Pearson
Edexcel

Examiners' Report
June 2019

IGCSE Chemistry 4CH1 2C

ResultsPlus

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications come from Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk.

Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

ResultsPlus

Giving you insight to inform next steps

ResultsPlus is Pearson's free online service giving instant and detailed analysis of your students' exam results.

- See students' scores for every exam question.
- Understand how your students' performance compares with class and national averages.
- Identify potential topics, skills and types of question where students may need to develop their learning further.

For more information on ResultsPlus, or to log in, visit www.edexcel.com/resultsplus.
Your exams officer will be able to set up your ResultsPlus account in minutes via Edexcel Online.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk.

June 2019
Publications Code 4CH1_2C_1906_ER

Introduction

This was the first time candidates had sat this new specification paper. The style of this paper is very similar to that of the legacy specification but has increased from 60 to 70 marks. Although both the legacy paper and this paper contained similar types of calculations, this was the first time there was a required minimum of marks for mathematical skills.

Question 1 (a)

As anticipated, the great majority of candidates were able to correctly label the diagram of an atom using the names of some particles which were given in the box. A small minority confused protons and neutrons in the nucleus.

Question 1 (b)

Candidates had to deduce the mass number of the atom from the diagram. The majority gave a correct answer of 13. However, significant numbers gave an answer of 6, obviously confusing mass number with atomic number, whilst others gave 12, presumably from miscounting the particles in the nucleus.

Question 1 (c)

Most candidates correctly completed the sentence by stating isotopes have the same number of protons but have a different number of neutrons. Some candidates stated they have the same number of electrons instead of protons. Although of course true of neutral atoms, this is not the correct definition of isotopes and was not credited. However, electrons were ignored in answers, so *isotopes have the same number of protons and electrons but have a different number of neutrons* scored both marks. Some incorrect responses involved candidates stating same atomic number and different mass number, probably showing that the full question stem had not been read.

(c) Complete the sentence about isotopes.

(2)

Isotopes are atoms that have the same number of electrons

but have a different number of protons .

ResultsPlus
Examiner Comments

Answers such as this stating the same number of electrons were not credited. Different numbers of protons is incorrect so this response scored 0.

ResultsPlus
Examiner Tip

Candidates should always use the correct definition of isotopes stating they have the same number of protons but a different number of neutrons.

Isotopes are atoms that have the same number of protons

but have a different number of electrons .

ResultsPlus
Examiner Comments

This response scored 1 mark for the same number of protons.

Question 2 (a)

It was disappointing that many candidates failed to score both marks on this question about the physical properties of the halogens. The most common misapprehensions were stating bromine as a gas at room temperature and even more thought solid iodine was purple or brown. These candidates may have been thinking about iodine vapour or iodine solution.

Question 2 (b)

The calculation of the relative atomic mass of chlorine was often well done. Some candidates failed to give their answer to 1 decimal place as required, perhaps showing they did not read the whole question. Others did the correct calculation but rounded it to 35.5 (as this is the periodic table value) whilst some tried to manipulate the calculation to give an answer of 35.5.

(b) Chlorine has two isotopes of mass numbers 35 and 37

The relative percentage of each isotope in a sample of chlorine is

chlorine-35 77.78% chlorine-37 22.22%

Calculate the relative atomic mass of this sample of chlorine.

Give your answer to one decimal place.

(3)

$\frac{(35 \times 77.78) + (37 \times 22.22)}{100} = 35.4444$

relative atomic mass = 35.4444

ResultsPlus
Examiner Comments

The candidate has used the correct method including dividing by 100. Unfortunately they have not then given the final answer to the required one decimal place so do not gain the third mark. This is therefore worth 2 marks.

Question 2 (c)

There were some very good answers to this question with many candidates scoring full marks. Common reasons for losing marks included stating the solution formed as a result of the reaction between aqueous solutions of chlorine and potassium bromide would be red-brown. This was probably from using information from the table, but red-brown referred to pure liquid bromine, whereas aqueous bromine, which is not red-brown, would be formed in the reaction. The other most common error was stating that chloride displaces bromide, instead of chlorine displaces bromine. Some answers included the use of reagents other than the two specified in the question. References to electrolysis were surprisingly common and did not gain any credit.

(c) A student is given an aqueous solution of chlorine and an aqueous solution of potassium bromide.

Explain how he can use these two solutions to compare the reactivity of chlorine with the reactivity of bromine.

(4)

In a beaker aqueous solution of chlorine and aqueous solution of potassium bromide will be poured. An aqueous colourless solution will be formed and a red vapour will be seen. The red vapour is bromine. Chlorine has displaced bromine; chlorine is more reactive than bromine.

ResultsPlus
Examiner Comments

This candidate has gained marks for adding the two solutions together and has stated that chlorine has displaced bromine and chlorine is more reactive than bromine. However, the candidate has incorrectly stated that the bromine will form as a red vapour.

Add the aqueous solution of chlorine to the potassium bromide solution, then stir and leave it for a time. the salt that will be formed is Potassium chloride. As chloride displaces Bromide because chlorine is more reactive than Bromine.

ResultsPlus
Examiner Comments

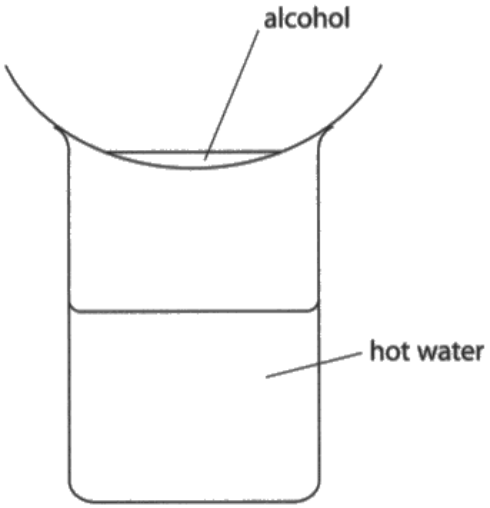
The candidate gains two marks for adding the chlorine solution to the potassium bromide solution and for stating chlorine is more reactive than bromine. However, chloride displaces bromide is incorrect; it should be chlorine displaces bromine.

Question 3 (a)

Many candidates correctly identified the volume of the liquid and the temperature of the water as the control variables. Suggestions referring to the concentration of the alcohol were not accepted and the volume of water was ignored.

3 Methanol, ethanol, propanol and butanol are alcohols. They are all liquids that evaporate easily when warmed.

A student uses this apparatus to compare the time taken for the four liquids to evaporate.



She uses this method.

- pour some methanol into an evaporating basin
- place the evaporating basin on top of a beaker containing hot water
- measure the time taken for the methanol to evaporate completely
- repeat the experiment with each of the other alcohols, using the same apparatus

(a) State two variables the student should control to make sure her results are valid.

(2)

1 The temperature of the hot water

2 The concentration of the alcohol

ResultsPlus
Examiner Comments

The temperature of the water is a correct answer but the concentration of the alcohol is not so this response scored 1 mark.

Question 3 (b)

Most candidates scored the mark for stating that alcohols are flammable or, alternatively, catch fire *easily*. It was surprising that many thought that the evaporating basin would burn or melt.

(b) State why it is not safe to heat the evaporating basin directly with a Bunsen flame.

(1)

The basin will melt

ResultsPlus
Examiner Comments

This candidate was one of many who thought that the evaporating basin would burn or melt.

Question 3 (c) (i)

Most candidates gained at least one mark but to score both marks thay had to exclude the anomalous result.

(c) The table shows the results of experiments done by four students, A, B, C and D.

Alcohol	Formula of alcohol	Time taken for liquid to evaporate in s				
		Student A	Student B	Student C	Student D	Mean time in s
methanol	CH_3OH	20	24	22	26	23
ethanol	C_2H_5OH	32	34	35	30	33
propanol	C_3H_7OH	45	47	50	48	48
butanol	C_4H_9OH	64	63	90	60	

(i) Calculate the mean (average) time for butanol to evaporate.

(2)

Mean = $\frac{64 + 63 + 90 + 60}{4}$

= 69 s (ANS)

mean time = 69 s

ResultsPlus
Examiner Comments

This candidate calculated a mean time but did not exclude the anomalous value so gained one mark.

ResultsPlus
Examiner Tip

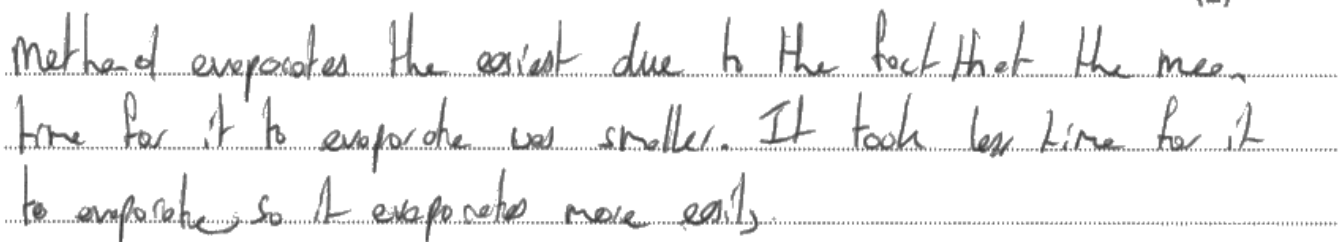
Candidates should remember that when calculating a mean, they should omit any anomalous results.

Question 3 (c) (ii)

Most candidates identified that methanol was the alcohol which evaporates most easily and gained the first mark. The question asked for an explanation for this from the results, and as the results in the table were values of times, the required explanation needed to refer to methanol taking the shortest time.

(ii) Explain how the results show which alcohol evaporates most easily.

(2)



ResultsPlus
Examiner Comments

The candidate correctly identified methanol as being the alcohol which evaporates most easily but unfortunately did not express the reason quite well enough. They would have needed to state the time was smaller/less *than all the other alcohols*, or had the *smallest/least* time.

ResultsPlus
Examiner Tip

Candidates need to be careful in their use of language to ensure their meaning is totally correct.

The results show that methanol evaporates most easily

ResultsPlus
Examiner Comments

The candidate gained one mark for correctly identifying methanol but did not give a reason.

ResultsPlus
Examiner Tip

In questions like this which are of the "Explain..." type, one mark is awarded for the answer which was methanol in this case, and the second mark is for the reason or explanation.

Question 3 (c) (iii)

This was generally well answered, with most candidates showing they knew how to present a relationship. However, some students gained only one mark as their answer referred to time rather than ease of evaporation as the question demanded.

(iii) State the relationship between the number of carbon atoms in the molecule and how easily the alcohol evaporates.

(2)

The lower the number of carbon atoms, the more easily the alcohol evaporates. For example, methanol has 1 carbon atom and takes the lowest time. When there are ~~more~~ fewer carbon atoms, there are weaker intermolecular attractions.

(Total for Question 3 = 9 marks)

ResultsPlus
Examiner Comments

This candidate gave a good succint answer in the first sentence. Although not required, they then continued to elaborate on their answer.

As the number of carbon atoms increases the time taken for the alcohol to evaporate increases.

ResultsPlus
Examiner Comments

The candidate starts the relationship well but then refers to time rather than ease of evaporation, as the question demanded, so was awarded one mark.

Question 4 (b)

Most candidates identified at least one property of aluminium that makes it suitable for saucepans. However, some candidates were a little careless by just stating that aluminium is a good conductor. This is not quite precise enough as it needed to be good conductor *of heat*.

(b) Aluminium is malleable and can be easily shaped to make saucepans used for cooking food.

State two other properties of aluminium that make it suitable for saucepans used for cooking food.

(2)

1 Good conductors of heat

2 It is light

ResultsPlus
Examiner Comments

The candidate scores 1 mark for good conductor of heat. The other answer *light*, is not quite good enough. The best scientifically correct answer would of course be *low density* but *lightweight* was accepted.

1 High melting point

2 light weight.

ResultsPlus
Examiner Comments

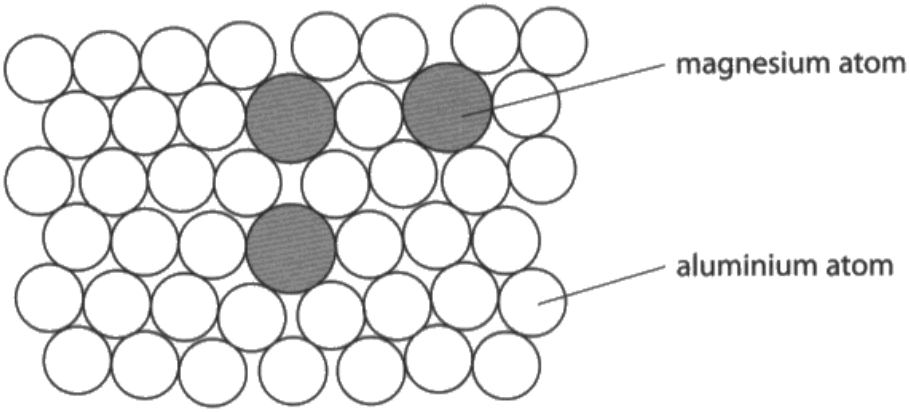
High melting point is a correct answer and *lightweight* was accepted although the best scientific answer would be *low density.*

Question 4 (c) (i)

The required definition of an alloy needed the idea of a *mixture.* The majority of candidates gave a suitable definition, with the most common correct answer being a *mixture of metals*. Some candidates stated an alloy is a compound which was not accepted.

(c) Magnalium is an alloy of aluminium and magnesium.

The diagram shows how the atoms are arranged in this alloy.



(i) State what is meant by the term **alloy**.

(1)

It's a metal made by combining two or more metallic elements to give greater strength

ResultsPlus
Examiner Comments

An acceptable alternative to mixture was to use the idea of combination or combining metals.

Question 4 (c) (ii)

The reasons for an alloy being harder than a pure metal were generally quite well understood with most candidates gaining some marks. However, many gave incomplete answers, often not referring to the atoms being different sizes or failing to refer to the layers being more difficult to slide over one another.

(ii) **Explain why magnalium is harder than aluminium.**

(3)

In Aluminium the metal ions are all the same size, and so there is a regular arrangement, therefore the layers can slide past eachother easily, whereas in magnalium, the larger magnesium ions mixed in, makes it much more difficult for the layers to slide past eachother, therefore making magnalium more harder.

(Total for Question 4 = 7 marks)

ResultsPlus
Examiner Comments

In this response the candidate refers to metal *ions* which was an acceptable alternative to metal *atoms.* There is reference to the magnesium ions being larger so making it more difficult for the layers to slide over each other. There was no reference to the regular arrangement of ions/atoms being disrupted/distorted or equivalent comment. Therefore, this answer scores 2 marks.

in magnesium and aluminium (3)

Different size in atoms ^means the layers of magnalium are distorted, unlike in aluminium. This means it is more difficult for the layers of atoms to slide over each other, making them harder. Aluminium has straight layers of positive ions so can slide over each other ^more easily.

ResultsPlus
Examiner Comments

This candidate refers to the different sized atoms, the layers being distorted and that it is more difficult for the layers to slide over each other. This response scores all 3 marks.

magnalium ~~[illegible]~~ has different sizes of atoms which make it difficult for the layers of positive ions to slide over each other so it is harder than aluminium.

ResultsPlus
Examiner Comments

The candidate uses the terms atoms and ions which are both acceptable. They refer to the different sizes of atoms which was acceptable, and to the layers being difficult to slide over each other, but there is no reference to the distortion/disruption of the regular arrangement of atoms or layers. This answer is worth 2 marks.

Question 5 (a)

The answers to this question involving bond energies were generally better than in recent legacy papers. As is always the case, there were sometimes arithmetical errors in parts (i) and (ii) but this did not prevent the possibility of gaining full marks in part (iii). However, some candidates did not include the negative sign after a correct calculation and so lost one mark. Some, having obtained the correct answer, then inexplicably made extra steps, such as dividing by 4.

(a) The tables give the bond energies for the bonds broken in the reactants and the bonds made in the products.

Bonds broken	
bond	bond energy in kJ/mol
N—N	159
N—H	391
O—O	143
O—H	463

Bonds made	
bond	bond energy in kJ/mol
N≡N	945
O—H	463

(i) Use the data in the tables to calculate the total amount of energy required to break all of the bonds in the reactants.

(1)

159 + 391 + 143 + 463 = 1156

energy required = 1156 kJ

(ii) Use the data in the tables to calculate the total amount of energy released when all of the bonds in the products are made.

(1)

945 + 463 = 1408

energy released = 1408 kJ

(iii) Calculate the enthalpy change, ΔH, in kJ/mol, for the reaction. Include a sign in your answer.

(3)

1408 − 1156 = − 252

ΔH = −252 kJ/mol

ResultsPlus
Examiner Comments

The answers to parts (i) and (ii) are both incorrect. However, using these answers and marking consequentially, the answer to part (iii) is numerically correct and also correctly has a negative sign. Hence part (iii) is awarded 3 marks.

(i) Use the data in the tables to calculate the total amount of energy required to break all of the bonds in the reactants.

(1)

391 × 4 = 1564
143 × 2 = 286
463 × 4 = 1852 +
4261

energy required = +4261 kJ

(ii) Use the data in the tables to calculate the total amount of energy released when all of the bonds in the products are made.

(1)

463 × 8 = 3704
+ 945
4649

energy released = +4649 kJ

(iii) Calculate the enthalpy change, ΔH, in kJ/mol, for the reaction. Include a sign in your answer.

(3)

4649
− 4261
0388

ΔH = +388 kJ/mol

ResultsPlus
Examiner Comments

The answer to part (i) is incorrect. The answer to part (ii) is correct and so scores 1 mark. In part (iii) using consequential marking, the answer is numerically correct but from the answers to (i) and (ii) the answer to part (iii) should be negative. Therefore, the candidate is given 2 marks.

Question 5 (b)

There were some excellent answers explaining why the reaction is exothermic. However, there were many examples of misunderstandings with candidates believing that energy is needed to make bonds. Many others tried to explain by comparing the number of bonds broken to the number of bonds formed.

(b) Explain, in terms of bonds broken and bonds made, why this reaction is exothermic.

(2)

Heat is being given out in this process because there is more energy released than energy required to break the bonds.

ResultsPlus
Examiner Comments

This candidate has made a good attempt at the explanation but after *there is more energy released* has omitted the idea of *when bonds are made*. This response was, therefore, given 1 mark.

The energy released by the bonds formed in the products is greater than the energy required to break the bonds in the reactants. This means there is a net loss of energy to the surroundings, thus the reaction is exothermic

ResultsPlus
Examiner Comments

This is a good explanation and was awarded 2 marks.

more bonds are made than bonds are broken causing the reaction to be exothermic

ResultsPlus
Examiner Comments

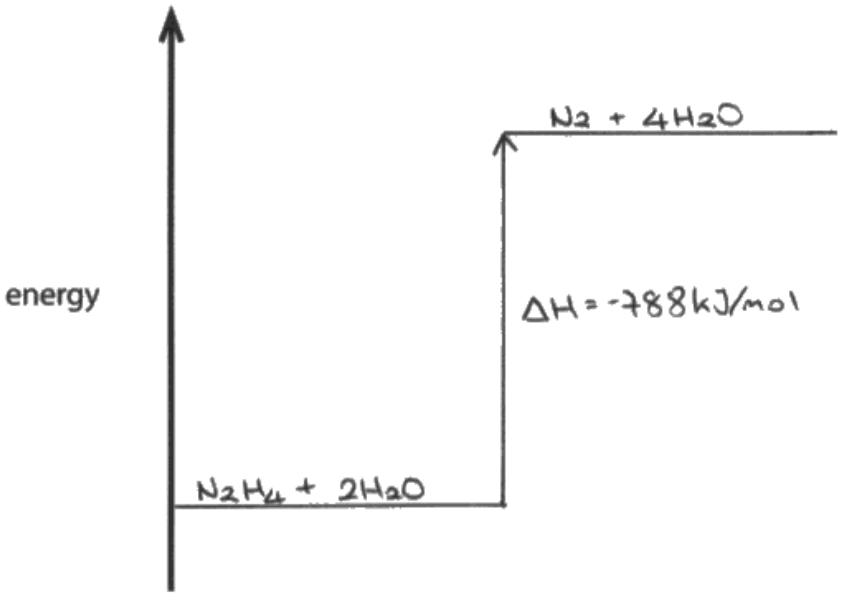
Many candidates such as this one, incorrectly tried to explain in terms of numbers of bonds made and broken. It is not worth any marks.

Question 5 (c)

There were many excellent energy level diagrams for the reaction. However, many candidates also drew and labelled the activation energy, showing they probably do not appreciate the difference between an energy level diagram and a reaction profile. On this occasion, references to the activation energy were ignored. Many candidates lost a mark by answering in a generic way, not picking up on the fact that specific reactants and products had been given and that they should show them in their diagram.

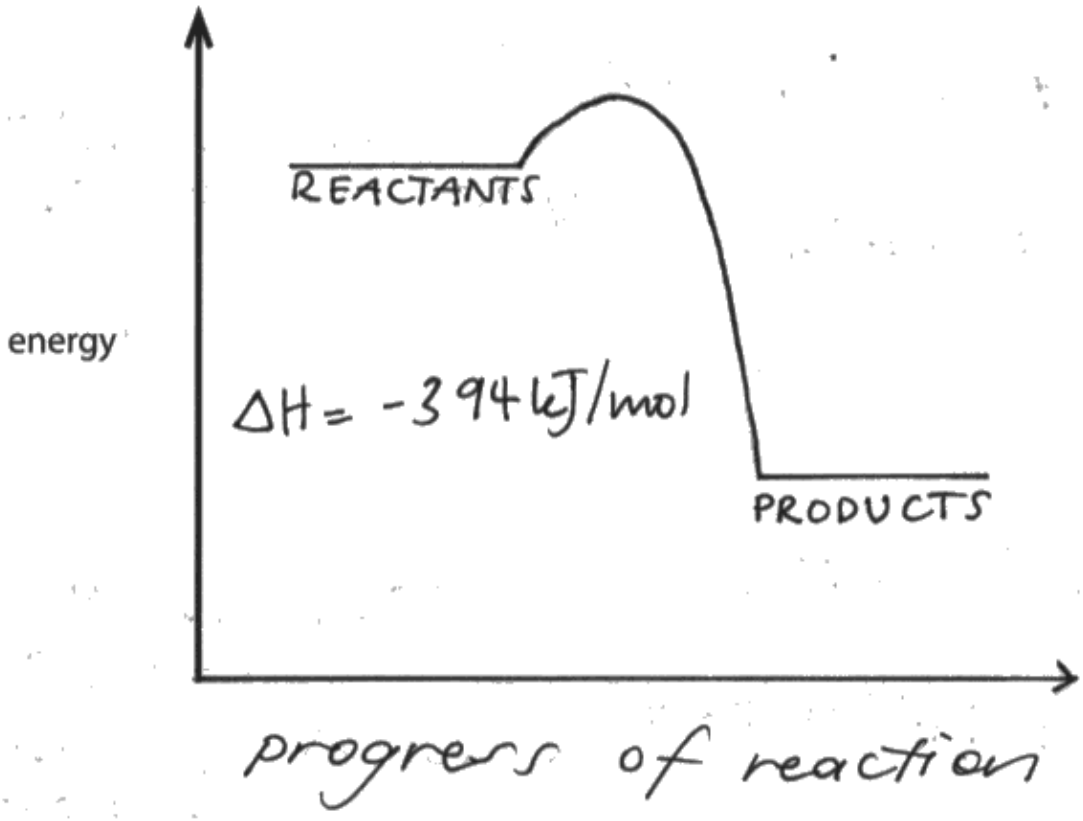
(c) Draw an energy level diagram for the reaction between N_2H_4 and H_2O_2

(3)



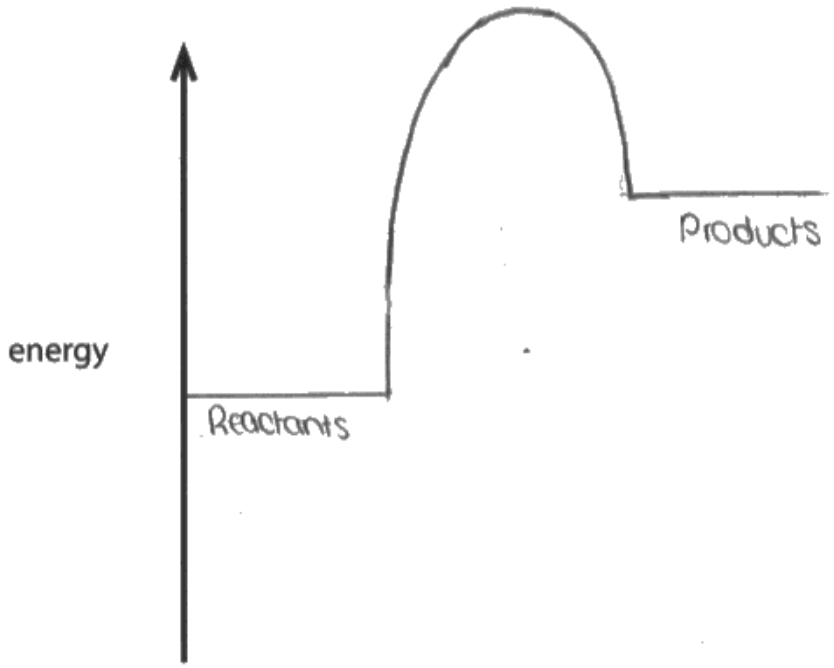
ResultsPlus
Examiner Comments

This candidate has shown an endothermic reaction, although the question stated that the reaction was exothermic. However, the candidate has correctly given the reactants and the products in their correct positions and so was awarded 2 marks.



ResultsPlus
Examiner Comments

This candidate, like many others, has answered in a generic way using *reactants* and *products*, instead of specifying what they were. However, the candidate has put the labels in the correct places and has shown an exothermic reaction so was awarded 2 marks.



ResultsPlus
Examiner Comments

This candidate has also answered in a generic way using *reactants* and *products*, instead of specifying what they were. However, the candidate has put the labels in the correct places but has shown an endothermic reaction so was awarded just 1 mark.

Question 6 (a) (i)

The majority of candidates correctly stated yeast with many also stating it contains zymase.

6 Some cars in Brazil use ethanol, C_2H_5OH, as a fuel instead of petrol.

The ethanol is made by the fermentation of glucose which is obtained from sugar cane.

The sugar is extracted from the sugar cane and then dissolved in water to make a sugar solution.

(a) (i) Name the substance that is added to the sugar solution that causes glucose to ferment.

(1)

• steam (and yeast as a catalyst / zymase as a catalyst)

ResultsPlus
Examiner Comments

The candidate has given steam as the answer so scores 0 despite a correct answer then being given as an additional answer in brackets.

phosphoric acid

ResultsPlus
Examiner Comments

This incorrect answer was seen quite often.

Question 6 (a) (iii)

This question was often well answered with many candidates stating that ethanol would react with oxygen forming ethanoic acid. Other candidates answered in an equally acceptable way by stating that the respiration would not be the necessary anaerobic, but aerobic, so forming carbon dioxide and water instead of ethanol.

(iii) Explain why fermentation is done in the absence of air.

(2)

To prevent the oxidation of ethanol ~~oxygen~~ to ethanoic acid.

ResultsPlus
Examiner Comments

This was an acceptable way of answering the question and scored 2 marks.

So that yeast can respire anaerobically to produce ethanol, if yeast respires in presence of oxygen (aerobically) the carbondioxide and water will be formed.

ResultsPlus
Examiner Comments

This way of answering the question was common and worth 2 marks

Question 6 (b) (i)

This was disappointingly answered with many candidates writing about fuels powering vehicles or machinery. Many gave answers from a Physics point of view in terms of energy stores. The required answer was taken directly from the specification containing the idea that a fuel is a substance that when burned, produces *heat* energy.

(b) (i) State what is meant by the term **fuel**.

(1)

A substance which when burnt releases ~~produces~~ energy.

ResultsPlus
Examiner Comments

This answer unfortunately was not quite worth the mark as it did not refer to releasing *heat* energy as given in the specification.

A substance that when burned releases heat energy.

ResultsPlus
Examiner Comments

This is a good answer and gains the mark.

is a liquid ~~that~~ that helps cars to move or any machinery to work.

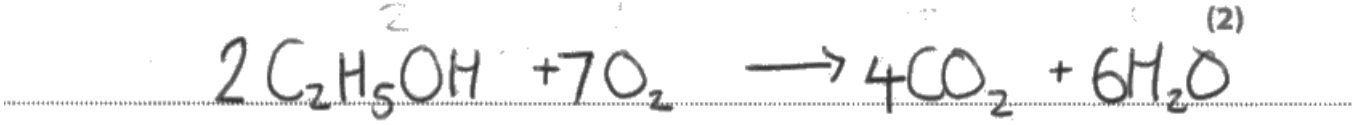
ResultsPlus
Examiner Comments

This type of answer was very common but not worth any credit.

Question 6 (b) (ii)

As well as large numbers of fully correct answers, there were many candidates who gave the correct formulae but did not balance the equation correctly and so scored 1 mark. The most common error was to put 3.5 moles of oxygen, having forgotten the oxygen in the ethanol. Surprisingly, there were a number of equations for respiration or photosynthesis given.

(ii) Write a chemical equation for the complete combustion of ethanol in air. **(2)**



ResultsPlus
Examiner Comments

As always, multiples were acceptable in equations. This attempt contains an error in the balancing of the equation, caused by forgetting the oxygen in the ethanol (a common error).

Question 6 (c)

There were many correct values of the temperature and pressure. However, candidates need to be careful about putting ranges as answers. They were not awarded the mark if any value fell out of the accepted ranges in the mark scheme. Candidates who did not specify actual values, but just stated *high* or *low* did not gain any marks.

(c) Ethanol is also manufactured by reacting steam with ethene, C_2H_4

The equation for this reaction is

$$C_2H_4(g) + H_2O(g) \rightarrow C_2H_5OH(g)$$

State the conditions of temperature and pressure used in this process.

(2)

temperature 300° – ~~400~~ °c

pressure ~~00~~ 60 - 70 atmospheres

ResultsPlus
Examiner Comments

The temperature range included 400° which is outside of the acceptable 250° - 350° range so did not score a mark. The pressure range was correct scoring 1 mark.

Question 6 (d) (i)

It was disappointing not to see more give the correct colour change when using acidified potassium dichromate(VI). A whole range of colour changes were seen, many seemingly associated with the use of indicators.

(d) When ethanol is heated with acidified potassium dichromate(VI), it is oxidised to ethanoic acid.

(i) State the colour change that occurs in the potassium dichromate(VI) during this reaction.

(1)

from ..... green ..... to ..... orange .....

ResultsPlus
Examiner Comments

This candidate, like others, had the correct colours but the wrong way around.

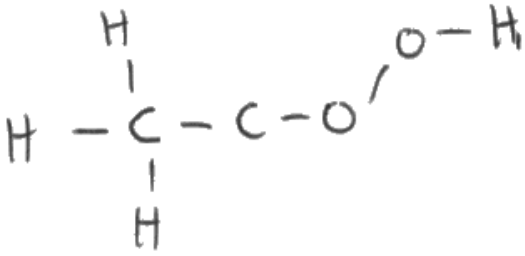
Question 6 (d) (ii)

Many candidates scored both marks by giving a fully correct displayed formula. The most common error was not to show the bond between the oxygen atom and the hydrogen atom.

(ii) The structural formula of ethanoic acid is CH_3COOH

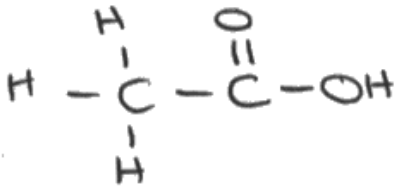
Draw the displayed formula of ethanoic acid.

(2)



ResultsPlus
Examiner Comments

This was quite a common answer which was not awarded any marks.



ResultsPlus
Examiner Comments

This was a very common answer with the bond missing between the oxygen atom and the hydrogen atom. It was awarded 1 mark.

Question 6 (d) (iii)

This equation proved very challenging to many candidates. Showing the formula of the sodium salt as $NaCH_3COO$ was allowed but not as $NaCH_2COOH$. Some condidates, having given two correct products, could then not correctly balance the equation and so scored just 1 mark.

(iii) Complete the equation for the reaction of ethanoic acid with sodium.

(2)

$$\text{.....}CH_3COOH(aq) + \text{.....}Na(s) \rightarrow \text{.....}CH_3COONa\text{.....}(aq) + \text{.....}H_2\text{.....}(g)$$

ResultsPlus
Examiner Comments

The formulae of the products are correct but the equation is not correctly balanced so this response scored 1 mark only.

Question 7 (a)

Many candidates understood the concept of dynamic equilibrium and gave very good answers describing the reaction taking place in both forward and backward directions at the same rate. The most common mistakes were simply stating that the reaction was reversible, which was insufficient, or stating that the concentrations of reactants and products were equal rather than remaining constant.

7 Dinitrogen tetraoxide, N_2O_4, is a colourless gas.

Nitrogen dioxide, NO_2, is a brown gas.

The two gases can exist together in dynamic equilibrium according to the equation

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

(a) Explain what is meant by the term **dynamic equilibrium**.

(2)

Dynamic equilibrium is when both the forwards and backwards reaction take place together, continously.

ResultsPlus
Examiner Comments

The candidate states the forward and backward reactions take place together but has not stated they occur at an equal rate so is awarded 1 mark only.

dynamic equilibrium is ~~[illegible]~~ when a reaction is in a closed system, thus the rates of forward and backward reaction happen at the same rate and ~~[illegible]~~ concentrations of reactants and products remain constant.

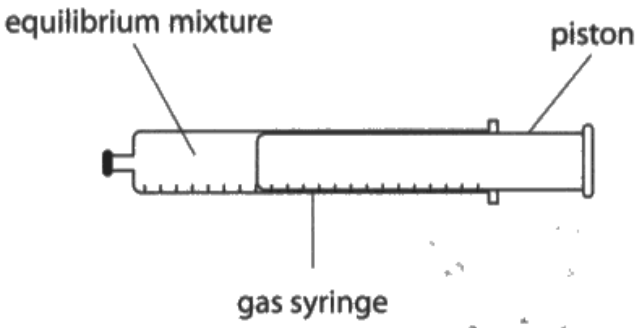
ResultsPlus
Examiner Comments

A very good answer worth 2 marks.

Question 7 (b) (i)

As in the legacy specification, candidates should avoid giving answers using Le Chatelier's Principle as comments such as '*the reverse reaction is favoured*' are ignored and do not gain credit. All that was required was to state the (position of) equilibrium shifts to the left because there are fewer moles (of gas) on the left. Some clearly confused equilibrium and rate as they just discussed collisions in their answers.

(b) Some N_2O_4 and some NO_2 are put into a sealed gas syringe and allowed to form an equilibrium mixture.



This equilibrium mixture is brown.

(i) The pressure of the gas in the syringe is increased by pushing in the piston. The mixture is then allowed to reach a new equilibrium at the same temperature as before.

Explain why the new equilibrium mixture contains less NO_2 than the original equilibrium mixture.

(2)

The pressure is ~~decreased~~ increased meaning the position of equilibrium shifts to the left (favours the backwards reaction) because there are less moles on that side. Therefore less NO_2 is is produced and more N_2O_4 is produced.

ResultsPlus
Examiner Comments

This response was worth 2 marks for stating the position of equilibrium shifts to the left because there are less moles on that side (left clearly implied). The statement '*favours the backward reaction*' is ignored.

As the pressure is increased, the equilibrium shifts to the left, so that there is less NO_2 and more N_2O_4 produced, as there are more molecules on the right hand side,

ResultsPlus
Examiner Comments

This response was also awarded 2 marks as it states the equilibrium shifts to the left and then uses the acceptable reverse argument by stating '*as there are more molecules on the right hand side*'.

Question 7 (b) (ii)

Many candidates realised that the colour was darker because the concentration of nitrogen dioxide had increased. Some answers were not quite precise enough, stating that the concentration of gas was higher but without being clear that they were referring to NO_2 gas.

(ii) A student suggests that the new equilibrium mixture would be lighter in colour than the original equilibrium mixture, as there is now less NO_2 present.

Suggest why the new equilibrium mixture is actually darker than the original.

(1)

because the concentration of particles increased so there are more in a smaller area, this darkens the colour.

ResultsPlus
Examiner Comments

This candidate, although correctly stating that the concentration of particles has increased, has not referred to NO_2 and so was not awarded the mark.

Question 7 (c) (i)

Many candidates gained the mark by stating that nitrogen and oxygen react. Although it was not necessary to state that the gases came from the air, the mark was not awarded if candidates gave an incorrect source of a gas e.g. stating the nitrogen came from the fuel.

(c) Carbon monoxide, CO, and oxides of nitrogen are produced in a car engine when petrol is burned.

These oxides can be partly removed by using a catalytic converter fitted to the car's exhaust system.

(i) State how oxides of nitrogen are produced in the car engine.

(1)

Due to the high temprature in the car engine, the nitrogen reacts with the oxygen in air and oxidises to form nitrogen oxides.

ResultsPlus
Examiner Comments

This is an example of a good answer which gained the mark.

By burning nitrogen with the help of the oxygen

ResultsPlus
Examiner Comments

Answers which referred to nitrogen *burning* did not gain credit.

Question 7 (c) (ii)

The majority of candidates gained the mark usually for referring to acid rain, although other answers were allowed.

(ii) Give a disadvantage of allowing oxides of nitrogen to escape into the atmosphere.
(1)

It Pollute air

ResultsPlus
Examiner Comments

Answers such as this were considered to be too vague and did not gain the mark.

Question 7 (c) (iii)

It was surprising that more candidates did not give a correct equation; many gave unbalanced equations or equations with a monatomic nitrogen.

(iii) Write a chemical equation for the reaction between nitrogen monoxide, NO, and carbon monoxide to form carbon dioxide and nitrogen.

(1)

$NO + CO \rightarrow CO_2 + N$

ResultsPlus
Examiner Comments

This was typical of many incorrect equations containing a monatomic nitrogen.

$NO + CO \rightarrow CO_2 + N_2$

ResultsPlus
Examiner Comments

An unbalanced equation which was often seen.

Question 8 (a)

As expected, this question on safety precautions was generally well answered. However, many candidates only gained 1 mark as they did not give a correct scientific reason for their safety precaution, e.g. wear gloves because the bleach may *burn your hands* instead of wear gloves because the bleach may *be corrosive*.

8 The concentration of NaClO(aq) in a solution of bleach is found by reacting it with hydrochloric acid.

The equation for the reaction is

$$NaClO(aq) + 2HCl(aq) \rightarrow NaCl(aq) + H_2O(l) + Cl_2(g)$$

An excess of dilute hydrochloric acid is added to 4.00 cm^3 of bleach solution.

60.0 cm^3 of chlorine gas is produced.

(a) Explain a safety precaution that should be taken when doing this experiment.

(2)

It should be done in a fume cupboard to prevent Cl_2 escaping and potentially damaging someone.

ResultsPlus
Examiner Comments

This response correctly suggests that a fume cupboard should be used but the reason is too vague; the candidate needs to state chlorine is toxic or poisonous. Hence, only 1 mark is given.

Question 8 (b)

Strong candidates performed well in all parts of this calculation question. It was also pleasing to see that part (b)(i), involving calculating the number of moles of chlorine from the given volume of gas, proved accessible to a wide range of candidates. However, it was disappointing to see some candidates showing the correct calculation but then not copying down the calculator value correctly.

In part (ii), good candidates used the equation provided to appreciate that the number of moles of NaClO was the same as the number of moles of chlorine in the part (i). Others incorrectly performed a further calculation instead.

Part (iii) involved converting from a number of moles in 4.00cm^3 to a concentration in mol/dm^3, and this often proved challenging, except to the best candidates. However, some candidates who had made errors in the previous part were able to gain credit through consequential marking.

(b) (i) Calculate the amount, in moles, of chlorine gas produced.
Assume one mole of chlorine gas occupies 24 000 cm^3.

(2)

mol = $\frac{60}{24000}$

amount of chlorine = 2.5×10^{-6} mol

(ii) Determine the amount, in moles, of NaClO in 4.00 cm^3 of bleach.

(1)

amount of NaClO = 2.5×10^{-6} mol

(iii) Calculate the concentration, in mol/dm^3, of the bleach solution.

(2)

$\frac{2.5 \times 10^{-6}}{4/1000}$

concentration = 6.25×10^{-4} mol/dm^3

ResultsPlus
Examiner Comments

This candidate showed the correct calculation in (i) and so gained the first mark. However, the answer shown was not correct.

In (ii) the answer given was the same as in part (i) and so gained the mark through consequential marking.

In (iii) the candidate has correctly used their answer to part (ii) and so gained the 2 marks through consequential marking.

Paper Summary

It was pleasing to see that the paper seemed to provide the opportunity for the full spectrum of candidates to show their understanding and knowledge. There was no evidence that candidates had any issues with the time allocation.

Based on their performance on this paper, candidates should:

- very carefully read each question, preferably more than once to ensure they understand what is being asked;
- answer questions accordingly, using the instructions given, without just repeating the information in the stem of the question or introducing extra unnecessary information;
- when using a calculator be careful to correctly copy the answer from the calculator display;
- in calculations, where requested, give the final answer to the requisite number of decimal places or significant figures;
- give specific rather than just generic, general answers;
- use scientific terminology rather than colloquial terms;
- when writing formulae take care with handwriting and also ensure correct use of upper/lower case letters and correct use of subscripts and superscripts.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London WC2R 0RL.