

Big Science

Competition

pen & paper

Year 10 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 4



**AUSTRALIAN * SCIENCE
INNOVATIONS**

ERASABLE PEN

The ink in pens is a mixture. The chemicals used in ink have been changed as new inks have been invented.

Erasable pens contain a special ink. The ink can be erased using friction. The ink cannot be seen when it is rubbed with the plastic eraser on the end of the pen.

Consider two hypotheses about how this pen erases the ink:

Hypothesis 1: Friction of the eraser on the page causes the ink to be pushed off the page.

Hypothesis 2: Friction from the eraser heats the ink. The ink is a chemical that is coloured at low temperature and becomes invisible at higher temperature.

1 Which of these predictions are consistent with Hypothesis 1?

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

Prediction	A	B	C	D
Erased ink cannot be made visible again.	no	yes	yes	no
The ink absorbs into the paper fibres.	no	yes	no	yes
Erasing the ink is only possible using the pen's eraser.	yes	no	no	no

2 Which of these predictions are consistent with Hypothesis 2?

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

Prediction	A	B	C	D
Erased ink could be made visible again.	no	yes	yes	no
Hot air will cause the writing to disappear.	no	yes	no	yes
Writing with a hot pen will not be visible.	yes	no	no	yes

AN EYE TO THE SKY

All early observations of objects in space relied on visible light. As technology has evolved we have been able to 'look' into space in different ways.

In AD 1054 Chinese astronomers saw a short-lived, bright light appear in the sky. The bright light is now thought to have been caused by a supernova. A supernova is an explosion of a star.

This supernova created a structure we now know as the Crab Nebula.

In 1968 repeating radio waves were discovered to be coming from the centre of the Crab Nebula. The object creating these radio waves is called the Crab Pulsar.

- 3 What does the discovery of the Crab Nebula and Crab Pulsar tell us about the nature of scientific knowledge?
- A. Scientific knowledge confirms what we already know to be true.
 - B. Current scientific knowledge can be used to explain past observations.
 - C. Current scientific knowledge always confirms the beliefs of pre-industrial societies.
 - D. Prior scientific knowledge only becomes relevant if it is confirmed by current research.
- 4 Light from very distant objects in the universe has changed by the time it reaches the Earth. This phenomenon is called the Red Shift.
- What causes the Red Shift?
- A. All objects in the universe are very hot.
 - B. The objects producing the light are moving away from Earth at high speeds.
 - C. Red light travels faster than other coloured light so more red light reaches Earth.
 - D. Any blue light from distant objects is absorbed in the atmosphere before it reaches Earth.
- 5 Why does the radiation from very distant objects help us understand the formation of the early universe?
- A. Objects near the edge of the observable universe were formed before those closer to the centre.
 - B. Objects must be very old before they can produce measureable amounts of radiation.
 - C. Radiation from very distant objects that reaches the Earth today was formed very early in the history of the universe.
 - D. Any radiation that reaches the Earth today from very distant objects must be very powerful, so the radiation must have come from the Big Bang.

UNDERWATER GREENHOUSE

An agricultural company tested growing plants in greenhouses that are 20 metres below the sea surface. The plants grow successfully in the underwater greenhouses.

- 6 What can be inferred from this?
- A. The nutrients in sand on the sea floor are the same as on land.
 - B. It does not matter that there is much less light underwater compared to on land.
 - C. Chlorophyll absorbs different frequencies of light than water.
 - D. Chlorophyll will effectively function with all frequencies of light reaching the sea floor
- 7 The greenhouses could be placed near the surface of the water.
What benefit would there be in placing the greenhouses 20 metres below the sea surface rather than near the surface itself?
- A. The temperature would be higher.
 - B. There would be more light available.
 - C. The plants could be more easily harvested.
 - D. There would be fewer disturbances from local weather.

ANSWERS

Question	Correct answer	Unit Name	Strand 1	Strand 2	AC ref 1	AC ref 1	Descriptor
1	C	Erasable Pens 1	SIS	CS	ACSIS164	-	Identifying observations consistent with hypotheses
2	D	Erasable Pens 2	SIS	CS	ACSIS164	-	Identifying observations consistent with hypotheses
3	B	An Eye to the Sky 1	SHE	ESS	ACSHE192	ACSSU188	Understands the role that past observations can play in science.
4	B	An Eye to the Sky 2	SU	ESS	ACSSU188	-	Understands the process that Red Shifts light from space.
5	C	An Eye to the Sky 3	SIS	ESS	ACSIS204	ACSSU188	Identifies why radiation from distant objects is valuable in astronomy.
6	C	Underwater Greenhouse 1	SIS	PS	ACSIS206	ACSSU155	Recognises that substances are apparently absorbing different wavelengths.
7	D	Underwater Greenhouse 2	SIS	PS	ACSIS206	ACSSU155	Identifies that water absorbs more heat than air for a given temperature change.