explain why ammonia has a higher boiling point than hydrogen sulfide. **2**

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c) Which one of these two molecules would you expect to dissolve to a greater extent in water. **2**

Explain your answer.

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Marks

Question 24 (3 marks)

During a practical session at school, a student was asked to design an experiment to determine which metal was more reactive – aluminium or zinc.

She placed equal amounts of the same hydrochloric acid solution into two test tubes.
She took a five gram sample of each metal from a jar and placed one into each test tube.

She summarised her results in the following table.

Metal Used	Initial Appearance	Reaction in Acid
zinc	shiny, silvery colour	immediate, vigorous effervescence
aluminium	dull, off white colour	did not react straight away; slight effervescence

a) Based on these results, propose a suitable conclusion for the experiment. **1**

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b) Write two half equations to represent the electron transfer reaction occurring when zinc reacts with the acid. **2**

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Marks

Question 25 (6 marks)

a) A hydrocarbon has the following percentage composition by weight

Carbon 40.0% Hydrogen 6.6% Oxygen 53.3%

i) Calculate the empirical formula of this compound. **2**

ii) What is the molecular formula of this compound in (i) above, given that its molecular mass is 180.16. **1**

b) In your course you carried out a first hand investigation on the combustion of wood and a candle. Compare the ease of burning of wood and candle. Account for any differences. **3**

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Marks

Question 26 (5 marks)

Consider the following processes:

I Boiling of water
II Melting of table salt
III Electrolysis of water

a) For each of the above processes, state the types of bonds or forces being broken and the types of particles (molecules, atoms, ion) being separated. **3**

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b) Describe the difference between a chemical change and a physical change. **2**

Include an example of a chemical change and an example of a physical change in your answer.

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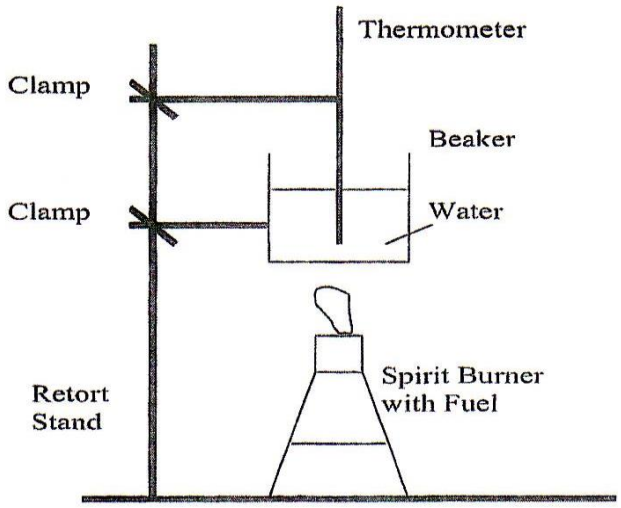
Marks

Question 27 (4 marks)

To measure the enthalpy change of combustion of a fuel, a student used the set-up shown in the diagram below.



Masses and temperatures were measured accurately and the results obtained from the experiment were as follows:

Mass of Water	= 500 g
Initial Temperature of Water	= 25^{o}C
Final Temperature of Water	= 95^{o}C
Initial Mass of Fuel	= 12.6g
Final Mass of Fuel	= 10.6g

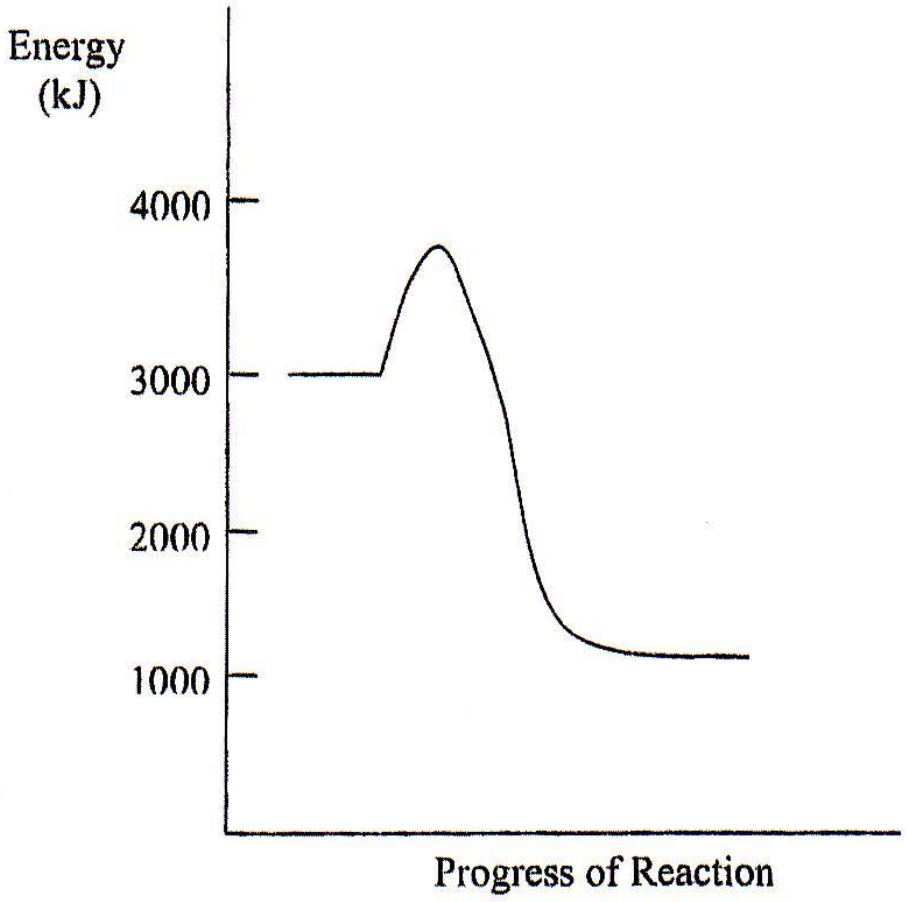
a) Calculate the heat absorbed by the water (specific heat capacity of water, 4.18 J kg^{-1} K^{-1}) **2**

b) Assuming that all the heat from the burning fuel was absorbed by the water, what was the energy change per gram of fuel burnt? **2**

Marks

Question 28 (3 marks)

The diagram shows the energy profile of the complete combustion of 43 g of hexane.



a) On the above diagram, label the activation energy **1**

b) On the above diagram, shade the section of the graph where new bonds are being formed **1**

c) What is the approximate value of ΔH for this reaction? **1**

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Marks

Question 29 (3 marks)

Calculate the heat energy released from the complete combustion of 500g of propane, given the following bond energies. **3**

BOND	BOND ENERGY (kJ mol^{-1})
C – C	346
C – H	414
H – H	436
O – H	463
O = O	498
C = O	803

End of Paper

Baulko Yearly 2009: MC: 1C 2C 3C 4B 5D 6C 7D 8B 9D 10D 11C 12C 13A 14D 15B

Q16a

criteria	marks
$Pb(NO_3)_2$ ------> $Pb^{2+}_{(aq)}$ + $2NO_3^-{}_{(aq)}$ $Pb^{2+}_{(aq)}$ + $2I^-_{(aq)}$ -------> $PbI_{2(s)}$	2
One of the above equations	1

b

criteria	marks
- Moles of sodium iodide 0.5 x 0.2 = 0.1 - 0.1 x 149.89 = 14.99g sodium iodide	2
One of the above	1

c

criteria	marks
- 0.05 moles of lead iodide - 0.05 x 461.00 = 23.05g of lead iodide.	2
One of the above.	1

17a

criteria	marks
- diamond - three dimensional network of carbon atoms. Each carbon atom forms four covalent bonds with each of its neighbours. - graphite - the carbon atoms are arranged in flat parallel layers. Within each layer each carbon atom is covalently bonded to three other carbon atoms forming a hexagonal arrangement. There are weak dispersion forces between the layers.	2
One of the above.	1

b

criteria	marks
- diamond - e.g. class cutting because it is a very hard substance. - graphite - e.g. lubricant as the bonding between the layers is only weak dispersion forces allowing the layers to slide past each other.	2
One of the above	1

18a

criteria	marks
-a mineral is a naturally occurring substance, usually a compound with a definite composition. - an ore is a mineral where it is economically viable to extract the metal.	2
One of the above.	1

b

criteria	marks
- energy requirements for the extraction of aluminium from aluminium oxide large. - aluminium is an active metal and forms strong bonds with oxygen which require a lot of energy to break.	2
One of the above	1

19 (a).

Criteria
• Uses electron dot structures to represent covalent bonding in the water molecules OR discusses sharing of electrons • Discusses covalent bonding as a sharing of electrons • Illustrates the formation of H-bonding between two water molecules • Recognises that H-bonding occurs between H and an atom of high electronegativity AND/OR • Recognises that H- bonding is a strong dipole-dipole force
• Discusses covalent bonding • Illustrates the formation of H-bonding between two water molecules • Recognises that H-bonding occurs between H and an atom of high electronegativity AND/OR • Recognises that H- bonding is a strong dipole-dipole force
• Discusses covalent bonding OR • Discusses H-bonding occurring between H and O atoms in water molecules

(b).i.

Criteria
• Recognises that water can dissolve ionic and polar substances (and smaller non-polar molecules that can occupy space between water molecules) • States that water is a polar molecule • Understands that water is attracted to polar molecules • Understands that water forms hydration shells with positive and negative ions
• Relates that waters ability to dissolve a wide range of substances depends on its polar character

(b).ii

Criteria
• States that water is polar and that hydrocarbons are non-polar AND • Recognises that there are no dipole-dipole forces of attraction betwee water and hydrocarbons which would allow them to dissolve OR • Recognises that dispersion forces between polar and non-polar substances are too weak for dissolving to occur OR • Recognises that water molecules through H-bonding bond more stron with each other than with non-polar molecules that have weak dispersion forces

Criteria	Marks
Writes a correctly balanced equation to summarise the photosynthetic process (subscripts are not required)	1

Criteria	Marks
States that photosynthesis is an important process in the carbon cycle Recognises that photosynthesis converts radiant energy into stored energy in chemical bonds (produces biomass) States that photosynthesis is an endothermic process Understands that the stored chemical energy in carbohydrates is available for animals (through cellular respiration) Identifies oxygen is a product of photo synthesis and is needed for respiration in animals	3
States that photosynthesis is an endothermic process and produces carbohydrates – glucose, starch Understands that the stored chemical energy in carbohydrates is available for animals (through cellular respiration) OR Identifies oxygen is a product of photo synthesis and is needed for respiration in animals	2
States that photosynthesis requires sunlight to make carbohydrates – glucose, starch and oxygen	1

Criteria	Marks
Correctly calculates enthalpy change for 0.01 mol $CaCl_2$ dissolved Substitutes correctly into equation Correctly calculates final temperature- answer must have units (not marked on sig. figures)	3
Correctly calculates enthalpy change for 0.01 mol $CaCl_2$ dissolved Substitutes correctly into equation- but incorrect calculation OR Correct calculation but no units supplied	2
Correctly calculates enthalpy change for 0.01 mol $CaCl_2$ dissolved OR Uses correct equation but substitutes incorrect values	1

$H = -mC(T_f - T_i)$

$-0.83kJ = -100 \times 4.18\ Jg^{-1}K^{-1} \times (T_f - 18)$

$-830\ J = -100 \times 4.18\ Jg^{-1}K^{-1} \times (T_f - 18)$

$T_f = 1.99 + 18 = 20^{\circ}C$

22.

Criteria	
• Recognises that solder has metallic bonding accounting for its electrical conductivity, adhesion,malleability,ductility AND • Solder has a low melting point/malleable/ductile OR • Solder forms metallic bonds with other metals	
• Relates any one property of solder	

Question 23

a) (i)

criteria
• Correctly draws the TWO Lewis dot diagrams • Correctly draws only one Lewis dot diagram

b)

criteria
Mentions that ammonia is a more polar molecule than hydrogen sulfid AND Hydrogen bonding is stronger than the dispersion forces in hydrogen sulfide, AND Hydrogen bonding is stronger than dispersion forces
Mentions that ammonia is a more polar molecule that hydrogen sulfide Ammonia has hydrogen bonding OR Hydrogen sulfide does not have hydrogen bonding

c)

criteria
Ammonia, AND Ammonia is able to replace the hydrogen bonds broken between water molecules with hydrogen bonds formed between water and ammonia
Ammonia

Question 24

a)

criteria
• zinc is more reactive metal than aluminium

b)

criteria
• $Zn \longrightarrow Zn^{2+} + 2e$ • $2H^{+} \longrightarrow H_2$ • Only one correct half equation

Question 25

a) (i)

criteria			mark
C	H	O	
40.0/12,01	6.6/1.008	53.3/16.00	
3.33	6.55	3.33	
3.33/3.33	6.55/3.33	3.33/3.33	2
1	1.97	1	
1	2	1	
CH_2O			
40.0/12.01	6.66/1.008	53.3/16.00	1

25a((ii)

Molecular mass of CH_2O = 30

180/30 = 6

(CH_2O) X 6 = $C_6H_{12}O_6$

b)

criteria	mark
Wood is harder to ignite than a candle, AND Candle has a wick, AND The activation energy to ignite wood is higher than to ignite a candle	3
Wood is harder to ignite than a candle, AND A candle has a wick OR there is a difference in activation energy	2
Wood is harder to ignite than a candle, OR A candle has a wick, OR The activation energy for the combustion in wood is different to that of a candle	1

Q 26a)

Criteria	marks
All 6 of the following pieces of info: I. H bonds broken, molecules separated II. Ionic bonds broken, ions separated III. Covalent bonds broken, atoms separated	3
4 or 5 of the above	2
2 or 3 of the above	1

You had to say H bonds ionic bonds etc (not intra/intermolecular forces)

26b)

criteria	marks
Correct physical change description + example, and Correct chemical change description + example	2
Either of the above, or Two correct descriptions, or Two correct examples	1

Q27a)

criteria	mark
Correct working	

27b)

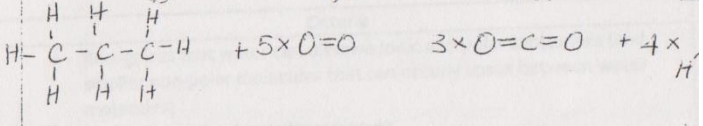
criteria	mark
Show 2 g of fuel burnt Correct answer with unit	2
Show 2 g of fuel burnt	1

Q28a) Activation energy must be shown as the difference between r
and the highest point of curve.
28b) New bonds being formed when energy is released, ie, on negat
graph.
28c) must have minus sign and unit, -1900kJ +/- 100kJ approx.

29

criteria	mark
• equation • energy absorbed by reactants, and energy released by products • calculation of energy released for 500g propane (using 11.3 mol	3
2 of above	2
One of the above	1

$C_3H_{8(g)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2$



Reactant Bonds to be broken (endothermic

8 × C-H : 8×414
2 × C-C : 2×346
5 × O=O : 5×498
Total : 6494 kJmol^{-1} absorbed

Product Bonds formed (exothermic)

6 × C=O : 6×803
8 × O-H : 8×463
Total : 8522 kJ.mol^{-1} released.

ΔH = (6494 − 8522) kJ.mol^{-1}
= − 2028 kJ.mol^{-1}

moles C_3H_8 = $\frac{500\,g}{(3\times12.01 + 8\times1.008)\,g/mol}$
= 11.34 mol.

Energy released when 500g C_3H_8 burns