M1. gives out heat / energy (a) 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 (N₂) / oxygen (O₂) / 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	1
	•	big(ger) surface area	1
	•	less (catalyst) needed / small amount of catalyst needed	1

[9]

M2.		(a) S	Stops / reduces air from escaping (owtte) allow keeping shape or keeping it hard	1	
	(b)	a lay	ver a few hundred atoms thick	1	
	(c)	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]

Page 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) hard<u>er</u> 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

Page 6

harder and stronger alone gains 1 mark

accept withstand pressure

not as vulnerable to damage owtte

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

1

[4]