



1. The article gives some information about graphene.

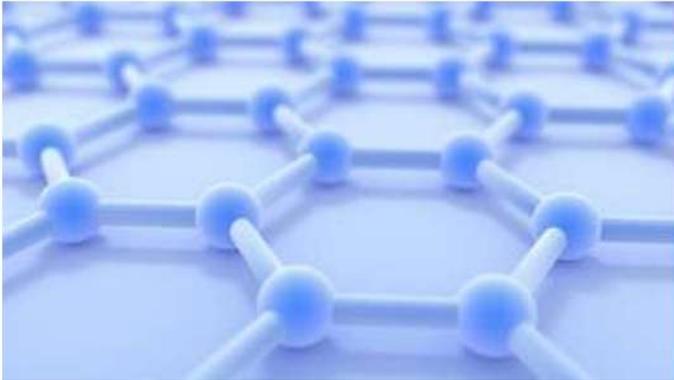
🎵 Nanotunes! 🎵

Carbon can be made into nano-thin, strong sheets called graphene.

A graphene sheet is a single layer of graphite.

Graphene conducts electricity and is used in loudspeakers.

The picture shows the structure of graphene.



© Jimmy/iStock

- (a) Use the picture and your knowledge of bonding in graphite to:
- (i) explain why graphene is strong;

(3)



(ii) explain why graphene can conduct electricity.

(2)

(b) Graphite is made up of layers of graphene.

Explain why graphite is a lubricant.

(2)

(Total 7 marks)

2.

Read the article and then answer the questions.



Nanotennis!

Tennis balls contain air under pressure, which gives them their bounce. Normal tennis balls are changed at regular intervals during tennis matches because they slowly lose some of the air. This means that a large number of balls are needed for a tennis tournament.



© Feng Yu/iStock

'Nanocoated' tennis balls have a 'nanosize' layer of butyl rubber. This layer slows down the escape of air so that the ball does not lose its pressure as quickly. The 'nanocoated' tennis balls last much longer and do not need to be replaced as often.

(a) Tick (✓) the best description of a 'nanosize' layer.

Description	Tick (✓)
A layer one atom thick.	
A layer a few hundred atoms thick.	
A layer millions of atoms thick.	

(1)



- (b) Suggest **two** ways in which using 'nanocoated' tennis balls would be good for the environment.

(2)
(Total 3 marks)

3.

Nanoparticles have many uses.

- (a) (i) Tick (✓) **one** use of nanoparticles.

In the extraction of iron

In suntan creams

In the test for oxygen

(1)

- (ii) How is the size of nanoparticles different from normal-sized particles?

Draw a ring around the correct answer.

much smaller

same size

much larger

(1)

- (b) Very small amounts of cerium oxide nanoparticles can be added to diesel fuel.

The cerium oxide is a catalyst.

- (i) Draw a ring around the correct answer to complete the sentence.

Only a very small amount of cerium oxide nanoparticles is needed because

the nanoparticles

are elements.

are very reactive.

have a high surface area to volume ratio.

(1)

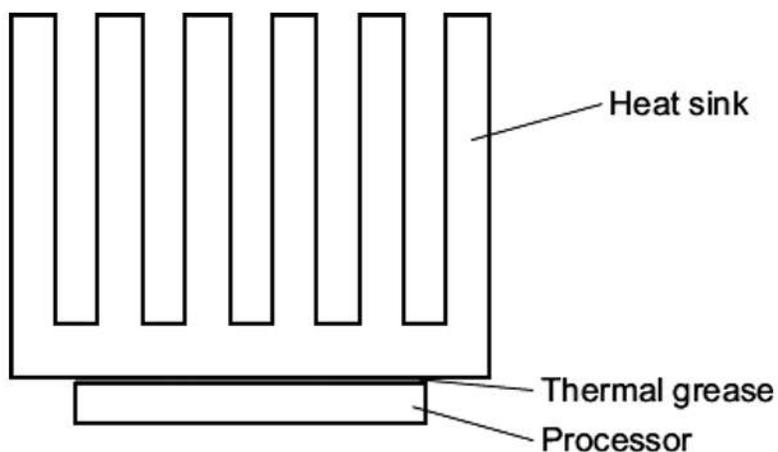


(ii) Explain how a catalyst increases the rate of a reaction.

(2)
(Total 5 marks)

4.

The diagram shows how a heat sink is placed on top of a processor in a computer. The heat sink is a large piece of metal which conducts heat away from the processor. If the processor gets too hot it may be damaged.



(a) (i) Describe the structure of a metal.

(3)



(ii) Why are metals very good conductors of heat?

(1)

(b) When viewed under a microscope, it can be seen that the surfaces of the processor and the heat sink that are in contact are not flat.

There are lots of tiny gaps between the two surfaces.

The gaps contain air, which does not conduct heat very well.

Thermal grease is used to fill the gaps between the processor and the heat sink to improve the transfer of heat from the processor to the heat sink.

One type of thermal grease contains nanosized particles of silver.

The manufacturer claims that the nanosized particles help to transfer heat better than normal sized particles.

(i) How are nanosized particles different from normal sized particles?

(1)

(ii) Suggest **one** reason why nanosized particles of silver might help to transfer heat better than normal sized particles.

(1)

(Total 6 marks)

5.



Read the article and then answer the questions.

TOXIC SOCKS?

Silver nanoparticles are added to the fibres used to make some socks. Silver has the special property that it can kill bacteria. As a result there are no unpleasant smells when wearing these socks.



Some scientists are concerned about the use of silver nanoparticles in socks.

The silver can be released from the socks when they are washed. This silver may end up in rivers. Silver in rivers may kill fish.

Scientists found that some makes of socks release the silver more easily than others. Socks in which the silver nanoparticles are trapped in the fibres released very little silver when washed.

By tfkrawksmysocks [CC BY-SA 2.0], via Flickr

- (a) Suggest why silver stops unpleasant smells when wearing the socks.

(1)

- (b) How is the size of silver nanoparticles different from normal sized silver particles?

(1)

(c) The silver nanoparticles are more effective at preventing unpleasant smells than normal sized silver particles.



Suggest why.

(1)

(d) The silver nanoparticles should be trapped in the sock fibres.

Use the information in the article to explain why.

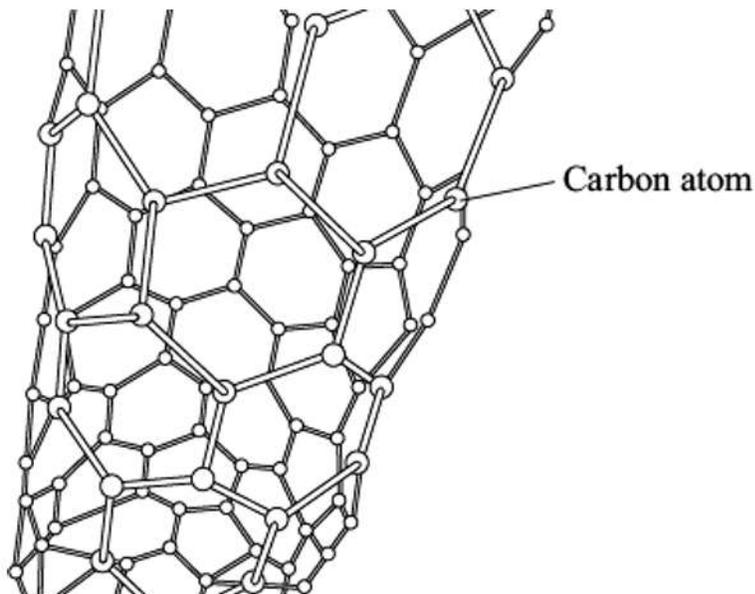
(2)

(Total 5 marks)



6. Lightweight handlebars for bicycles are made from materials containing carbon nanotubes. Carbon nanotubes are lightweight but very strong.

The diagram shows the structure of a carbon nanotube.



(a) What does the term 'nano' tell you about the diameter of carbon nanotubes?

Tick (✓) the correct answer in the table.

Answer	Tick (✓)
The diameter of the tube is very small.	
The diameter of the tube is large.	
The diameter of the tube is very large	

(1)

(b) Look at the diagram and then draw a ring around the correct word to complete each sentence.

(i) Carbon nanotubes are similar to graphite because each carbon atom is joined

to

two
three
four

 other carbon atoms.

(1)



(ii) The carbon atoms are joined by

covalent
ionic
metallic

 bonds.

(1)

(iii) Carbon nanotubes are very strong because the

atoms
bonds
electrons

 are hard to break.

(1)

(Total 4 marks)

7.

Read the article about the use of nanoparticles in sun creams.

Sun creams

Many sun creams use nanoparticles. These sun creams are very good at absorbing radiation, especially ultraviolet radiation. Owing to the particle size, the sun creams spread more easily, cover better and save money because you use less. The new sun creams are also transparent, unlike traditional sun creams which are white. The use of nanoparticles is so successful that they are now used in more than 300 sun cream products.

Some sun creams contain nanoparticles of titanium oxide. Normal-sized particles of titanium oxide are safe to put on the skin.

It is thought that nanoparticles can pass through the skin and travel around the body more easily than normal-sized particles. It is also thought that nanoparticles might be toxic to some types of cell, such as skin, bone, brain and liver cells.

(a) Explain why nanoparticles pass through the skin and travel around the body more easily than normal-sized particles of titanium oxide.

(2)



(b) Explain why sun creams containing nanoparticles should be tested further.

(1)

(c) Suggest why some companies that make sun creams might not want to do more tests.

(2)

(Total 5 marks)

8.

This question is about diamonds.

Draw a ring around the correct answer to complete each sentence.

(a) Diamonds are found in meteorites.

(i) Meteorites get very hot when they pass through the Earth's atmosphere, but the diamonds do not melt.

Diamond has a

high
low
very low

 melting point.

(1)

(ii) Most diamonds found in meteorites are nanodiamonds.

A nanodiamond contains a few

hundred
thousand
million.

 atoms

(1)

(b) Diamonds are used for the cutting end of drill bits.

Diamonds can be used for drill bits because they are

hard.
shiny.
soft.

(1)



(c) The figure below shows the arrangement of atoms in diamond.



(i) Diamond is made from

carbon
nitrogen
oxygen

 atoms.

(1)

(ii) Each atom in diamond is bonded to

three
four
five

 other atoms.

(1)

(iii) Diamond has a giant

covalent
ionic
metallic

 structure.

(1)

(iv) In diamond

all
none
some

 of the atoms are bonded together.

(1)

(Total 7 marks)