



## Mark schemes

- 1.** (a) (i) giant lattice  
*allow each carbon atom is joined to three others* 1
- atoms in graphene are covalently bonded  
*max. 2 marks if any reference to wrong type of bonding* 1
- and covalent bonds are strong **or** need a lot of energy to be broken  
*allow difficult to break* 1
- (ii) because graphene has delocalised electrons  
*allow each carbon atom has one free electron* 1
- which can move throughout the structure  
*do **not** accept just electrons can move.* 1
- (b) because there are weak forces between molecules  
*allow no bonds between the layers* 1
- so layers / molecules can slip / slide. 1
- [7]
- 2.** (a) a layer a few hundred atoms thick 1
- (b) any **two** from:  
*any **two** ideas*
- less materials or save resources
  - less energy
  - less fuel
  - less pollution / greenhouse effect / global warming
  - less waste
- ignore references to cost / recycling* 2
- [3]
- 3.** (a) (i) In suntan creams 1
- (ii) Much smaller 1



- (b) (i) have a high surface area to volume ratio 1
- (ii) because a catalyst provides an alternative / different pathway / mechanism / reaction route

*accept adsorption or 'increases concentration at the surface' ignore absorption*

1

(that has) lower activation energy

*allow weakens bonds*

*allow idea of increased successful collisions*

*max 1 mark for incorrect chemistry eg increased energy of particles*

1

[5]

4.

- (a) (i) *mention of molecules / intermolecular / ionic / covalent = max 2*

atoms / positive ions

1

any **two** from:

- (atoms / positive ions) in regular pattern / lattice / layer / giant structure (or diagram)
- delocalised electrons  
*accept electrons move within / through the structure*  
*allow free (moving) electrons*  
*allow sea of electrons*
- (atoms / positive ions) held together by strong / electrostatic attractions  
*allow strong (metallic) bonds*

2

- (ii) delocalised electrons

*accept electrons move within / through the structure*

*allow free electrons*

1

- (b) (i) smaller / very small

*accept converse*

*accept 1 - 100 nanometres in size*

*accept a few hundred atoms*

*accept larger surface area **or***

*large surface area for their size*

1



- (ii) nanoparticles / more can fit into (tiny) gaps  
*allow nanosize particles have large(r) surface area*

1

[6]

5.

- (a) kills bacteria

*allow destroys bacteria*  
*ignore attacks / reacts with bacteria*  
*ignore 'traps the smell'*

**or**

stops growth of bacteria

*ignore microbes*

1

- (b) smaller / very small / tiny

*assume they are referring to nanoparticles unless they state otherwise*  
*accept 1 - 100nm in size*  
*accept a few hundred atoms in size*  
*accept normal size particles are (much) larger*

1

- (c) any **one** from:

- big(ger) surface area
- react fast(er)  
*accept more reactive*  
*ignore kill faster*

1

- (d) so they do not get released during washing  
**or** so they do not get into rivers / ecosystem / environment

1

because this could harm fish / aquatic life  
**or** so the socks keep their odour-preventing properties (owtte)

1

[5]

6.

- (a) the diameter of the tube is very small

1

- (b) (i) three

1

- (ii) covalent

1



(iii) bonds

1

[4]

7.

(a) nanoparticles / they are small(er)

*accept 1–100 nm or a few atoms in size*

1

so can easily pass through pores / skin / cell / membranes / arteries / veins / capillaries / into blood stream owtte

*must be a comparative statement*

*can be inferred from smaller particles*

*allow absorbed for pass through*

1

(b) any **one** from:

- may be toxic (to cells / specific cells)  
*allow may harm / damage / kill cells / organs / tissues **or** may cause cancer*
- to ensure safety **or** reduce risk **or** risk of litigation  
*allow may cause allergies / side effects*  
*ignore harmful / dangerous unqualified eg harmful to body / people*
- nanoparticles may have different properties
- to see if they pass into the body

1

(c) any **two** sensible ideas from eg:

- testing is expensive **or** testing costs money  
*allow it costs money*  
*ignore litigation*
- testing is time consuming
- don't see any reason to test since normal sized particles (of titanium oxide) do not cause harm  
*accept normal sun cream does **not** cause harm owtte*
- don't want to risk not producing a popular product (owtte)  
*eg if unsafe will have to stop production **or** have to remove product if toxic*
- testing process / unfavourable results might cause alarm / reduce sales / reduce profit (less money)
- do not want to be seen doing animal testing

2



**8.**

(a) (i) high

1

(ii) hundred

1

(b) hard

1

(c) (i) carbon

1

(ii) four

1

(iii) covalent

1

(iv) all

1

**[7]**