BOSTES | BOARD OF STUDIES TEACHING & EDUCATIONAL STANDARDS NSW

2014 HIGHER SCHOOL CERTIFICATE EXAMINATION

Senior Science

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
  Black pen is preferred
- Draw diagrams using pencil
- Board-approved calculators may be used
- Write your Centre Number and Student Number at the top of pages 13, 15, 17, 21 and 23

Total marks – 100

Section I Pages 2–23

75 marks

This section has two parts, Part A and Part B

Part A – 20 marks

- Attempt Questions 1–20
- Allow about 35 minutes for this part

Part B – 55 marks

- Attempt Questions 21–30
- Allow about 1 hour and 40 minutes for this part

Section II Pages 25–35

25 marks

- Attempt ONE question from Questions 31–35
- Allow about 45 minutes for this section

Section I
75 marks

Part A – 20 marks
Attempt Questions 1–20
Allow about 35 minutes for this part

Use the multiple-choice answer sheet for Questions 1–20.

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1 Which substance is a colloid?

(A) Alcohol

(B) Mayonnaise

(C) Oil

(D) Salad dressing

2 What is the main role of the human skin?

(A) To regulate the body's water content

(B) To assist in body temperature control

(C) To help microflora enter and leave the body

(D) To control the movement of gases into and out of the body

3 What does electromagnetic radiation consist of?

(A) Waves that can travel through space

(B) Waves that cannot travel through space

(C) Radiation in the form of magnetic energy

(D) Radiation in the form of alpha particles

4 Which of the following is an invasive medical technique?

(A) X-rays

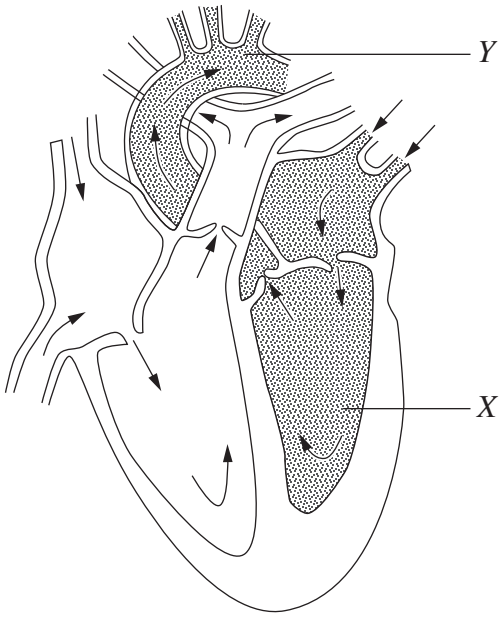
(B) Ultrasound

(C) Keyhole surgery

(D) Magnetic resonance imaging

Use the diagram to answer Questions 5 and 6.

Heart cross-section



5 What is the structure at *X*?

(A) Right atrium

(B) Left ventricle

(C) Tricuspid valve

(D) Pulmonary cavity

6 Which is the correct statement about the blood in vessel *Y*?

(A) It is low in oxygen and leaving the heart.

(B) It is high in oxygen and entering the heart.

(C) It is low in oxygen and entering the heart.

(D) It is high in oxygen and leaving the heart.

7 What property of water makes it possible for a small insect to walk on it?

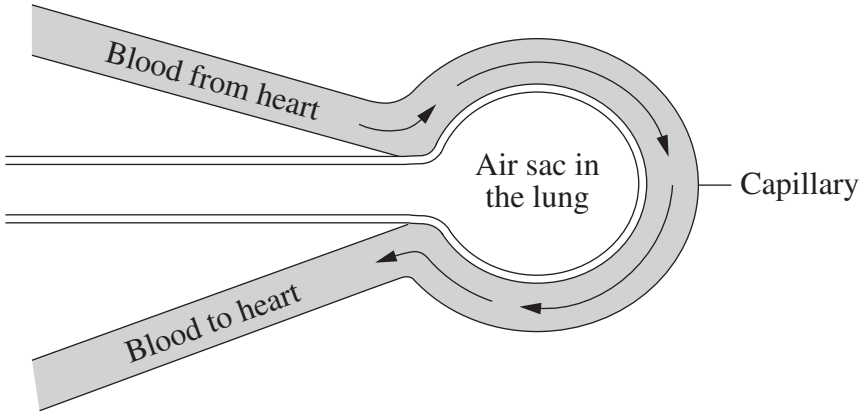
(A) pH

(B) Solubility

(C) Surface tension

(D) Temperature

8 The diagram represents a magnified view of an alveolus in the human lung. The arrows indicate blood flow.



Which two systems are interacting in this diagram?

(A) Skeletal and muscular

(B) Nervous and endocrine

(C) Reproductive and digestive

(D) Respiratory and circulatory

9 An emulsion is a mixture containing which of the following?

(A) Two gases

(B) Two solids

(C) Two liquids

(D) A solid and a liquid

10 The diagram represents the information transfer process.

Which statement is true?

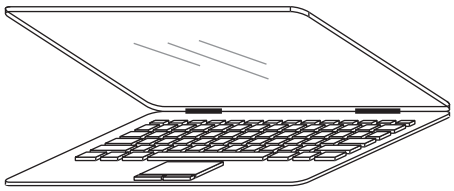
(A) The encoded message is always digital.

(B) The sending device always uses more energy than the receiving device.

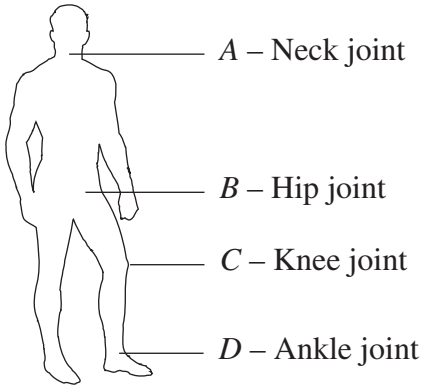
(C) The encoded message always requires the use of electromagnetic waves.

(D) The sending device and the receiving device always use a common code.

11 The way that the screen of this laptop computer opens can be used as a model for a type of joint in the human body.



In which part of the human body would this type of joint be found?



(A) *A*

(B) *B*

(C) *C*

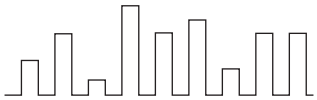
(D) *D*

12 Which of the following represents an AM radio wave?

(A) 

(B) 

(C) 

(D) 

13 Which of the following hypotheses could best be investigated using thermography?

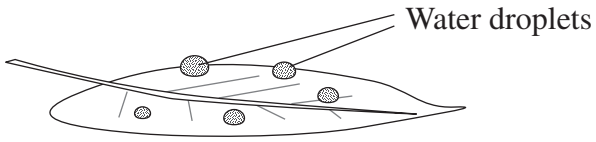
(A) Electrical activity of the brain changes when a person dreams.

(B) Heart rate increases when a person stands up from a sitting position.

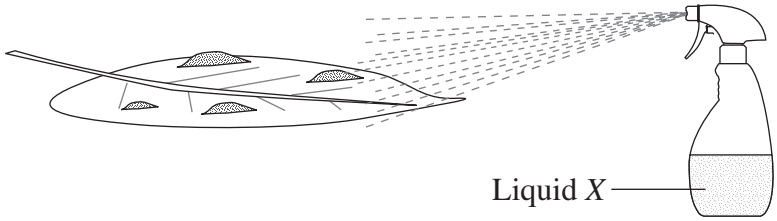
(C) Lycra clothing reduces heat loss from a cyclist travelling at high speed.

(D) Concentration of carbon dioxide in gases exhaled from the lungs increases with exercise.

14 After the garden was watered, droplets of water on the leaves of some plants looked like this.



A liquid *X* was sprayed onto the leaf. The water droplets spread over the leaf.



What is liquid *X*?

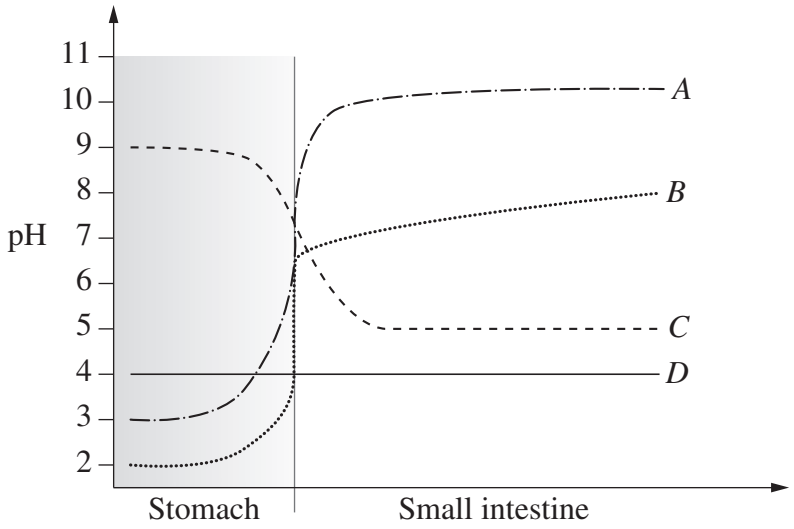
(A) Alcohol

(B) Detergent

(C) Emulsion

(D) Oil

15 Which line on the graph represents the change in pH through the stomach and small intestine?



(A) *A*

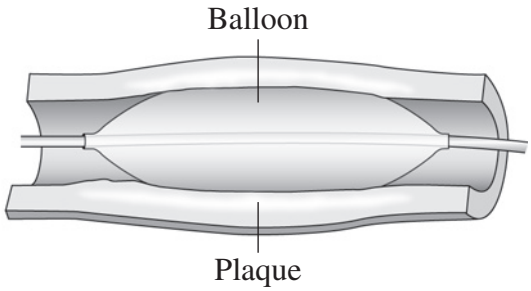
(B) *B*

(C) *C*

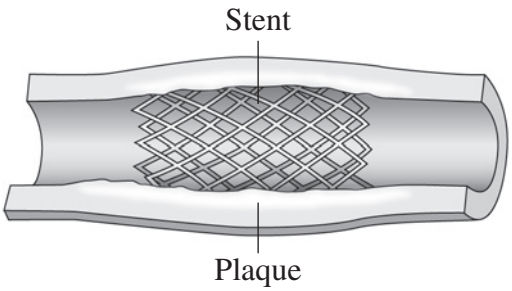
(D) *D*

16 Which of the following diagrams represents the technique of angioplasty?

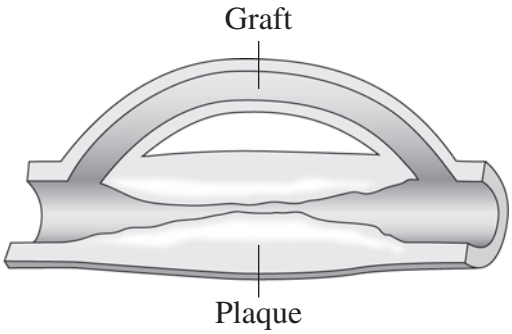
(A)



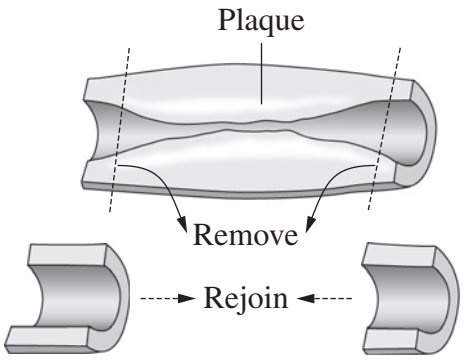
(B)



(C)



(D)



17 It would never be possible for astronauts near Mars to have a conversation in real time with someone on Earth.

What is the reason for this?

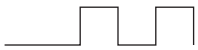
(A) Electromagnetic waves cannot be reflected.

(B) Sound waves cannot travel through a vacuum.

(C) Electromagnetic waves travel at the speed of light.

(D) Microwaves and radio waves travel in straight lines.

18 Most electronic communication produces a digital signal which uses a binary code.

Number (base 10)	***Binary code***	***Digital signal***
0	00000	
1	00001	
2	00010	
3	X	

What is the binary code at X ?

(A) 00011

(B) 00100

(C) 00101

(D) 01010

19 Consider the following data sets.

A

Time spent running (minutes)	*Heart rate upon stopping* (beats per minute)
1	90
2	120
3	130
6	140

B

Type of medication	*Time taken to dissolve* (minutes)
Capsule	10
Tablet	5
Enteric-coated tablet	300
Slow-release tablet	120

C

Product	*pH*
Shampoo	5.5
Soap	7.5
Body wash	6.0
Skin moisturiser	5.0

D

Date in July	*Text messages sent*
1	90
2	5
3	200
6	140

These data sets were graphed on separate graphs.

For which data set would it be most appropriate to draw a line of best fit?

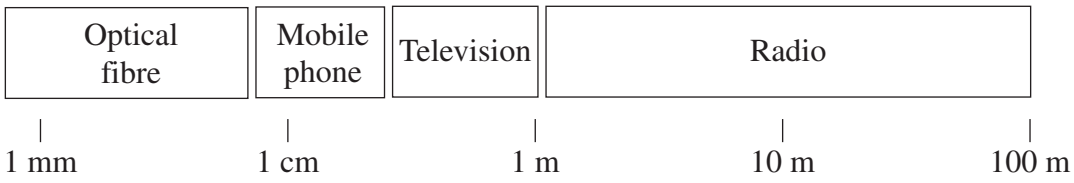
(A) *A*

(B) *B*

(C) *C*

(D) *D*

20 The diagram shows wavelengths of components of the electromagnetic spectrum used for communication.



The frequency of an electromagnetic wave is related to its wavelength by

$$\text{speed} = \underset{(\textit{in hertz})}{\text{frequency}} \times \underset{(\textit{in metres})}{\text{wavelength}}$$

where speed $= 3 \times 10^8$ m s^{-1}

For what purpose would an electromagnetic wave which has a frequency of 1×10^{10} hertz be used?

(A) Optical fibre

(B) Mobile phone

(C) Television

(D) Radio

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Senior Science

Centre Number

Student Number

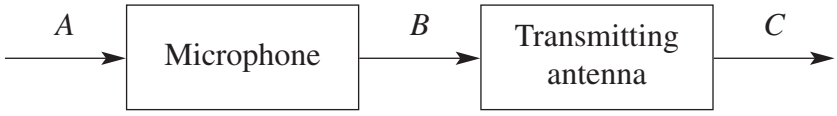
Section I (continued)

Part B – 55 marks
Attempt Questions 21–30
Allow about 1 hour and 40 minutes for this part

Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.

Question 21 (2 marks)

Identify the forms of energy at *A*, *B* and *C* in this section of the radio communication system shown. **2**



A ..... *B* ..... *C* .....

Question 22 (6 marks)

(a) What are the properties of the cement that is used to keep an artificial implant in place in a hip joint? **2**

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(b) How does an uncemented artificial hip implant form a bond with bone? **2**

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(c) What are the roles of synovial fluid in the operation of a hip joint? **2**

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Question 23 (4 marks)

(a) What are the benefits of using optical fibres, rather than copper wires, for communication? **2**

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(b) Using a labelled diagram, illustrate the process of total internal reflection. **2**

Question 24 (7 marks)

A student followed the experimental procedure below.

1. Pour 75 mL of water and 75 mL of cooking oil into a 250 mL conical flask. Insert a stopper. Label it *Flask A*.
2. Into an identical flask pour 5 mL of liquid detergent, 70 mL of water and 75 mL of cooking oil. Insert a stopper. Label it *Flask B*.
3. Shake both flasks vigorously for 1 minute.
4. Allow the flasks to sit undisturbed for 5 minutes.

(a) Describe what would be observed in each flask after Step 4. **2**

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(b) What type of mixture is in each flask? **2**

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(c) Propose possible consequences of detergents being non-biodegradable. **3**

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Question 25 (6 marks)

An event is to be organised in which a live telecast of a rock group performing at a venue in Britain is to be broadcast at a music festival in Australia. Several different communication systems will be necessary to organise and present the event. **6**

Describe the features and roles of THREE different communication systems that would be needed for this event to occur.

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Question 26 (6 marks)

Please turn over

Question 26 (6 marks)

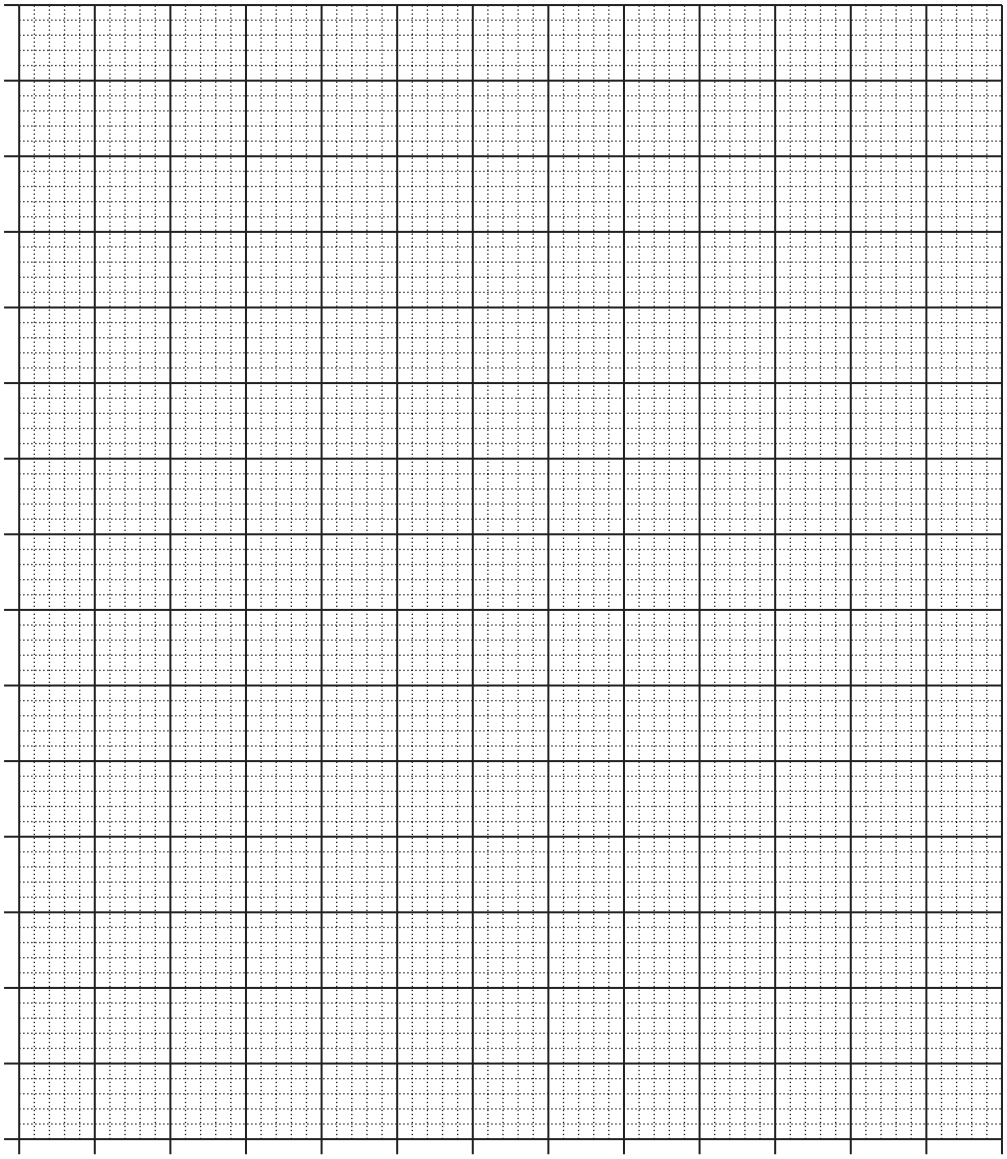
Jo used a heart rate monitor while running at a constant speed on a treadmill. The results from the monitor are shown in the table.

Time (minutes)	*Heart rate* (beats/minute)
0.0	65
0.5	85
1.0	100
1.5	113
2.0	123
2.5	129
3.0	135
4.0	140
5.0	140
6.0	140

Question 26 continues on page 19

Question 26 (continued)

(a) Graph these results. **3**



(b) Account for the shape of the graph. **3**

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End of Question 26

Question 27 (6 marks)

Explain the benefits of a range of minimally invasive medical techniques and non-invasive medical techniques. Include examples in your answer. **6**

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Centre Number

Student Number

Section I – Part B (continued)

Question 28 (3 marks)

What are advantages of using multiple communication systems to inform people about emergencies? Include examples of these communication systems in your answer. **3**

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Question 29 (7 marks)

(a) Draw a flow chart to summarise the digestion of food through the digestive system. Use the following list of words to construct the flow chart. **4**

- Oesophagus
- Enzymes
- Acid
- Small intestine
- Peristalsis
- Mechanical breakdown
- Alkali
- Stomach
- Mouth

(b) Explain the purpose of the enteric coating used on some tablets. **3**

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Question 30 (8 marks)

Increases in scientific understanding have broadened options for maintaining life. **8**

Discuss this statement with reference to life support systems and the release of medications in the body.

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Senior Science

Section II

25 marks
Attempt ONE question from Questions 31–35
Allow about 45 minutes for this section

Answer parts (a)–(c) of the question in Section II Answer Booklet 1.
Answer parts (d)–(e) of the question in Section II Answer Booklet 2.
Extra writing booklets are available.

Question 31 — Polymers (25 marks)

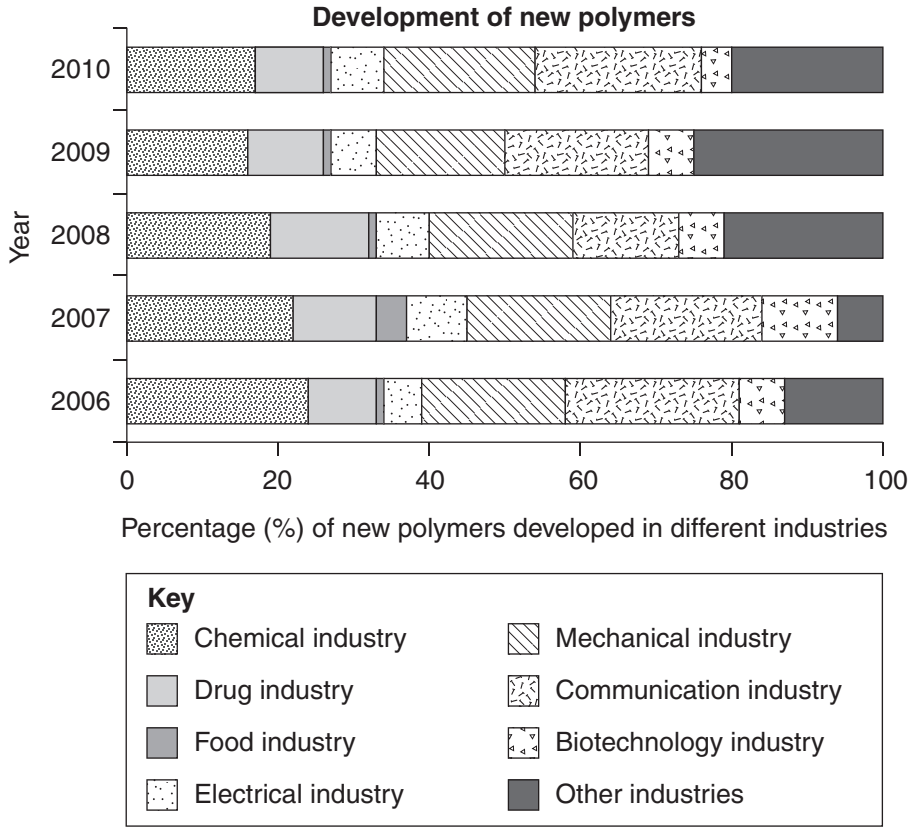
Answer parts (a)–(c) in Section II Answer Booklet 1.

(a) (i) Name ONE natural polymer. **1**

(ii) What are the benefits of using polystyrene as a packaging material? **2**

(iii) Outline the effect of heat on both thermosetting polymers and thermoplastic polymers. **2**

(b) The graph shows the different industries for which new polymers have been developed. **4**



The data in this graph could have been represented in a number of ways, such as a line graph, sector or pie graph or column graph.

What are the benefits and problems of using the type of graph shown to display data about the development of new polymers?

(c) Evaluate the need for biodegradable plastics. **4**

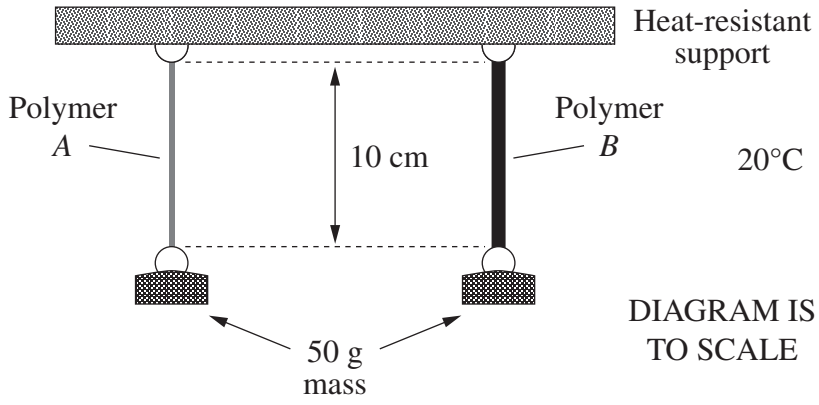
Question 31 continues on page 27

Question 31 (continued)

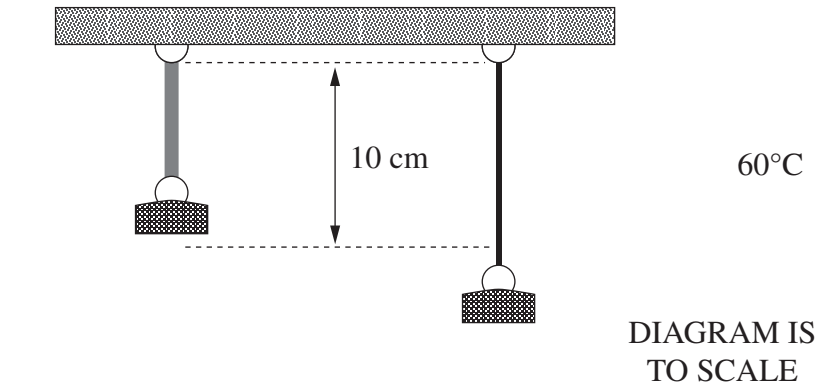
Answer parts (d)–(e) in Section II Answer Booklet 2.

(d) A poorly-designed investigation was carried out to determine the effect of temperature on the length of two different polymer fibres. **5**

Step A The apparatus was set up using 10 cm lengths of polymers *A* and *B*. It was in a temperature-controlled environment at 20°C.



Step B The apparatus was then placed in a temperature-controlled environment at 60°C and the following result was observed.



Analyse the validity of this investigation. In your answer, refer to the THREE different types of variables, including independent and dependent variables.

(e) Assess the impact on society of using natural and synthetic polymers. Include examples of both types of polymers. **7**

End of Question 31

Question 32 — Preservatives and Additives (25 marks)

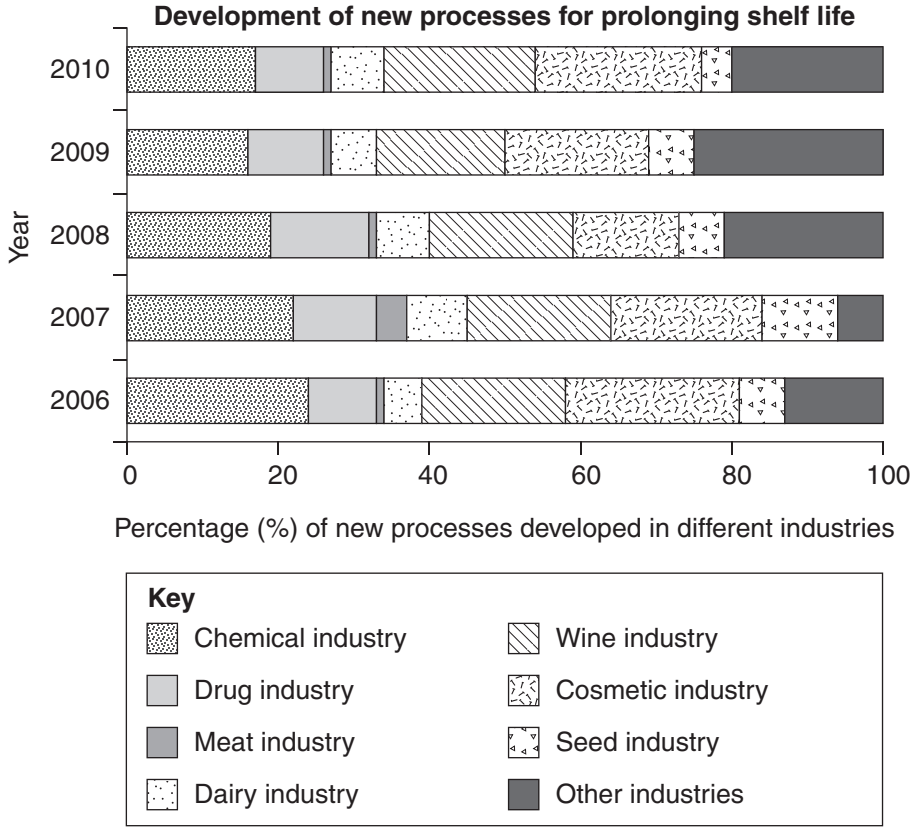
Answer parts (a)–(c) in Section II Answer Booklet 1.

(a) (i) Name ONE microbe that causes food spoilage. **1**

(ii) What are the effects of temperature on microbes that cause food poisoning? **2**

(iii) Outline procedures that are used to treat food poisoning. **2**

(b) The graph shows the different industries for which new processes have been developed for prolonging shelf life. **4**



The data in this graph could have been represented in a number of ways, such as a line graph, sector or pie graph or column graph.

What are the benefits and problems of using the type of graph shown to display data about these new processes?

(c) Evaluate the need for labelling food products to show which additives and preservatives are present. **4**

Question 32 continues on page 29

Question 32 (continued)

Answer parts (d)–(e) in Section II Answer Booklet 2.

(d) A poorly-designed investigation was carried out to determine the effects that the use of two different anticaking agents have on table salt. **5**

Step A

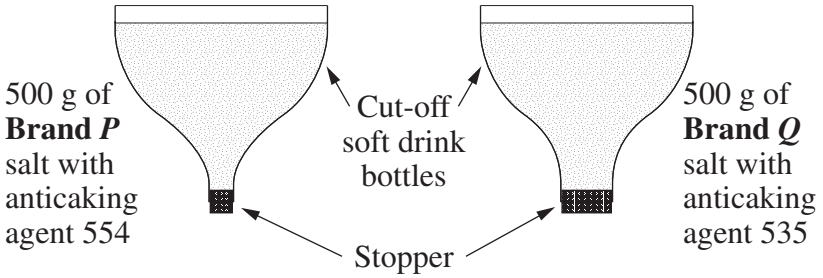


DIAGRAM IS
TO SCALE

Step B The stoppers were removed and the time taken for each container to empty was measured and recorded.

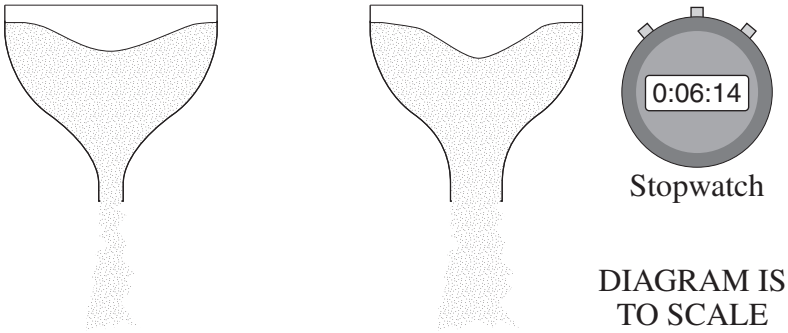


DIAGRAM IS
TO SCALE

Analyse the validity of this investigation. In your answer, refer to the THREE different types of variables, including independent and dependent variables.

(e) Assess the impact on society of using physical and chemical methods of food preservation. Include examples of both methods of food preservation. **7**

End of Question 32

Question 33 — Pharmaceuticals (25 marks)

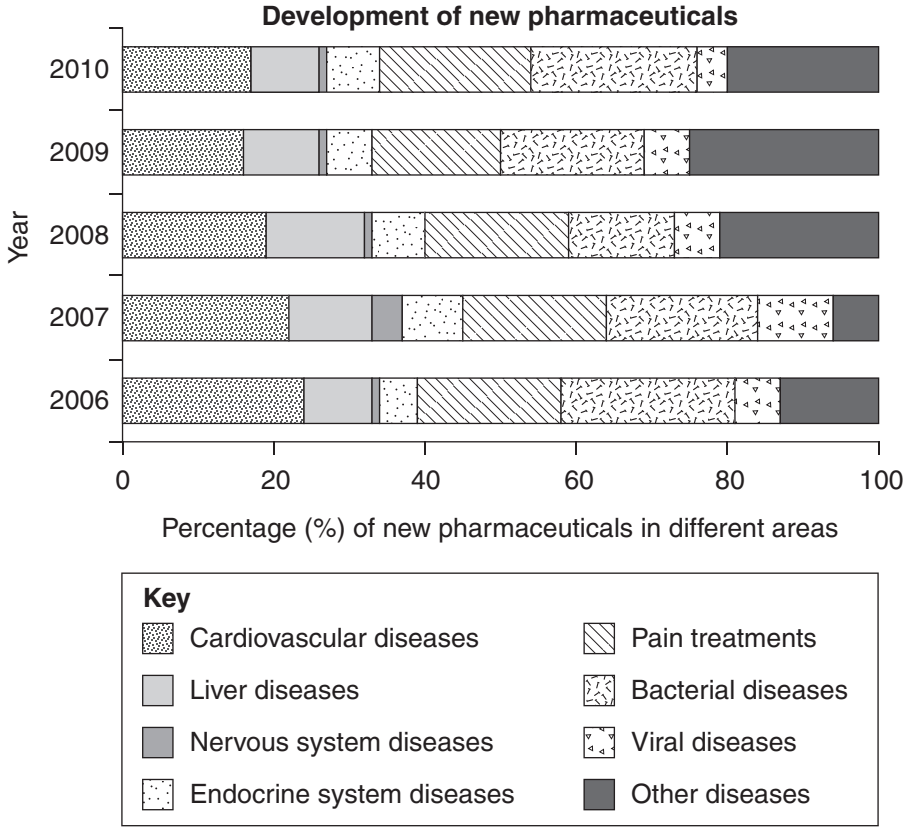
Answer parts (a)–(c) in Section II Answer Booklet 1.

(a) (i) Name ONE sense organ. **1**

(ii) What is the difference between the responses of muscles and glands as effectors? **2**

(iii) Outline the sequence of events involved in a reflex arc. **2**

(b) The graph shows the different areas for which new pharmaceuticals have been developed. **4**



The data in this graph could have been represented in a number of ways, such as a line graph, sector or pie graph or column graph.

What are the benefits and problems of using the type of graph shown to display data about new pharmaceuticals?

(c) Evaluate the importance of EITHER Louis Pasteur OR Robert Koch to our knowledge of bacteria. **4**

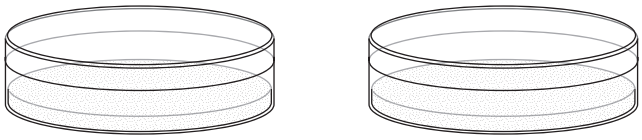
Question 33 continues on page 31

Question 33 (continued)

Answer parts (d)–(e) in Section II Answer Booklet 2.

(d) A poorly-designed investigation was carried out to determine the relationship between temperature and the rate of reproduction of a specific bacterium. **5**

Step A Identical sterile nutrient agar plates were exposed to the air for 15 minutes then sealed and placed in different stable-temperature environments.

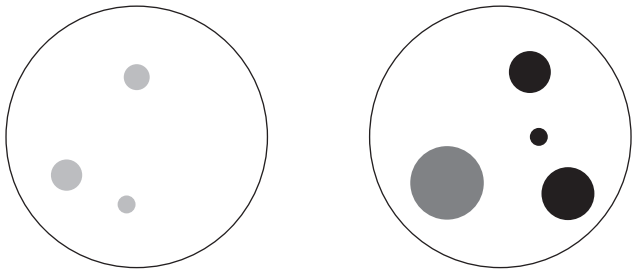


10°C 30°C

DIAGRAM IS TO SCALE

Step B The plates were examined after one week and the results were recorded as follows.

The colonies of different types of bacteria are indicated by different shades of grey.



10°C 30°C

DIAGRAM IS TO SCALE

Analyse the validity of this investigation. In your answer, refer to the THREE different types of variables, including independent and dependent variables.

(e) Assess the impact on society of using analgesics and antibiotics to treat disease. Include examples in your answer. **7**

End of Question 33

Question 34 — Disasters (25 marks)

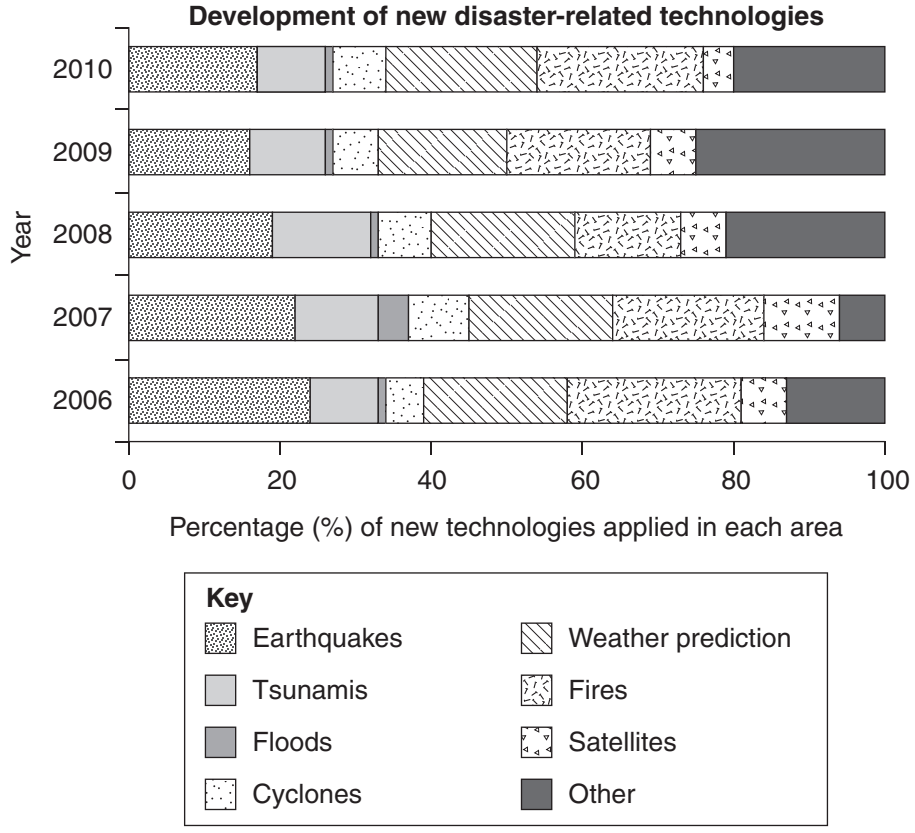
Answer parts (a)–(c) in Section II Answer Booklet 1.

(a) (i) Name ONE specific natural disaster. **1**

(ii) Why do insurance companies use specific definitions and terminology in insurance contracts? **2**

(iii) Outline the effect of the slope of the land on the speed at which a bushfire spreads. **2**

(b) The graph shows the different areas for which new technologies have been developed to help predict or reduce the effects of disasters. **4**



The data in this graph could have been represented in a number of ways, such as a line graph, sector or pie graph or column graph.

What are the benefits and problems of using the type of graph shown to display data about new disaster-related technologies?

(c) Evaluate the importance of satellite photographs in the interpretation of weather patterns. **4**

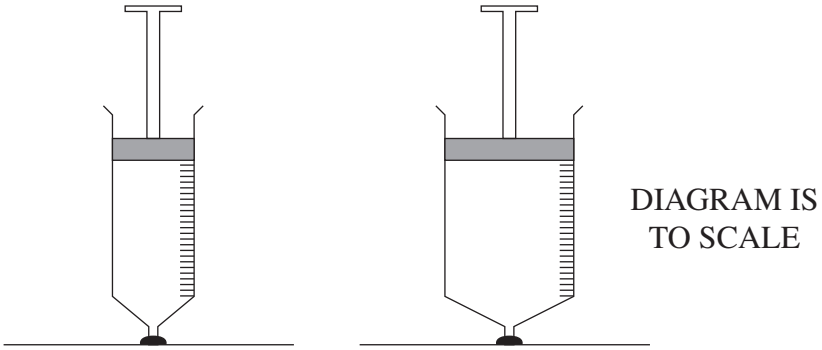
Question 34 continues on page 33

Question 34 (continued)

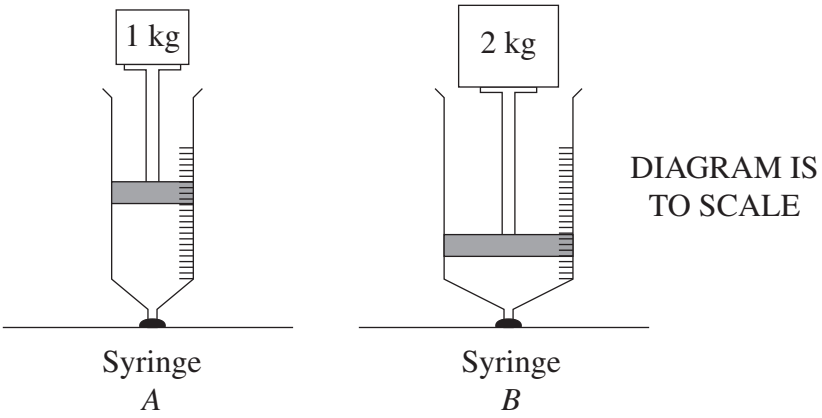
Answer parts (d)–(e) in Section II Answer Booklet 2.

(d) A poorly-designed investigation was carried out to determine the effect of changing pressure on the volume of a gas. **5**

Step A Plungers were inserted into two different syringes and the ends were sealed as shown in the diagram. The volume of gas in the syringe was recorded using scales on the syringes.



Step B Masses were placed on the syringe plungers as shown and the resulting volumes of gases trapped in the syringes were recorded.



Analyse the validity of this investigation. In your answer, refer to the THREE different types of variables, including independent and dependent variables.

(e) Assess the impact on society of using warning devices and emergency services to minimise the effects of fires. Include examples in your answer. **7**

End of Question 34

Question 35 — Space Science (25 marks)

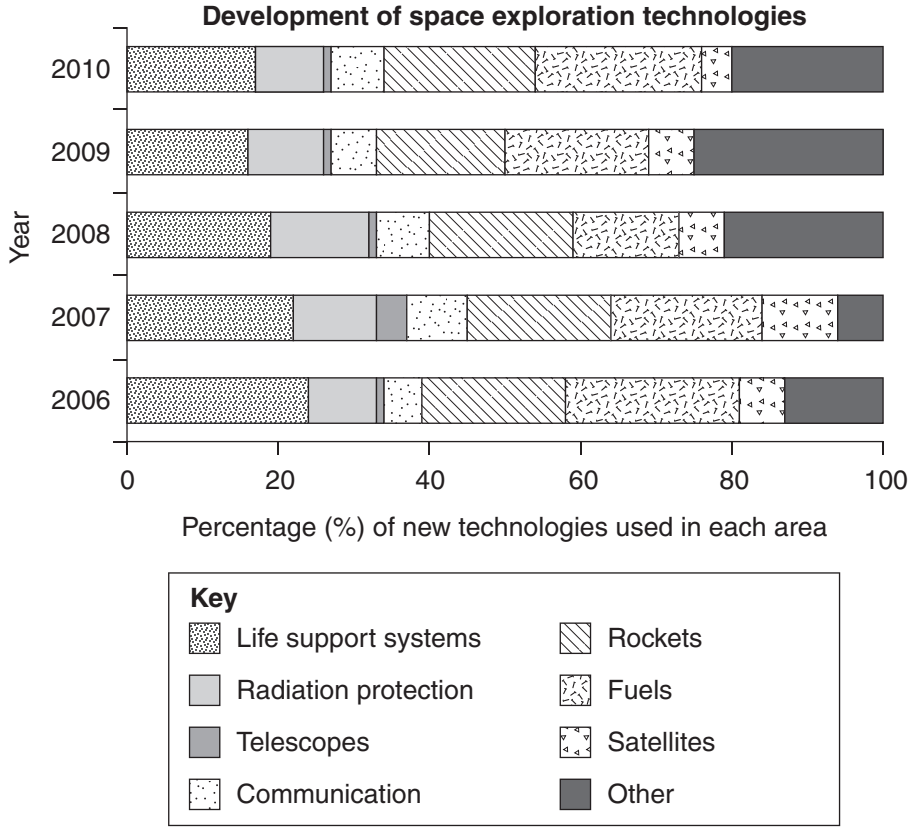
Answer parts (a)–(c) in Section II Answer Booklet 1.

(a) (i) Name ONE human circadian rhythm. **1**

(ii) What are possible effects on an astronaut whose circadian rhythms are disrupted? **2**

(iii) Outline what an astronaut can do to maintain normal circadian rhythms during space travel. **2**

(b) The graph shows areas for which new technologies have been developed for space exploration. **4**



The data in this graph could have been represented in a number of ways, such as a line graph, sector or pie graph or column graph.

What are the benefits and problems of using the type of graph shown to display data about new space exploration technologies?

(c) Evaluate the importance of exercising all the major muscle groups of the body while in space. **4**

Question 35 continues on page 35

Answer parts (d)–(e) in Section II Answer Booklet 2.

(d) A poorly-designed investigation was carried out to compare the performance of two different cameras when they were used to photograph stars. Performance is determined by the number of stars visible in the photograph. **5**

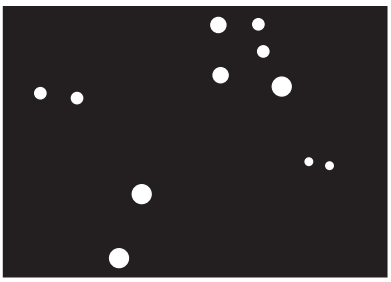
Step A A photograph of a part of the night sky was taken using Camera *A* with a 10-second exposure.

Camera *A*

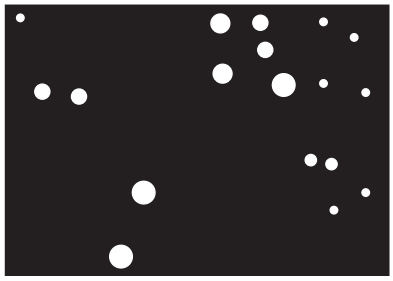
Original photo

Step B The same part of the sky was photographed using Camera *B*. Two photos were taken using exposures of 20 seconds and 30 seconds respectively.

Camera *B*



20 seconds



30 seconds

Analyse the validity of this investigation. In your answer, refer to the THREE different types of variables, including independent and dependent variables.

(e) Assess the impact on society of using technologies that have been developed for space exploration. Include examples in your answer. **7**

End of paper

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