

Big Science

Competition

 pen & paper

Year 9 Paper

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



**AUSTRALIAN * SCIENCE
INNOVATIONS**

ACID DRAINAGE

Acid drainage from old mine sites is an environmental problem. Ground water combines with sulfide minerals and oxygen in these old mines to form sulfuric acid.

The sulfuric acid reacts with any metal ores left in the mine to form a new substance.

The new substance made by these reactions enters the surface water to become an environmental hazard.



**Old mine
entrance**

- 1 What property must this new substance possess?
 - A. It is acidic.
 - B. It is a liquid.
 - C. It is soluble.
 - D. It reacts with oxygen.

- 2 Acid drainage also occurs naturally.

What would be the main difference between acid drainage in mines and that which occurs naturally?

 - A. The process in the mines requires less oxygen.
 - B. The natural process occurs much more slowly.
 - C. Sulfuric acid is only created from the rocks in mines.
 - D. Metals dissolve to different extents in mines compared to naturally.

- 3 Acid drainage from mining can be treated before it is released into the environment.

Which form of treatment uses a chemical reaction?

 - A. Adding caustic soda or lime to the water.
 - B. Covering waste rock from mines with plastic sheeting.
 - C. Sealing mine shafts to prevent movement of water in and out.
 - D. Storing mining waste underwater where oxygen levels are very low.

4 Different ways of treating acid drainage are being explored.

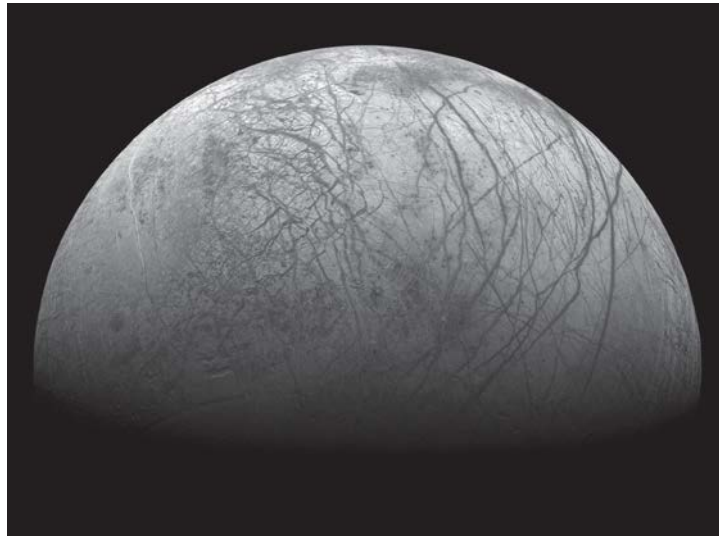
Which of these treatments is most likely to involve the development of new technology?

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

Is this treatment likely to involve the development of new technology?	A	B	C	D
Bicarbonate is added to produce an iron sulfide sludge that can be used as paint pigments.	no	no	yes	yes
The waste products from aluminium refineries are being added to acid drainage wastes to reduce the effect on the environment.	no	yes	no	no
Recovered dissolved iron is used in fuel cells to generate electricity.	yes	yes	yes	no

EUROPA'S OCEAN

Europa is one of Jupiter's moons. The surface of Europa is covered in pure water ice slabs, with dark bands running across them. The dark bands are thought to be created when material rises up to the frozen surface.



Dark bands on Europa's icy surface

- 5 Scientists placed samples of chemical substances into a sealed chamber. The conditions in the chamber modelled the conditions on the surface of Europa. In the chamber, sodium chloride was observed to go from white to a yellowish brown colour.

Which hypothesis is supported by this observation?

- A. There is a salty ocean below the ice slabs on Europa.
 - B. The dark bands contain impurities deposited by meteors.
 - C. Sodium chloride cannot change colour in Earth's atmosphere.
 - D. Pure water ice on Europa contains elements other than hydrogen and oxygen.
- 6 Photographs of Europa's surface were obtained by the Galileo spacecraft in 1998. Scientists noticed that there were areas on the surface where the dark bands did not line up properly. They proposed that this was caused by slabs of ice sliding below one another.
- Which geological feature on Earth does this most closely resemble?
- A. A chain of islands.
 - B. A geothermal vent.
 - C. A mid-ocean ridge.
 - D. A subduction zone.

MAGNETIC SHIELDS IN SPACE

Magnetic shields are being built around spacecraft. These shields protect astronauts and equipment from the harmful effects of radiation.

A magnetic field around a spacecraft will deflect radiation away.

7 On the spacecraft, which of these is most important to protect from damage by radiation?

- A. The lenses of digital cameras.
- B. The memory storage of computers.
- C. The LED emergency lighting system.
- D. The loud speakers of communication equipment.

8 Exposure to high energy radiation increases the risk of cancer in people. Cancer can occur when parts of a cell are damaged by radiation.

Damage to which part of the cell increases the risk of developing cancer?

- A. the nucleus
- B. the cytoplasm
- C. the mitochondria
- D. the cell membrane

ANSWERS

Question	Unit Name	Correct answer	Strand 1	Strand 2	AC ref 1	AC ref 1	Descriptor
1	Acid Drainage 1	C	SU	CS	ACSSU113	-	Recognises metals can dissolve to create a solution.
2	Acid Drainage 2	B	SIS	ESS	AC SIS124	ACSSU153	Makes a prediction based on the timescales of geological processes.
3	Acid Drainage 3	A	SHE	CS	AC SHE136	ACSSU225	Considers possible treatments of mining waste to identify the one involving a chemical change.
4	Acid Drainage 4	A	SHE	CS	AC SHE136	-	Identifies a treatment for mining waste that involved a technological solution.
5	Europa's Ocean's 1	A	SIS	CS	AC SIS171	-	Evaluates evidence that supports an hypothesis.
6	Europa's Ocean's 2	D	SU	ESS	ACSSU158	-	Recognises analogy of ice plates to tectonic plates to identify form of subduction.
7	Magnetic Shields in Space 1	B	SIS	PS	AC SIS170	ACSSU182	Uses understanding of energy to identify a technology that is at risk of damage
8	Magnetic Shields in Space 2	A	SIS	BS	AC SIS170	ACSSU149	Uses understanding of cell structure to identify possible cause of cancer