BOSTES BOARD OF STUDIES TEACHING & EDUCATIONAL STANDARDS NSW

2016 HIGHER SCHOOL CERTIFICATE EXAMINATION

Senior Science

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black pen
- Draw diagrams using pencil
- Board-approved calculators may be used

Total marks – 100

Section I Pages 2–24

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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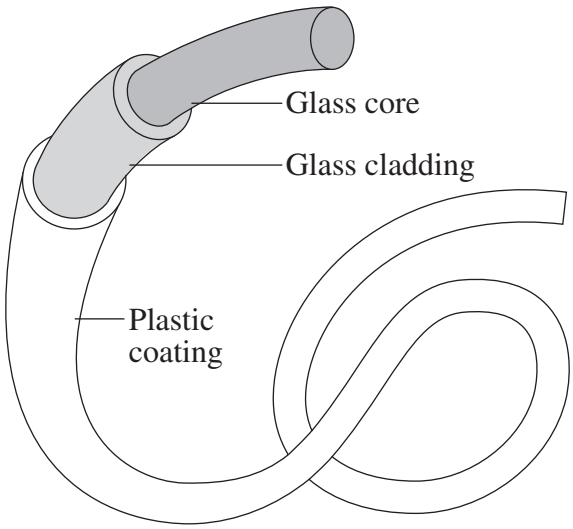
1 The diagram shows part of a communication system.



What form of energy is used to transmit data through this part of the communication system?

(A) Electrical

(B) Light

(C) Microwave

(D) Sound

2 Which statement is true about ALL mixtures?

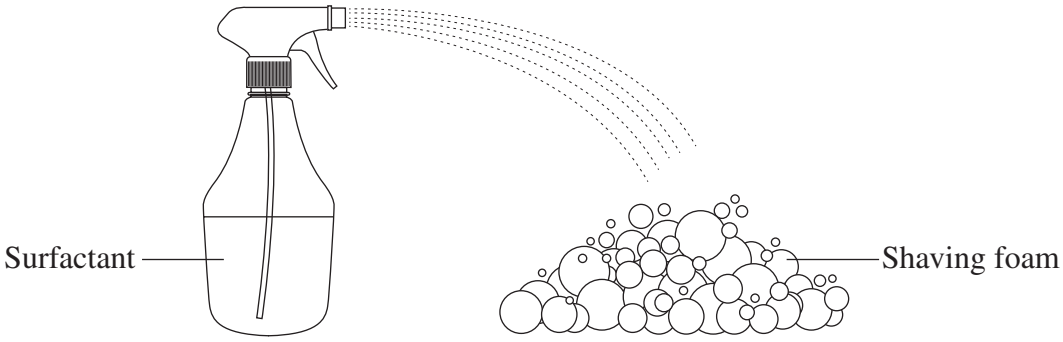
(A) They are uniform throughout.

(B) They contain dissolved substances.

(C) They contain particles in suspension.

(D) They consist of at least two substances.

3 A surfactant was sprayed over shaving foam.



What effect will the surfactant have on the foam?

(A) The foam will last longer.

(B) The foam will form a colloid.

(C) The foam will collapse quickly.

(D) The foam will have increased surface tension.

4 Which of the following is a minimally invasive medical procedure?

(A) Thermography

(B) Keyhole surgery

(C) Ultrasound imaging

(D) Magnetic resonance imaging

5 Food passes through several major organs in the human digestive system.

Which list shows the correct sequence for three of these organs?

(A) Oesophagus, large intestine, stomach

(B) Oesophagus, large intestine, small intestine

(C) Stomach, oesophagus, small intestine

(D) Stomach, small intestine, large intestine

6 When food is cooked in water or oil, certain vitamins can be dissolved.

Which statement is correct?

(A) Cooking in oil dissolves vitamin A.

(B) Cooking in oil dissolves vitamin C.

(C) Cooking in water dissolves vitamin D.

(D) Cooking in water dissolves vitamin K.

7 Which row in the table correctly matches a structure of the respiratory system with one of its functions?

	Structure	*Function*
(A)	Alveolus	Traps dust and microbes
(B)	Bronchus	Forces air into lungs
(C)	Capillary	Allows the exchange of gases
(D)	Trachea	Prevents food from passing into the lungs

8 A patient was suffering from poor blood flow resulting from a build-up of plaque in the blood vessels.

What procedure could be used to improve the blood flow?

(A) Angiogram

(B) Angioplasty

(C) Insertion of a prosthesis

(D) Insertion of a pacemaker

9 What is the purpose of subdermal implants?

(A) To apply medication to the surface of the skin

(B) To minimise the side effects of the active ingredient

(C) To release medication as quickly as possible into the bloodstream

(D) To release medication into the body over a prolonged period of time

10 A teacher is holding a smartphone found in a classroom and is discussing with the principal the return of the phone to its owner (Figure 1). The screen of the smartphone shows messages sent between two students (Figure 2).

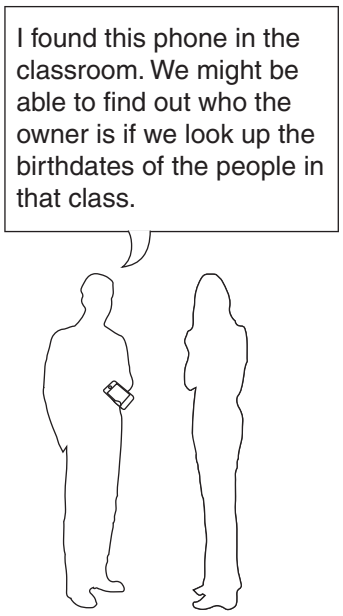


Figure 1

Figure 2

Which row in the table correctly classifies the types of information in this diagram?

		I found this phone in the classroom. We might be able to find out who the owner is if we look up the birthdates of the people in that class.	What star sign are you?
(A)	Non-verbal	Verbal	Non-verbal
(B)	Verbal	Non-verbal	Verbal
(C)	Non-verbal	Verbal	Verbal
(D)	Verbal	Non-verbal	Non-verbal

11 Why is silicone a suitable material for use in artificial finger joints?

(A) It is rigid and lasts a long time.

(B) It is easy to mould and maintains its shape.

(C) It has high strength and is able to be mass produced.

(D) It reacts with living tissue and stimulates growth of cartilage.

12 What is an advantage of using electromagnetic waves instead of using electric current in copper wires for communication?

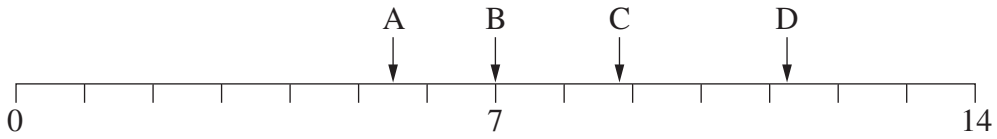
(A) Electromagnetic waves do not require a physical link.

(B) Electromagnetic waves can be encoded with digital information.

(C) Electromagnetic waves are not stopped by any kind of physical barrier.

(D) Electromagnetic waves do not require a source of energy for their production.

13 A student carried out tests to find the pH of a range of skin and hair products, A, B, C and D. The results are shown on the pH scale.



Which product is closest to the natural pH of human skin?

(A) A

(B) B

(C) C

(D) D

14 Two astronauts, working five metres apart, are carrying out maintenance on the outside of the International Space Station.

What type of wave would be the most suitable for communication with each other over this distance?

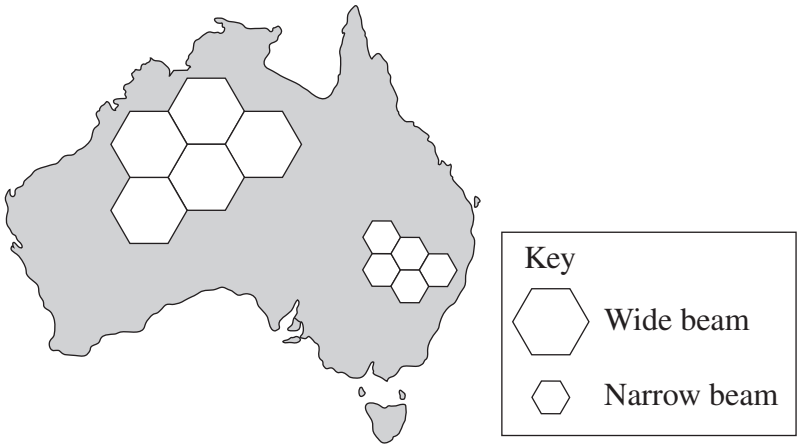
(A) Infrared

(B) Radio

(C) Sound

(D) Ultrasound

15 The diagram shows some areas covered by transmissions from Australia's communications satellite, Sky Muster.



Some areas are covered by a narrow beam that allows more data to be transmitted and other areas are covered by a wide beam that has less data capacity.

How does Sky Muster transmit different amounts of data to different locations?

(A) It uses different aerials.

(B) It changes orbits to cover different areas.

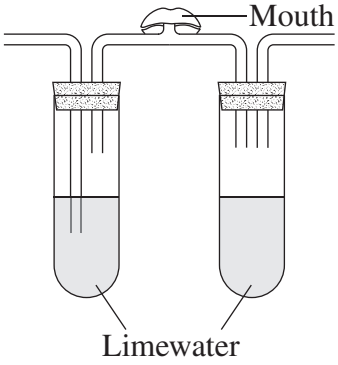
(C) It uses both radio waves and microwaves.

(D) It uses control motors that allow it to be pointed in different directions.

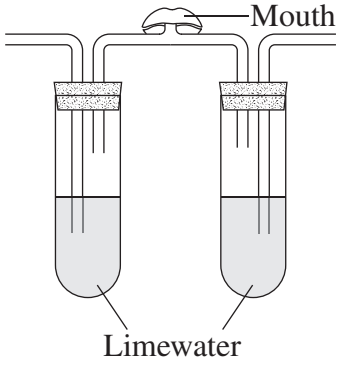
16 Limewater is a clear solution. It goes milky when carbon dioxide is bubbled through it. The greater the concentration of carbon dioxide, the more milky its appearance. In this experiment inhalation and exhalation only occur through the tube in the person's mouth.

Which arrangement could be used to demonstrate that there is more carbon dioxide in exhaled air than in inhaled air?

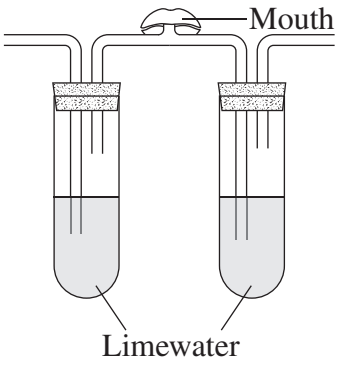
(A)



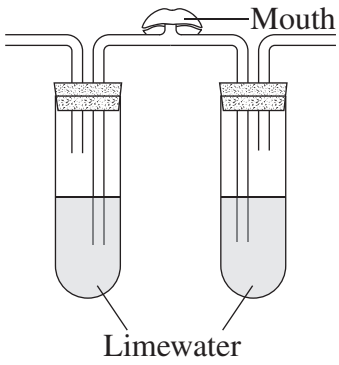
(B)



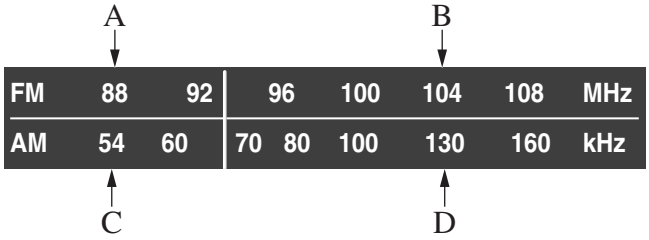
(C)



(D)



17 Four stations are labelled on the tuning indicator dial of an AM/FM radio.



Which arrow indicates the station transmitting with the longest wavelength?

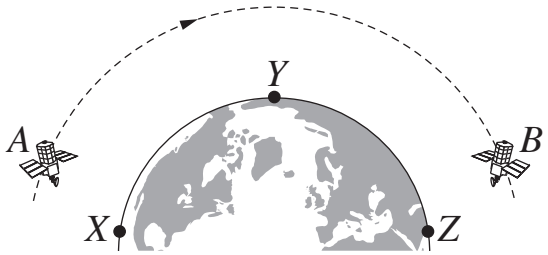
(A) A

(B) B

(C) C

(D) D

18 Two geostationary satellites, *A* and *B*, are orbiting the Earth. Three microwave communication stations *X*, *Y* and *Z* are located on Earth as shown. It takes approximately 130 milliseconds for a microwave signal to travel one way between an Earth station and a geostationary satellite. The time taken for a signal to travel directly between any two stations on Earth may be considered to be zero, since these distances are small compared to the satellite distances.



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What is the shortest time, in milliseconds, for a signal to travel from *X* to *Z* using the least number of Earth-based stations and geostationary satellites necessary for this communication?

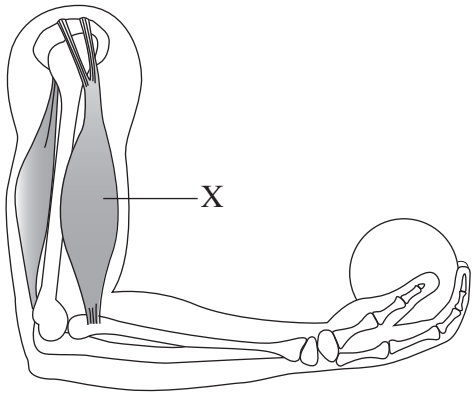
(A) 0

(B) 130

(C) 260

(D) 520

19 Consider the behaviour of the muscle X in the arm as the weight is being lifted.



What would the heart be doing if the muscles in the wall of the right atrium were behaving in the same way as muscle X?

(A) Filling the atrium with blood

(B) Pushing blood into the lungs

(C) Pumping blood to the brain from the atrium

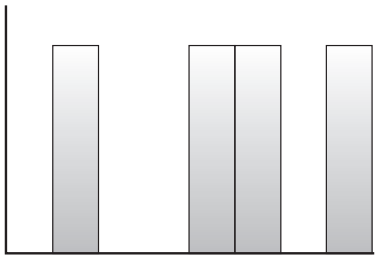
(D) Opening the valve between the atrium and the ventricle

20 The table shows how some decimal numbers are represented using binary numbers.

Decimal number	1	2	3	4	…	8	9	10	11	12	13
Binary number	0001	0010	0011	0100	…	1000	1001	1010	1011	1100	1101

The binary code for the letter ‘A’ is 01000001 and the code for ‘C’ is 01000011.

What letter is represented by the following digital signal?



(A) D

(B) E

(C) M

(D) N

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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.

Extra writing space is provided on pages 23 and 24. If you use this space, clearly indicate which question you are answering.

Write your Centre Number and Student Number at the top of this page.

Please turn over

Question 21 (5 marks)

(a) Draw labelled diagrams to distinguish between a suspension and a colloid. **3**

Suspension	Colloid

(b) Identify a different example for each type of emulsion. **2**

Oil-in-water .....

Water-in-oil .....

Question 22 (3 marks)

Explain how cardiopulmonary resuscitation (CPR) maintains the flow of blood to the lungs and to other parts of the body of a person whose heart is not beating. **3**

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Question 23 (4 marks)

Explain how TWO advantages of using optical fibres in communication systems benefit society. **4**

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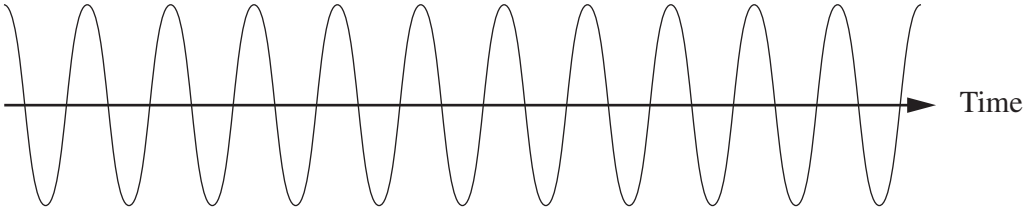
Question 24 (6 marks)

(a) This diagram shows an electromagnetic wave carrying no information. **2**



Draw a diagram on the time axis below to show how this wave would be different if it were carrying information about a sound, using amplitude modulation (AM).

(b) Describe how amplitude modulation of a radio wave can be used to carry information about both the loudness and the pitch of a sound. In your answer you MAY refer to the diagram you drew in part (a). **2**

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(c) What are TWO advantages of using frequency modulation (FM), as opposed to amplitude modulation, to communicate information? **2**

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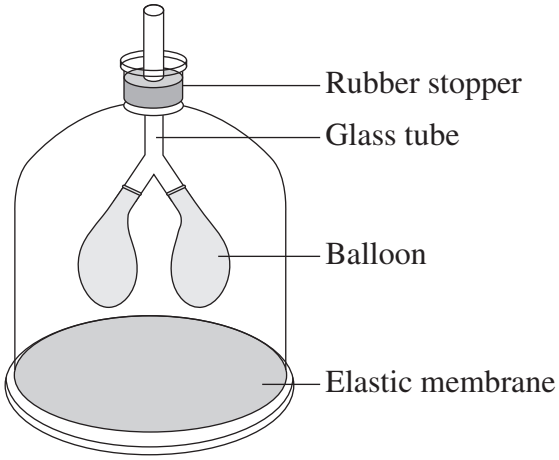
Question 25 (5 marks)

The diagram represents a model of part of the human respiratory system.



(a) How could this model be used to demonstrate the action of the diaphragm in inhalation and exhalation? **3**

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(b) Describe a limitation of this model, when applying it to the process of breathing. **2**

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Question 26 (4 marks)

What similarities and differences are there between the energy transformations that occur during a conversation using mobile phones and a conversation using land-connected telephones? **4**

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Question 27 (8 marks)

(a) Name an everyday chemical product and explain a precaution that may be needed in the use and handling of this product. **2**

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(b) Analyse the effects that THREE different types of everyday products may have on the roles of the skin. **6**

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Question 28 (6 marks)

Relate the uses of UHMWPE and superalloy to the properties of each. **6**

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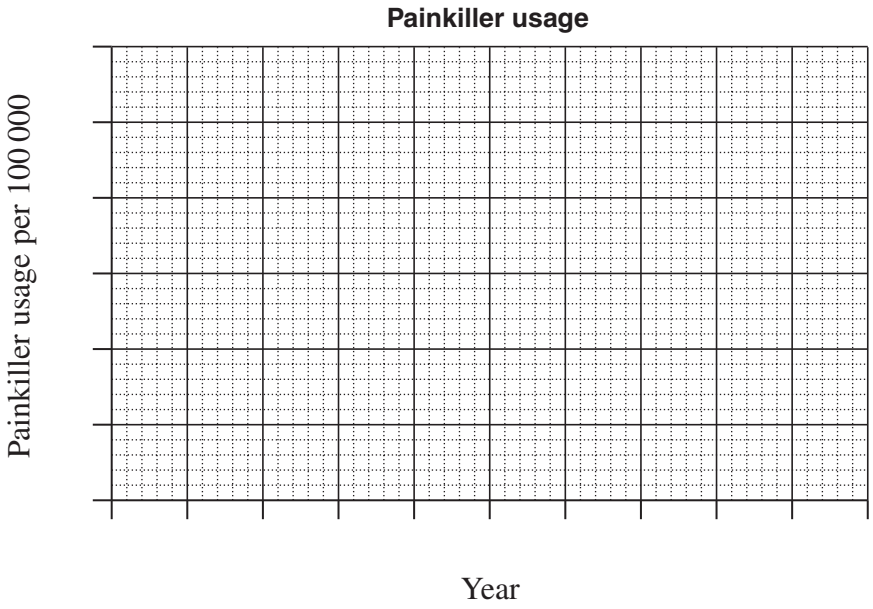
Question 29 (6 marks)

The table shows the proportion of males and females in Australia who have used a particular painkiller.

Year	*Males* (per 100 000)	*Females* (per 100 000)
1995	960	500
2000	840	450
2005	750	530
2010	560	500

(a) Use the data in the table to construct an appropriate graph. **4**



(b) Outline the trends for both males and females over the time shown. **2**

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Question 30 (8 marks)

Analyse the effects that advances in scientific understanding and technology have on the long-term health of humans. **8**

In your answer, include an example from each of the modules:

- Lifestyle Chemistry
- Medical Technology – Bionics
- Information Systems.

Section I Part B extra writing space

If you use this space, clearly indicate which question you are answering.

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Section I Part B extra writing space

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Office Use Only – Do NOT write anything, or make any marks below this line.

Senior Science

Section II

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

Answer parts (a)–(e) of one question in the Section II Writing Booklet. Extra writing booklets are available.

Question 31 — Polymers (25 marks)

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a) (i) Silk is an example of which type of polymer? **1**

(ii) What are the features of a polymer molecule? **2**

(b) (i) Two different polymers were tested and the results have been tabulated below.

	Polymer A	*Polymer B*
Flammability	Low	Medium
Shrinkage	Medium	Medium
Moisture absorbency	Low	High

Justify the use of Polymer A rather than Polymer B as a material for a firefighter's uniform. **2**

(ii) Outline the procedures you would follow to make a natural polymer and a synthetic polymer such as playdough and slime. **4**

(c) Explain the impact that the availability of fossil fuels will have on the future production of polymers. **4**

Question 31 continues on page 27

Question 31 (continued)

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

(d) (i) List the steps in the procedure you would follow to determine the amount of plastic material that is thrown out per day in your school or your home. **3**

(ii) Explain a safe work practice that you would use during this investigation. **2**

(e) Assess the versatility of both the thermoset plastics and thermoplastics and their impact on society. **7**

End of Question 31

Question 32 — Preservatives and Additives (25 marks)

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a) (i) Nisin is a chemical produced by a type of bacterium. It is a preservative added to cheese products to prevent spoilage caused by other microorganisms. **1**

What is the name of the group of chemicals to which nisin belongs?

(ii) To what types of foods are nitrites typically added and why are they added? **2**

(b) (i) Consider the following information from a food package. **2**

INGREDIENTS
Whole milk (40%), concentrated skim milk, sugar, strawberries (9%), gelatine, culture, thickener (1442).

Outline the type of information that this label tells the consumer.

(ii) The following is from the manufacturer's label on a food product. **4**

Contains only natural plant-derived materials
FREE FROM
Harmful substances
Artificial chemicals
and
over 400 potentially harmful ingredients

Assess the usefulness of the information on this label to the consumer.

(c) Substances added to food products may have effects other than their original purpose. **4**

Discuss this statement with reference to specific additives.

Question 32 continues on page 29

Question 32 (continued)

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

(d) (i) List the steps in the procedure you would follow to culture bacteria and measure their growth at temperatures of 10°C, 20°C, 30°C and 40°C over a five-day period. **3**

(ii) Explain a safe work practice you would use during this investigation. **2**

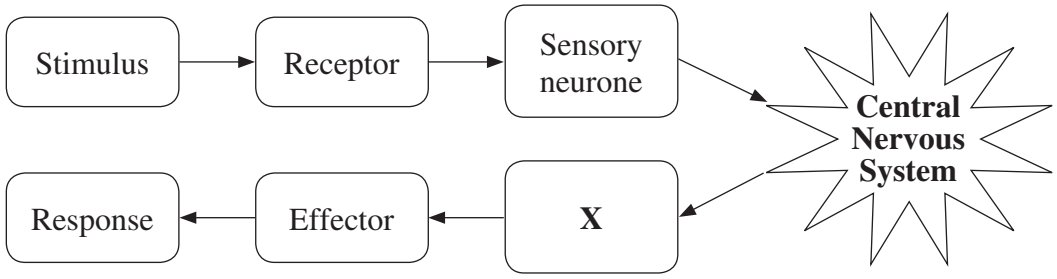
(e) Analyse the relationship between physical methods of food preservation and the conditions under which many microorganisms grow. **7**

End of Question 32

Question 33 — Pharmaceuticals (25 marks)

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a)

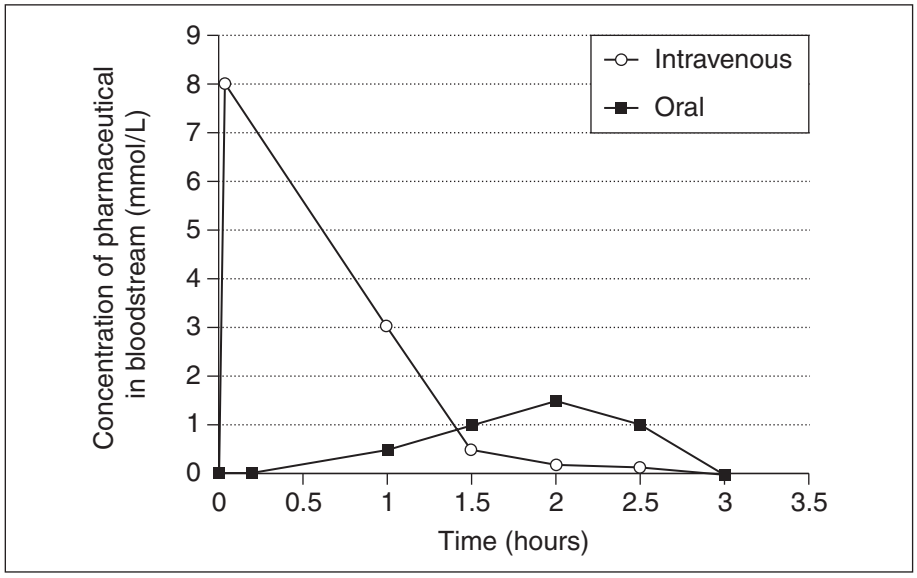


(i) Identify the type of neurone at **X** in a typical reflex arc. **1**

(ii) Outline the relationship between the synapse and the continuation of a message. **2**

(b) (i) Draw a labelled diagram to distinguish between an artery and a capillary. **2**

(ii) Pharmaceuticals can be introduced into the bloodstream either by swallowing (orally) or by direct injection (intravenously). **4**



Use the graph to assess the effectiveness of the two methods shown.

(c) Describe the series of physiological responses that occurs in the body as part of the inflammation response. **4**

Question 33 continues on page 31

Question 33 (continued)

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

(d) (i) List the steps in the procedure you would follow to culture bacteria and measure their growth at temperatures of 10°C, 20°C, 30°C and 40°C over a five-day period. **3**

(ii) Explain a safe work practice you would use during this investigation. **2**

(e) Analyse the link between the historical development in our understanding of the causes of disease and the development of pharmaceutical substances. **7**

In your answer, refer to the contributions of two of the following: Lister, Pasteur and Koch.

End of Question 33

Question 34 — Disasters (25 marks)

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a) (i) Identify one specific Australian disaster that was the result of both human activity and natural processes. **1**

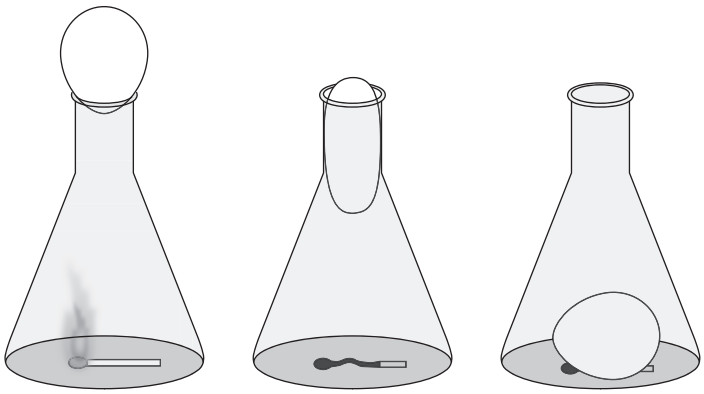
(ii) What could be done to reduce the damage if a similar event were to occur in the future? **2**

(b) Students performed the following experiment to demonstrate the effect of differences in air pressure.

Method

1. Put the empty flask on a table.
2. Peel the boiled egg.
3. Light a match and drop it into the flask.
4. Quickly put the egg over the mouth of the flask.

The result can be seen in the diagrams.



(i) Explain why the egg enters the flask. **2**

(ii) Describe how a tropical cyclone forms. In your answer, refer to the principle demonstrated in the experiment in part (b) (i). **4**

(c) Explain what steps a person should take if caught in a bushfire. **4**

Question 34 continues on page 33

Question 34 (continued)

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

(d) (i) Outline the steps involved in the operation of a sprinkler system as a protection device inside a building. **3**

(ii) Why are evacuation drill procedures necessary in the workplace? **2**

(e) Analyse the roles that police, ambulance and the State Emergency Service play in the minimisation of the effects of disasters. **7**

End of Question 34

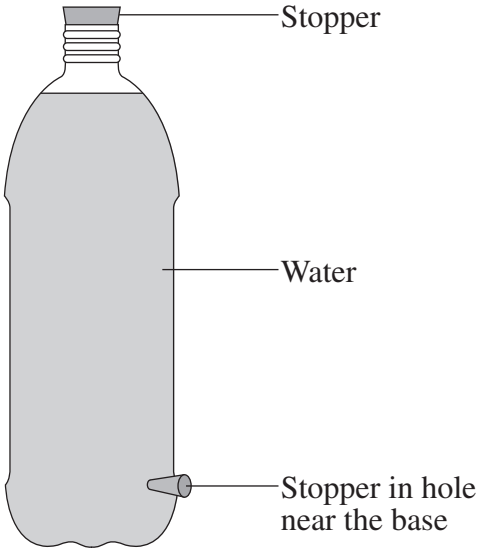
Question 35 — Space Science (25 marks)

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a) (i) Identify a component of the Space Transportation System (shuttle). **1**

(ii) Outline an example of Australia's involvement in space exploration. **2**

(b) Astronauts in the International Space Station removed both stoppers from a bottle to demonstrate a scientific principle. When they did this no water came out.



(i) Explain a situation on Earth in which the water in the bottle would behave in the same way when the stoppers were removed. **2**

(ii) How does the relationship between mass and gravitational pull relate to the revolution of the planets around the Sun? **4**

(c) Explain the nature of Earth's atmosphere. **4**

Question 35 continues on page 35

Question 35 (continued)

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

(d) (i) Compare and contrast the types of information gathered by the Hubble Telescope and the Voyager missions. **3**

(ii) Explain an advantage of the Hubble Telescope over Earth-based telescopes of the same type. **2**

(e) Analyse why humans' long-term survival in space depends both on understanding how the human body works and on the development of new technologies. **7**

End of paper

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