

2016 HSC Senior Science Marking Guidelines

Section I, Part A

Multiple-choice Answer Key

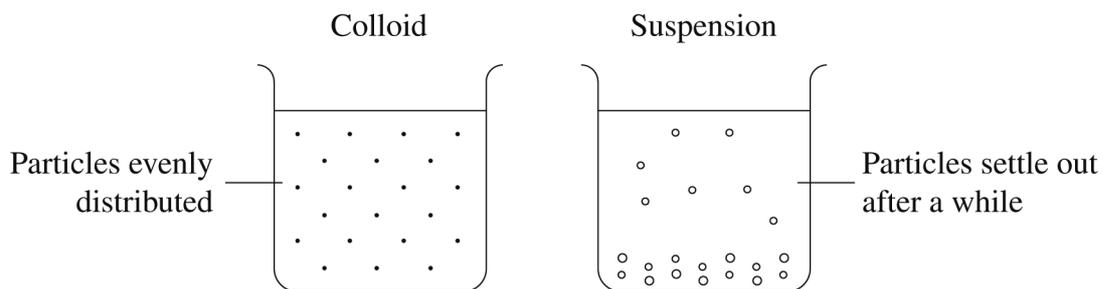
Question	Answer
1	B
2	D
3	C
4	B
5	D
6	A
7	C
8	B
9	D
10	C
11	B
12	A
13	A
14	B
15	A
16	C
17	C
18	D
19	D
20	C

Section I, Part B

Question 21 (a)

Criteria	Marks
• Both diagrams are correctly labelled and drawn showing distribution of particles	3
• Two features of the diagrams are shown (label, differences in particle size, distribution of particles)	2
• Any relevant information on a diagram	1

Sample answer:



Question 21 (b)

Criteria	Marks
• An example of each correctly identified	2
• One example correctly identified	1

Sample answer:

Oil-in-water: milk

Water-in-oil: butter

Question 22

Criteria	Marks
• Relates the external compressions of the chest to the movement of blood through a specific part of the circulatory system/heart	3
• Describes features of CPR	2
• Identifies one aspect/feature of CPR	1

Sample answer:

Pushing on the chest of the person compresses the chambers of the heart, forcing blood out of the right ventricle to the lungs and out of the left ventricle to the other parts of the body. When this happens, blood cannot flow from the ventricles to the atria because the valves between these chambers only allow blood to flow from the atria to the ventricles.

Between compressions, the lack of pressure on the heart allows all the chambers to fill with blood where the pressure is lower. The cycle continues with the next compression of the chest by the person administering the CPR.

Question 23

Criteria	Marks
• Identifies TWO advantages of optical fibres • Links advantages to benefits to society	4
• Identifies advantage(s) of optical fibres • Links advantage(s) to a benefit	2–3
• Any relevant information	1

Sample answer:

Optical fibres have the advantages of being able to transfer large quantities of data rapidly at low cost. These have benefited society by giving people almost instant access to movies and music, which has improved the entertainment options for people. The capacity to transmit large amounts of secure data has given more people access to banking, stock trading and insurance. Social media have flourished as a result of data access via optical fibres and these have benefited society by improving communication.

Question 24 (a)

Criteria	Marks
• Shows correct features of an AM wave	2
• Shows a correct feature of an AM wave	1

Sample answer:

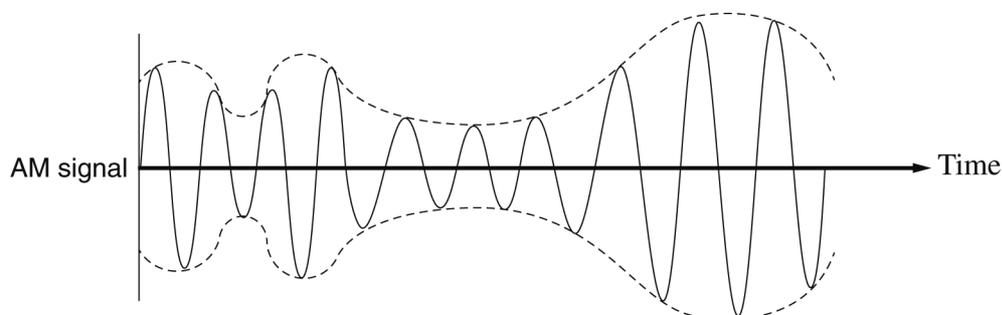


Diagram shows variations in amplitude and NO variation in frequency of the carrier wave.

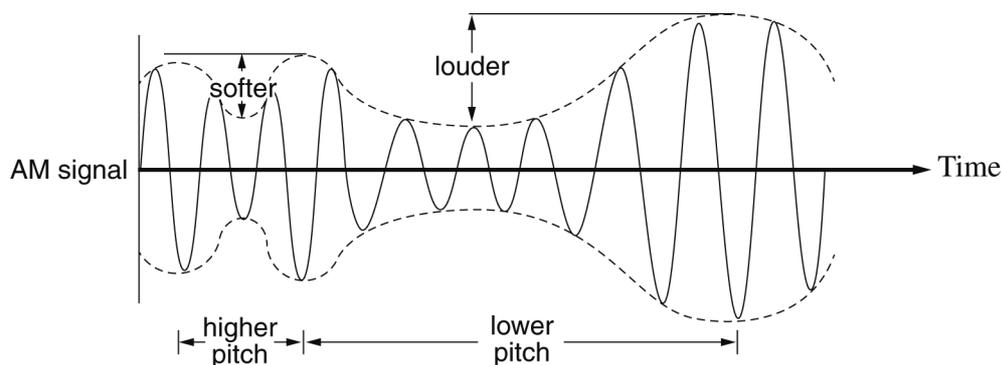
Question 24 (b)

Criteria	Marks
• Outlines how both loudness and pitch are encoded in an AM wave	2
• Outlines how either loudness OR pitch is encoded in an AM wave	1

Sample answer:

Information about the loudness of a sound is encoded into an AM wave by changing the amount of variation in the amplitude. Information about the pitch of a sound is achieved by how often the amplitude of the AM wave changes.

Answers could include:



Question 24 (c)

Criteria	Marks
• Outlines advantages of FM compared to AM	2
• Identifies an advantage of FM	1

Sample answer:

Frequency modulation has the advantage of being affected less by lightning or other electrical interference, resulting in a better quality sound free of distortion and interference than is possible with AM that is subject to the effects of electrical interference. FM typically has a limited range so that different cities can use the same FM frequency, which is not possible with AM that has a longer range.

Question 25 (a)

Criteria	Marks
• Relates the action of the elastic membrane to the process of inhaling and exhaling	3
• Relates a feature of the model to either inhalation or exhalation	2
• Any relevant information	1

Sample answer:

Inhalation: Pulling down on the elastic membrane causes the balloons to inflate. This represents the diaphragm contracting, causing air to be drawn into the lungs.

Exhalation: Pushing up on the elastic membrane causes the balloons to deflate. This represents the diaphragm relaxing and causing air to be expelled from the lungs.

Question 25 (b)

Criteria	Marks
• States a reason why this model is limited when applied to the process of breathing	2
• Identifies a limitation of the model	1

Sample answer:

The model of the respiratory system is contained in a rigid glass container whereas the human chest cavity is fluid-filled and moves in response to muscles pulling on the ribs, assisting the process of breathing.

Question 26

Criteria	Marks
• Identifies similarities and differences in the energy conversions in the systems	4
• Identifies similarities and a difference, or a similarity and differences, in the energy conversions in the systems	3
• Identifies a similarity and/or a difference in the energy transformations that take place in both systems	2
• Any relevant information	1

Sample answer:

Similarities: The microphones in both mobile phones and land-connected phones convert sound to electrical energy. The speakers in both convert electrical energy into sound energy.

Differences: Communication using mobile phones involves the conversion of electrical energy to electromagnetic energy in the transmitting antenna and from microwaves to electrical energy in the receiving antenna whereas in land-connected phones either electrical energy is sent through copper cables or electrical energy is converted to light energy for transmission through optical fibres and back into electrical energy at the receiving end.

Question 27 (a)

Criteria	Marks
• Relates an effect of the named chemical product to its use and handling, and provides a cause for this effect	2
• States a precaution OR effect	1

Sample answer:

Hand sanitiser can harm the microflora living on the skin, potentially removing good microflora and allowing harmful opportunistic microflora to proliferate, causing skin irritation or allowing harmful fungal infections to occur.

Question 27 (b)

Criteria	Marks
<ul style="list-style-type: none"> Describes roles of the skin and relates the use of three different types of products to the effects they have on the skin. Must identify different categories of chemicals 	6
<ul style="list-style-type: none"> Outlines role(s) of the skin and relates the use of products to the effects that they have on the skin 	4–5
<ul style="list-style-type: none"> Outlines a role of the skin and/or states effects of products on the skin 	2–3
<ul style="list-style-type: none"> Any relevant information 	1

Sample answer:

The skin prevents disease-causing organisms from entering the body. It also provides an environment that is favourable to microflora that, by competing for resources, prevent pathogens from proliferating.

Excessive or inappropriate use of soaps, shampoos and cosmetics may reduce the numbers or types of these favourable bacteria, by killing them, removing them or creating conditions unfavourable for their growth, such as changing the skin pH. This can cause further changes to the pH of the skin because one role of bacteria is to produce chemicals that help to lower the skin pH.

This may then allow pathogenic bacteria and fungi to grow. These can irritate the skin causing rashes or lesions that allow pathogens to directly enter the body and cause disease.

The skin is an excretory organ, getting rid of water and minerals. Cosmetics can rehydrate the skin or remove oil from the skin. Removing oil can affect the microflora balance on the skin. Using moisturisers slows loss of water from the skin.

Question 28

Criteria	Marks
<ul style="list-style-type: none"> Relates the properties of UHMWPE and superalloy to their respective uses 	6
<ul style="list-style-type: none"> Outlines properties and uses of both UHMWPE and superalloy 	4–5
<ul style="list-style-type: none"> States properties and/or uses of UHMWPE and/or superalloy 	2–3
<ul style="list-style-type: none"> Any relevant information 	1

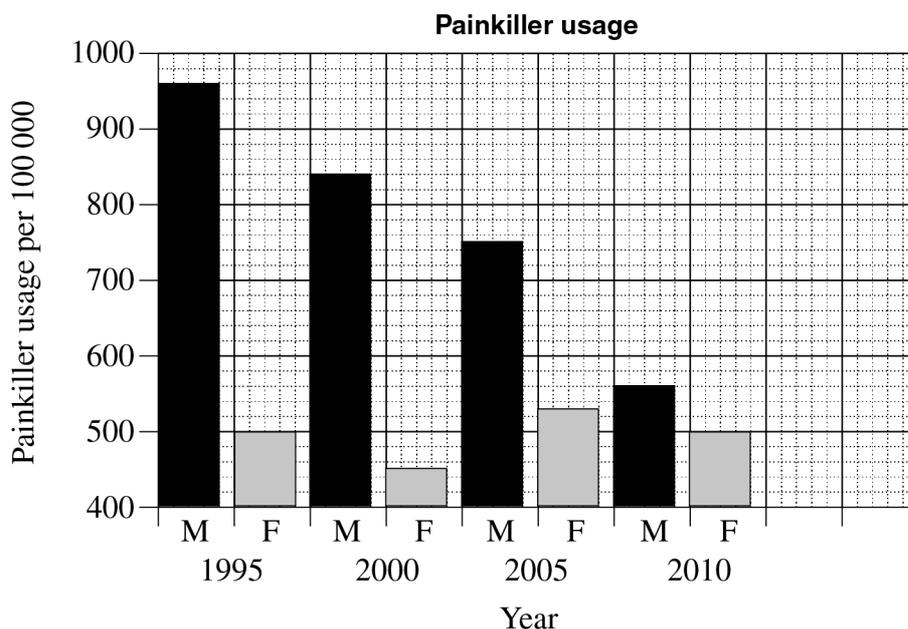
Sample answer:

UHMWPE is a suitable alternative to cartilage surrounding a ball and socket joint. It is a good alternative to cartilage because it can be made with a low-friction surface permitting easy movement. Its inertness makes it biocompatible with surrounding tissues.

Superalloy is used to make a ball and stem for the bone components of a large joint eg hip joints. They need to have high strength, which is a property of superalloy to support the weight of the body. Superalloy is also inert and therefore does not react with chemicals in the body.

Question 29 (a)

Criteria	Marks
<ul style="list-style-type: none"> Constructs an appropriate type of graph Uses appropriate scales on axes Plots data correctly Gives a relevant key or distinguishes between data for males and females 	4
<ul style="list-style-type: none"> Any THREE of the above 	3
<ul style="list-style-type: none"> Any TWO of the above 	2
<ul style="list-style-type: none"> ONE of the above 	1

Sample answer:**Question 29 (b)**

Criteria	Marks
<ul style="list-style-type: none"> Sketches in simple terms the trend for both males and females 	2
<ul style="list-style-type: none"> Gives a general trend for males and/or females 	1

Sample answer:

In males, painkiller usage has decreased in the period 1995–2010.

In females, painkiller usage has remained relatively constant in the period 1995–2010.

Question 30

Criteria	Marks
<ul style="list-style-type: none"> • Describes ONE advance in scientific understanding and ONE technological advance from each module • Outlines the effects these have on the long-term health of humans • Links the advances to health improvements • Demonstrates comprehensive knowledge and understanding • Answers in a logical and coherent manner using scientific terminology 	8
<ul style="list-style-type: none"> • Describes ONE advance in scientific understanding AND/OR ONE technological advance from each module • Outlines the effects these have on the long-term health of humans • Links the advances to health improvements • Demonstrates thorough knowledge and understanding • Answers in a clear, coherent manner and uses some scientific terminology 	6–7
<ul style="list-style-type: none"> • Outlines ONE advance in scientific understanding AND technological advance from at least two modules • Outlines the effects these have on health • Links the advances to health improvements • Demonstrates sound knowledge and understanding 	4–5
<ul style="list-style-type: none"> • Identifies ONE advance in scientific understanding OR technological advance from at least two modules AND/OR <ul style="list-style-type: none"> • Outlines a health benefit • Demonstrates basic knowledge and understanding 	2–3
<ul style="list-style-type: none"> • Any relevant information 	1

Sample answer:

Increased knowledge and understanding of the way the digestive system works has led to the development of specific drugs. These are able to target specific areas or functions within the body. This reduces side effects in the patient and treats symptoms more effectively than with older broad-spectrum, non-specific drugs eg enteric-coated tablets.

New technologies in the coating on tablets/capsules have led to better health outcomes for people that require slow-release medications for extended pain relief or enteric-coated tablets that avoid irritating the lining of the oesophagus or stomach. This allows patients to take medication on a long-term basis without affecting the stomach and oesophagus.

We now understand the role of electrical impulses in controlling the beating of the heart. The development of electronic pacemakers can replace the function of the sinoatrial node in causing the heart to beat regularly. Pacemakers allow people to live normal lives for many years despite having a faulty SA node which would otherwise have caused their death.

Advances in communications systems such as the use of radio waves, optical fibres and digital technologies have improved diagnostic techniques that allow early intervention in health problems which can lead to long-term improvements. For example, internal examination using optical fibres and pulse oximeters using digital technologies are less invasive and more accurate than just symptomatic diagnoses previously used.

Section II

Question 31 (a) (i)

Criteria	Marks
• States natural polymer	1

Sample answer:

Silk is a natural polymer.

Question 31 (a) (ii)

Criteria	Marks
• States TWO features of polymer molecules	2
• States ONE feature of polymer molecules	1

Sample answer:

A polymer molecule is a large molecule that consists of identical repeating units (monomers).

Question 31 (b) (i)

Criteria	Marks
• Uses information from the table to state why Polymer A is better than Polymer B for a firefighter uniform	2
• States information from the table without justification	1

Sample answer:

Polymer A shows low flammability and low moisture absorbency. Polymer B shows medium flammability and high moisture absorbency. Therefore Polymer A is the best choice for a firefighter uniform as it is less likely to catch fire and being less moisture absorbent it won't fill with moisture from the firefighter body as a result of the heat from the fire.

Question 31 (b) (ii)

Criteria	Marks
• Outlines complete procedures for making both playdough and slime	4
• Outlines most of the procedures for making both playdough and slime	3
• Outlines a complete procedure for making either playdough or slime	2
• States a brief procedure for making either playdough or slime	1

Sample answer:

Playdough – combine 100g of plain flour with 50g of salt in a saucepan. Add a teaspoon of cooking oil and 50 mL of water. Stir the mixture. Stir over a high heat until the mixture thickens into dough. Knead until it is soft and flexible.

Slime – combine 100mL PVA glue, 100mL of water in a jar. Shake until the glue dissolves in the water. Stir 2 tablespoons of borax into 100mL of water. Allow the mixture to settle and decant off the excess water and discard. Add the wet borax to the jar and close the lid. Shake vigorously until slime forms.

Question 31 (c)

Criteria	Marks
• Demonstrate cause and effect linking our use of polymers to the availability of fossil fuels	4
• Provides characteristics and features of fossil fuels and polymers	3
• States how fossil fuels are used in production of polymers	2
• Any relevant information	1

Sample answer:

Fossil fuels – coal, oil and natural gas – are the basis for our production of polymers (plastics). The cracking of petroleum into all the smaller fractions then polymerising these monomers and adding additives allows us to produce many different polymers (plastics). As our supplies of fossil fuels are depleting this will mean we will have to find different sources for the production of many polymers. Recycling of plastics should reduce our requirements on fossil fuels and allow us to still produce the polymers we require.

Question 31 (d) (i)

Criteria	Marks
<ul style="list-style-type: none"> • Procedure listed in steps • Steps in correct logical order • Calculation of data • Minimum of three days for data collection 	3
<ul style="list-style-type: none"> • Procedure listed in steps • Steps in correct logical order • Calculation of data OR minimum of three days for data collection 	2
<ul style="list-style-type: none"> • Some correct procedure outlined 	1

Sample answer:

Set up containers for plastic material to be thrown into at home.
 At the end of the day, weigh all the plastic material from Day 1.
 Discard this plastic material into your recycling bin.
 Replace empty containers for Day 2 collection of plastic material.
 Weigh at the end of the day.
 Continue collecting and weighing over a 7 day period.
 Average your result to obtain a value for a 1 day period.

Question 31 (d) (ii)

Criteria	Marks
<ul style="list-style-type: none"> • Relates cause and effect to the safe work practice 	2
<ul style="list-style-type: none"> • States a safe work practice 	1

Sample answer:

Since most of the plastic in the home would be used to hold food, wash your hands after handling it.

Question 31 (e)

Criteria	Marks
<ul style="list-style-type: none"> • Demonstrates a comprehensive knowledge and understanding of thermoset plastics and thermoplastics • Describes the versatility of each type of plastic • Describes an impact on society of each plastic • Includes at least two examples of each plastic • Answer is logical, coherent and uses scientific terminology 	7
<ul style="list-style-type: none"> • Demonstrates a thorough knowledge and understanding of thermoset plastics and thermoplastics • Describes the versatility of each type of plastic • Describes an impact on society of each type of plastic • Includes an example of both plastics • Answer is logical, coherent and uses scientific terminology 	5–6
<ul style="list-style-type: none"> • Demonstrates a sound knowledge and understanding of thermoset plastics and thermoplastics • Describes the versatility of each type of plastic OR describes an impact on society of each plastic • Includes an example of either plastic • Uses some scientific terminology 	3–4
<ul style="list-style-type: none"> • Demonstrates a basic knowledge and understanding of thermoset plastics and thermoplastics • Outlines the versatility of each type of plastic OR outlines an impact on society of plastic OR includes an example of one or both plastics 	1–2

Sample answer:

Thermoset plastics have a lot of cross-linking between the long chain molecules. They can be moulded into the desired shape but once cooled they become very hard and rigid. If they are to be reheated they cannot be reshaped. These plastics are very useful for applications where they have to withstand heat such as saucepan handles, plates or where strength is important such as in light switches. This type of plastic has had a great impact on society creating useful alternatives to products that are more expensive and not easily accessible. Examples of thermoset plastics are polyesters and polyurethanes.

Thermoplastics do not have a lot of cross-linking between polymer chains. They can be softened by heat and hardened by cooling and this can be continually repeated. These properties allow both easier processing and recycling. This type of plastic has also had a great impact on society once again giving us very affordable alternatives, eg polyethylene, polypropylene and PVC.

Question 32 (a) (i)

Criteria	Marks
• Names the group of chemicals	1

Sample answer:

Bacteriocins

Question 32 (a) (ii)

Criteria	Marks
• Gives a reason why nitrites are added to a specific type of food	2
• Identifies a type of food or a purpose of using nitrites	1

Sample answer:

Nitrites are typically added to processed meat products to improve the colour and to inhibit the growth of bacteria.

Question 32 (b) (i)

Criteria	Marks
• Outlines TWO types of information on the label	2
• Identifies ONE piece of information on the label	1

Sample answer:

The label identifies the individual ingredients in the product and the relative amounts of each because the ingredients are arranged in order from the highest to lowest percentage (by weight).

Answers could include:

The label includes percentages by weight of some ingredients.

It includes a numeric code for the thickener, which would allow the consumer to look up exactly what thickener was included in the product.

Question 32 (b) (ii)

Criteria	Marks
<ul style="list-style-type: none"> Makes a valid assessment about the usefulness of the label AND Refers to specific aspects of the label which limit its usefulness 	4
<ul style="list-style-type: none"> Makes a valid assessment about the usefulness of the label AND Refers to an aspect of the label which limits its usefulness 	3
<ul style="list-style-type: none"> Refers to specific aspects of the label 	2
<ul style="list-style-type: none"> Refers to a piece of specific information on the label 	1

Sample answer:

This label is not useful to the consumer because:

- it does not provide specific useful information required by labelling laws
- it contains statements that are intended to lead the consumer to draw incorrect inferences
- it implies that any artificial chemicals are dangerous and hence the product is somehow better because it does not contain them
- there is an incorrect implication that plant-derived materials are safe, when in fact the vast majority of plants cannot be safely consumed
- most of the label makes generalised statements about substances that are NOT present in the product.

Question 32 (c)

Criteria	Marks
<ul style="list-style-type: none"> Identifies issues related to the statement and provides points for and/or against its proposition with reference to specific additives 	4
<ul style="list-style-type: none"> Identifies additive/s, purpose/s and side effect/s 	3
<ul style="list-style-type: none"> Identifies an additive and its purpose or a side effect 	2
<ul style="list-style-type: none"> Identifies an additive OR states a use or side effect of an additive 	1

Answers could include:

Xylitol is added to sweeten some lollies and it has the beneficial side effect of helping to prevent dental caries.

Salt is added to improve the taste of some foods but it also may adversely affect thirst or blood pressure.

Artificial sweeteners are added to products to make them taste sweeter while avoiding the harmful effects of sugar (eg for a diabetic person). However, for some people these sweeteners may leave an unpleasant aftertaste which they describe as 'bitter' or 'metallic'.

Question 32 (d) (i)

Criteria	Marks
<ul style="list-style-type: none"> • Procedure listed in steps • Steps in correct, logical order • Control identified/implied • Variables identified and controlled • Repetition 	3
<ul style="list-style-type: none"> • Procedure listed in steps • Steps in correct, logical order • Control identified/implied OR some variables identified 	2
<ul style="list-style-type: none"> • Some correct procedure outlined 	1

Sample answer:

1. Sterilise workbench and wash hands
2. Collect 16 identical sterile agar plates with lids on
3. Inoculate 12 plates with the same bacterial source
4. Seal and label each plate and place in 4 different incubators set at 10°C, 20°C, 30°C, 40°C respectively.
5. Seal the unopened plates (control) and place one in each of the incubators.
6. Leave for five days, then remove and observe the plates.
7. Each day at the same time, count the number of colonies of bacteria and measure the colony diameters and record this data in a table and record observations of the control.

Question 32 (d) (ii)

Criteria	Marks
<ul style="list-style-type: none"> • Identifies a risk factor • Describes a relevant safe work practice • Clearly links practice to risk factor 	2
<ul style="list-style-type: none"> • Identifies a risk factor OR <ul style="list-style-type: none"> • Outlines a safe work practice 	1

Sample answer:

The risk involved with culturing bacteria is that a dangerous strain may be exposed to students and staff. A safe work practice is to NOT open the sealed agar plates but dispose of them in contaminated waste containers and wash hands thoroughly after handling.

Question 32 (e)

Criteria	Marks
<ul style="list-style-type: none"> Relates a range of physical changes used in food preservation methods to the removal of requirements for the growth of microorganisms AND Makes it clear either explicitly or through the examples used that they understand the meaning of 'physical' in the context of food preservation Makes extended use of scientific terminology 	7
<ul style="list-style-type: none"> Relates physical changes used in food preservation methods to the removal of requirements for the growth of microorganisms AND Makes it clear either explicitly or through the examples used that they understand the meaning of 'physical' in the context of food preservation Makes some use of scientific terminology 	5–6
<ul style="list-style-type: none"> Relates physical changes used in a range of food preservation methods to the removal of requirements for the growth of microorganisms 	3–4
<ul style="list-style-type: none"> Outlines/identifies a feature of a physical method of food preservation 	1–2

Sample answer:

Some physical methods of food preservation rely on modifying the conditions necessary for growth of microorganisms – such as temperature, water/air supply and pH – to either slow or prevent their growth.

Freezing and refrigeration place food in conditions where it is too cold for microorganisms to reproduce optimally, helping to preserve the food.

Canning and pasteurisation create conditions too hot for microorganisms to live and so when the food is heated in these processes and then sealed, it is preserved.

Pickling and salting preserves foods because it kills microorganisms by upsetting the water balance of microorganisms' cells.

Vacuum packing preserves foods by removing oxygen and water necessary for growth of microorganisms. This process also seals the food to prevent new organisms from entering and spoiling the food.

Question 33 (a) (i)

Criteria	Marks
<ul style="list-style-type: none"> Correctly identifies X 	1

Sample answer:

Motor neurone

Question 33 (a) (ii)

Criteria	Marks
<ul style="list-style-type: none"> States or implies the definition of a synapse Clearly shows the relationship between a synapse and the continuation of a message 	2
<ul style="list-style-type: none"> Identifies a synapse OR <ul style="list-style-type: none"> Identifies the pathway for a message 	1

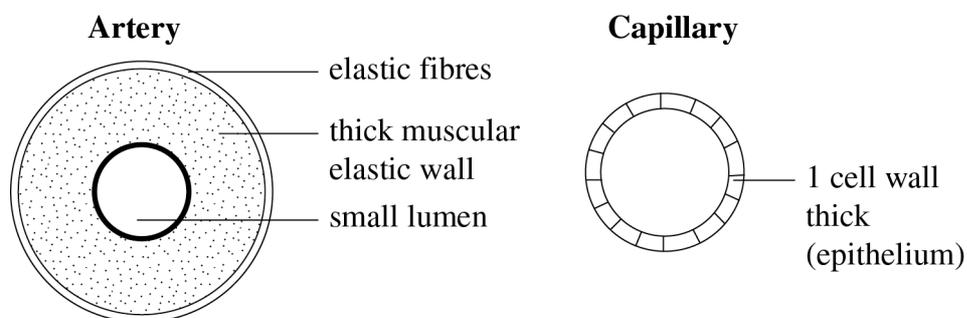
Sample answer:

When a nervous impulse or message arrives at the end of a neurone, it must cross the gap or synapse using chemical neurotransmitters, to pass the message on to the next neurone.

Question 33 (b) (i)

Criteria	Marks
<ul style="list-style-type: none"> Draws a recognisable diagram of an artery and a capillary Identifies each diagram as artery OR capillary Labels one feature for each diagram 	2
<ul style="list-style-type: none"> Draws a diagram of an artery and a capillary Has an identifying label on each diagram 	1

Sample answer:



Question 33 (b) (ii)

Criteria	Marks
<ul style="list-style-type: none"> Identifies both pathways into the bloodstream Identifies the time taken and the relative concentration of the pharmaceutical in the bloodstream for each method Makes reference to the graph to support their answer Makes a judgement about the use of each method to deliver pharmaceuticals 	4
<ul style="list-style-type: none"> Identifies one pathway into the bloodstream Identifies the time taken and/or the relative concentration of pharmaceuticals in each method Refers to graph to support observations OR makes a general judgement about each method 	3
<ul style="list-style-type: none"> Identifies one or both pathways Identifies time taken and/or concentration of pharmaceuticals in each method OR makes a general judgement about one method 	2
<ul style="list-style-type: none"> Makes a correct observation 	1

Sample answer:

Pharmaceuticals can be injected directly into the bloodstream through a vein. This means that all of the drug enters the bloodstream immediately and is transported around the body in the circulatory system within a very short time, as shown on the graph. The drug is then dispersed throughout the body to the target areas (different organs/body tissues).

If pharmaceuticals are taken orally, the drug has to travel through the digestive system before being absorbed into the bloodstream, taking up to two hours as shown on the graph. This method is slower and less pharmaceutical is absorbed into the bloodstream. Intravenous is better for delivering a full dose and is faster, whereas orally is more suitable where a slow release dose is required over a longer period.

Question 33 (c)

Criteria	Marks
<ul style="list-style-type: none"> • Correct physiological responses are described • Sequence of responses in logical order 	4
<ul style="list-style-type: none"> • Most physiological responses are described • Sequence of responses in logical order OR <ul style="list-style-type: none"> • All responses described • Sequence of responses incorrect 	3
<ul style="list-style-type: none"> • Two physiological responses correctly described 	2
<ul style="list-style-type: none"> • One physiological response correctly identified 	1

Sample answer:

- Blood vessels dilate (enlarge) and more blood flows to the affected area.
- Fluids move out of capillaries into the affected/damaged tissue (swelling).
- White blood cells are attracted to the damaged tissue and release chemicals (histamines and prostaglandins) promoting inflammation.
- Affected area may become red and hot and body temperature may increase.

Question 33 (d) (i)

Criteria	Marks
<ul style="list-style-type: none"> • Procedure listed in steps • Steps in correct, logical order • Control identified/implied • Variables identified and controlled • Repetition 	3
<ul style="list-style-type: none"> • Procedure listed in steps • Steps in correct, logical order • Control identified/implied OR some variables identified 	2
<ul style="list-style-type: none"> • Some correct procedure outlined 	1

Sample answer:

1. Sterilise workbench and wash hands
2. Collect 16 identical sterile agar plates with lids on
3. Inoculate 12 plates with the same bacterial source
4. Seal and label each plate and place in 4 different incubators set at 10°C, 20°C, 30°C, 40°C respectively.
5. Seal the unopened plates (control) and place one in each of the incubators.
6. Leave for five days, then remove and observe the plates.
7. Each day at the same time, count the number of colonies of bacteria and measure the colony diameters and record this data in a table and record observations of the control.

Question 33 (d) (ii)

Criteria	Marks
<ul style="list-style-type: none"> • Identifies a risk factor • Describes a relevant safe work practice • Clearly links practice to risk factor 	2
<ul style="list-style-type: none"> • Identifies a risk factor OR <ul style="list-style-type: none"> • Outlines a safe work practice 	1

Sample answer:

The risk involved with culturing bacteria is that a dangerous strain may be exposed to students and staff. A safe work practice is to NOT open the sealed agar plates but dispose of them in contaminated waste containers and wash hands thoroughly after handling.

Question 33 (e)

Criteria	Marks
<ul style="list-style-type: none"> • Demonstrates a comprehensive knowledge and understanding of the topic • Describes the historical development of our understanding of the causes of disease • Links the contributions of TWO of Lister, Pasteur and Koch • Describes the relationship between advances in knowledge of the causes of disease and advances in pharmaceuticals • Answer is logical, coherent and uses scientific terminology 	7
<ul style="list-style-type: none"> • Demonstrates a thorough knowledge and understanding of the topic • Describes the historical development of our understanding of the causes of disease • Links knowledge of the causes of disease with the development/use of pharmaceuticals • Links the contributions of at least ONE of Lister, Pasteur and Koch • Answer is logical, coherent and uses some scientific terminology 	5–6
<ul style="list-style-type: none"> • Demonstrates a sound knowledge and understanding of the topic • Describes the contribution of Lister and/or Pasteur and/or Koch AND/OR links knowledge of causes of disease with the development/use of pharmaceuticals • Uses some scientific terminology 	3–4
<ul style="list-style-type: none"> • Demonstrates a limited/basic knowledge and understanding of the topic • Provides some relevant information about Lister and/or Pasteur and/or Koch AND/OR Provides some relevant information about disease and pharmaceuticals 	1–2

Sample answer:

In the mid 1800s, Louis Pasteur discovered that food spoilage and fermentation were caused by microbes. He further discovered that particular microbes caused disease in silkworms and that different microbes (bacteria) caused diseases like anthrax in sheep. Robert Koch, working in Germany, was aware of Pasteur's work on microorganisms and devised a series of steps to identify the particular microbe or bacteria that caused a specific disease. These steps, or postulates, have helped scientists to identify the causes of infectious diseases.

Once the cause of a disease is known, pharmaceuticals can be developed that can target the microbe that causes the disease and help the body fight the infection. Early pharmaceuticals, like penicillin, were developed by observation of the effect of the fungus *Penicillium notatum* on the growth of bacteria. This is a broad spectrum antibiotic that inhibits the growth of a wide range of bacteria.

With the discoveries by Pasteur and Koch, that different diseases are caused by different bacteria, newer antibiotics have been developed that target specific bacteria or groups of bacteria such as doxycycline or erythromycin. These can either affect the rates of cell division, destroy cell walls or inhibit growth. This reduces the negative effect on the beneficial bacteria/microflora that inhabit a human body and also helps reduce the development of antibiotic resistance by bacteria.

Progress in the development of pharmaceuticals would not have been possible if earlier work by Pasteur and Koch did not provide the means to identify the causes of disease. Their contributions were the foundation of later discoveries and developments in the pharmaceutical industry.

Question 34 (a) (i)

Criteria	Marks
• States a specific Australian disaster that was the result of both processes	1

Sample answer:

Thredbo landslide

Question 34 (a) (ii)

Criteria	Marks
• Describes a method to reduce damage in similar circumstances	2
• Outlines a method to reduce damage in similar circumstances	1

Sample answer:

A regular maintenance schedule of roads and stronger materials can be used, eg at Thredbo the road where the landslide began is now supported by massive gabion retaining walls.

Question 34 (b) (i)

Criteria	Marks
• Links differences in air pressure to the movement of the egg into the flask	2
• States a reason for the egg entering the flask	1

Sample answer:

The flame inside the flask causes the air to expand and escape and lowers the air pressure in the flask. Outside the flask the air pressure is higher. When the egg is placed on the top of the flask the higher air pressure outside the flask pushes the egg into the flask.

Question 34 (b) (ii)

Criteria	Marks
• Gives a characteristic and feature of how a tropical cyclone forms	4
• States steps involved in the formation of a cyclone	3
• States a step involved in the formation of a cyclone	2
• Any relevant information	1

Sample answer:

Cyclones are examples of extremely violent storms produced by a large difference in air pressure. They normally form over oceans near the equator where warm, moist air is rising and more air is being drawn in to replace it.

Very low pressure at the centre causes surface winds to spiral inwards towards the low pressure area (eye) where it forms an intense vortex around the eye. As a result the air pressure rises as the cyclone builds and then falls dramatically when the eye hits.

Question 34 (c)

Criteria	Marks
• Links reasons with two steps	4
• States two steps, giving reasons for one of the steps	3
• States two steps OR • Gives reasons for one step	2
• States one step	1

Answers could include:

Stay on flat ground / do not run uphill away from the fire because fire spreads more rapidly uphill. Stay in a vehicle / cover yourself with a blanket to reduce potential exposure to smoke and radiant heat.

If inside a house, remain indoors with windows and doors closed to restrict the entry and spread of flames and smoke. Monitor emergency messages.

Question 34 (d) (i)

Criteria	Marks
• Sketches in general terms the steps involved	3
• Identifies some steps	2
• Identifies a step	1

Sample answer:

Detectors detect smoke or heat. The detectors cause the activation of the sprinkler system in the region of the fire. A supply of water must be maintained throughout the fire. Once the fire is controlled the sprinkler system is turned off.

Question 34 (d) (ii)

Criteria	Marks
• Links a reason for evacuation procedures	2
• States a reason for evacuation procedures	1

Sample answer:

Evacuation drill procedures are necessary in the workplace to ensure that in an emergency everyone can be safely removed from the area and those in charge can account for everyone.

Question 34 (e)

Criteria	Marks
<ul style="list-style-type: none"> • Demonstrates comprehensive knowledge and understanding of the topic • Describes the roles of the police, ambulance and SES • Links these roles to the minimisation of the effects of disasters • Describes the interactions between these services • Answer is logical, coherent and uses scientific terminology 	7
<ul style="list-style-type: none"> • Demonstrates thorough knowledge and understanding of the topic • Describes the roles of the police, ambulance and SES • Links these roles to the minimisation of the effects of disasters AND/OR outlines interactions between two of these services • Answer is logical, coherent and uses some scientific terminology 	5–6
<ul style="list-style-type: none"> • Demonstrates sound knowledge and understanding of the topic • Describes the roles of two of these services AND/OR links one of the services to the minimisation of the effects of disasters • Uses some scientific terminology 	3–4
<ul style="list-style-type: none"> • Demonstrates limited/basic knowledge and understanding of the topic • Provides some relevant information about a service AND/OR provides some relevant information about any disaster 	1–2

Answers could include:

Roles of the police:

- they help to control bystanders
- they coordinate every other service making sure they are all doing their jobs
- investigate causes.

Roles of the ambulance:

- they provide First Aid to injured people
- they rush the extremely injured people to hospital
- help rescue victims.

Roles of the SES:

- volunteers helping communities cope with emergencies
- search and rescue
- clean up.

These services need to work closely together communicating with each other during times of disaster. In this way they are more efficient and help to minimise the effects of the disaster.

Question 35 (a) (i)

Criteria	Marks
• States a correct component of the STS	1

Sample answer:

Orbiter (not shuttle) OR external fuel tank OR ceramic tile

Question 35 (a) (ii)

Criteria	Marks
• Relates a correct Australian example to what it is able to do	2
• Provides a correct Australian example	1

Sample answer:

Radiotelescope at Narrabri helped to produce images of colliding galaxies OR Parkes telescope produces information about pulsars.

Question 35 (b) (i)

Criteria	Marks
• Outlines a situation on Earth and gives a reason for the behaviour of the water	2
• Outlines a situation on Earth or gives a reason	1

Sample answer:

On Earth when the bottle is in freefall (dropped) the water will remain inside the bottle during the fall. This is because it is experiencing weightlessness.

Question 35 (b) (ii)

Criteria	Marks
• Links distance of planets from the Sun, mass and gravity of the planets to the revolution around the Sun	4
• Links either distance of planets from the Sun OR mass and gravity of the planets to the revolution around the Sun	3
• Links either mass OR gravitational pull OR distance from the Sun to revolution of planets	2
• Any relevant information	1

Sample answer:

The orbits of the planets around the Sun are caused by the gravitational pull of the Sun. The Sun's gravitational pull on the planets increases as the mass of the planet increases and decreases as the distance of the planet from the Sun increases. The force of gravity the Sun exerts on the planets causes the path of the planets to be approximately circular. The further the planets are from the Sun the greater the time it takes them to orbit the Sun.

Question 35 (c)

Criteria	Marks
• Links density of gases and concentration of gases to their position in the atmosphere	4
• Links density of gases OR concentration of gases to their position in the atmosphere	3
• Gives characteristics of density of gases OR concentration of gases in relation to their position in the atmosphere	2
• Any relevant information	1

Sample answer:

With increasing altitude the density of the atmosphere decreases due to a lower concentration of gas particles. Due to the Earth's gravitational pull, pressure in the atmosphere results in greater densities at the Earth's surface.

Question 35 (d) (i)

Criteria	Marks
• States a similarity AND a difference of the types of information gathered by Hubble and Voyager	3
• States similarities OR differences of the types of information gathered by Hubble and Voyager	2
• Any relevant information	1

Sample answer:

Both Hubble and Voyager missions gather visible light in order to obtain the clearest images of their mission targets.

Hubble gathers images and data from within our galaxy and the universe beyond whereas Voyager missions gathered images and data from the outer planets within our Solar System.

Question 35 (d) (ii)

Criteria	Marks
• Describes an advantage of Hubble over Earth-based telescopes • Gives a reason for this being advantageous	2
• States an advantage of the Hubble telescope over Earth-based telescopes	1

Sample answer:

Hubble telescope obtains images that are much clearer than Earth-based optical telescopes due to its position above most of Earth's atmosphere.

Question 35 (e)

Criteria	Marks
<ul style="list-style-type: none"> • Demonstrates comprehensive knowledge and understanding of the topic • Describes technologies that operate in space • Links long-term survival in space to how the body works and new technologies • Describes the relationship between harmful effects on the body of living in space and strategies used to minimise these effects • Answer is logical, coherent and uses scientific terminology 	7
<ul style="list-style-type: none"> • Demonstrates thorough knowledge and understanding of the topic • Describes at least ONE technology that operates in space • Links long-term survival in space to how the body works OR new technologies • Describes the relationship between harmful effects on the body of living in space and strategies used to minimise these effects • Answer is logical, coherent and uses some scientific terminology 	5–6
<ul style="list-style-type: none"> • Demonstrates sound knowledge and understanding of the topic • Outlines a technology that operates in space • Outlines harmful effects on the body of living in space and a strategy used to minimise these effects • Uses some scientific terminology 	3–4
<ul style="list-style-type: none"> • Demonstrates limited/basic knowledge and understanding of the topic • Provides some relevant information about living in space AND/OR Provides some relevant information about a technology used in space AND/OR Provides some relevant information about how the body works 	1–2

Answers could include:

Microgravity causes muscle atrophy. By ensuring astronauts carry out resistance exercises using machines that operate in zero gravity for at least two hours per day, muscle deterioration is minimised.

Microgravity also causes a loss of bone density. By taking calcium supplements and carrying out resistance exercises, calcium uptake is optimised and loss of bone density is minimised.

The air within a spacecraft is constantly being recycled. Excessive CO₂ is toxic to the human body. CO₂ needs to be removed by scrubbers to maintain the CO₂ at an acceptable level.

Communication technologies such as mobile phone technology are employed to ensure astronauts are frequently in contact with family and friends. This assists with their psychological wellbeing.

2016 HSC Senior Science Mapping Grid

Section I Part A

Question	Marks	Content	Syllabus outcomes
1	1	H10	9.4.2.2.1, 9.4.6.2.1
2	1	H8	9.2.1.2.3
3	1	H8	9.2.1.2.5
4	1	H3	9.3.5.2.2
5	1	H9	9.2.5.2.1
6	1	H8	9.2.5.2.7
7	1	H7	9.3.4.2.1
8	1	H4, H7, H9,	9.3.2.2.9
9	1	H4, H8	9.2.5.2.5, 9.2.5.2.6
10	1	H3, H4, H10	9.4.1.2.3
11	1	H8	9.3.3.2.5
12	1	H1, H3, H10	9.4.6.2.3
13	1	H9	9.2.3.2.4
14	1	H1, H3, H10	9.4.2.2.1, 9.4.2.2.3, 9.4.3.2.1
15	1	H1, H3, H10	9.4.3
16	1	H9, H14	9.3.4.3.2
17	1	H10	9.4.2.2.1
18	1	H3, H10	9.4.4
19	1	H9, H14	9.3.2.2.1
20	1	H10, H13, H14	9.4.5.2.3

Section I Part B

Question	Marks	Content	Syllabus outcomes
21 (a)	3	H8, H13.1.e	9.2.1.2.3
21 (b)	2	H8	9.2.1.2.2
22	3	H9	9.3.4.2.2
23	4	H3, H4, H6	9.4.6
24 (a)	2	H10	9.4.2.3.1
24 (b)	2	H10	9.4.2.3.1
24 (c)	2	H10	9.4.3.2.3, 9.4.3.3.1, 9.4.2.3.1
25 (a)	3	H14.1.f	9.3.4.3.1, H14
25 (b)	2	H14.1.f	9.3.4.3.1, H14.1f
26	4	H10	9.4.1.3.1, 9.4.1.2.5
27 (a)	2	H4, H6, H8, H12.1.d	9.2.1.3.1

Question	Marks	Content	Syllabus outcomes
27 (b)	6	H4, H6, H7, H8, H9	9.2.3.2.5, 9.2.3.3.2, 9.2.3.2.4, 9.2.3.2.1
28	6	H8	9.3.3.2.6, 9.3.3.2.8, 9.3.3.3.6
29 (a)	4	H2, H13.1.f	9.2, H13.1.f
29 (b)	2	H2, H13.1.f, H14.1.a	9.2, H13.1.f
30	8	H1, H5, H8, H9, H10, H13	9.2, 9.3, 9.4

Section II

Question	Marks	Content	Syllabus outcomes
Question 31		Polymers	
(a) (i)	1	H8	9.5.1.2.3
(a) (ii)	2	H6, H8	9.5.1.2.1
(b) (i)	2	H14.1.a	9.5.1.2.4, 9.5.1.2.5
(b) (ii)	4	H11.2.c	9.5.2.3.1
(c)	4	H6, H1	9.5.2.2.3
(d) (i)	3	H11.2.c	9.5.4.3.3
(d) (ii)	2	H12.1.d	H12.1.d
(e)	7	H1, H3, H8, H13	9.5.3
Question 32		Preservatives and Additives	
(a) (i)	1	H8	9.6.4.2.1
(a) (ii)	2	H8	9.6.2.3.2, 9.6.2, 3.3
(b) (i)	2	H4, H6, H8, H13.1.b/d	9.6.5.2.1, 9.6.5.2.4
(b) (ii)	4	H8, H14.1.d	9.6.5.2.1
(c)	4	H8, H4	9.6.1.2.1, 9.6.1.2.2
(d) (i)	3	H11.2.c	9.6.3.2.2, 9.6.3.3.2
(d) (ii)	2	H12.1.d	H12.1.d
(e)	7	H8, H1, H13	9.6.2
Question 33		Pharmaceuticals	
(a) (i)	1	H9	9.7.1.2.6
(a) (ii)	2	H9	9.7.1.2.7
(b) (i)	2	H9	9.7.2..3.1
(b) (ii)	4	H7, H8, H9, H14	9.7.3
(c)	4	H7, H9	9.7.3.2.2, 9.7.3.3.1
(d) (i)	3	H3, H8, H11.2.c	9.7.4.3.2
(d) (ii)	2	H2, H3, H12.1.d	H12.1.d
(e)	7	H1, H7, H8, H9, H11, H13, H14	9.7.4
Question 34		Disasters	
(a) (i)	1	H6	9.8.1.2.4
(a) (ii)	2	H1, H3, H6	9.8.1.3.2

Question	Marks	Content	Syllabus outcomes
(b) (i)	2	H10, H6, H4, H14g	9.8.2.3.1
(b) (ii)	4	H4	9.8.2.2.3
(c)	4	H2, H3, H10	9.8.3.3.7
(d) (i)	3	H10, H6	9.8.4.2.1
(d) (ii)	2	H11.3.b	9.8.4.3.3
(e)	7	H3, H7, H6, H13	9.8.5
Question 35		Space Science	
(a) (i)	1	H6, H8, H10	9.9.4.2.1
(a) (ii)	2	H1, H3, H4, H5	9.9.5.3.4
(b) (i)	2	H2, H14.1.d/h	9.9.2.2.2
(b) (ii)	4	H1, H2	9.9.2.2.1
(c)	4	H6	9.9.1.2.1, 9.9.1.2.2
(d) (i)	3	H1, H3, H4, H10	9.9.5.2.5
(d) (ii)	2	H1, H3, H6, H10	9.9.5.2.5, 9.9.5.3.1, 9.9.5.2.4
(e)	7	H1, H3, H4, H6, H7, H8, H9, H10, H13	9.9.6