AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.6.2 REVERSIBLE REACTIONS AND DYNAMIC EQUILIBRIUM (PACK 3)

SCORE	PERCENTAGE
/63	%

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Q1.

(a) 80

1

(b) volcanoes

allow ammonia
allow meteorites

1

(c) ⇌

ignore any extra words

1

(d) rate

allow speed
allow pace

*do **not** accept time*
*do **not** accept amount*
*do **not** accept level*
*do **not** accept point*

1

(e) a mixture designed as a useful product

1

(f) bar for K to 5.8%

allow ± ½ a small square

1

(g) $\frac{0.225 \times 100}{3.0}$

1

(h) use has increased

1

(increase is) less in country B
or (increase is) less in country D

allow (increase is) more in country A
***or** (increase is) more in country C*

1

example of data

1

[10]

Q2.

(a) <u>damp / moist</u> litmus paper

ignore colour of litmus paper

1

bleaches / goes white

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1

(b) forward and reverse rates equal

1

because no escape of reactants or products

allow closed system
allow particles for reactants or products

1

(c) equilibrium shifts

allow no longer in equilibrium

1

to right-hand side

allow in favour of forward reaction

1

to produce more of any products
or
to reduce any reactants

allow correct references to Le Chatelier's Principle

1

(new) equilibrium will be established

1

(d) amount of chlorine gas increases

1

(because) system shifts to counteract the change

allow (because) system shifts to take in energy
allow (because) system shifts in endothermic direction

1

(e) no change

1

because equal numbers of molecules
or
moles (of gas) on each side

1

[12]

Q3.

(a)

Level 2: Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	3-4
Level 1: Relevant features are identified and differences noted.	1-2

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No relevant content	0
Indicative content • bioleaching is very slow, but although slow, phytomining can be made more efficient by growing quick growing plants • bioleaching extracts copper from quarrying waste, but phytomining extracts copper from contaminated ground • phytomining decontaminates polluted ground, but bioleaching can produce toxic run off which may go into rivers • phytomining takes a long time to stop • bioleaching is a very slow process • plants are burned in phytomining	

4

(b) (plants burned to produce) ash

1

copper compounds in ash dissolved in sulfuric acid

1

(c) $CuSO_4$ + Fe

1

→ Cu + $FeSO_4$

1

(d) electron transfer

1

(e) delocalised electrons

1

carry charge through the metal

1

(f) turns from white

1

to blue

1

[13]

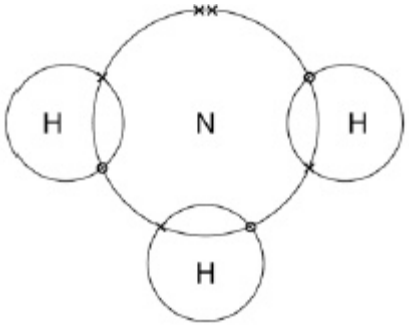
Q4.

(a) 3 × bonding pairs of electrons

1

2 × unbonded electrons on nitrogen

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2

(b) decreases yield

1

more moles on left hand side

1

(c) decreases yield

1

exothermic reaction

1

(d) moves to right hand side

or

more ammonia produced

1

to replace the ammonia

1

[8]

Q5.

(a) small molecules

1

with weak intermolecular forces

1

(so) only a small amount of energy is needed to separate the molecules

any reference to bonds being weak or being broken negates the second and third mark unless they are stated to be intermolecular bonds or bonds between molecules

1

(b) decreases

1

because the equilibrium shifts in the endothermic direction

allow reverse reaction favoured if forward reaction is exothermic

1

(c) increases

1

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because there are more molecules of gas on the left-hand side

or converse

1

[7]

Q6.

(a) *x* axis scale correct

1

y axis scale correct

1

all points plotted correctly

± ½ small square

1

curve correct, omitting the anomalous point

1

(b) relative formula mass of NH_4NO_3 = 14 + (4 × 1) + 14 + (3 × 16) = 80

1

mass of ammonium nitrate in 1 dm^3 at 20 °C = 190 × 10 = 1 900 g

1

number of moles of ammonium nitrate in 1 900 g = 1 900 / 80 = 23.75 mol

1

(c) small beads would dissolve slower than fine powder

1

because the surface area of the bead is less than fine powder

1

(d) increasing the temperature at equilibrium will reduce the amount of ammonia produced

1

because the reaction is exothermic

1

increasing the pressure at equilibrium will increase the amount of ammonia produced

1

because the equilibrium will shift towards the smaller number of molecules in the equation (which is ammonia)

1

[13]

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Q1.

(a) A majority of students indicated that nitrogen makes up 20% of the Earth's atmosphere, suggesting confusion with oxygen. 32% of students correctly ticked the box for 80%.

(b) 24% of students knew a source of nitrogen in the first billion years of the Earth's existence, most suggesting volcanoes. The students who did not gain credit often forgot that they were asked to consider this time period and gave an answer from modern times, e.g. fertiliser, plants, animals, or human activity such as transport.

Some students revealed a misunderstanding of basic chemical principles in giving answers such as oxygen, argon, carbon dioxide or water. These elements and compounds contain no nitrogen, so cannot be its source.

(c) 35% of students achieved this mark by giving an acceptable symbol for a reversible reaction. Some students added further reactants or products, which were ignored. Incorrect responses included ↔ and ≡

(d) 'Time' was a frequently seen incorrect response. 16% of students achieved credit for a response such as rate, speed or pace.

(e) There were some very creative attempts at this question, however, the definition of a formulation was not well known. 4% of students were awarded this mark. There were a small number of accurate, succinct responses, but although a larger proportion of students realised that a formulation is a mixture, few were able to add that it has a use or purpose.

Some students were able to give examples, but not a definition. Others confused formulation with formula, defined a compound, or suggested that a formulation is a compound designed as a useful product.

(f) 82% of students achieved this mark with a clearly drawn bar to 5.8%. A tolerance of ± ½ square was allowed, but rarely needed. Some students appeared to mistake the scale and counted down two small squares from the 6.0% line, giving a bar to 5.6%, rather than the 5.8% they expected. A very small minority of students drew bars which finished a long way from the 5.8% line.

(g) Most students were aware that $\frac{3.0 \times 100}{0.225}$ was **not** a correct calculation for the percentage of iron in the fertilizer. However, the other three options proved almost equally popular, suggesting that many students find percentage calculations challenging. 39% of students achieved a mark here.

(h) This question discriminated well. 92% of students were able to access this question and achieve at least one mark by agreeing that the use of fertilizer increased.

Many students continued to provide some data from Figure 2, with 51% achieving two marks. A large proportion of students gave data from a country chosen to exemplify this, while others added the totals for 2003 and 2015.

10% of students went on to recognise that the increase in fertiliser use differed between the countries in Figure 2, and that in countries A or C the difference was 'much larger' but that it wasn't 'much larger' in countries B or D.

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Q2.

(a) 53% of students achieved credit on this question. The majority of those in their response omitted to write 'damp or moist' when describing the litmus paper test. Limewater was a popular incorrect answer.

(b) 34% of students achieved any credit on this question; with 5% of responses achieving both marks. The idea of a 'closed system' was the most popular creditworthy answer.

Students described a reversible reaction, explained that the reactants changed into the products and vice versa but rarely indicated that it was the rate of these reactions that was equal. Some students gave the confused answer that 'the rate that reactants are used up is equal to the rate that the products are formed'.

(c) In this question and in parts **(d)** and **(e)**, it was apparent that, although many students could recall Le Chatelier's Principle, few were able to apply it.

23% of students achieved more than one mark on this question, with 2% of students achieving all four marks. Students (34% that achieved one mark) were able to suggest a shift in the equilibrium but often in the wrong direction: 'The equilibrium shifts to the left so that more NaClO can be formed to react with the HCl'.

Some students gave responses that discussed changes in terms of the exothermic or endothermic direction though this was not given in the stem of the question.

A simple response that 'reaction would do the opposite' because of Le Chatelier was frequently given. Very few students concluded their explanation with 'a new equilibrium would be established'.

(d) Many students answered incorrectly by explaining the effect of temperature on the rate of reaction rather than on the equilibrium. 8% of students achieved both marks. And a further 28% achieved a single mark, predominately for identifying that the amount of chlorine gas increased. 14% of students made no attempt at this question.

(e) This was a challenging question whereby 7% of students achieved any marks. Many students answered incorrectly by explaining the effect of pressure on the rate of reaction rather than on the equilibrium. Those that answered with reference to the number of molecules on each side of the equation seemed to think that 2HCl was one molecule and consequently talked of the equilibrium shifting to the left, the side with fewer molecules. Approximately 12% of students made no attempt at this question.

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