M1. (a) gives out heat / energy

allow release / loses

allow the products have less energy

or

energy / heat transferred to the surroundings

ignore temperature rises

allow more energy given out in forming bonds than taken in to break bonds

1

(b) (i) speed up the reaction (owtte)

accept changes the rate

accept lowers activation energy

accept increases <u>successful</u> collisions

accept allows reaction to take place at a lower temperature

1

(ii) nitrogen (N_2) / oxygen (O_2) / products are safe **or** not harmful / pollutant / toxic / dangerous / damaging

ignore releases nitrogen / oxygen unless qualified

or

(harmful) nitrogen monoxide / NO is not released into the air.

accept prevents / less acid rain

ignore greenhouse gas / ozone layer

1

(iii) 2 and 2

accept correct multiples or fractions

1

(iv) idea of catalyst not being used up

allow not changed by reaction

ignore catalyst does not take part

ignore catalyst not used in the reaction

1

(v) idea of different reactions (require different catalysts)

accept catalysts work for specific reactions

allow different gases

1

(c) • smaller / very small / or any indication of very small / 1–100 nanometres / a few (hundred) atoms

ignore just small

ignore size of the converter

1

• big(ger) surface area

1

• less (catalyst) needed / small amount of catalyst needed

1

[9]

M2. (a) Stops / reduces air from escaping (owtte)

*allow keeping shape **or** keeping it hard*

1

(b) a layer a few hundred atoms thick

1

(c) any **two** from:

- last longer
- use fewer balls
- less materials **or** save resources
- less manufactured

  accept less factories
- less energy
- less fuel
- less pollution / greenhouse effect / global warming
- less waste

  ignore references to cost / recycling

  *any **two** ideas*

2

[4]

M3. (a) 1-100 nm in size

or

a few (hundred) atoms in size

accept very / really small / tiny
or 10^{-9}
*accept billionth of a metre **or** any number that implies very small*
accept measured in nanometers
if answer 'very small' ignore incorrect numerical values

1

(b) any **two** from:

- less tennis balls need to be made
- tennis balls last longer **or** don't have to replace as often
- less materials / resources / fuel used up / saves resources
  accept saving materials
- less energy used **or** making tennis balls uses energy
  accept saving energy
- less pollution caused
  accept named pollutant
  accept global warming / greenhouse effect
- less waste
  eg fewer tennis balls going to landfill

2

[3]

M4. (a) any **one** from:

- they are made of layers
  *do **not** accept line / rows / lattice*
- atoms / ions / particles / layers (of atoms) can slide over each other

1

(b) any **one** from:

- smaller / tiny **or** very small
  *do **not** allow small alone*
- correct size range 1 to 100 nanometres
- a few hundred atoms in size
  if they state smaller and give a size outside range ignore size if it is less than 20,000

1

(c) harder

1

plus **one** from:

- so does not wear as quickly / erode as quickly
  ignore corrode
- less vulnerable to damage owtte
  *harder to wear down = **1** mark*
- because they have a high surface area to volume ratio

or

stronger (1)

plus **one** from: (1)

- less likely to break / do not break
  accept withstand pressure
- not as vulnerable to damage owtte
  *harder and stronger alone gains **1** mark*

- do not bend out of shape
- because they have a high surface area to volume ratio

1

[4]