

1(a). Nanoparticles are very small particles.

Put a **ring** around the correct range for the size of nanoparticles.

0.1 to 1 nm                  1 to 100 nm                  100 to 200 nm                  200 to 1000 nm

[1]

(b). Which statements about nanoparticles are **true** and which are **false**?

Put a tick (✓) in one box in each row.

|  | True | False |
|--|------|-------|
| Nanoparticles can be used to make sports equipment stronger. |      |       |
| Nanoparticles can occur naturally.                           |      |       |
| Nanoparticles have the same properties as larger particles.  |      |       |
| Nanoparticles are about the same size as some molecules.     |      |       |

[2]

(c). Doctors use stitches to hold together large cuts so that they can heal properly.

A hospital is considering buying a new type of material to use for stitches.

They need to choose between a material that contains silver nanoparticles and a material that does not.

Which material should they choose?

Justify your answer by explaining the risks and benefits of using each.

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[3]

[Total: 6]

2(a). Nanoparticles of cerium oxide,  $\text{CeO}_2$ , are added to diesel fuel.

They act as a catalyst for the combustion of the fuel.

Describe a property of nanoparticles that makes them good catalysts.

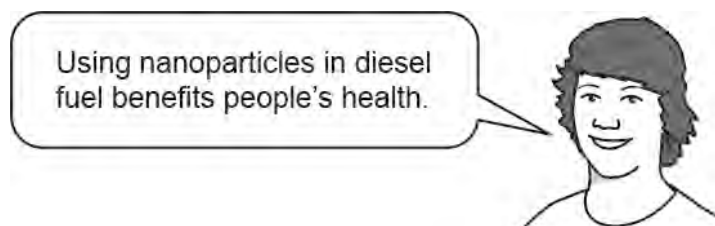
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----- [1]

(b). The addition of nanoparticles allows more complete combustion of the fuel.

Kai talks about nanoparticles in diesel fuel.



Evaluate Kai's statement.

In your answer give arguments **for** and **against** the use of nanoparticles.

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----- [3]

**END OF QUESTION PAPER**

| Question                         |      | Answer/Indicative content   | Marks      | Guidance   |       |                               |   |  |                          |   |  |                               |  |   |                                  |   |  |   |  |
|----------------------------------|------|---|------------|--|-------|-------------------------------|---|--|--------------------------|---|--|-------------------------------|--|---|----------------------------------|---|--|---|--|
| 1                                | a    | 1 to 100 nm;  | 1          |  |       |                               |   |  |                          |   |  |                               |  |   |                                  |   |  |   |  |
|                                  | b    | <table border="1"> <thead> <tr> <th>Sentence</th> <th>True</th> <th>False</th> </tr> </thead> <tbody> <tr> <td>... to make sports equipment.</td> <td>✓</td> <td></td> </tr> <tr> <td>... can occur naturally.</td> <td>✓</td> <td></td> </tr> <tr> <td>... same properties as larger</td> <td></td> <td>✓</td> </tr> <tr> <td>... same size as some molecules.</td> <td>✓</td> <td></td> </tr> </tbody> </table> | Sentence   | True   | False | ... to make sports equipment. | ✓ |  | ... can occur naturally. | ✓ |  | ... same properties as larger |  | ✓ | ... same size as some molecules. | ✓ |  | 2 | All four correct = 2 marks<br>3 or 2 correct = 1 mark<br>1 or 0 correct = 0 mark |
| Sentence                         | True | False   |            |  |       |                               |   |  |                          |   |  |                               |  |   |                                  |   |  |   |  |
| ... to make sports equipment.    | ✓    |   |            |  |       |                               |   |  |                          |   |  |                               |  |   |                                  |   |  |   |  |
| ... can occur naturally.         | ✓    |   |            |  |       |                               |   |  |                          |   |  |                               |  |   |                                  |   |  |   |  |
| ... same properties as larger    |      | ✓   |            |  |       |                               |   |  |                          |   |  |                               |  |   |                                  |   |  |   |  |
| ... same size as some molecules. | ✓    |   |            |  |       |                               |   |  |                          |   |  |                               |  |   |                                  |   |  |   |  |
|                                  | c    | <p>nanoparticle material is stronger / nanoparticle material has antibacterial properties;</p> <p>nanoparticles may be harmful to the body / nanoparticles not been fully investigated / long term effects / unknown effects;</p> <p>(Chooses either material) with idea of risks outweigh benefits or vice versa:</p>  | 3          | <p><b>Ignore:</b> may enter body / side effects / harmful to the environment / cost / harmful alone</p> <p><b>Allow</b> named long term effect eg cancer</p> |       |                               |   |  |                          |   |  |                               |  |   |                                  |   |  |   |  |
|                                  |      | <b>Total</b>  | <b>6</b>   |  |       |                               |   |  |                          |   |  |                               |  |   |                                  |   |  |   |  |
| 2                                | a    | large surface area to volume ratio / (very) small but have a large surface area ✓   | 1 (AO 1.1) | <p><b>Examiner's Comments</b></p> <p>The high surface area to volume ratio of nanoparticles was very well known.</p>   |       |                               |   |  |                          |   |  |                               |  |   |                                  |   |  |   |  |

| Question |   | Answer/Indicative content   | Marks   | Guidance   |
|----------|---|---|---|--|
|          | b | <p><b>For:</b><br/>           (More complete combustion hence) less pollutants / less harmful gases / less incomplete combustion /less named pollutant: (carbon) particulates / carbon monoxide / CO, unburnt fuel/hydrocarbons AW ✓</p> <p>Carbon monoxide is toxic//blocks haemoglobin / CO or particulates or unburnt HCs cause breathing or respiratory difficulties / particulates cause asthma/breathing difficulties / may cause cancer etc ✓</p> <p><b>Against:</b><br/>           CeO<sub>2</sub>/nanoparticles (may be) harmful / toxic / risks not known ✓</p> | <p>3<br/>(AO 3.1b)</p> <p>(AO 1.1)</p> <p>(AO 3.1b)</p> | <p>IGNORE 'more complete combustion' alone (repeats Q)<br/>           IGNORE 'less pollution'</p> <p>ALLOW idea of nanoparticles may harm humans, plants, animals or the environment<br/>           IGNORE 'nanoparticles may be pollutants /cause pollution' (too vague) 16</p> <p><b><u>Examiner's Comments</u></b></p> <p>Almost all candidates were able to give arguments either for or against nanoparticles. Most either stated one of the benefits of ensuring complete combustion by identifying one of the products of incomplete combustion (such as carbon monoxide) and linking this to a health issue (such as toxicity). Many candidates also know that the health effects of nanoparticles are not yet fully known. In answering this type of question, candidates are advised to ensure that they answer both 'sides' of the argument rather than giving too much detail about one 'side' only.</p> |
|          |   | <b>Total</b>  | <b>4</b>  |  |