M1. Measure <u>volume</u> of gas / <u>mass loss</u>

If 'measure concentration' must explain how to score mark

1

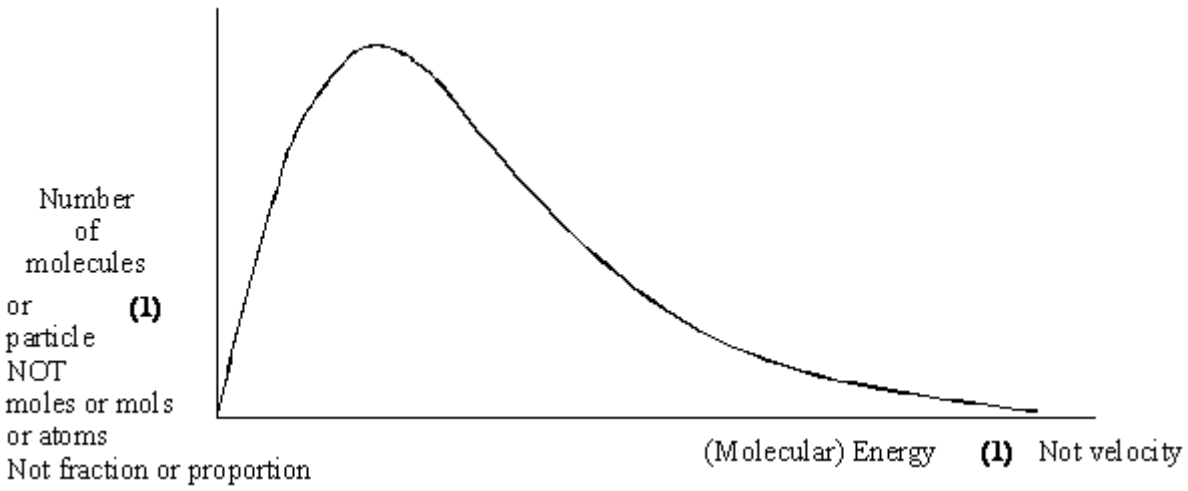
At (regular) time intervals

Ignore references to temperature
Accept 'against time'
Do not accept 'with time' or 'over time' on its own

1

[2]

M2. (a) (i)



(ii) The total number of particles (or molecules) in the sample

OR the number of molecules present

(iii) No molecules have no energy

OR all molecules have some energy

Do not allow "if there are no molecules there is no energy"

4

(b) (i) The minimum energy required **(1)**

for a reaction to occur **(1)**

OR to start reaction or for a successful collision

(ii) Changes: Catalyst **(1)**

Explanation: Alternative route **(1),** with a lower activation energy **(1)**

OR a lower activation energy (1)
so more molecules can react (1)/more molecules have this energy

If change incorrect CE = 0

Allow answers anywhere in b (ii)

5

[9]

M3. (a) Sulfur OR S OR S_8

Sulphur

1

(b) **M1** The activation energy is the <u>minimum</u> / <u>least</u> / <u>lowest</u>

Mark these independently

1

M2 Energy for a reaction to occur / to go / to start

OR

Energy for a <u>successful / effective</u> collision

1

(c) Explanation:

M1 <u>Twice</u> as many / <u>double</u> number of <u>particles</u>

M1 NOT molecules

1

M2 <u>More / twice / double</u> (effective) <u>collisions</u> (in a given time)

OR

Double / greater / increased collision frequency

1

(d) (i) (Measured) change in concentration (of a substance) in unit time / given time

May be written mathematically
OR the gradient of the concentration (against) time

1

(ii) The measured change / amount (of precipitate) / cloudiness is fixed or constant or unchanged

1

[7]

M4. (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

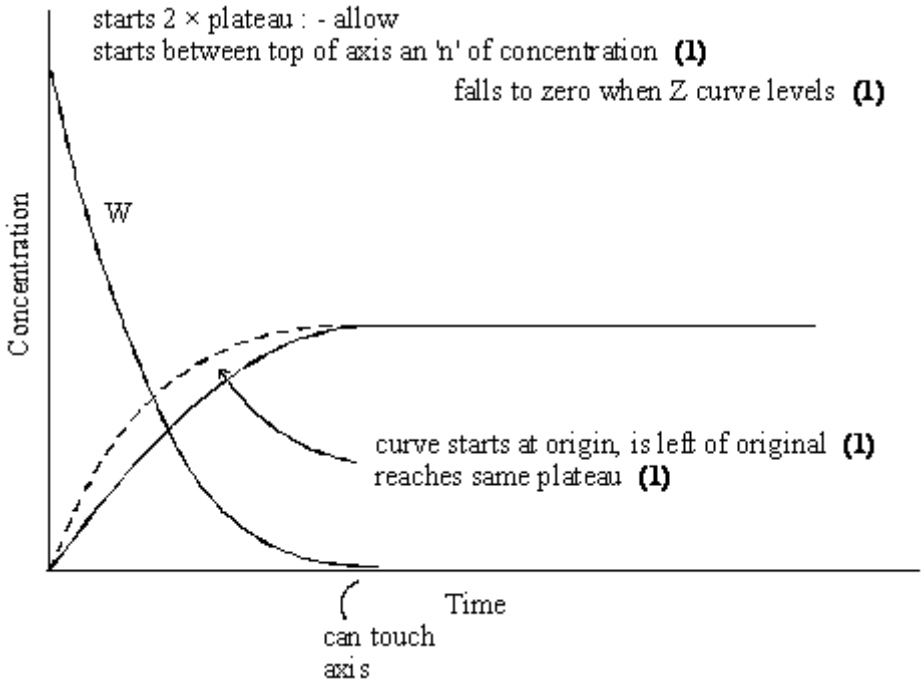
(c) provides alternative reaction route **(1)**
with a lower activation energy **(1)**

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

[12]

M5. (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) $2H_2O_2 \rightarrow 2H_2O + O_2$

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

[10]

M6. (a) minimum energy

1

to start a reaction/ for a reaction to occur/ for a successful collision

1

(b) activation energy is high / few molecules/particles have sufficient energy to react/few molecules/particles have the required activation energy

(or breaking bonds needs much energy)

1

(c) molecules are closer together/ more particles in a given volume

1

therefore collide more often

1

(d) many

1

more molecules have energy greater than activation energy (QoL)

1

(e) speeds up a reaction but is chemically unchanged at the end

1

(f) increases the surface area

1

[9]