PEARSON EDEXCEL GCSE COMBINED SCIENCE (HIGHER) · 1SC0

CHEMISTRY



MARK SCHEME

TOPIC 4: EXTRACTING METALS AND EQUILIBRIA: REVERSIBLE REACTIONS AND EQUILIBRIA (PAPER 1)

SCORE	PERCENTAGE
/58	%

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Mark Scheme

Q1.

	Answer	Acceptable answers	Mark
(a)	An explanation linking Marking point 1 – one from • forward and back reactions take place (at the same time) (1) • rate of the forward and back reactions is the same (1) Marking point 2 – one from • no (overall) change in the {amount/concentration/mas s/ volume} of each {substance / reactant / product} (1) • no observable change (1)	assume 'both reactions' implies the forward and back reaction allow reversible reaction with the same rate (1) allow reversible reaction in a closed system (1) do not allow the forward reaction equals the reverse reaction allow overall effect is nil (1) allow reactants and products reach a balance (1) ignore forward reaction cancels out back reaction do not allow {amount / concentration /mass/volume} of reactants and products are equal	**(2)**
(b)(i)	An explanation linking two of • higher pressure favours forward reaction/equilibrium shifts to the right (1) • because decrease in {volume / number of molecules}/side with lower volume (1) • yield increases (1)	ignore answers related to rate/collisions maximum (1) if 3 statements given, but 1 is incorrect	**(2)**
(b)(ii)	An explanation linking any two of • lower temperature favours forward reaction/equilibrium shifts to the right (1) • because (forward) reaction is exothermic (1) • yield increases (1)	ignore answers related to rate/collisions if answer refers to increasing temperature, maximum (1) for (forward) reaction is exothermic / reverse reaction is endothermic maximum (1) if 3 statements given, but 1 is incorrect	**(2)**
(b)(iii)	catalyst	iron	**(1)**
(c)(i)	3 × 1000 (1) (= 3000)		**(1)**
(c)(ii)	mark is for the working Method 1 14 + (3 × 1) (1) g of NH_3 makes 14 + (4 × 1) + 14 + (3 × 16) (1) g NH_4NO_3	full marks awarded for an answer of 160 g with or without any working allow ecf on incorrect Mr s for either method	**(3)**

34 g of NH_3 makes $\frac{(14 + (4 \times 1) + 14 + (3 \times 16)) \times 34}{17}$ or $\frac{80 \times 34}{17}$ or $2(14 + (4 \times 1) + 14 + (3 \times 16))$ g NH_4NO_3 (1) = 160 Method 2 moles of NH_3 = $^{34}/_{17}$ (1) = 2 moles of NH_4NO_3 = moles of NH_3 or relative formula mass NH_4NO_3 = 80 (1) mass NH_4NO_3 = 2 x 80 (1) = 160 g	allow ecf for incorrect moles eg if moles of NH_3 = 0.5 relative formula mass NH_4NO_3 = 80 (1) mass NH_4NO_3 = 0.5 × 80 (1) = 40 g		

(**Q32 1SC0/1CH, June 2013**)

Q2.

Question number	Answer	Additional guidance	Mark
(i)	$N_2 + 3H_2 \rightleftharpoons 2NH_3$ (3)	MP1: three formulae and no others on correct sides of an equation. allow incorrect cases and subscripts e.g. n^2 (1) MP2 depends on MP1: balancing these correct formulae, allow multiples (1) MP3: stand alone mark: equilibrium symbol, allow $\rightleftharpoons$, $\eqrightarrow$ (1) allow equation written in reverse	**AO2 1 (3)**

Question number	Answer	Mark
(ii)	**D** 450 200 is the only correct answer **A**, **B** and **C** are incorrect because the temperature is 450℃ and the pressure is 200 atm.	**AO1 1 (1)**

Question number	Answer	Additional guidance	Mark
(iii)	catalyst/ increase rate of reaction(s)/ lower activation energy/ increase rate of attainment of equilibrium	ignore provide an alternative route for the reaction	**AO1 1 (1)**

Question number	Answer	Additional guidance	Mark
(iv)	An explanation including any two from: • <u>moves in</u> exothermic direction (1) • moves {right/ forwards / towards ammonia/ to products} (1) • to oppose the temperature reduction / to release heat / to increase the temperature (1)	MP1/ MP2/ MP3 are marked independently reject contradictions within MP2 or within MP3 allow to increase yield ignore just 'to oppose the (temperature) change' allow to increase heat	**AO1 1 (2)**

(**QU03a 1SC0/1CH, June 2023**)

Q3.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking • both reactions happen at the same rate (1) • (because) there is no overall change in the system (1)	 ignore both reactions happen at the same time allow total amount/concentration of products and reactants are <u>constant</u> ignore reference to amounts/concentration of products and reactants being <u>equal</u> ignore closed system	**(2) AO1.1**

Question number	Answer	Mark
(ii)	**A** 200 1000 **B, C** and **D** are incorrect as a temperature of 200ºC and a pressure of 1000 would give the highest percentage yield of ammonia	**(1)** **AO3.1**

Question number	Answer	Additional guidance	Mark
(iii)	An explanation linking: • equilibrium would move {backwards / to left} (1) • (because) there are more moles on {left hand side / reactants} (1)	allow references to low**er** yield / less product formed / more reactant formed. allow particles / molecules for moles allow RA throughout if no other mark scored, 'equilibrium shifts to the side with more moles / molecules' scores 1 mark. ignore all references to temperature / heat / exothermic / endothermic. ignore all references to rate.	**(2)** **AO1.1**

(**QU06b 1SC0/1CH, June 2025**)

Q4.

Question number	Answer	Additional guidance	Mark
	20265000 with or without working scores 2 101325 x 200 (1) = 20265000 (Pascals) (1)	allow 20270000 / 20300000 for 2 506.625/ 506.63/ 506.6/ 507 scores 1	**(2)** **AO2**

(**Q03c 1SC0/1CF, Nov 2021**)

Q5.

Question number	Answer	Mark
	backward (1) equal (1)	(2) AO1

(**Q03b 1SC0/1CF, Nov 2021**)

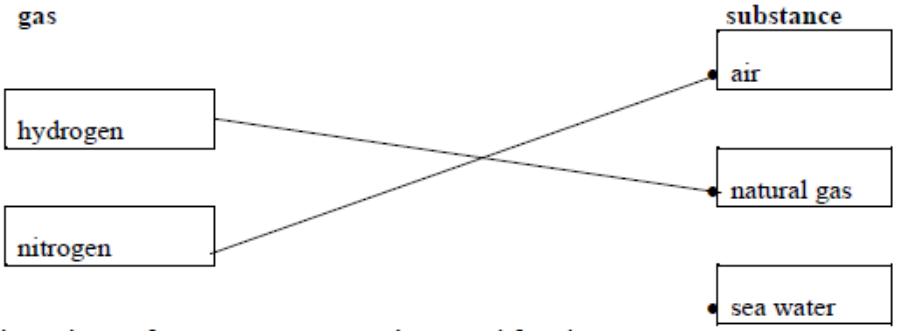
Q6.

Question number	Answer	Mark
(i)	hydrogen row: 10 4 -6	(1) AO2

Question number	Answer	Additional guidance	Mark
(ii)	$N_2 + 3\ H_2 \rightleftharpoons 2\ NH_3$ (2) Formulae of nitrogen **and** hydrogen (1)	balancing mark only if formulae correct	(2) AO2

(**Q03d 1SC0/1CF, Nov 2021**)

Q7.

Question number	Answer	Mark
	 if two lines leave from a gas, no mark scored for that gas	(2) AO1

(**Q03a 1SC0/1CF, Nov 2021**)

Q8.

	Answer	Acceptable answers	Mark
	An explanation linking Marking point 1 – one from • forward and back reactions take place (at the same time) (1) • rate of the forward and back reactions is the same (1) Marking point 2 – one from • no (overall) change in the {amount/concentration/mas s/ volume} of each {substance / reactant / product} (1) • no observable change (1)	assume 'both reactions' implies the forward and back reaction allow reversible reaction with the same rate (1) allow reversible reaction in a closed system (1) do not allow the forward reaction equals the reverse reaction allow overall effect is nil (1) allow reactants and products reach a balance (1) ignore forward reaction cancels out back reaction do not allow {amount / concentration /mass/volume} of reactants and products are equal	**(2)**

(**Q39 1SC0/1CH, June 2013**)

Q9.

Question number	Answer	Additional guidance	Mark
	A description including METHOD OF HEATING AND COOLING • put tube into hot water (1) • then into cold water/ add cold water/ add ice (1) OBSERVATIONS • colour goes darker AND colour goes lighter/ colourless	steps 1 and 2 can be reversed, but must be practical e.g. ignore 'heat tube up' allow water from kettle reject placing tube in kettle/ heating with steam MP3 is for observation but depends on tube being heated and cooled (even if MP1 and/or MP2 not scored) allow colour changes in both hot and cold ignore clear allow suitable diagram(s) ignore opening of tube ignore attempts at explanation	**AO3 3a (3)**

(**QU03b 1SC0/1CH, June 2023**)

Q10.

Question number	Answer	Additional guidance	Mark
	A description including DECOMPOSITION • **heat** the (hydrated) {crystals / solid} (1) • (solid) goes white/ steam is observed / water produced (1) REVERSE REACTION • add water / water rejoins / water reacts with anhydrous solid (1) • (solid) goes blue (again) / heat is released (1)	ignore anything to do with Le Chatelier etc.. ignore 'closed system' MP4 independent of MP3	**(4)**

(**Q04a 1SC0/1CH, June 2019**)

Q11.

	Answer	**Acceptable answers**	**Mark**
(i)	An explanation linking two of • higher pressure favours forward reaction/equilibrium shifts to the right (1) • because decrease in {volume / number of molecules}/side with lower volume (1) • yield increases (1)	ignore answers related to rate/collisions maximum (1) if 3 statements given, but 1 is incorrect	**(2)**
(ii)	An explanation linking any two of • lower temperature favours forward reaction/equilibrium shifts to the right (1) • because (forward) reaction is exothermic (1) • yield increases (1)	ignore answers related to rate/collisions if answer refers to increasing temperature, maximum (1) for (forward) reaction is exothermic / reverse reaction is endothermic maximum (1) if 3 statements given, but 1 is incorrect	**(2)**
(iii)	catalyst	iron	**(1)**

(**Q40 1SC0/1CH, June 2013**)

Q12.

Question number	Answer	Additional guidance	Mark
	An explanation linking: • ammonia and hydrogen chloride / gas**es** form (in the forward reaction) (1) • the gas / gases rise to the top of the container (1) • where it is cooler / the gas(es) cool (1) • the reverse reaction takes place / **reaction** forms {white solid/ammonium chloride} (at the top of tube) (1)	allow formula throughout allow endothermic reaction takes place reject ammonium chloride gas / hydrochloric acid forms for MP1 only allow exothermic reaction takes place allow hydrogen chloride and ammonia react (at the top of the tube)	**(4)** **AO3.2**

(**QU06c 1SC0/1CH, June 2025**)

Q13.

Question number	Answer	Additional guidance	Mark
	An explanation to include • less purple / lighter/ paler / fades (1) • because less iodine (1)	Ignore equilibrium shifts right, forward reaction favoured reject 'goes colourless' for MP1 reject **ALL** iodine reacts to give HI for MP2 (credit **some** iodine reacts / **some** iodine is used up) ignore 'more HI' ignore forwards reaction is favoured	**(2)**

(**Q04b 1SC0/1CH, June 2019**)

Q14.

Question Number	Answer	Acceptable answers	Mark
(a)	Increases {plant/ crop} growth/ yield/ size/ growth rate Adds minerals/ specified suitable element eg N, P, K/ nutrients	Allow synonyms for increase eg promote, helps, enhances etc Reject kills pests	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	A description linking two of the following • gets washed into water (1) • encourages growth of algae/ weed / algal bloom (1) • algae use up oxygen (1) • algae blocks sunlight (1) • **kills** aquatic life (1) • eutrophication (1) • contaminates drinking water (1)	Allow any sensible water eg river, lake etc but ignore sea Ignore damages, harms etc; allow any specified **water** life eg fish, **water** plants, animals **in water** Ignore effect of fertiliser on field eg on weeds.	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	ammonia + nitric acid → ammonium nitrate (2) Spelling must be correct but allow missing one 'm' from ammonia and/or ammonium	LHS (1) R ammonium RHS (1) R ammonia nitrate Allow fully correct balanced equation for 2 Ignore state symbols. If mixed words/symbols, any side with symbols scores 0.	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	**A** corrosive		**(1)**

Question Number	Answer	Acceptable answers	Mark
(d)(i)	(reaction is) **reversible** / (reaches dynamic) **equilibrium**	Allow equilibria R static equilibrium	**(1)**

Question Number	Answer	Acceptable answers	Mark
(d)(ii)	**C** NH_3		**(1)**

(**Q07 1SC0/1CF, June 2014**)

Q15.

Question Number	Answer	Acceptable answers	Mark
(a) (i)	**C** $N_2 + 3H_2 \rightleftharpoons 2\ NH_3$		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a) (ii)	reaction is reversible / goes both ways (1)	reaches equilibrium (1)	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b) (i)	A description linking urea contains the highest percentage of nitrogen (1) (this is important because) nitrogen enables plants to grow (1)	 ignore references to oxygen	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b) (ii)	An explanation linking any **two** of the following points (excess) fertiliser is washed into rivers (by rainfall) (1) plants/algae (in the river) grow bigger / more quickly (1) oxygen is used up (by bacteria) when the plants decay/die (1) (this leads to) fish/animals die (due to lack of oxygen) (1)	 allow grow better / increases growth must indicate idea of an increase in growth/faster growth	**(2)**

(**Q09 1SC0/1CF, June 2015**)

Q16.

Question Number	Answer	Acceptable answers	Mark
(a)	**B** 200 cm^3		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	65.0 g Zn produces 24 dm^3 H_2 (1) 13.0 g Zn produces $\frac{13.0}{65.0}$ x 24 (1) (= 4.8 dm^3 H_2)	$\frac{13.0}{65.0}$ mol Zn produces $\frac{13.0}{65.0}$ mol H_2 Vol of H_2 = $\frac{13.0}{65.0}$ x 24 (2) (= 4.8dm^3) 4.8 dm^3 (2) without working allow 65/13 x 24 (1) = 120dm^3 13/65 (1) x (1/24) = 0.00833 dm^3 0.2 anywhere 1 mark x 24 anywhere 1 mark	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	**D** natural gas		**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	An explanation linking forward and back reactions take place / reversible / dynamic (1) at the same rate / equilibrium (1)	dynamic equilibrium = 2 marks	**(2)**

Question Number		Indicative Content	Mark
QWC	*** (d)**	A description including some of the following points Higher pressure: • higher pressure gives increased yield • equilibrium shifts to right hand side • because decrease in number of molecules going from left to right • therefore decrease in volume • favoured by increase in pressure • reaches equilibrium faster • because molecules closer together • so get more frequent collisions Higher temperature • higher temperature reaches equilibrium faster • because molecules move faster • therefore more frequent collisions • molecules have more energy • therefore more collisions have required energy • but yield will be lower • because higher temperature favours endothermic reaction • equilibrium shifts to left hand side • which is decomposition of ammonia / ammonia reforms elements Use of catalyst • catalyst causes reaction to reach equilibrium faster / catalyst increases rates (of both forward and back reactions) • *lowers the activation energy (of both forward and back reactions)* • *reaction follows a new pathway* • does not affect yield • equilibrium position not affected	**(6)**

Level	**0**	No rewardable content
1	**1 - 2**	• a limited description e.g. one valid effect of change OR general comment indicating improved yield or faster rate • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	**3 - 4**	• a simple description e.g. at least two valid effects of change with one point of explanation OR at least three valid effects of change • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	• a detailed description e.g. at least three valid effects of change with two points of explanation OR at least two valid effects with three points of explanation (in total) • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

(**Q11 1SC0/1CH, June 2014**)

Q17.

Question Number	Answer	Acceptable answers	Mark
(i)	**A** 333 dm^3		**(1)**

Question Number	Answer	Acceptable answers	Mark
(ii)	An explanation linking • all / three gases present/ nitrogen, hydrogen and ammonia (1) • ammonia decomposes/ ammonia turns back to reactants/ reaction goes both ways / reversible (1)	reject ammonium ignore incomplete reaction assume that "both reactions" refer to forward and backward reaction allow **dynamic** equilibrium	**(2)**

Question Number	Answer	Acceptable answers	Mark
(iii)	An explanation linking • increased / high**er** {yield / amount of ammonia} (1) • because fewer (gas) molecules/ moles on RHS/ 4 mole(cule)s on left and 2 on right/ decreased volume on RHS/equilibrium shifts to RHS/ equilibrium shifts in forward direction (1)	mark independently ignore "high yield" reject answers referring to exothermic or endothermic ignore any references to rate	**(2)**

Question Number	Answer	Acceptable answers	Mark
(iv)	An explanation to include • **rate** increased/ time to reach equilibrium reduced (1) • because gas molecules closer / more concentrated (1) • so increased **collision** rate / more **collisions** in a given time / more frequent **collisions**(1)	mark independently ignore any refs to equilibrium ignore 'time is faster'/ allow 'quicker' allow atoms/ particles instead of molecules; allow more molecules present (in same container) do not allow 'more collisions'	**(3)**

(**Q07 5CH1H/01, June 2015**)

Q18.

Question Number	Answer	Mark
(i)	**B** -78 -33 does not conduct **The only correct answer is B** ***A*** *is not correct because simple molecular, covalent substances do not have high mpt and bpt* ***C*** *is not correct because ammonia is a gas at room temperature and does not conduct* ***D*** *is not correct because simple molecular, covalent substances do not have these properties*	**(1)** AO 2 1

Question Number	Answer	Additional guidance	Mark
(ii)	$N_2 + 3H_2 \rightarrow 2NH_3$ (2) left hand side formulae (1) balancing of correct formulae (1)	accept multiples allow = or ⇌ in place of → ignore state symbols even if incorrect do not allow N2, n2, etc	**(2)** AO 2 1

(**Q14 1SC0/1CH, June 2018**)

Q19.

Question number	Answer	Mark
	B turns blue is the only correct answer. A, C and D are incorrect because the position of equilibrium will shift to the left-hand side	**(1)** **AO2**

(**Q04c 1SC0/1CH, Nov 2021**)