

# Reversible Reacts + Dynamic Equilibrium

## Mark Scheme 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.6 Rate + Extent Chemical Change
Sub-Topic	Reversible Reacts + Dynamic Equilibrium
Difficulty Level	Gold Level
Booklet	Mark Scheme 1

Time Allowed: 49 minutes

Score: /48

Percentage: /100

Grade Boundaries:

<b>M1.(a)</b>	small molecules	1
	with weak intermolecular forces	1
	(so) only a small amount of energy is needed to separate the molecules <i>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</i>	1
	(b) decreases	1
	because the equilibrium shifts in the endothermic direction <i>allow reverse reaction favoured if forward reaction is exothermic</i>	1
	(c) increases	1
	because there are more molecules of gas on the left-hand side <i>or converse</i>	1
		[7]
<b>M2.(a)</b>	x axis scale correct	1

y axis scale correct

1

all points plotted correctly

$\pm \frac{1}{2}$  small square

1

curve correct, omitting the anomalous point

1

(b) relative formula mass of  $\text{NH}_4\text{NO}_3 = 14 + (4 \times 1) + 14 + (3 \times 16) = 80$

1

mass of ammonium nitrate in  $1 \text{ dm}^3$  at  $20^\circ\text{C} = 190 \times 10 = 1\,900 \text{ g}$

1

number of moles of ammonium nitrate in  $1\,900 \text{ g} = 1\,900 / 80 = 23.75 \text{ mol}$

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]

**M3.(a)** the forward and backward reactions occur

*allow reversible*

1

at (exactly) the same rate

1

in a closed system

*allow therefore the concentrations / amounts of the reactants and products remain the same*

1

(b) (i) increasing the temperature would lower the yield of ethanol **or** the (position of) equilibrium moves to the left

*if student has stated that increasing the temperature increases the yield then award 0 marks*

1

since the backwards reaction is endothermic **or** the forward reaction is exothermic

1

(ii) increasing the pressure would increase the yield of ethanol **or** the (position of) equilibrium moves to the right

*if student has stated that increasing the pressure decreases the yield then award 0 marks*

1

because the position (of equilibrium) moves in the direction of the lower number of moles (of gas)

*2 (moles / molecules / volumes / particles) on lhs / 1 (mole / molecule / volume / particle) on rhs*

1

- (c) (a catalyst) provides an alternative pathway

1

with lower activation energy

**or**

(a catalyst) lowers the activation energy (1)

so less energy is needed to react **or** more particles react (1)

1

[9]

- M4.** (a) same number of (gaseous) molecules / moles / volume on both sides of the equation

*allow particles for molecules*

*do **not** accept atoms*

*ignore amount*

1

- (b) (forward) reaction is exothermic  
*accept reverse answer*

1

- (c) any **three** from:

- particles gain energy
- particles move faster  
*allow particles collide faster / quicker*  
*ignore move more / vibrate more*
- particles collide more **or** more collisions
- more of the collisions are successful **or**

more of the particles have the activation energy **or**  
particles collide with more force / energy

3

(d) any **two** from:

- more product (obtained in shorter time)  
*accept better yield (of product)*
- less fuel needed  
*accept less energy / heat / electricity needed*

**or**

lower fuel costs  
*ignore cheaper unqualified*

- less pollution caused by burning fuels

**or**

less specified type of pollution caused by producing heat / burning fuels  
*allow correct specified pollutants caused by burning fossil fuels eg CO<sub>2</sub> / greenhouse gases **or** correct effect of burning fossil fuels eg global warming*  
*accept thermal / heat pollution*

- using less fuel conserves resources  
*accept sustainable*  
*accept fossil fuels are non-renewable*

2

[7]

**M5.** (a) fewer product molecules than reactant molecules (owtte) **or**  
*accept forward reaction produces fewer molecules*  
*accept left hand side for reactants and right hand side for products*

3 reactant molecules and 1 product

**or** 3 volumes of gas becomes 1 volume of gas

*accept high pressure favours the side with fewer molecules*  
*ignore references to reaction rate*

1

(b) any **three** from:

- low temperature gives best yield  
*accept add heat as increased temperature **or** 'less' as poor yield*  
**or** high temperature gives poor yield
- because the reaction is exothermic  
*accept reverse argument if clearly expressed*
- reaction too slow at low temperature  
**or** reaction faster at high temperature  
*accept add heat and reaction goes faster*
- temperature used gives a reasonable yield at a fast rate / compromise explained  
*allow get less product but it takes less time for **2** marks*

3

[4]

**M6.** (a) (i) any **one** from:

- they are positive / cations
- they are  $H^+$
- opposite charges attract  
*ignore atom*

1

(ii) potassium is more reactive (or reverse)

*assume 'it' refers to hydrogen  
allow potassium reacts with water  
allow potassium is very reactive **or** most reactive metal / element  
allow hydrogen gains electrons more easily / is reduced more easily  
accept potassium is higher up the reactivity series*

1

(b) 6 and 2

*accept correct multiples and fractions*

1

(c) (i) the reaction / it is reversible **or** a description of a reversible reaction

*allow 'it is an equilibrium'*

*allow reversible symbol drawn correctly*

*allow 'the reverse / back reaction'*

1

(ii) **lithium nitride**

assume that 'it' or if they do not specify means lithium nitride

assume lithium / lithium nitrate refers to lithium nitride

- hydrogen is bonded / held / absorbed / has formed a compound / reacted with lithium nitride

1

plus **one** of:

- does not explode / cause a fire
- is not free / less hydrogen
- is not under pressure
- does not leak
- is only released slowly

1

- compound of hydrogen with lithium nitride / product is (more) stable / less reactive / less chance of a reaction

*accept converse for hydrogen as below*

*assume that gas / hydrogen means gas in the cylinder*

- *hydrogen (in cylinder) / gas is not bonded / held absorbed / in a compound / reacted with lithium nitride*

1

*plus **one** of:*

- *can explode / cause a fire*
- *is free*
- *is under pressure*
- *can leak*
- *releases quickly*



1

- (d) (i) loss of an electron **or** loses electrons  
*do not accept any ref. to oxygen*

1

- (ii) full outer shell of 8 electrons on circle  
*need not be paired*  
*can be x, dot or e*  
*do **not** accept if extra electrons added to inner shell*

1

[10]