



# **A-Level Chemistry**

## **Effects of Catalysts**

### **Mark Scheme**

**Time available: 56 minutes**

**Marks available: 55 marks**

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## Mark schemes

1.

- (a) (If any factor is changed which affects an equilibrium), the (position of) equilibrium will shift / move so as to oppose / counteract the change.

*Must refer to equilibrium*

*Ignore reference to "system" alone*

*A variety of wording will be seen here and the key part is the last phrase*

**OR**

(When a system / reaction in equilibrium is disturbed), the (position of) equilibrium shifts / moves in a direction which tends to reduce the disturbance

*An alternative to shift / move would be the idea of changing / altering the position of equilibrium*

1

- (b) (i) M1

A substance that speeds up the reaction / alters the rate but is chemically unchanged at the end / not used up

*Both ideas needed for **M1***

*Credit can score for **M1**, **M2** and **M3** from anywhere within the answer*

M2

Catalysts provide an alternative route / alternative pathway / different mechanism

M3

that has a lower activation energy /  $E_a$

**OR**

lowers the activation energy /  $E_a$

3

- (ii) (Time is) less / shorter / decreases / reduces

*Credit "faster", "speeds up", "quicker" or words to this effect*

1

- (iii) None

1

- (c) (i) R

1

- (ii) T

1

- (iii) R

1

- (iv) P

1

2.

- (a) **M1** The activation energy is the minimum / least / lowest energy

*Mark independently*

*Ignore "heat" and ignore "enthalpy"*

**M2** (energy) for a reaction to occur / to go / to start

OR (energy) for a successful / effective collision

*Ignore "breaking the bonds"*

2

- (b) **M1** Catalysts provide an alternative route OR an alternative mechanism OR alternative / different path(way)

**M2** Lowers the activation energy

*Mark independently*

*Ignore reference to "surface"*

2

- (c) (i) Stay(s) the same

1

- (ii) Increases

*Credit "increase" or "increased"*

1

- (iii) Increases

*Credit "increase" or "increased"*

1

- (iv) Stay(s) the same

1

- (d) (i) **M1** yeast or zymase

**M2** ethanol

*Ignore "enzyme"*

*In M2, ignore "alcohol" and ignore any formula*

2

(ii) **M1** (Concentrated)  $\text{H}_3\text{PO}_4$  OR (Concentrated)  $\text{H}_2\text{SO}_4$

**M2** butan-2-ol

*Credit correct names*

*Ignore "hydrogenphosphate or hydrogensulfate"*

*Ignore "dilute" or "aq"*

*Do not penalise absence of hyphens in name.*

*In M2, ignore any formula*

2

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3.

(a) Gradient (or slope) (or draw a tangent)

1

(b) (i) Curve **X** is lower and starts at origin

1

And levels out at same volume as original curve

1

(ii) Curve **Y** is steeper than original and starts at origin

1

Then levels out at half the volume of the original

1

(c) (i)  $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$

1

(ii) Speeds up (alters the rate of) a chemical reaction

1

Remains unchanged (or not used up)

1

(iii) Remains unchanged (or not used up or not in the overall reaction equation)

1

Offers alternative reaction route (or acts as an intermediate)

1

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4.

(a) minimum energy **(1)**  
required before a reaction can occur or go or start **(1)**

2

(b) speeds up (changes) reaction rate **(1)**  
without being (chemically) changed **(used up) (1)**

2

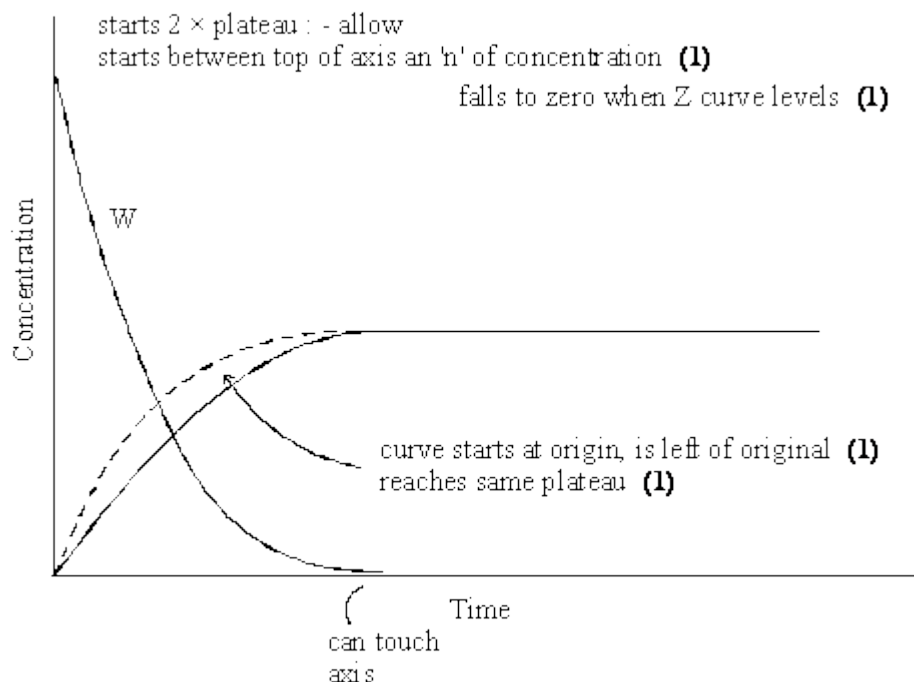
(c) provides alternative reaction route **(1)**  
with a lower activation energy **(1)**

*in (b) and (c) reward 4 marks for 4 points wherever found*

2

(d) (i)

(ii)



(iii) fewer collisions (1)

W used up (1)

or reactants

or reagents

or fewer particles

6

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5.

(a) Increase in temperature:

Yield is increased (Allow if for  $\text{H}_2$  (g) or products) (1)

Reaction endothermic (1)

Equilibrium moves to the right OR forward, OR Equilibrium moves to oppose change OR to absorb heat (1)

*If "Yield statement" incorrect allow max one if reaction stated to be endothermic*

**Increase in pressure:**

Yield is decreased (Allow if for  $\text{H}_2$  (g) or products) (1)

Increase in moles of gas or 2 moles increased to 4 moles or more moles on right (1)

Equilibrium moves to the left OR backwards, OR Equilibrium moves to oppose change OR to reduce pressure (1)

*If "Yield statement" incorrect allow max one if number of moles change is correct.*

6

(b) **Equilibrium yield:**

Unaffected **or** equilibrium unchanged **(1)**

Rate or speed increased **(1)**

Forward and backwards reactions equally or by the same amount **(1)**

**Amount of hydrogen produced:**

More hydrogen produced (1)

4

**[10]**