

**Big Science**

**Competition**

 pen & paper

# Year 7 Paper

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## INSTRUCTIONS

1. Do not open this booklet until told to do so by your teacher.
2. Use only B or 2B pencil.
3. Answers must be recorded on the answer sheet provided.
4. Calculators may be used.
5. Diagrams are not necessarily drawn to scale.

## SAMPLE QUESTIONS ONLY

**ANSWERS INCLUDED ON PAGE 5**

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**AUSTRALIAN \* SCIENCE  
INNOVATIONS**

## PLASTIC ROADS

Plastic waste is a major type of pollution.

There are many types of plastic. The use of waste plastic in road surfaces is being investigated.

Two things are done to the waste plastics before they can be used as part of a road surface:

1. the plastics are sorted and the required type of plastic selected
2. the selected plastic is cut into tiny pieces.

Once the waste plastic has been sorted and cut into pieces, it is melted. The melted plastic can then be moulded into any shape needed.

- 1 Which property is most likely to be used to select the required type of plastic from the waste?
  - A the colour of the plastic
  - B the shape of the plastic
  - C the original use of the plastic
  - D the chemical composition of the plastic
  
- 2 The plastic to be used in the road surface has been tested over a temperature range of  $-40\text{ }^{\circ}\text{C}$  to  $+80\text{ }^{\circ}\text{C}$ .

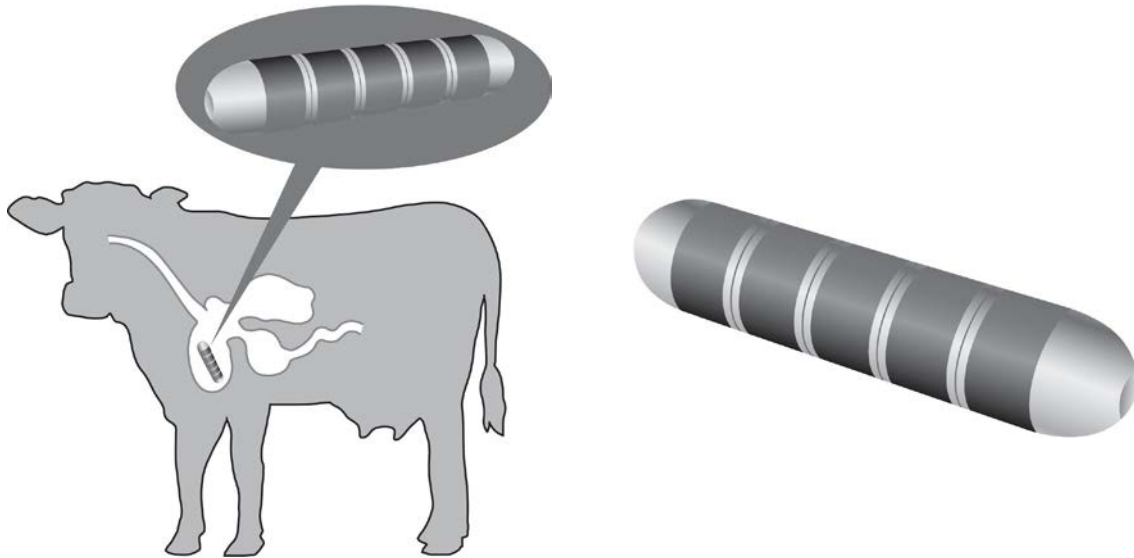
Why was this range of temperature used to test the plastic?

- A The range would cover most weather conditions.
- B  $-40\text{ }^{\circ}\text{C}$  is the coldest temperature possible.
- C The range contains simple numbers, so calculations based on them are easier to carry out.
- D The range does not need to exceed  $+80\text{ }^{\circ}\text{C}$  as all solids turn to liquid at this temperature.

## COW MAGNETS

When cows eat grass, any metal objects in the grass are eaten as well. These objects can damage the gut of the cow and this damage can cause the cow to become ill. This condition is known as *hardware disease*.

To prevent some metal objects causing hardware disease the cow has a powerful magnet placed in the upper part of its gut. The magnet does not harm the cow and collects any magnetic objects that the cow swallows. These objects, and the magnet, remain in the first part of the cow's gut where they do not cause hardware disease.

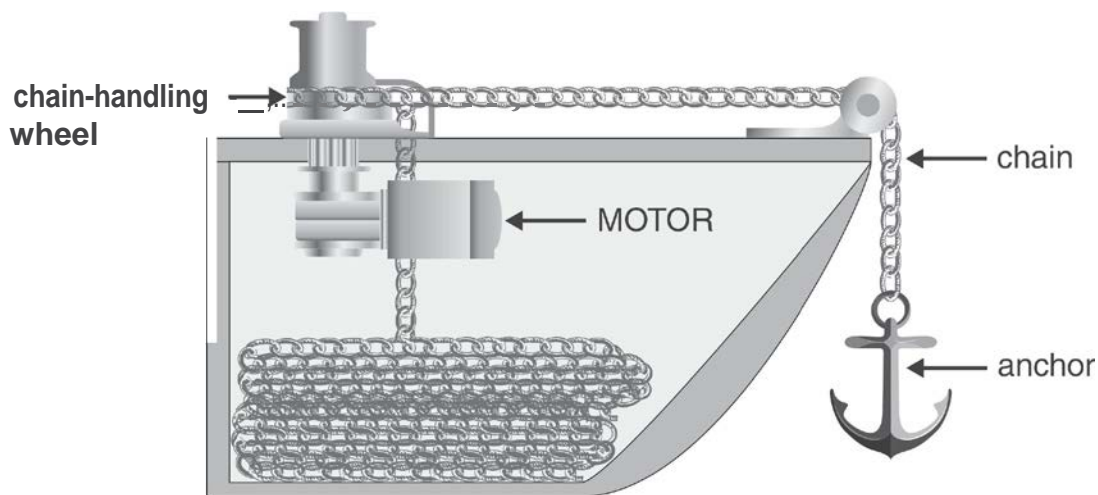


**Location of the magnet in the upper part of a cow's gut (magnet not to scale)**

**Magnet (approximate size: 2 cm diameter, 9 cm long)  
Note the ceramic discs separating the five magnets**

- 3 Which of these objects would be collected by the magnet inside the cow?
- A iron nail
  - B copper wire
  - C aluminium drink can
  - D bronze (copper and nickel alloy) coin
- 4 Which of these facts about magnets best explains why five small magnets are used rather than a single large magnet?
- A More magnetic poles means more places to attract objects.
  - B Permanent magnets become demagnetised if they are heated.
  - C Magnetic forces are able to pass through non-magnetic materials.
  - D The poles of magnets will align themselves with the Earth's magnetic field.

An *electric windlass* is a winch that raises and lowers an anchor using a motor. Lubricants are added to the chain so it moves smoothly through the chain-handling wheel.



**An electrical windlass**

- 5 If no electrical power is available on a boat, the chain-handling wheel can be loosened. This allows the anchor and chain to move freely to the ocean floor.

What makes the anchor move to the ocean floor?

- A The large mass of the anchor.
- B The force of gravity on the anchor.
- C The large amount of chain available.
- D The force provided by water pressure.

- 6 The lubricant reduces the friction between the chain and the chain-handling wheel.

The lubricant also provides a layer of protection between metal objects and sea water.

Which additional problem does this layer of lubricant reduce?

- A rusting
- B slipping
- C burning
- D evaporation

# NANO FILTERS

Nano-particles are extremely small. They can pass through the holes in typical filters. Plant fibre can now be used to make nano-filters that remove these very small particles.

7 A substance is produced in the form of nano-particles. It is also produced as a single, large block. What is the difference between the same mass of the nano-particles and the block of material?

- A the density of the particles
- B the weight of material present
- C the total surface area present
- D the substance's chemical composition

8 A nano-filter can remove 100 nm sized particles from a solution.

What other sized particles is this nano-filter able to remove?

Select the column that provides a correct response for each particle.

| Can this particle size be removed? | A   | B   | C   | D  |
|------------------------------------|-----|-----|-----|----|
| 50nm                               | yes | no  | yes | no |
| 200 nm                             | no  | yes | yes | no |
| 500 nm                             | no  | yes | no  | no |

## ANSWERS

| Question | Unit            | Correct answer | Strand 1 | Strand 2 | AC ref 1   | AC ref 1  | Descriptor  |
|----------|-----------------|----------------|----------|----------|------------|-----------|---|
| 1        | Plastic Roads 1 | D              | SIS      | CS       | AC SIS132  | AC SSU077 | Uses knowledge that different materials have different properties to solve a problem. |
| 2        | Plastic Roads 2 | A              | SIS      | ESS      | AC SIS131  | AC SSU096 | Uses knowledge of extreme weather to explain part of an experimental design.          |
| 3        | Cow Magnets     | A              | SU       | PS       | AC SSU076  | -         | Identifies a magnetic material.   |
| 4        | Cow Magnets 2   | A              | SIS      | PS       | AC SIS132  | AC SSU076 | Uses scientific knowledge of magnets to assess the design of a device.                |
| 5        | Anchors Away 1  | B              | SU       | PS       | AC SSU117  | -         | Selects the correct explanation of movement of an object as being due to gravity.     |
| 6        | Anchors Away 2  | A              | SHE      | CS       | AC SHE1006 | AC SSU074 | Identifies rusting as the reason for why lubricant solves a practical problem.        |
| 7        | Nano-filters 1  | C              | SU       | CS       | AC SSU074  |           | Identifies a change in the properties of a materials based on particle size.          |
| 8        | Nano-filters 2  | B              | SIS      | CS       | AC SIS132  | AC SSU113 | Uses scientific knowledge to predict the behavior of a filter.                        |