8224
Paper 2

1. GENERAL COMMENT

The quality of language used for the responses was, for the most part very impressive. However, it seems learners struggle to mobilise the correct scientific terms for use in their answers. For instance, the key words to properly answer question 3 b (iii) were missing. Instead of 'more successful collisions' the candidates simply wrote 'more collisions.'

Spelling errors were prevalent.

The presentation of the work was also impressive; the candidates' handwriting was neat and legible. However, some responses were written in pencil and then overlaid with ink and not rubbed out. We really struggled to read those responses. Candidates may use pencil for diagrams, graphs and rough working but they should not overlay the pencil with ink. Should they wish to change the response written in pencil to ink they should completely erase the pencil marks. Candidates should take note that any working done in pencil is treated as rough working and is not credited.

The candidates struggled with the command words used in questions. In particular it appears the term explain is not well understood by the candidates. The term '*explain*' requires the candidates to proffer reasons. Instead, a number of candidates gave a very general related comment rather than an actual explanation. Question 4 b (iii) is a case in point. The candidates were asked to explain why carbon dioxide is a gas while silicon (IV) oxide is a solid at room temperature; the candidates simply stated that carbon dioxide requires less energy to change states than silicon (IV) oxide. Although this is true it cannot be enough to score 4 marks. They were required to give details about the structures and the intermolecular forces present.

The candidates found graphing very difficult. First, their drawings were done with a careless abandon and the axes were not labelled. Second, they failed to interpret graphs and neglected to make use of their graphs in their answers. For instance, in 3 b (iii) the candidates were required to use their graph but most of them failed to show on the graphs how they were using them.

Some candidates gave giving very long winding responses. This resulted in a loss of marks because some of them contradicted themselves. Candidates also made use of brackets, for instance to provide further clarification. Candidates should be made aware that examiners do not read anything that is placed in brackets. Zero credit was earned for anything written in brackets.

It seems a number of topics were not covered to the detail required for AS level while others, such as organic chemistry were not covered at all. Chemical equilibrium proved difficult for the candidates and many demonstrated they lack basic understanding. For instance, in 2(a)(ii) learners were required to describe observations. Instead, the few candidates who had some understanding of equilibrium described the corpuscular processes which are not observable. In 3(c)(ii) most candidates revealed that they espouse the misconception of compartmentalization of dynamic equilibrium i.e. the reactants and products are situated in different containers. Consequently, most candidates gave statements such as "endothermic side is favoured" instead of "endothermic reaction is favoured and the position of equilibrium shifts to the left hand side".

2. COMMENTS ON SPECIFIC QUESTIONS

Question 1

This question was well answered by most candidates. Only a very proportion of the candidature lost marks due to carelessness. For instance, the candidates were using two capital letters for the chemical symbols.

Mark scheme/expected answers

(a) $^{19}_{9}F^-$ or $^{20}_{10}Ne$

(b) $^{32}_{16}S$

(c) $^{32}_{16}S$ or $^{34}_{16}S^{2-}$

(d) $^{20}_{10}Ne$

(e) $^{20}_{10}Ne$ or $^{32}_{16}S$ or $^{16}_{8}O$

Question 2

(a) (i) Poorly answered. This was a simple recall question but a lot of candidates failed to realise that they were required to give the colour of the vapour - not that of the solid or of the solution.

Mark scheme/expected answers

purple

(ii) Few candidates were able to answer this question correctly and the mark was only accessed by the strongest candidates.

Mark scheme/expected answers

Colour stays the same

(b) (i) Well answered. However, a few candidates lost marks because they used curved brackets () instead of the square brackets [] that represent concentration. There are a few candidates who forgot to square [HI] or were confused by the subscript in iodine and hydrogen.

Mark scheme/expected answers

$K_C = [HI]^2 / [H_2][I_2]$

(ii) Well answered. Candidates seem to enjoy calculations and do well in them. However, marks were lost because of premature rounding as well as, disappointingly, incorrect rounding.

Mark scheme/expected answers

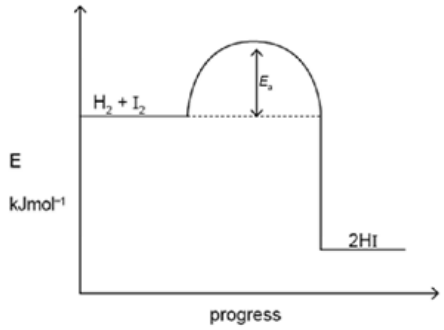
M1 $45.9 = \frac{[HI]^2}{[H_2][I_2]}$

M2 $[HI]^2$ = [0.228][0.228] x 45.9

M3 $[HI]$ = 1.54 mol dm^{-3}

(c) Answered fairly well. Almost every candidate scored at least one mark. Candidates lost marks because the axes were not labelled. In addition, Ea was not labelled clearly and we could not decipher where it started or ended.

Mark scheme/expected answers



- line or arrow (judge by eye) **and** Ea or activation energy label
- reaction is exothermic
- shape ie "up and over"
- E or kJ mol^{-1} on left hand axis and reactants + products

Question 3

(a) (i) Well answered. A few candidates gave nitric acid which does not work for this reaction. We gave them benefit of doubt.

Mark scheme/expected answers

Sulfuric acid / hydrochloric acid

(ii) Well answered. Only a few candidates failed to get this mark. Candidates should be encouraged to learn the full definition for a catalyst. Some candidates restricted their definition to enzymes.

Mark scheme/expected answers

Substance that speeds up a chemical reaction **and**
but is not consumed by the reaction **or** provides an alternative mechanism / pathway **or** lowers Ea

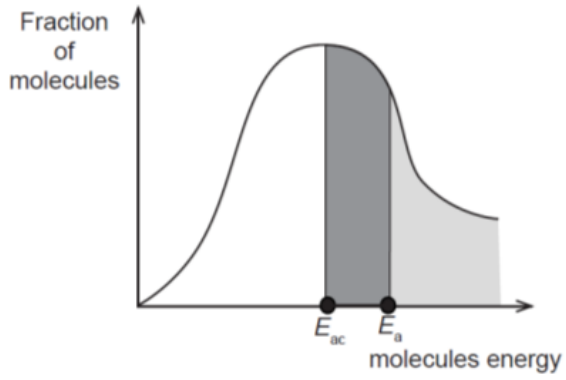
(iii) Few candidates gained credit for this question. It seems the concept of homogenous and heterogeneous catalyst is not well understood.

Mark scheme/expected answers

Homogenous
- all in same phase / state (as the reactants)

(b) (i) Poorly answered. The drawings were very poor and the labels were misplaced. Many of the sketches showed some confusion between the ideas of a Boltzmann distribution and an energy profile for a reaction. The few candidates who attempted the Boltzmann curve failed to realise that it must start at the origin and must not touch the x-axis at the right-hand end.

Mark scheme/expected answers



(ii) Poorly answered. Eac was incorrectly marked to represent a change on the y axis.

Mark scheme/expected answers

Marked on the curve / on the graph **on the x-axis**
(Look for E_{ac} on the bottom axis at lower energy than E_a)

(iii) Only the strongest candidates answered this question correctly. Candidates gave 'ordinary level' responses that did not demonstrate an understanding of the distribution of molecular energies. In addition, there was no evidence in their responses that they used the graphs - which should have been shaded.

Mark scheme/expected answers

M1 Evidence that graph was used (**shading** on the graph)
M2 More particles have energy ≥ E_a
M3 More fruitful / effective / successful **collisions**

(c) (i) Well answered. However, a few candidates could not clearly show they were comparing.

Mark scheme/expected answers

- Particles have higher speed / more **kinetic** energy
- increasing the number of collisions
- have more particles possess / have / exceeds Ea.

(ii) Poorly answered. Most candidates failed to realise that they were required to apply Le Chatelier's principle. The few candidates who recognised that this question was about LCP made a general reference about the effect of temperature but failed to relate the general theory to the specific context of the question.

Mark scheme/expected answers

Forward reaction is exothermic / back reaction is endothermic
Increase in temperature favours reverse / back / endothermic reaction **or** equilibrium position shifts to the left

Question 4

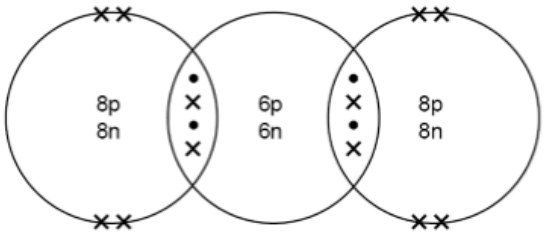
(a) Well answered. However, some candidates failed to use all the key words of the definition as stated in the syllabus. Candidates should be encouraged to learn full definitions.

Mark scheme/expected answers

Mass of an atom or isotope relative to 1/12 of the mass of an atom of carbon 12.

(b) (i) The dot and cross diagram was known by almost all candidates. However, some candidates forgot the lone pairs on the oxygen.

Mark scheme/expected answers



(ii) Well answered for shape. Many candidates could not offer a reasonable explanation for the shape.

Mark scheme/expected answers

Shape – linear
Explanation – repulsion of two areas of negative charge or two electron pairs

(iii) Candidates found this question challenging, even though the question tested really basic concepts. Most candidates chose to answer the question in terms of the energy taken in to break the intermolecular forces, but neglected to identify the forces involved.

Mark scheme/expected answers

M1 CO_2, simple molecular / simple covalent with
M2 (weak) van der Waals forces

M3 SiO_2, giant / lattice with
molecular / covalent
M4 **strong** (not strong**er**) covalent bonds.
(must not be between **molecules**, loses M4)

(c) (i) Well answered. Candidates generally score very high in calculations. However, there were a few errors emanating from improper use of the calculator.

Mark scheme/expected answers

28.1+(1×3)+58.9+(12×4)+(16×4)

= 202

$$\frac{28.1}{202}\times 100 = 13.9$$

(ii) Well answered. However, marks were lost due to premature rounding.

Mark scheme/expected answers
$73.1/A_r$ and 26.9/28.1
Correct use of 4
Ar = 19.1 (3 or more SF)

Question 5

(a) Many responses were not awarded full credit due to lack of clarity. Not enough care was taken in selecting terminology. It is the atom that loses electrons from its outer shell and not the ion.

Mark scheme/expected answers
Removal of (an outer) shell in forming an ion from an atom /
Loss of outer / valence shell electrons

(b) There were few good answers that were awarded full credit. The second mark was not available to most candidates because they could not clearly explain shielding. Some candidates attributed the increase in radius to a decrease in nuclear charge. This is not true. An accurate phrasing of that response could be "decrease in effective nuclear charge".

Mark scheme/expected answers
Addition / occupation of more shells (down the group)
Shielding effect increases

(c) **(i)** Well answered. A few candidates gave the 'ordinary level' configuration.

Mark scheme/expected answers
K^+: $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $(4s^0)$
or Ca^{2+}: $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $(4s^0)$
or (Ne) $3s^2$ $3p^6$ $(4s^0)$

(ii) Well answered. A few candidates failed to clearly show that the comparison was between nuclear charge and not between cationic charge.

Mark scheme/expected answers
• Same number of shells
• nuclear charge in Ca^{2+} is greater than K^+ / Ca has more protons than K
• greater attraction /pull of Ca nucleus for outer shell / for shells / for electrons

Question 6

This entire question was poorly answered. It seems organic chemistry was not adequately covered in centres.

Mark scheme/expected answers

6 (a) (i)	Sunlight / UV / heat / T > 400 °C	
6 (a) (ii)	Free radical substitution **or**	
	Initiation, propagation & termination	[1]
	$Br_2 \rightarrow 2Br\bullet$	[1]
	$CH_3CH_3 + Br\bullet \rightarrow CH_3CH_2\bullet + HBr$	[1]
	or $CH_3CH_2\bullet + Br\bullet \rightarrow CH_3CH_2Br$	
6 (b) (i)	halogenoalkanes / haloalkanes / bromoalkanes	
6 (b) (ii)	bromoethane	
6 (c) (i)	NaOH / KOH / OH^- / H_2O **AND** aq / dil / H_2O / water	[1]
	reflux / heat / boil / T > 80 °C	[1]
6 (c) (ii)	C–Cl bond is stronger than C–Br bond	[1]
	more energy is required for hydrolysis / breaking C-hal bond in chloroalkanes	[1]
6 (d)	oxidation	
6 (e) (i)	MnO_4^- / manganate VII / $KMnO_4$	[1]
	Hot, conc, acidified	[1]
6 (e) (ii)	Propanoic acid (forms)	[1]
	CO_2 (forms)	[1]

3. POSITIVE SUGGESTIONS TO TEACHERS

- Teachers are advised to cover all the objectives in the syllabus and to insist that learners define terms as they are defined in the syllabus.
- Teachers should encourage the candidates to write legibly. They should discourage learners to write in ink over pencil. If candidates wish to use pencil first then should completely erase the pencil.
- Teacher should advise learners to show all their working clearly, neatly and in ink. Any working that is written in pencil is considered rough working.
- Teachers should discuss the terms used in science examinations. A glossary of the command words used in examinations is given on page 34 of the syllabus.