M1. (a) Peak lower

1

and moved to right

1

start at the origin and curve crosses once only

1

(b) (i) (Rate of reaction) <u>increases</u>

1

(At a higher temperature) <u>more molecules/particles</u>

1

have the minimum energy needed to react/have activation energy/have successful collisions

Mark CE if incorrect effect given

1

(ii) (Rate of reaction) <u>increases</u> 1

lowers activation energy 1

so that more molecules are able to react 1

Mark CE if incorrect effect given

[9]

M2. (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**

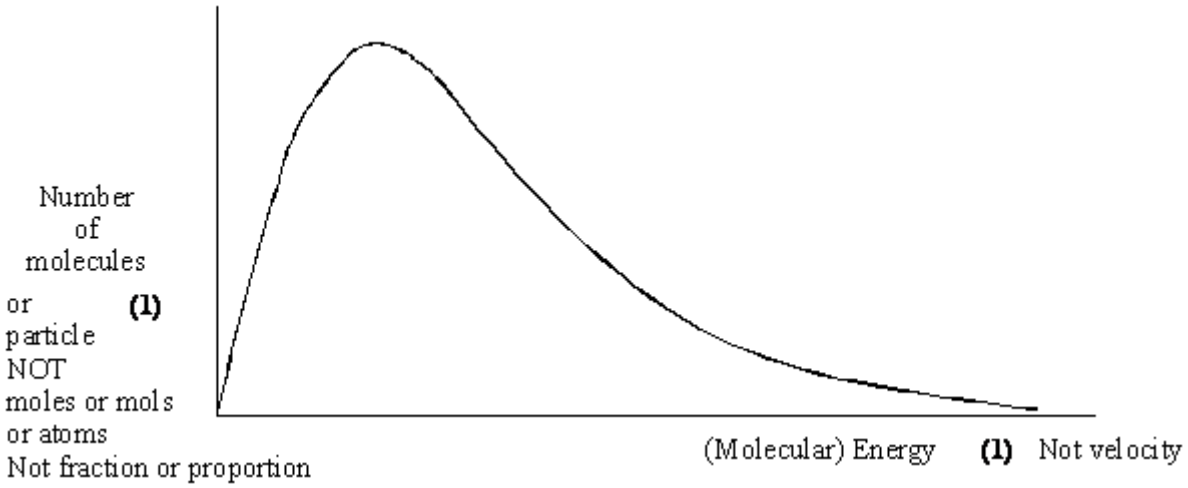
more molecules have energy greater than activation energy (QoL) **1**

(e) speeds up a reaction but is chemically unchanged at the end **1**

(f) increases the surface area **1**

[9]

M3. (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

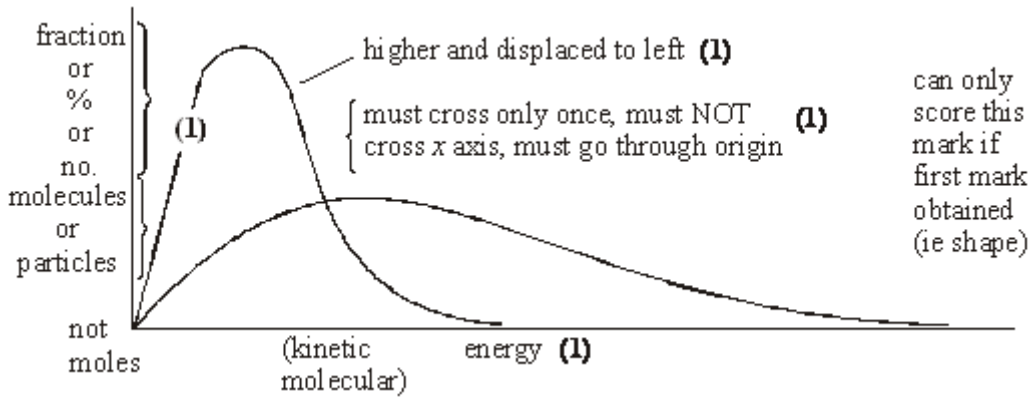
If change incorrect CE = 0

Allow answers anywhere in b (ii)

5

[9]

M4. (a)



2

(b) See above

2

(c) Energy < E_a or must have enough energy (to react) **(1)**

1

(d) Increase concentration (or pressure) **(1)**

1

(e) Many **(1)** more molecules have E > E_a / enough energy **(1)**
NOT KE increases with T

2

(f) Lowers E_a **(1)**
alternative route **(1)**

2

[10]

M5. (a) the minimum energy;

1

Energy required for a reaction to occur;
(or to start a reaction or for successful collisions)

1

(b) axes labelled:- y: number *(or fraction or %)* of molecules *(or particles)*
x: energy *(or KE);*

1

curve starts at origin;

1

skewed to right;

1

approaches x axis as an asymptote;
(penalise a curve that levels off > 10% of max peak height or a curve that crosses the energy axis)

1

second curve displaced to the left (and does not cross T_1 curve for a second time)

1

and peak higher;

1

many fewer molecules;

1

fewer molecules have $E > E_a$;

(can score this mark from suitably marked curves)

1

(c) molecules *(or particles or collisions)* do not have enough energy;

(or orientation may be wrong)

1

increase the pressure;

1

(or increase the concentration or reduce the volume) increases the collision frequency;

(or more collisions)
(do not allow if stated to be due to increase in energy implied by temperature increase)

1

add a catalyst;

1

lowers activation energy (or E_a) *(Q of L mark);*

1

[15]