

GCSE Chemistry (9 – 1)

Nanoparticles

Name:

Group:

Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.



For markers use	
Question	Mark
1	/5
2	/8
3	/8
4	/6
5	/8
Total	/35
%	
Grade	

Information

- The maximum mark for this paper is 35 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. From medicine to sunscreens, nanoparticles are tiny particles whose unique properties are being used to develop a wide range of new technologies.

Circle the letter of the correct answer for each of the following questions.

- a) The width of a human hair is 1.4×10^{-4} m. A carbon nanotube has a width of 1.4×10^{-9} m. How many times wider the human hair is than the carbon nanotube.

A

10

B

100

C

1000

D

100000

(1 mark)

- b) Which of the following values represents a possible diameter for a nanoparticle?

A

5.0×10^{-10}

B

5.0×10^{-8}

C

5.0×10^{-6}

D

5.0×10^{-4}

(1 mark)

- c) A student wrote down four statements about nanoparticles. Which statement is scientifically incorrect?

A Nanoparticulate materials can be used as catalysts.

B Nanoparticles are much smaller than atoms.

C There are possible risks when using nanoparticulate materials which are difficult to predict.

D Nanoparticulate materials have an extremely large surface area to volume ratio.

(1 mark)

- d) Which property of nanoparticles makes them very effective catalysts?

A They have no potential risks.

B They are smaller than atoms.

C They have a high surface area to volume ratio.

D They have a low surface area to volume ratio.

(1 mark)

- e) Some modern plasters have a dressing that contains silver nanoparticles.



Which statement best explains the advantage of using silver nanoparticles in the plaster dressing?

A The nanoparticles are very small and can enter the bloodstream to fight infection.

B The nanoparticles are transparent, so the plaster looks cleaner.

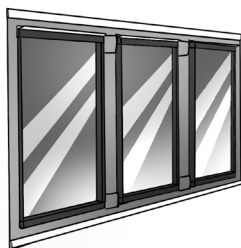
C The nanoparticles conduct heat away from the wound.

D The nanoparticles have antibacterial properties to help prevent infections.

(1 mark)

(Total for Question 1 is 5 marks)

2. Self-cleaning windows are coated with a thin, transparent layer of titanium dioxide nanoparticles. This coating uses energy from sunlight to break down dirt that lands on the window.



- a) What is the typical size range of a particle that is classified as a nanoparticle?

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(1 mark)

- b) Nanoparticles have a very high surface area to volume ratio.

A student is investigating how the surface area to volume ratio changes with the size of a cube.

The table below shows their results for a cube with a side length of 2 cm.

Complete the table below by calculating the surface area, volume, and surface area to volume ratio for a cube with a side length of 10 cm.

Side length of cube (cm)	Surface area (cm ²)	Volume (cm ³)	Surface area to volume ratio
2	24	8	3
10			

(3 marks)

- c) Explain why a coating of titanium dioxide nanoparticles is more effective at breaking down dirt than a coating of fine titanium dioxide particles.

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 (2 marks)

- d) The use of nanoparticles in consumer products like self-cleaning windows is increasing.

Explain why some scientists are concerned about the potential long-term effects of using nanoparticles.

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 (2 marks)

(Total for Question 2 is 8 marks)

3. Nanoparticles are very small particles that have unusual properties.
Particles less than 100 nanometres in size are classified as nanoparticles.

a) 100 nanometres is:

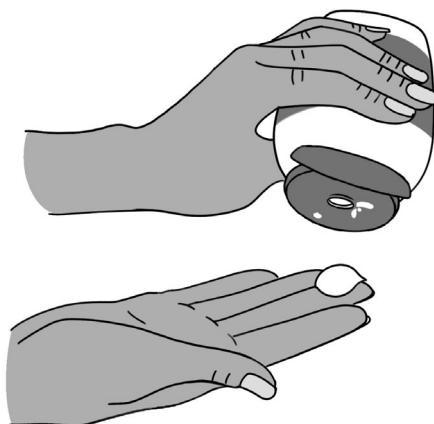
A	B	C	D
1.0×10^{-4}	1.0×10^{-7}	1.0×10^{-9}	1.0×10^{-5}

(1 mark)

Sunscreens work by creating a barrier on the skin that blocks harmful ultraviolet (UV) radiation given out by the sun from reaching the skin.

Many modern sunscreens contain nanoparticles of zinc oxide.

Older sunscreens used fine particles of zinc oxide. Fine particles have a diameter of around 2,500 nanometres (nm).



b) Compare the sunscreen made with fine particles to the sunscreen made with nanoparticles.

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(2 marks)

c) Explain why using nanoparticles of zinc oxide provides more effective protection from UV radiation than using the same mass of fine particles of zinc oxide.

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(2 marks)

- d) The use of nanoparticles in sunscreens is a topic of debate.
Evaluate the use of nanoparticles in sunscreens.
In your answer, you should refer to both the benefits and the potential risks.

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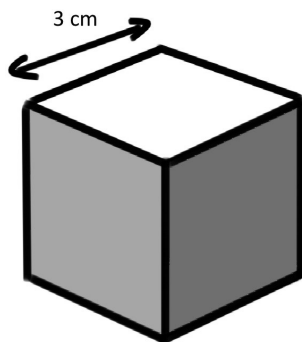
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(3 marks)

(Total for Question 3 is 8 marks)

4. Nanoparticles have many uses, including as catalysts.

A scientist investigates the properties of a cube of silver. The cube is shown in the figure below.



- a) Calculate the surface area to volume ratio of the cube of silver.
Show your working.

Surface area to volume ratio = ...

(3 marks)

- b) Explain why a certain mass of silver is more effective as a catalyst when it is in the form of nanoparticles compared to a coarse powder.

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(3 marks)

(Total for Question 4 is 6 marks)

5. A company is developing a new method to purify water using silver nanoparticles, which have antibacterial properties. The effectiveness of the nanoparticles depends on their surface area to volume ratio.

The company tests two different sizes of silver particles, A and B, which are both perfect cubes.

- Particle A is a nanoparticle with a side length of 50 nm.
- Particle B is a much larger particle with a side length of 2000 nm.

- a) Calculate the surface area, volume, and surface area to volume ratio for the larger Particle B. Complete the table below.

Particle	Side length (nm)	Surface area (nm ²)	Volume (nm ³)	Surface area to volume ratio
Particle A	50	15 000	125 000	0.12
Particle B	2000			

(3 marks)

- b) Using the data in the table above, explain why a given mass of Particle A would be more effective at purifying water than the same mass of Particle B.

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(2 marks)

- c) After purification, small traces of silver nanoparticles might remain in the drinking water and could eventually be released into the wider environment.

Evaluate the use of silver nanoparticles for purifying drinking water on a large scale. You must refer to the benefits and the potential risks in your answer.

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(3 marks)

(Total for Question 5 is 8 marks)