

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
- Write your Centre Number and Student Number at the top of pages 9, 11, 13, 17, 19 and 21

Total marks – 100

Section I Pages 2–22

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 21–31
- Allow about 1 hour and 40 minutes for this part

Section II Pages 23–28

25 marks

- Attempt ONE question from Questions 32–36
- Allow about 45 minutes for this section

Section I

75 marks

Part A – 20 marks


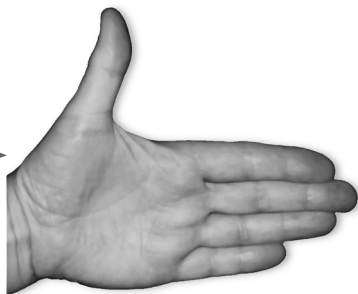

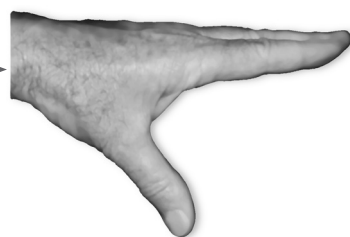
Attempt Questions 1–20

Allow about 35 minutes for this part

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

- 1 Which of the following causes rhythmic contractions of cardiac muscles?
- (A) The hormone called adrenalin
 - (B) Carbon dioxide levels in the blood
 - (C) Nerve impulses from the spinal cord
 - (D) Electrical impulses produced by special tissue within the heart
- 2 Images can be sent digitally using
- (A) letters.
 - (B) zeros and ones.
 - (C) analogue signals.
 - (D) modulated waves.
- 3 What is the function of an artificial lung?
- (A) To oxygenate blood and remove carbon dioxide
 - (B) To take over the function of the diaphragm if it fails
 - (C) To force air in and out of the lungs during heart surgery
 - (D) To maintain breathing after cardiopulmonary resuscitation
- 4 Which statement about mixtures is correct?
- (A) All colloids are foams.
 - (B) All solutions are colloids.
 - (C) All emulsions are colloids.
 - (D) All suspensions are solutions.

5 Two movements are shown in these photographs.

| <i>Movement</i> | <i>Starting position</i> | <i>Finishing position</i> |
|-----------------|---|--|
| 1 |  |  |
| 2 |  |  |

Which type of joint allows these movements to occur?

- (A) Pivot
- (B) Sliding
- (C) Double hinge
- (D) Ball and socket

6 The main ingredients of a perfume are listed by the manufacturer as:

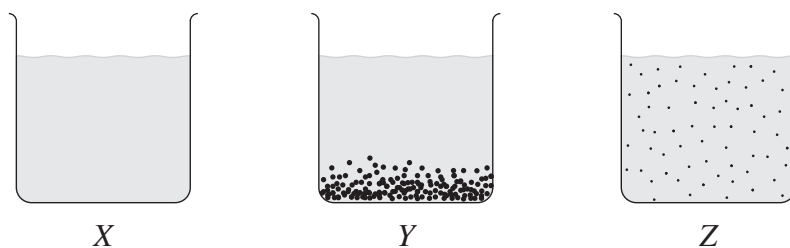
alcohol (77%), water, fragrance

What is the main purpose of the alcohol?

- (A) To kill skin bacteria
- (B) To dissolve the fragrance
- (C) To give the product an appealing smell
- (D) To give the product an attractive colour

- 7 Which of the following identifies features of optical fibres used for communication?
- (A) Flexible and made of glass
 - (B) Hollow and made of silicone
 - (C) Transparent and conduct electricity
 - (D) Secure and convert electricity to light

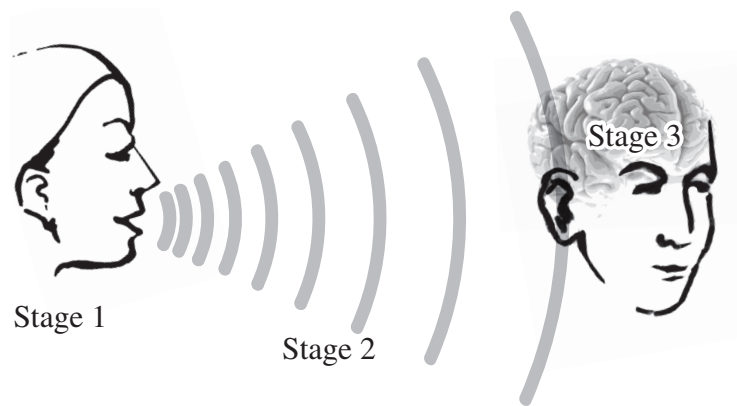
- 8 Three beakers *X*, *Y* and *Z* contain mixtures which have been left standing for a long period of time.



Which row of the table correctly represents the mixtures in diagrams *X*, *Y* and *Z*?

| | <i>X</i> | <i>Y</i> | <i>Z</i> |
|-----|------------|------------|------------|
| (A) | Colloid | Suspension | Solution |
| (B) | Solution | Colloid | Suspension |
| (C) | Solution | Suspension | Colloid |
| (D) | Suspension | Colloid | Solution |

- 9 The diagram shows the basic pattern of information transfer.



What is the process occurring at Stage 3?

- (A) Decoding
 (B) Transmission
 (C) Energy transfer
 (D) Communication
- 10 Which row of the table correctly matches the medical condition with the biomedical technology used to treat that condition?

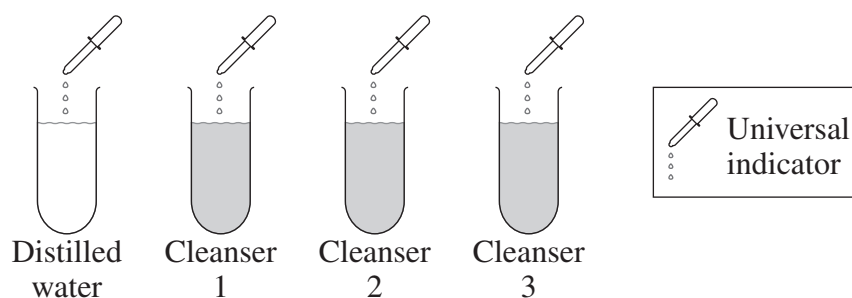
| | <i>Medical condition</i> | <i>Biomedical technology</i> |
|-----|---------------------------|------------------------------|
| (A) | Worn cartilage in a joint | Pyrolytic carbon |
| (B) | Damaged hip joint | Cochlear implant |
| (C) | Faulty heart valve | UHMWPE |
| (D) | Irregular heartbeat | Pacemaker |

- 11 Oxygen molecules which enter the body through the nose pass through several structures in order to enter the bloodstream.

Which of the following shows the structures in the correct sequence?

- (A) Alveoli → trachea → aorta → veins
 (B) Bronchi → trachea → atria → capillaries
 (C) Trachea → bronchi → alveoli → capillaries
 (D) Diaphragm → trachea → ventricles → veins

- 12 The technique of angioplasty is used in which of the following situations?
- (A) To correct a faulty heart valve
 (B) To relieve build-up of plaque
 (C) To control an irregular heart rhythm
 (D) To carry out cardiopulmonary resuscitation
- 13 Why are shampoos effective in removing oil from the hair and scalp?
- (A) They contain surfactants that dissolve oils.
 (B) They are mildly acidic which allows them to degrade oils.
 (C) They contain emulsifying agents that disperse oil droplets.
 (D) They contain nutrients that promote the growth of microflora which feed on oils.
- 14 Which statement correctly compares the properties of radio waves and microwaves?
- (A) Radio waves travel at the same speed as microwaves.
 (B) Radio waves have the same frequency as microwaves.
 (C) Radio waves have shorter wavelengths than microwaves.
 (D) Radio waves carry more information per second than microwaves.
- 15 An investigation was conducted to measure the pH values of skin cleansers.



Which row of the table shows the independent variable and the control in this investigation?

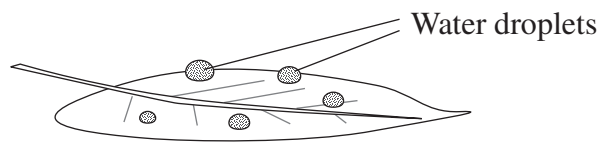
| | <i>Independent variable</i> | <i>Control</i> |
|-----|-----------------------------|---------------------|
| (A) | pH | Distilled water |
| (B) | Universal indicator | pH |
| (C) | Cleansers | Distilled water |
| (D) | Cleansers | Universal indicator |

16 Oil-based chemicals are often added to soft drinks for flavour and colour.

Which of these substances could also be added to soft drinks to make the mixture uniform and stable?

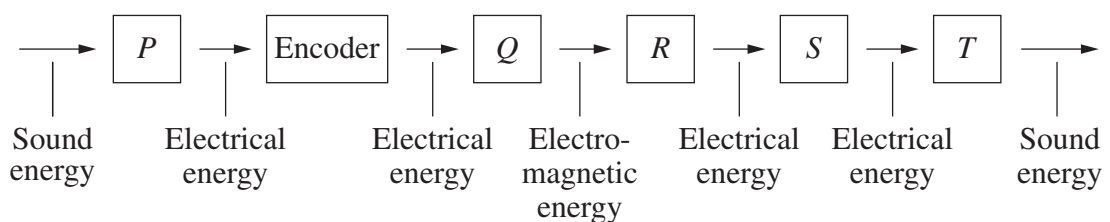
- (A) A colloid
- (B) An emulsifier
- (C) A lubricant
- (D) A solute

17 The diagram shows water droplets on a leaf.



What is the main reason for the shape of the water droplets on the leaf?

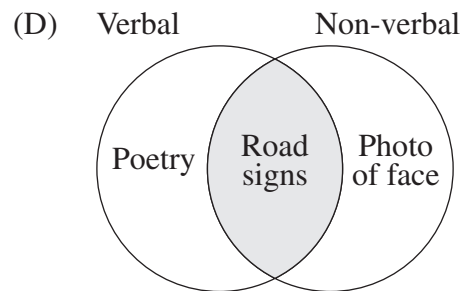
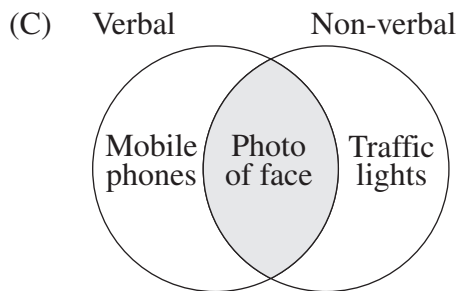
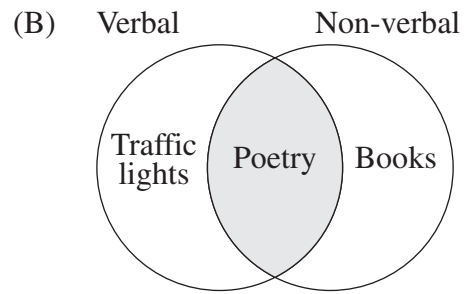
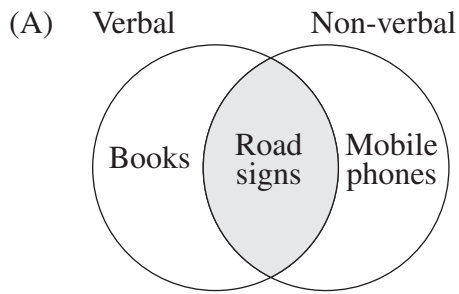
- (A) Water is repelled by natural oils on the leaf.
 - (B) There is gravitational attraction between water molecules.
 - (C) Repulsive forces are provided by surfactants dissolved from the leaf surface.
 - (D) Attractive forces exist between water molecules on the surface of the droplets.
- 18 The diagram shows energy transformations that occur during the transmission of a person's voice using radio.



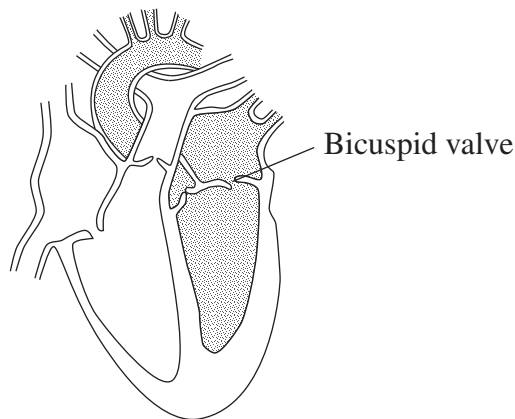
Which of the following correctly identifies TWO components of this system?

- (A) R – Antenna, T – Speaker
- (B) Q – Antenna, R – Decoder
- (C) P – Microphone, Q – Decoder
- (D) P – Speaker, T – Microphone

19 Which of the following Venn diagrams correctly classifies the different types of communication?



20 The diagram shows a cross-section of the heart.



What would happen if the bicuspid valve fails to close properly?

- (A) The left ventricle would not fill with blood.
- (B) Too little blood would be pumped out of the left ventricle.
- (C) Too much blood would be pumped out of the right atrium.
- (D) Oxygenated and deoxygenated blood would mix in the heart chambers.

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Centre Number

Section I (continued)

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Student Number

Part B – 55 marks

Attempt Questions 21–31

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 (3 marks)

- (a) Why is thermography used as a diagnostic tool? **2**

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- (b) Outline ONE disadvantage of using thermography as a diagnostic tool. **1**

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Question 22 (4 marks)

Relate TWO properties of electromagnetic waves to their usefulness in specific communication systems. **4**

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Section I – Part B (continued)

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Question 23 (6 marks)

- (a) Why are articulating ends of artificial joints covered in polyethylene? **3**

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- (b) Describe the properties of superalloys that make them useful in artificial joints. **3**

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Question 24 (5 marks)

What impact has the mobile phone’s capacity to carry different types of information had on society?

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Section I – Part B (continued)

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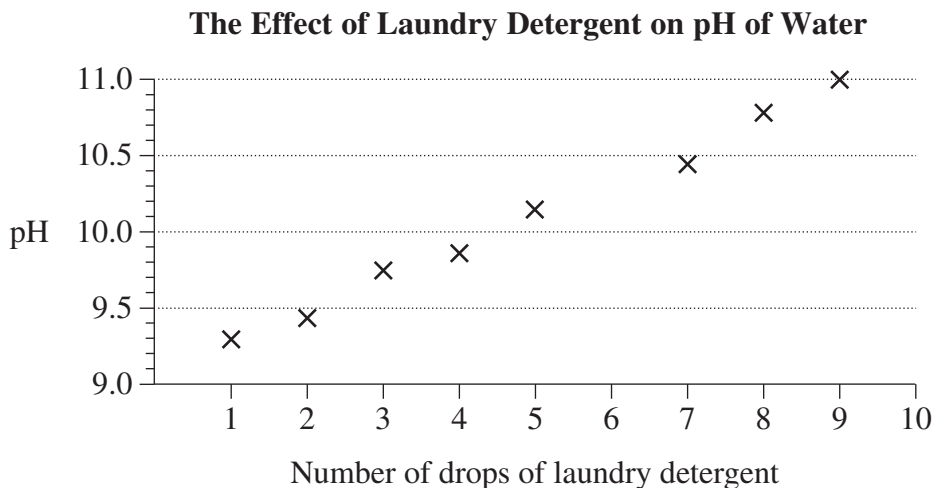
Student Number

Question 25 (8 marks)

Please turn over

Question 25 (8 marks)

- (a) A clean beaker contained 200 mL of pure water. A pH sensor was placed in it. Laundry detergent was added a drop at a time. The mixture was stirred and the pH was measured.



- (i) Draw a line of best fit on the graph and show how you would estimate the pH when 6 drops of laundry detergent were added. **2**

The pH would be

- (ii) Explain why data from this graph could not be used to predict the pH of a mixture of 200 mL of pure water and 100 drops of laundry detergent. **2**

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- (iii) Why would it be inappropriate to use this detergent to wash your hands? **2**

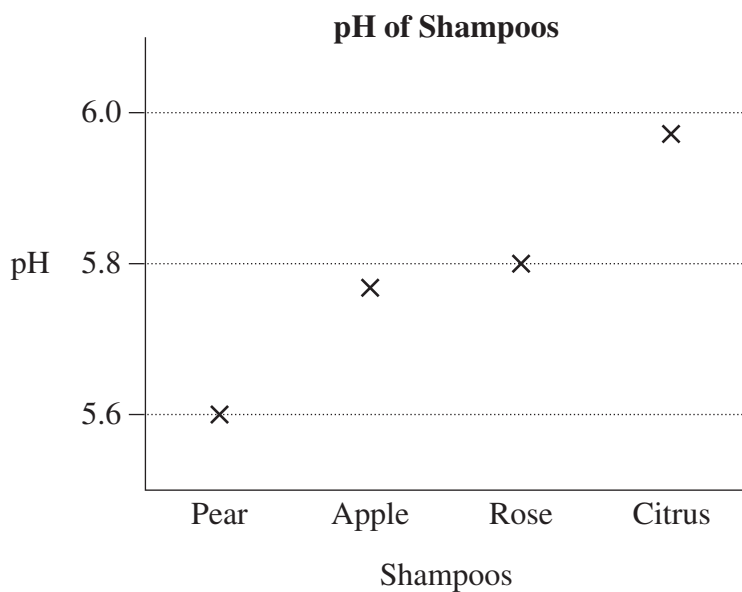
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Question 25 continues on page 15

Question 25 (continued)

(b) The pH of four shampoos (Pear, Apple, Rose and Citrus) was measured and graphed.

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Evaluate the usefulness of this graph in predicting the pH of a fifth shampoo.

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End of Question 25

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Section I – Part B (continued)

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Question 26 (4 marks)

Contrast the coding systems of compact discs (CDs) and AM radio.

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Please turn over

Question 27 (4 marks)

(a) Define the term *microflora*. **1**

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(b) What is the relationship between microflora and the pH of skin? **1**

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(c) Explain the effect that body soaps can have on the action of microflora. **2**

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Section I – Part B (continued)

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Question 28 (5 marks)

- (a) Outline an investigation that can be conducted to identify individual aspects that make up a heartbeat. **2**

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- (b) Account for the observations made during this investigation. **3**

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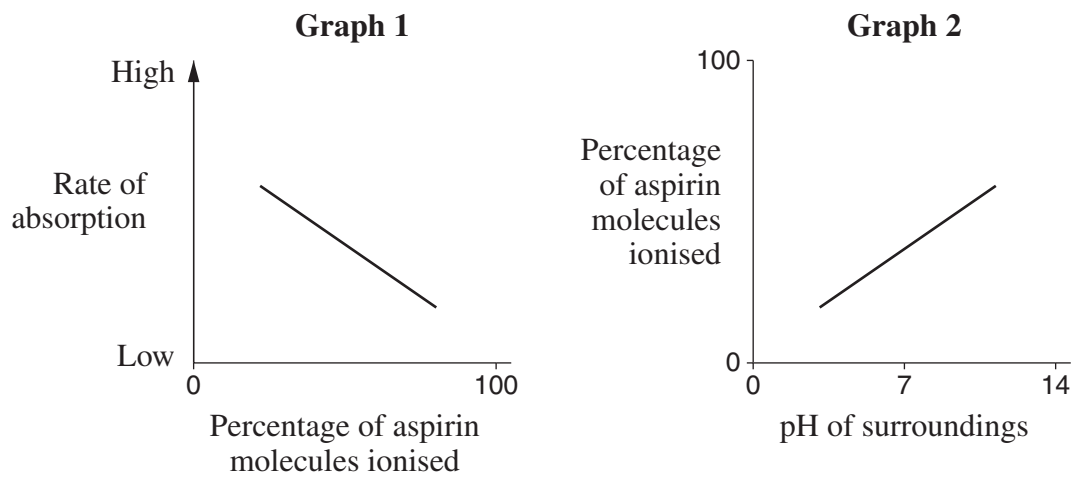
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Question 29 (4 marks)

Ionisation of a drug changes its neutral molecules into a charged form.

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Based on these graphs, in which part of the digestive system is aspirin absorbed most rapidly after it is swallowed? Justify your answer.

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Section I – Part B (continued)

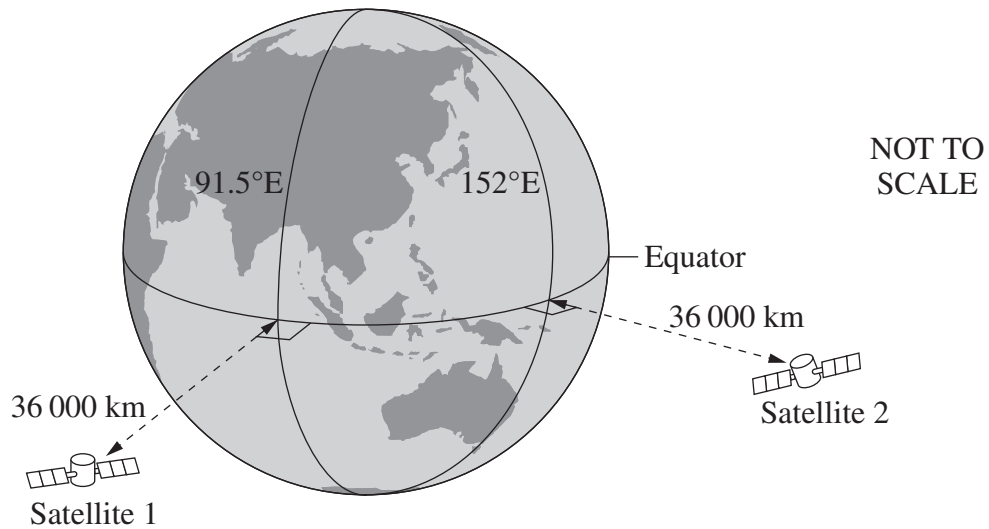
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Student Number

Question 30 (4 marks)

The diagram shows the locations of two communication satellites.

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Account for the locations of these satellites.

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Question 31 (8 marks)

Analyse why knowledge about structures and functions of the body is necessary in the design and use of ONE medication and ONE bionic device.

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Section II

25 marks

Attempt ONE question from Questions 32–36

Allow about 45 minutes for this section

Answer parts (a)–(b) of the question in Section II Answer Booklet 1.

Answer parts (c)–(d) of the question in Section II Answer Booklet 2.

Extra writing booklets are available.

| | Pages |
|---|-------|
| Question 32 Polymers | 24 |
| Question 33 Preservatives and Additives | 25 |
| Question 34 Pharmaceuticals | 26 |
| Question 35 Disasters | 27 |
| Question 36 Space Science | 28 |

Question 32 — Polymers (25 marks)

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

- (a) (i) What is ONE use for the polymer PVC? **1**
- (ii) State TWO properties of PVC that make it useful for the purpose identified in part (i). **2**
- (b) (i) A student wants to compare the thermal insulation capacities of wool and cotton fibres.
- (1) Write a hypothesis suitable for this investigation. **2**
- (2) Describe a valid and reliable procedure that could be used to test this hypothesis. **4**
- (ii) Relate TWO properties of wool, other than thermal insulation, to its use. **3**

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

- (c) Students investigated the amount of plastic thrown out at their school. They counted and weighed the items and collected the following data:
- 20 water bottles 6 kg, 125 fruit juice containers 5 kg, 55 pieces of cling wrap plastic 0.5 kg, 375 food bar wrappers 1.8 kg, 70 drinking straws 0.4 kg
- (i) Present the data in an appropriate table. **3**
- (ii) The items and their masses are to be graphed. **3**
- Justify a suitable type of graph for representing the data. Use a sketch of the graph to clarify your answer.
- (d) Assess the effects of natural and synthetic polymers on the environment. **7**

Question 33 — Preservatives and Additives (25 marks)

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

- (a) (i) Name ONE type of food additive that is NOT a preservative. **1**
- (ii) State TWO effects of food additives. **2**
- (b) (i) A student wants to compare the shelf lives of ultra-high temperature (UHT) milk and pasteurised milk.
- (1) Write a hypothesis suitable for this investigation. **2**
- (2) Describe a valid and reliable procedure that could be used to test this hypothesis. **4**
- (ii) Explain how TWO physical methods, other than UHT and pasteurisation, limit the effects of microorganisms. **3**

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

- (c) Students collected the following data from a range of cosmetics. The data represents the percentage of water and volume of alcohol respectively in 100 mL of each product.
- shampoo 70% and 2 mL, moisturiser 60% and 8 mL, mouthwash 75% and 20 mL, deodorant 30% and 5 mL, perfume 20% and 75 mL
- (i) Present the data in an appropriate table. **3**
- (ii) The products and their water content are to be graphed. **3**
- Justify a suitable type of graph for representing the data. Use a sketch of the graph to clarify your answer.
- (d) Assess the role of government legislation in labelling and regulating ingredients in food products. **7**

Question 34 — Pharmaceuticals (25 marks)

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

- (a) (i) Identify the process by which bacteria reproduce. **1**
- (ii) State TWO limitations of penicillin in treating bacterial infections. **2**
- (b) (i) A student wants to compare the rates at which aspirin capsules and enteric-coated aspirin tablets dissolve in the conditions found in the stomach.
- (1) Write a hypothesis suitable for this investigation. **2**
- (2) Describe a valid and reliable procedure that could be used to test this hypothesis. **4**
- (ii) Explain TWO ways in which aspirin relieves pain. **3**

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

- (c) Students collected the following data from an investigation into the time taken for different bacteria to double in number at different temperatures.
- S. aureus* 28 minutes at 37°C, *E. coli* 21 minutes at 40°C, *L. acidophilus* 80 minutes at 30°C, *B. subtilis* 26 minutes at 42°C, *C. perfringens* 10 minutes at 35°C
- (i) Present the data in an appropriate table. **3**
- (ii) The bacteria and the time taken for them to double in number are to be graphed. **3**
- Justify a suitable type of graph for representing the data. Use a sketch of the graph to clarify your answer.
- (d) Analyse the role of the circulatory system in both the transportation of pharmaceuticals and the body's natural response to disease. **7**

Question 35 — Disasters (25 marks)

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

- (a) (i) Identify ONE type of fire extinguisher. **1**
- (ii) State TWO responsibilities of a manager with regard to fire extinguishers in a workplace. **2**
- (b) (i) A student wants to compare the speeds at which gum leaves and pine needles burn.
- (1) Write a hypothesis suitable for this investigation. **2**
- (2) Describe a valid and reliable procedure that could be used to test this hypothesis. **4**
- (ii) Explain TWO methods used to reduce the risk associated with bushfires. **3**

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

- (c) Students collected the following data about the dates and number of deaths from natural disasters that have occurred in Australia.
- Brisbane floods (2010) 35 deaths, Newcastle earthquake (1989) 13 deaths, Thredbo landslide (1997) 18 deaths, Victoria bushfire (2009) 173 deaths, Darwin cyclone (1974) 71 deaths
- (i) Present the data in an appropriate table. **3**
- (ii) The disasters and the numbers of deaths are to be graphed. **3**
- Justify a suitable type of graph for representing the data. Use a sketch of the graph to clarify your answer.
- (d) Analyse the relationship between the damage to the environment, the location of the epicentre and the three different waves that are produced by earthquakes. **7**

Question 36 — Space Science (25 marks)

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

- (a) (i) During which part of a space mission would solid rocket boosters be used? **1**
- (ii) State TWO benefits of using space shuttles for the return of astronauts to Earth. **2**
- (b) (i) A student wants to determine whether disruption to sleep cycles increases astronauts' reaction times.
- (1) Write a hypothesis suitable for this investigation. **2**
- (2) Describe a valid and reliable procedure that could be used to test this hypothesis. **4**
- (ii) Explain TWO problems, other than disruption to sleep cycles, that astronauts face while in space. **3**

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

- (c) Students collected the following data when investigating the number of astronauts and the duration in days respectively of different space transportation system (STS) missions.
- STS-131, 7 and 15 days; STS-132, 6 and 12 days; STS-133, 6 and 13 days; STS-134, 6 and 16 days; STS-135, 4 and 13 days
- (i) Present the data in an appropriate table. **3**
- (ii) The missions and their duration are to be graphed. **3**
- Justify a suitable type of graph for representing the data. Use a sketch of the graph to clarify your answer.
- (d) Analyse the roles of space probes and telescopes in gathering different types of information about the solar system, galaxies and deep space. **7**

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