NSW EDUCATION STANDARDS AUTHORITY

2017 HSC Senior Science Marking Guidelines

Section I, Part A

Multiple-choice Answer Key

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

Section I, Part B

Question 21 (a)

Criteria	Marks
• Correctly identifies a variable that needs to be kept constant	1

Sample answer:

The volume of the solvent the tablet is dissolved in.

Question 21 (b)

Criteria	Marks
• Provides a correct method including repetition • Outlines TWO different conditions • Provides control of a fixed variable	4
• Provides a method involving TWO conditions • Identifies control of fixed variable OR includes repetition	3
• Provides a method	2
• Provides some relevant information	1

Sample answer:

Four test tubes containing a pH = 1 solution (representing the stomach) and four test tubes containing a pH = 7 (representing the small intestine) were set up at the same temperature (37°C) and containing the same volume of solvent.

Two tablets and two enteric-coated tablets were placed in separate test tubes for each of the different pH conditions and the time taken for each of the tablets and enteric-coated tablets to dissolve was measured.

Question 22 (a)

Criteria	Marks
• Provides TWO correct properties	2
• States a correct property	1

Sample answer:

Pyrolytic carbon has a low coefficient of friction (ie it is very slippery) and is durable.

Question 22 (b)

Criteria	Marks
• Provides detailed links between the properties of pyrolytic carbon and its use in heart valves	3
• Provides a clear link between a property of pyrolytic carbon and its use in heart valves OR • Provides links between properties and uses of pyrolytic carbon	2
• Provides some relevant information	1

Sample answer:

Pyrolytic carbon is slippery which prevents blood cells sticking to it, which reduces the risk of blood clots forming. Also, being durable, it will not break down in the turbulent, constantly moving environment of the heart.

Question 23

Criteria	Marks
• Describes properties of detergents and relates these properties to their use/s	6
• Describes properties of detergents and relates a property to their use	5
• Describes one property and a use of detergents	4
• Identifies properties and a use of detergents	3
• Identifies a property and a use of detergents OR • Identifies properties	2
• Any relevant information	1

Sample answer:

Detergent molecules have two key parts. One part is charged (polar) and thus forms bonds with water molecules, which are strongly polar. The other part is a long-chained component of the molecule, which interacts strongly with oils that consist of similarly long-chained molecules.

Detergents are used to emulsify oils in water so that the oils can be washed or cleaned from materials more easily.

Agitation breaks oils into droplets, which become surrounded by detergent molecules with their polar ends outside the oil droplets. Water molecules are attracted to the exposed polar parts of the detergent molecule and the outward-facing polar ends of the water molecules cause repulsion between the engulfed oil droplets so they remain dispersed and can be easily washed away by the water.

Question 24 (a)

Criteria	Marks
• Outlines a correct use	1

Sample answer:

Transmission of microwave signals for communication.

Question 24 (b)

Criteria	Marks
• Correctly identifies THREE criteria	3
• Identifies TWO criteria	2
• Identifies ONE criterion OR • Provides some relevant information	1

Sample answer:

Criteria for a geostationary satellite include:

- they are in a high-Earth orbit (36 000 km)
- they orbit above Earth's equator
- they travel in the same direction that Earth rotates on its axis.

Answers could include:

24-hour orbit instead of 36 000 km altitude.

Question 25 (a)

Criteria	Marks
• Identifies a relevant precaution and links to risk	2
• Identifies a relevant precaution	1

Sample answer:

If using an electrical beater be careful to keep your fingers away from the rotating blades as they might damage your fingers.

Question 25 (b)

Criteria	Marks
• Names the type of mixture • Correctly explains a feature of the mixture	3
• Names the type of mixture AND correctly identifies a feature OR • Explains a feature	2
• Provides some relevant information	1

Sample answer:

The small air bubbles were captured in the liquid of the egg white. The trapped air causes the volume of liquid to increase. The resulting mixture is a foam.

Answers could include:

- The resulting mixture is a colloid
- There are changes in texture or colour.

Question 26

Criteria	Marks
• Clearly describes differences between television and mobile communications • Links differences to impacts on the way society communicates	6
• Describes differences between television and mobile communications • Links to impact on the way society communicates	5
• Contrasts a difference between television and mobile communications • Describes an impact on the way society communicates	4
• Correct statements about differences between television and mobile communications AND/OR • Describes an impact on the way society communicates	2–3
• Provides some relevant information	1

Sample answer:

A television program may be viewed by millions of people around the world, whereas a mobile phone conversation is usually between two people (or small group). Television is therefore able to influence the knowledge or thinking (political programs, advertising) of large numbers of people over a short period of time, while mobile phone communication is restricted to a few people.

Television communications have tended to be one-way (passive) whereas mobile phone communication is two-way (interactive). Television provides images or information that cannot be directly challenged or clarified whereas mobile phone communications allow discussion, debate or clarification of issues.

Question 27 (a)

Criteria	Marks
• Identifies uses of AM radio waves and microwaves and relates these to the differences in their frequencies	2
• Identifies a use of radio waves or microwaves OR • States that microwaves have a higher frequency than radio waves	1

Sample answer:

Microwaves have a higher frequency than the waves used for AM radio and so microwaves can be used to transmit more information in a given time. Microwaves are used for mobile phones, which transmit images and other data whereas AM radio waves transmit only audio information.

Answers could include:

Reference to bandwidth and number of channels.

Question 27 (b)

Criteria	Marks
• Outlines clearly how TWO identified variables could be kept constant	3
• Outlines how ONE identified variable could be kept constant OR • Identifies TWO variables that would need to be kept constant	2
• Provides some relevant information	1

Sample answer:

The same sounds would need to be used in the comparison and the sounds would have to be listened to using the same speakers. The first could be achieved by listening to the same music broadcast by each type of radio station. The second could be achieved by using an AM/FM radio and switching from one band to the other so the stations would be heard through the same speakers.

Question 28 (a)

Criteria	Marks
• Correctly identifies TWO methods	1

Sample answer:

Cemented and uncemented.

Question 28 (b)

Criteria	Marks
• Clearly outlines ONE advantage of each method AND • Clearly outlines ONE disadvantage of each method	4
• Outlines ONE advantage of each method AND outlines a disadvantage of a method	3
• Identifies an advantage of either method • Identifies a disadvantage of either method	2
• Provides some relevant information	1

Sample answer:

Using cement to fix an artificial limb is quick to achieve full strength. However, the cement can break down after a while. Uncemented fixings have bioactive surfaces so the process takes longer to achieve full strength and is usually used on younger patients as it will last longer.

Question 29

Criteria	Marks
• Provides examples of each technique • Clearly links each example to an increase in understanding of how the body works	6
• Provides examples of one technique and one example of the other • Links each example to an increase in understanding of how the body works	5
• Provides examples of one technique and one example of the other • Links an example to an increase in understanding of how the body works OR • Provides an example of each technique • Links each example to how the body works	4
• Provides an example of each technique • Links an example to how the body works OR • Provides examples of one technique • Links examples to how the body works	3
• Provides an example of a technique • Attempts to link example to how the body works OR • Provides two examples OR • Outlines how a technique improves our understanding of the body	2
• Provides some relevant information	1

Sample answer:

Laparoscopy and colonoscopy are examples of minimally invasive techniques. Laparoscopy is a type of keyhole surgery that is used to see what might be causing certain problems in our body, such as pelvic pain or infertility. Colonoscopy enables the viewing of the wall of the large intestine allowing us to see how polyps or tumours develop over time.

Thermography and ultrasound are non-invasive techniques. Thermography has increased our understanding of how blood flow near the surface of the skin is altered in response to injury or infection. Ultrasound allows us to observe the development of the foetus, checking its growth and position and alerting medical staff to any possible complications before the baby is born.

Question 30 (a)

Criteria	Marks
• Correctly outlines procedures used for THREE variables that need to be controlled for a valid comparison to be made	3
• Outlines procedures for TWO variables that need to be controlled • May include non-essential variables	2
• Identifies a relevant procedure or variable	1

Sample answer:

For the comparison to be valid, three identical containers must have the same volume of water. The same amount of oils A, B and C must be added and each mixture must be shaken for the same length of time before timing begins.

Question 30 (b)

Criteria	Marks
• Correctly draws a table with columns and rows • Table has relevant headings, including units • Data correctly entered	2
• Provides a partially correct table	1

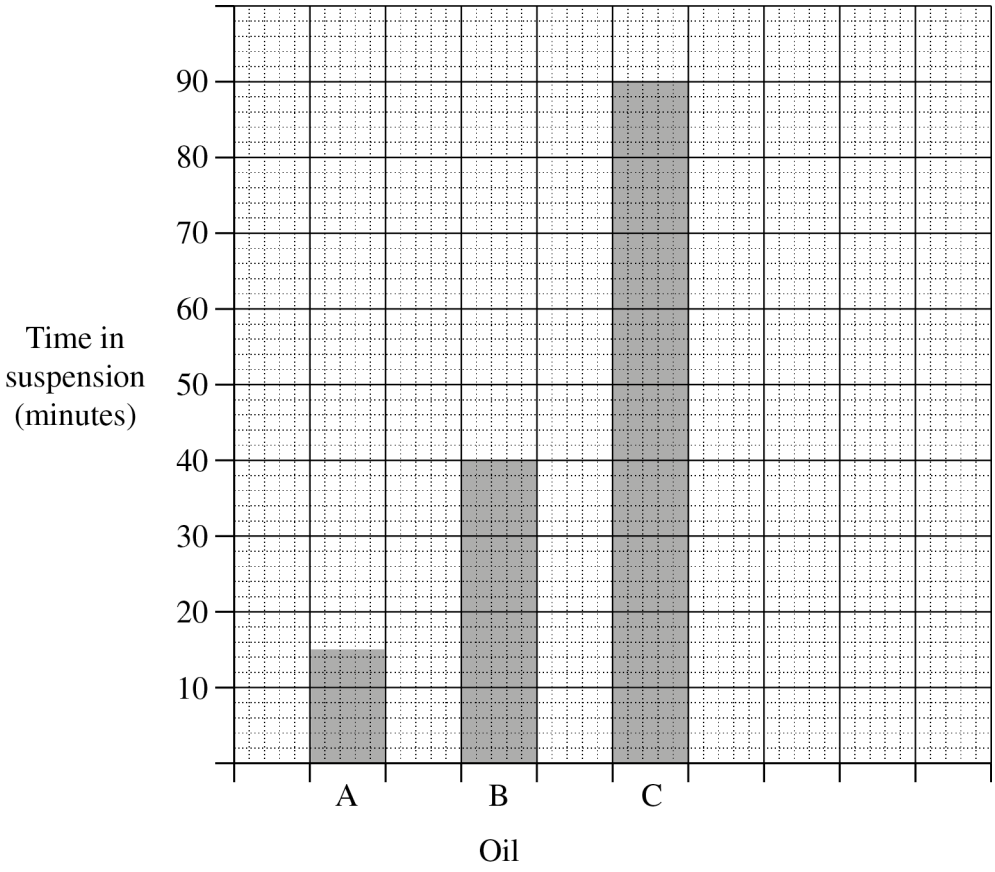
Sample answer:

Oil	*Time in suspension* (minutes)
A	15
B	40
C	90

Question 30 (c)

Criteria	Marks
• Constructs a column/bar graph • Axes correctly labelled • Units present • Correct plot	3
• Provides a mostly correct graph	2
• Some relevant graphing skill shown	1

Sample answer:



Section II

Question 31 (a) (i)

Criteria	Marks
• Provides a correct name for a synthetic polymer	1

Sample answer:

Polyethylene

Question 31 (a) (ii)

Criteria	Marks
• Clearly outlines how a valid use of the synthetic polymer is related to its properties	3
• Outlines how a valid use of the synthetic polymer is related to a property OR • Provides properties of the synthetic polymer	2
• Provides some relevant information	1

Sample answer:

Polyethylene is very flexible and can be made into very thin film. This makes it suitable to be used as cling wrap.

Question 31 (b) (i)

Criteria	Marks
• Provides a correct outline of the process shown	2
• Provides some relevant information	1

Sample answer:

The images show the process of polymerisation. In Image 1, separate small molecules are shown. In Image 2, these monomers have started to join together to form a large molecule, which is completed as a polymer in Image 3.

Question 31 (b) (ii)

Criteria	Marks
• Provides a coherent, logical response linking implications to the non-renewable nature of petroleum	4
• Links an implication to the non-renewable nature of petroleum	3
• Outlines an implication	2
• Provides some relevant information	1

Sample answer:

Most synthetic polymers are sourced from petroleum. Currently, it is difficult and uneconomic to produce synthetic polymers from alternative sources that have similar properties to the ones widely in use by society. However, petroleum is a non-renewable resource that is also used extensively as an energy source. Within the next 50 to 100 years it is predicted that petroleum reserves will run out. As the supply of petroleum decreases, costs of synthetic polymers will rise and there could be shortages. Research into cheap, alternative sources of synthetic polymers as well as more effective recycling will need to increase to meet demand.

Question 31 (c)

Criteria	Marks
• Provides a detailed explanation of the problems associated with recycling plastics	4
• Provides an explanation of the problems associated with recycling plastics	3
• Attempts to provide an explanation of the problems associated with recycling plastics	2
• Provides some relevant information	1

Sample answer:

Plastics are polymers that can be moulded or shaped. There are many different classes of plastics which can create problems for recycling. Plastics have to be sorted (usually in a highly labour-intensive process). Even plastics of the same class, such as blown HDPE bottles, will have different melting points and so it is difficult to recycle the mixture. It is illegal to use recycled plastics for food containers, so even plastic that has been recycled is generally turned into a lower quality item. Additives such as plasticisers, stabilisers and fire retardants can include toxic substances, and so it is impractical to recycle these.

Question 31 (d) (i)

Criteria	Marks
• Provides purposes of the code/s	2
• Provides some relevant information	1

Sample answer:

The codes provide consumers with information about the type of plastic to allow it to be identified and also to help in sorting plastics.

Question 31 (d) (ii)

Criteria	Marks
• Provides a detailed explanation of how to assess the reliability of secondary sources	3
• Provides an explanation of how to assess the reliability of secondary sources	2
• Provides some relevant information	1

Sample answer:

The information is from an individual or organisation that is an acknowledged expert in the field, such as government websites and must be repeated in other reputable sources.

Question 31 (e)

Criteria	Marks
• Identifies natural polymers • Outlines a range of properties of those polymers • Describes uses in society • Makes a clear judgement based on criteria	6
• Identifies natural polymers • Outlines properties of those polymers • Describes uses in society • Provides a judgement	4–5
• Identifies natural polymers and/or provides properties and/or provides a use in society	3
• Identifies a natural polymer and/or provides a property and/or provides a use in society	2
• Provides some relevant information	1

Sample answer:

Wool and cotton are natural fibres that have had a significant impact on society. Because they are produced from animals and plants respectively, they have been used for making fabrics for thousands of years.

Wool has good insulation properties even when it is wet, so its use to make warm clothing has contributed to the survival of humans in cold climates. Wool has a low flammability making it useful and safe for clothing, especially for infants and elderly people. The good elasticity of wool has also made it useful for clothing that allows people to move freely when wearing it. These properties of wool have contributed directly to its benefit to society and hence its widespread use.

Cotton has an affinity for a range of dyes and this has increased its appeal and use in fabrics for a range of uses. Cotton absorbs moisture readily, making it useful for making clothing that is comfortable in hot climates. Cotton fibres are resistant to abrasion and so it is useful in society for making durable cotton fabric for use in clothing.

Both wool and cotton have been very significant in their economic contributions to society in terms of the benefits to the producers of the raw fibres, the manufacturers of products made from cotton and wool as well as the retailers.

Question 32 (a) (i)

Criteria	Marks
• Identifies a physical means of food preservation	1

Sample answer:

Refrigeration

Question 32 (a) (ii)

Criteria	Marks
• Clearly describes how the method in (i) is able to preserve food	3
• Describes how the method in (i) is able to preserve food	2
• Provides some relevant information	1

Sample answer:

Refrigeration lowers the temperature of the environment the food is exposed to. This temperature, of around 4°C, severely inhibits the growth and reproduction of most microorganisms found in food. This means the numbers present in the food are usually not significant enough to cause illness to consumers.

Question 32 (b) (i)

Criteria	Marks
• Outlines the difference in the use of the terms • Provides the correct meaning for one	2
• Provides a correct meaning for one OR • Outlines a difference	1

Sample answer:

Fruit juice must be wholly made up from fruit or vegetables or reconstituted juice, whereas fruit drink may be made up of one or more different fruits – no less than 50 mL/L – plus added water, sugars and other additives like preservatives, flavours and colouring.

Question 32 (b) (ii)

Criteria	Marks
• Describes problems • Gives reasons why these are problems	4
• Outlines problems • Provides a reason for these being problems	3
• Identifies a problem and a reason for this being a problem OR • Identifies problems	2
• Identifies a relevant issue	1

Sample answer:

Negative labelling such as the use of 'no preservatives' may create the impression that all preservatives are harmful. This may limit the availability of some foods to consumers but also risk the omission of essential and affordable foods. Labels that use the words 'no added sugar' can mislead consumers into thinking that they have no sugar in them when in fact the natural product, such as fruit, dried fruits etc, is high in natural sugars and therefore high in kilojoules.

Question 32 (c)

Criteria	Marks
• Identifies a specific cause of food poisoning • Links this cause to relevant symptoms • Provides method of treatment • Links the treatment to the cause and/or symptoms of the poisoning	4
• Identifies a specific cause of food poisoning • Describes symptoms • Outlines treatment of the poisoning	3
• Identifies a cause of food poisoning AND/OR • Describes a symptom of food poisoning AND/OR • Outlines a treatment of the poisoning	2
• Some relevant information about food poisoning	1

Sample answer:

Bacteria like *Clostridium botulinum* can cause severe food poisoning. The bacteria multiples rapidly in bottled or canned food that has not been heated high enough to kill the bacteria. The toxin from *Clostridium* attacks the nervous system causing gradual paralysis and possibly death due to respiratory failure. Treatment includes an antitoxin injection to attach to the toxin and prevent it from harming the nerves. Respiratory support is also needed until the body can recover.

Question 32 (d) (i)

Criteria	Marks
• Provides a correct definition	2
• Provides a feature	1

Sample answer:

Bacteriocins are chemical compounds that are produced by different bacteria which inhibit the growth of other bacteria.

Question 32 (d) (ii)

Criteria	Marks
• Provides a detailed explanation of how to assess the reliability of secondary sources	3
• Provides an explanation of how to assess the reliability of secondary sources	2
• Provides some relevant information	1

Sample answer:

The information is from an individual or organisation that is an acknowledged expert in the field, such as government websites and must be repeated in other reputable sources.

Question 32 (e)

Criteria	Marks
• Outlines advances in scientific understanding • Outlines advances in technologies • Links advances in scientific and technological understanding with food preservation • Describes the impacts	6
• Outlines scientific advances regarding food preservation • Outlines advances in technologies regarding food preservation • Describes the impacts	5
• Outlines scientific advance(s) regarding food preservation • Outlines advances in technology(ies) regarding food preservation • Outlines impact(s)	4
• Provides a method of food preservation • Identifies an advance in technology or scientific understanding • Identifies an impact	3
• Provides a method of food preservation OR • Identifies an advance in technology or scientific understanding AND/OR • Identifies an impact	2
• Provides some relevant information	1

Sample answer:

Early methods of food preservation such as drying, pickling or salting are long-standing technologies that were based on observable results.

Discoveries, using microscopes, of microbes that were shown to cause food spoilage, led to other methods that targeted the microbe. Chemicals that kill microbes, like nitrates and sulfites, as well as boiling and pasteurisation that also kill most pathogens, were then used. This makes more food available to the wider population for a longer time as the food remains edible, as it is less prone to spoilage.

Further scientific discoveries and advances in technology that have led to modifying the environment of microbes, such as vacuum packing and freezing, would not have been possible without the scientific understanding of how microbes live and reproduce.

More recent advances in technology have seen the use of UHT and irradiation that kill microbes and give food extended shelf life.

Natural preservatives like bacteriocins have been used more recently to replace artificial preservatives. The discovery of their effect on microbes has led to their wide usage due to their stability, and because they are non-toxic, non-allergenic and readily digested.

Question 33 (a) (i)

Criteria	Marks
• Identifies the term	1

Sample answer:

Reaction time

Question 33 (a) (ii)

Criteria	Marks
• Clearly outlines differences between the responses in terms of the brain and time for the response	3
• Outlines differences between the responses in terms of either the brain or time for the response	2
• Provides some relevant information	1

Sample answer:

A reflex action does not involve conscious processing by the brain whereas in the driver's reaction time, the brain processes visual information before a conscious decision is made to apply the brake. Reflex times are shorter than reaction times.

Question 33 (b) (i)

Criteria	Marks
• Identifies the sample and provides a reason for the choice	2
• Identifies the sample correctly OR • Provides relevant information about the action of penicillin	1

Sample answer:

Sample 2 is consistent with the presence of penicillin since penicillin stops bacteria dividing.

Question 33 (b) (ii)

Criteria	Marks
• Clearly outlines both observations and inferences in a manner that reflects understanding of the discovery	4
• Outlines both observation/s and inference/s in a manner reflecting some understanding of the discovery	3
• Outlines observation/s or inference/s	2
• Outlines an observation or inference	1

Sample answer:

Examining petri dishes on which *Staphylococcus* bacteria were growing, it was observed that a mould was also growing in the dish and that bacteria were not present in a ring surrounding the mould.

It was inferred that the mould was producing a substance that inhibited bacterial growth and hence that this substance should be able to be isolated.

A mixture extracted from juices produced by this mould killed a wide variety of harmful bacteria but was not toxic to animals.

Question 33 (c)

Criteria	Marks
• Provides a detailed explanation of the effects of aspirin on pain reduction	4
• Provides an explanation of the effect(s) of aspirin on pain reduction	3
• Relates an effect of aspirin to pain reduction	2
• Any relevant information	1

Sample answer:

Aspirin inhibits the formation of prostaglandins. Since one function of prostaglandins is to increase the sensitivity of the pain receptors on nerve endings, inhibiting their formation decreases the intensity of the signals sent to the brain, which interprets the stimulus as pain, and so reduces the pain felt.

Another effect of prostaglandins is to increase blood flow to injured tissue, causing swelling and intensifying pain. Because aspirin reduces prostaglandins it limits the swelling and associated pain.

Question 33 (d) (i)

Criteria	Marks
• Outlines a change in blood vessels and the effect of this on fluid in the blood	2
• Identifies a relevant process	1

Sample answer:

When soft tissue is damaged, capillaries in the tissue become leaky. This allows fluid to move from the circulatory system into this surrounding tissue, causing swelling as the fluid accumulates.

Answers could include:

White cells attracted to the area where tissue is damaged release histamines and prostaglandins that promote the process of inflammation.

Question 33 (d) (ii)

Criteria	Marks
• Provides a detailed explanation of how to assess the reliability of secondary sources	3
• Provides an explanation of how to assess the reliability of secondary sources	2
• Provides some relevant information	1

Sample answer:

The information:
Is from an individual or organisation that is an acknowledged expert in the field, such as government websites and must be repeated in other reputable sources.

Question 33 (e)

Criteria	Marks
• Provides a detailed analysis of the relationship between body function and the circulation of chemicals in the bloodstream	6
• Provides an analysis of the relationship between body function and the circulation of chemicals in the bloodstream	5
• Provides an explanation of the relationship between body function and the circulation of chemicals in the bloodstream	4
• Describes the effect of one component of the blood OR • Describes the circulation of chemicals in the bloodstream	3
• Identifies components of the blood	2
• Identifies a component of the blood	1

Sample answer:

The circulatory system delivers chemicals in the blood to every tissue in the body. Because blood contains many different chemicals, as well as having the capacity to transport substances added artificially, it also plays a vital role in controlling and modifying functions of the body.

Natural chemicals in the blood include dissolved oxygen which makes respiration possible. It may also contain prostaglandins to assist with recovery from injury or infection. Blood also carries many hormones — produced by different glands — which control a wide range of processes in the body, such as the flight/fight response produced by adrenalin.

Substances introduced artificially into the blood include hormones such as insulin and other drugs such as aspirin and antibiotics. Aspirin can reduce pain associated with inflammation by inhibiting prostaglandin production that causes pain. Antibiotics introduced into the blood can kill bacteria in the body, helping to restore normal function prevented by these organisms.

Answers could include:

Information about red cells, vitamins, minerals, salts, glucose and their functions in the body, information related to plasma and fluid balance.

Question 34 (a) (i)

Criteria	Marks
• Provides correct response	1

Sample answer:

Atmospheric pressure

Question 34 (a) (ii)

Criteria	Marks
• Describes how tropical cyclones are formed	3
• Outlines how tropical cyclones are formed	2
• Provides some relevant information	1

Sample answer:

Tropical cyclones form over oceans when warm moist air begins to rise. This causes the air pressure at the surface of the ocean to drop, resulting in an intense low pressure system. Strong winds blow in from higher pressure areas. The resulting winds get stronger as this cycle continues, and begin to rotate in a spiral pattern.

Question 34 (b) (i)

Criteria	Marks
• Identifies ALL waves correctly	2
• Identifies at least ONE wave correctly	1

Sample answer:

A L-waves
B S-waves
C P-waves

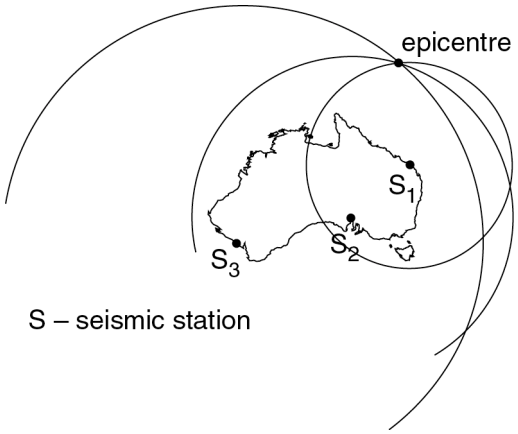
Question 34 (b) (ii)

Criteria	Marks
• Explains all steps required to locate the epicentre	4
• Outlines steps to locate the epicentre	3
• Identifies steps to locate the epicentre	2
• Provides some relevant information	1

Sample answer:

The difference in the arrival times of P and S waves, due to the difference in their speeds can be used to determine the distance of three seismic stations from an earthquake's epicentre. Circles can be drawn on a map, with a radius equal to the distance from each seismic station to the epicentre. The intersection of the three circles indicates the location of the epicentre.

Answers could include:



Question 34 (c)

Criteria	Marks
• Provides a detailed explanation for controlled burns and back-burning	4
• Provides an explanation for back-burning and/or controlled burns	3
• Provides information on back-burning or controlled burns	2
• Provides some relevant information	1

Sample answer:

Back-burning and controlled burns are both intentionally lit fires to reduce the amount of fuel available to fires. During uncontrolled fires, back-burns are used ahead of the fire front to create a barrier against the oncoming fire.

Controlled burns are used during periods of low fire risk to create firebreaks, for protection and better access for fire control equipment.

Question 34 (d) (i)

Criteria	Marks
• Identifies TWO types of information that need to be gathered	2
• Identifies information that needs to be gathered	1

Sample answer:

The student could have gathered the following information:

- When the disaster occurred
- Where the disaster occurred.

Question 34 (d) (ii)

Criteria	Marks
• Provides a detailed explanation of how to assess the reliability of secondary sources	3
• Provides an explanation of how to assess the reliability of secondary sources	2
• Provides some relevant information	1

Sample answer:

The information:
Is from an individual or organisation that is an acknowledged expert in the field, such as government websites and must be repeated in other reputable sources.

Question 34 (e)

Criteria	Marks
• Provides a detailed analysis of how a range of technologies contributes to the prediction of natural disasters	6
• Provides an analysis of how a range of technologies contributes to the prediction of natural disasters	5
• Provides an explanation of how a range of technologies contributes to the prediction of natural disasters	4
• Identifies technologies used to predict natural disasters • Identifies natural disasters	3
• Identifies a technology used to predict natural disasters • Identifies a natural disaster OR • Identifies technologies used to predict natural disasters	2
• Provides some relevant information	1

Sample answer:

Severe weather events such as cyclones and severe thunderstorms can be predicted using weather satellites and ground based radar. Weather satellites provide continuous images of shifting cyclone movement allowing predictions of speed, path and landfall to be accurately made. Ground based radar provides continuous monitoring of rainfall intensity, storm movement and wind speed allowing predictions of flooding and potential damage to be made.

Bushfire conditions can be predicted using data from automatic remote weather stations across the country to provide temperature, humidity, wind speed and direction. Satellite images can provide real-time data on vegetation conditions during high bushfire risk periods.

Question 35 (a) (i)

Criteria	Marks
• Correctly identifies ONE spin-off	1

Sample answer:

Thermal blankets

Question 35 (a) (ii)

Criteria	Marks
• Correctly compares original use to current use in society	3
• Makes a correct statement about usage	2
• Provides some relevant information	1

Sample answer:

New materials were developed for astronauts' gloves. These materials have phase-change thermal properties which absorb excess thermal energy during peak heating periods and discharge heat at other times. These materials are now used in thermal blankets, firefighting gear, scuba diving suits and outer clothing garments.

Answers could include:

Life support systems, pacemakers, ceramics, miniaturisation of electronic systems, carbon fibre composites, foodstuffs and packaging.

Note: The following are often misconceived as spin-offs and are not acceptable answers: Teflon, non-stick fry pans, velcro, space pen, MRI, bar codes, Tang orange juice, cordless power tools, quartz clocks, smoke detectors and microchips.

Question 35 (b) (i)

Criteria	Marks
• Identifies the role of gravity and mass	2
• Provides some relevant information	1

Sample answer:

Gravitational attraction between the mass of the Earth and particles of gas (which have mass) holds the atmosphere to Earth's surface.

Question 35 (b) (ii)

Criteria	Marks
• Explains the benefits that high altitudes provide • Makes reference to diagram	4
• Outlines information about altitude and image quality OR • Correctly refers to diagram • Explains a reason for altitude	3
• Provides some correct information OR makes some valid reference to the diagram	2
• Provides some relevant information	1

Sample answer:

The higher an optical telescope is above sea level the clearer the image. This is due to the fact that distortion, refraction and absorption decrease given fewer numbers of particles in the atmosphere. From the shading on the diagram, it can be inferred that atmospheric density decreases with increasing altitude, minimising the effects of these factors.

Question 35 (c)

Criteria	Marks
• Provides a detailed explanation of contributions made to society by space programs with examples	4
• Provides an explanation of contributions to society by space program with some examples	3
• Identifies contributions – may use examples	2
• Provides some relevant information	1

Sample answer:

Space programs contribute to society in many ways. New satellites are regularly being put into orbit for communications (TV, phones) and information gathering eg weather monitoring. People in space stations regularly conduct experiments and monitor the effects on the human body of long-term space flight in preparation for interplanetary missions.
Space programs continue to gather and process information about planets, stars and galaxies to increase our understanding of the universe.

Question 35 (d) (i)

Criteria	Marks
• Justifies ONE precaution to protect astronauts from radiation	2
• Provides some relevant information	1

Sample answer:

A visor allows the astronaut clear vision yet protects the eyes from harmful solar radiation.

Question 35 (d) (ii)

Criteria	Marks
• Provides a detailed explanation of how to assess the reliability of secondary sources	3
• Provides an explanation of how to assess the reliability of secondary sources	2
• Provides some relevant information	1

Sample answer:

The information:
Is from an individual or organisation that is an acknowledged expert in the field, such as government websites and must be repeated in other reputable sources.

Question 35 (e)

Criteria	Marks
• Provides a detailed explanation of how technological advances have contributed to the space program and space vehicle development	6
• Provides an explanation of how technological advances have contributed to the space program and space vehicle development	5
• Provides a limited of how technological advances have contributed to the space program and space vehicle development	4
• Provides a limited explanation of how technological advances have contributed to the space program or space vehicle development	3
• Provides some relevant information on technological or space vehicle developments	2
• Provides some relevant information	1

Sample answer:

Technological advances have led to larger and more powerful rockets capable of lifting heavier payloads and reaching greater velocities. This has been fundamental in the continuation of space programs over time. They include the Saturn V rocket used for moon landings, missions to the outer planets and beyond, and multiple satellite launches from single rockets.

Better heat resistant materials such as silica tiles allowed the reusable Space Shuttle to transport astronauts to the Space Station and repair the Hubble Space Telescope. New power supplies such as nuclear batteries and solar panels have increased the range of space missions in both space and time.

Technological developments in communication systems have improved the quantity and quality of data with successive missions. For example the Voyager craft transmitted less data more slowly than the New Horizons mission to Pluto more than two decades later.

2017 HSC Senior Science Mapping Grid

Section I
Part A

Question	Marks	Content	Syllabus outcomes
1	1	9.2.1.2.2, 9.2.1.2.3, 9.2.1.3.2	H8
2	1	9.3.4.2.3	H9
3	1	9.4.2.2.3, 9.4.2.2.1	H4, H10
4	1	9.3.2.2.4	H4, H7, H9
5	1	9.2.3.2.1, 9.2.3.2.4	H7, H9
6	1	9.3.5.2.3, 9.4.2.2.4, 9.4.6	H7, H10
7	1	9.3.3.2.3	H9
8	1	9.4.4.2.1, 9.4.4.2.2	H10
9	1	9.2.1.2.4, 9.2.1.3.4	H8
10	1	9.4.1.2.3	H10
11	1	9.4.2.2.1, 9.4.2.3.1, 9.4.5	H3, H10
12	1	9.3.2.2.1, 9.3.2.2.2	H9
13	1	9.2.5.2.1, 9.2.5.2.3/6	H3, H7, H8, H9, H14
14	1	9.3.5.2.2	H9, H10
15	1	9.4.2.2.1, 9.4.2.2.3	H10
16	1	9.4.6.2.1, 9.4.6.2.3	H10
17	1	9.3.2.2.1, 9.3.2.3.7, 9.3.2.3.4	H3, H9
18	1	9.3.2, 14.1 (a), 12.3 (c)	H9, H12, H14
19	1	9.2.4.3.1, 9.1, 12.4 (d), (e)	H12
20	1	9.4.5.2.1, 9.4.1.2.1	H10

Section I
Part B

Question	Marks	Content	Syllabus outcomes
21 (a)	1	9.2.4.3.1, 11.2 (b), 11.2 (c)	H8, H11
21 (b)	4	9.2.4.3.1, 11.2, 11.3 (a)	H8, H11
22 (a)	2	9.3.2.2.7	H9
22 (b)	3	9.3.2.2.7	H9
23	6	9.2.1.3.5, 9.2.2.2.1, 9.2.2.2.3, 9.2.2.2.4	H8
24 (a)	1	9.4.4	H7
24 (b)	3	9.4.4.2.1, 9.4.4.3.1	H7
25 (a)	2	9.2.1.3.3, 11.3 (b)	H11
25 (b)	3	9.2.1.2.3, 9.2.1.3.3	H8
26	6	9.4.1.3.1/2	H4, H10
27 (a)	2	9.4.2.2.1, 9.4.2.2.2, 9.4.3.2.3	H10
27 (b)	3	9.4.3.3.1, 11.2 (b)	H11

Question	Marks	Content	Syllabus outcomes
28 (a)	1	9.3.3.2.9	H3, H9
28 (b)	4	9.3.3.2.10	H3, H9
29	6	9.3.5	H1, H9
30 (a)	3	9.2.1.2.3, 9.2.1.3.2, 11.2 (b)	H2, H11
30 (b)	2	9.2.1.3.2, 13.1 (e)	H13
30 (c)	3	9.2.1.3.2, 13.1 (f)	H13

Section II

Question	Marks	Content	Syllabus outcomes
Question 31		**Polymers**	
(a) (i)	1	9.5.2.2.1	H8
(a) (ii)	3	9.5.2.2.1, 9.5.2.3.2, 9.5.2.3.3	H3, H4, H6, H8
(b) (i)	2	9.5.1.2.1, 9.5.1.2.2, 9.5.1.3.1	H8
(b) (ii)	4	9.5.2.2.2, 9.5.2.2.3	H3, H4, H5, H6
(c)	4	9.5.4.3.1, 9.5.4.3.2, 9.5.3.2.4, 9.5.4.2.4	H3, H4, H8
(d) (i)	2	9.5.4.3.4	H4, H8
(d) (ii)	3	9.5.4.3.4, 12.4 (e)	H12
(e)	6	9.5.1.2.3, 9.5.1.2.4, 9.5.1.2.5, 9.5.4.2.1, 9.5.4.2.2, 9.5.2.2.3	H4, H6, H8
Question 32		**Preservatives and Additives**	
(a) (i)	1	9.6.2.2.1, 9.6.2.2.2	H4
(a) (ii)	3	9.6.2.2.2	H4
(b) (i)	2	9.6.5.2.2	H2
(b) (ii)	4	9.6.5.2.1, 9.6.5.3.1	H4
(c)	4	9.6.3.2.2, 9.6.3.2.3, 9.6.3.3.1	H7
(d) (i)	2	9.6.4.2.2	H8
(d) (ii)	3	9.6.4, 9.1, 12.4 (e)	H12
(e)	6	9.6	H1, H3, H4, H13
Question 33		**Pharmaceuticals**	
(a) (i)	1	9.7.1.3.1	H9
(a) (ii)	3	9.7.1.2.4, 9.7.1.3.1	H9
(b) (i)	2	9.7.4.2.5	H7, H8
(b) (ii)	4	9.7.4.3.4	H1
(c)	4	9.7.3.2.5/6/7	H7
(d) (i)	2	9.7.3.3.1	H7
(d) (ii)	3	9.7.3.2.1, 9.7.3.3.1, 12.4 (e)	H12
(e)	6	9.7.2.2.5, 9.7.3.2.2/7, 9.7.3.3.1	H7, H9
Question 34		**Disasters**	
(a) (i)	1	9.8.2.2.1	H4, H10

Question	Marks	Content	Syllabus outcomes
(a) (ii)	3	9.8.2.2.3	H4
(b) (i)	2	9.8.3.2.1	H4, H10
(b) (ii)	4	9.8.3.2.3, 9.8.3.2.1, 9.8.3.2.2	H4, H10
(c)	4	9.8.3.2.8, 9.8.3.3.5	H4
(d) (i)	2	9.8.1.3.2	H13
(d) (ii)	3	9.8.1.3.2, 12.4 (e)	H12, H14
(e)	6	9.8.5.2.2	H1, H3
Question 35		**Space Science**	
(a) (i)	1	9.9.6.2.2	H4
(a) (ii)	3	9.9.6.2.2	H4
(b) (i)	2	9.9.1.2.1/2	H3
(b) (ii)	4	9.9.5.2.4/5, 9.9.5.3.3	H1, H3
(c)	4	9.9.6.3.1	H4, H13
(d) (i)	2	9.9.5.3.5	H3
(d) (ii)	3	9.9.9.3.5, 12.4 (e)	H12
(e)	6	9.9.4	H5, H13