

B O A R D O F S T U D I E S
NEW SOUTH WALES

2012 HSC Senior Science 'Sample Answers'

When examination committees develop questions for the examination, they may write 'sample answers' or, in the case of some questions, 'answers could include'. The committees do this to ensure that the questions will effectively assess students' knowledge and skills.

This material is also provided to the Supervisor of Marking, to give some guidance about the nature and scope of the responses the committee expected students would produce. How sample answers are used at marking centres varies. Sample answers may be used extensively and even modified at the marking centre OR they may be considered only briefly at the beginning of marking. In a few cases, the sample answers may not be used at all at marking.

The Board publishes this information to assist in understanding how the marking guidelines were implemented.

The 'sample answers' or similar advice contained in this document are not intended to be exemplary or even complete answers or responses. As they are part of the examination committee's 'working document', they may contain typographical errors, omissions, or only some of the possible correct answers.

Section I, Part B

Question 21 (a)

Sample answer:

Shine a light into one end of a fibre and observe by eye the light coming out the other end of the fibre.

Question 21 (b)

Sample answer:

Both optical fibres and microwaves use electromagnetic waves. Both allow data to be transmitted across long distances.

Optical fibres can carry many more voice signals than microwaves. The electromagnetic wave in an optical fibre travels more slowly than the microwaves through air.

Question 22 (a)

Sample answer:

Silicone is unaffected by changes in pH. It is an unreactive compound.

Question 22 (b)

Sample answer:

Wear safety glasses so that the acid doesn't burn your eyes.

Conduct the experiment in a well-ventilated room because, when silicone is squeezed from a tube, it produces fumes that are not healthy to inhale.

Question 23***Sample answer:***

In cardiac resuscitation the heart is compressed, which forces blood out of the heart and towards the lungs and body. When the compression is released the valves don't let blood flow backwards, so new blood enters the heart. This is effective because it continues to move blood containing oxygen and nutrients around the body to reach important organs including the brain.

In pulmonary resuscitation, air is forced into the patient's lungs. The chest and diaphragm force the air back out. This is effective because there is enough oxygen in the air that is blown out of the resuscitator's lungs to keep the patient alive. All cells and tissues require oxygen for respiration.

Question 24 (a)***Sample answer:*****To test the effect of age on change in heart rate due to exercise.**

1. Gather three groups of 10 people. One group should be composed of people all aged 10, one group should be composed of people all aged 20 and another group composed of people all aged 30. When choosing the groups consider keeping other variables similar, eg BMI, fitness level, sex.
2. Calculate the resting pulse rate of each person based on measurements of the pulse for at least 10 seconds.
3. Each person walks at the same speed on a treadmill for 5 minutes.
4. Immediately take the pulse of each person to determine the pulse rate.
5. Wait for each individual's pulse rate to return to its resting pulse rate.

Repeat steps 3–5 three times.

Question 24 (b)***Answers could include:***

- Calculate the average for the increase in pulse rate for each group
- Graph the average increase for each group
- Discuss trends, ignore outliers, observe for contradictions in data
- Compare the increases in pulse rate between the test groups

Question 24 (c)***Answers could include:***

Sex, body mass index

Question 25***Sample answer:***

People with pacemakers need less ongoing medical intervention, therefore society does not need to spend as much on the healthcare system.

Companies that make the pacemakers provide employment for large numbers of people in manufacture, distribution and advertising of the product, hence there are widespread economic benefits. Therefore the impact of pacemakers on society has been significant.

Answers could include:

People who would otherwise be disabled are still able to live independent lives and contribute to society through work or family support.

Question 26***Sample answer:***

Microflora help maintain the normal pH of the skin by digesting dead epidermal cells and excreting slightly acidic chemicals. Some aerobic bacteria produce fatty acids from sebum that inhibit the growth of many pathogenic organisms. The normal colonies of microflora on the skin provide competition for pathogenic microbes and usually outcompete them.

Question 27 (a)***Sample answer:***

The sound quality of AM is poorer than FM.

Question 27 (b)***Sample answer:***

FM radio waves have high frequencies which allow them to carry more data and therefore allow them to be used for high-quality music transmission. AM radio waves have lower frequencies and therefore are used more for spoken transmissions such as talk-back radio.

Answers could include:

AM radio waves can be reflected off the ionosphere and can therefore travel longer distances than FM radio waves, which are not reflected.

Question 27 (c)***Sample answer:***

In the modulation process two waves are added together, the signal and the carrier wave. In AM only the wave's amplitude is changed whereas in FM only the wave's frequency is changed. The variation in the amplitude or frequency carries the information to where it is decoded.

Answers could include:

Diagrammatic representation of AM and FM modulation including the two individual components and the resulting signal.

Question 28***Sample answer:***

Television provides coverage in real time using moving images whereas a newspaper provides a permanent record that can be carried around and referred to at any time.

Answers could include:

- Access to information no matter where you are in the world
- Access to different types of information for people with disabilities, eg radio is more useful for people who are visually impaired.

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

The tablet is the only form that will dissolve quickly in the water.

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

B will dissolve in the tap water at 20°C and it has a high absorption in the stomach, which has a low pH.

Question 30***Sample answer:***

Emulsifiers allow oil and water, which alone do not mix, to become dispersed in each other in a mixture called an emulsion. Soaps and detergents are emulsifying agents. When placed on the skin with water, oils on the skin become dispersed in the water, allowing the oils to be removed along with the dirt and bacteria that may be in the oil.

Surfactants lower the surface tension of water. Soaps and detergents are surfactants. When the surface tension is reduced, the water is able to more readily wet the skin, especially if it is oily, and this assists in the removal of dirt from the skin.

Solvents dissolve substances. Perfumes often contain alcohol as the solvent for the chemicals that provide the smell of the perfume. The solvent allows tiny amounts of the perfume molecules to be applied as a dilute solution and the solvent also allows the perfume molecules to be spread evenly over a large area of skin. The alcohol solvent evaporates quickly, leaving the less volatile perfume molecules behind.

Section II

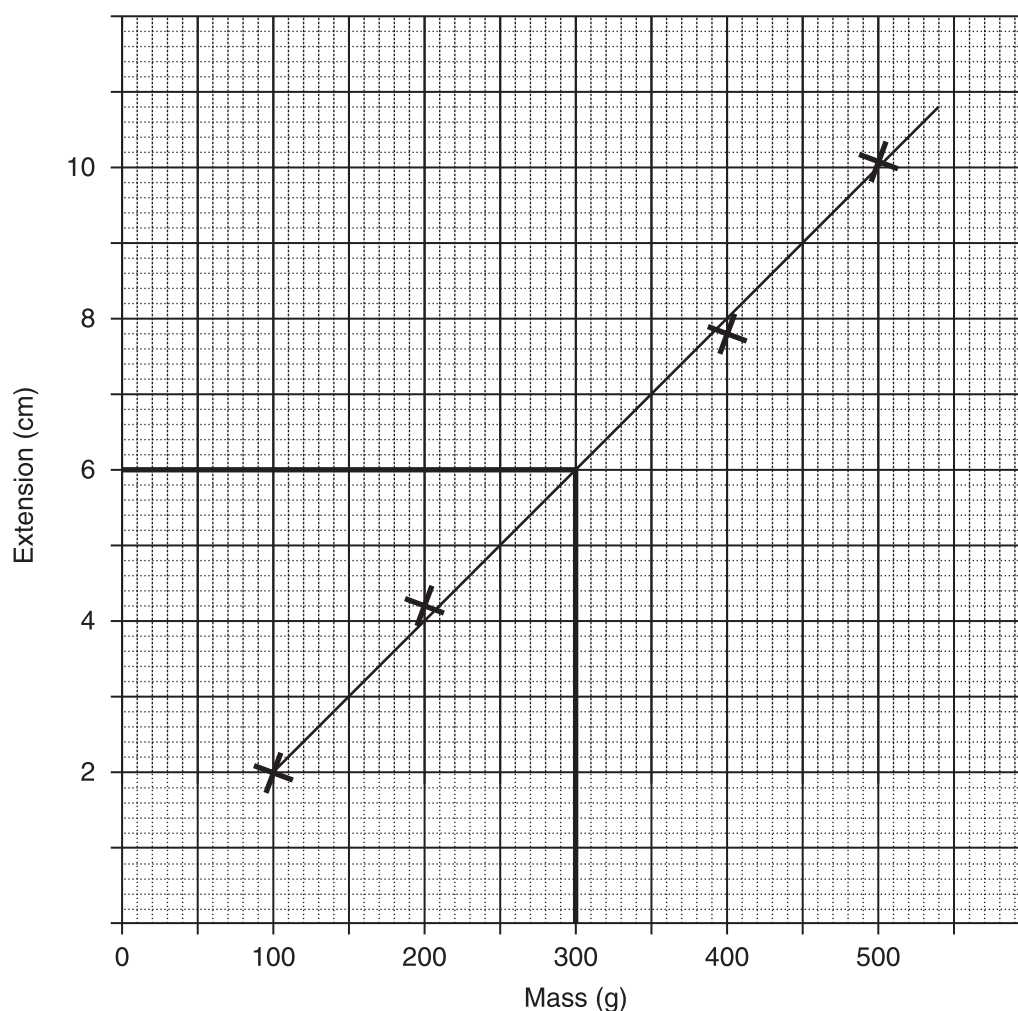
Question 31 (a)

Sample answer:

There is a finite amount of fossil fuels that petrochemicals are derived from. Synthetic polymers are mainly made from petrochemicals and hence, because the supply of petrochemicals will diminish over time, the supply of synthetic polymers will diminish.

Question 31 (b) (i)

Sample answer:



Question 31 (b) (ii)***Sample answer:***

When mass = 300 g
Extension = 6 cm

Question 31 (c)***Sample answer:***

Silk and cotton are both natural polymers. Silk has high strength which makes it useful for making parachutes. Cotton has a high moisture absorbency so it is useful for summer clothing.

Question 31 (d) (i)***Sample answer:***

Ensure that information was valid on checking that the sources were reputable (such as a .gov or .edu website or information that includes the author, statement of bias, feedback mechanism for errors or is peer reviewed). The source also needs to be up to date. The information can also be confirmed by using a range of quality sources and checking that the information correlates in each source.

Question 31 (d) (ii)***Sample answer:***

Some plastics cannot be recycled and other plastics cannot be 100% recycled because they contain additives. It is also difficult to convince the public to recycle as it may require more time or effort. It is costly for the consumer to recycle if there is no easy access to a recycling service.

Answers could include:

Benefits related to recycling.

Question 31 (e)***Answers could include:***

Plastics are very versatile because they can be produced with a wide range of properties, such as heat resistance (eg silicone), flexibility, strength, hardness (eg Perspex). Two important types of plastics are thermosetting and thermoplastic. These have different properties. Thermosetting plastics are hardened permanently by heat, while thermoplastics are softened by heat and hardened by cooling.

Plastics can be mass produced from cheap raw materials (fossil fuels), making them inexpensive. A range of types of plastics can be made for different uses and can be moulded and shaped, such as for drink bottles and food containers. They can also be drawn out into fibres and used for clothing, such as polyester, nylon, Kevlar bulletproof vests, fleece jackets.

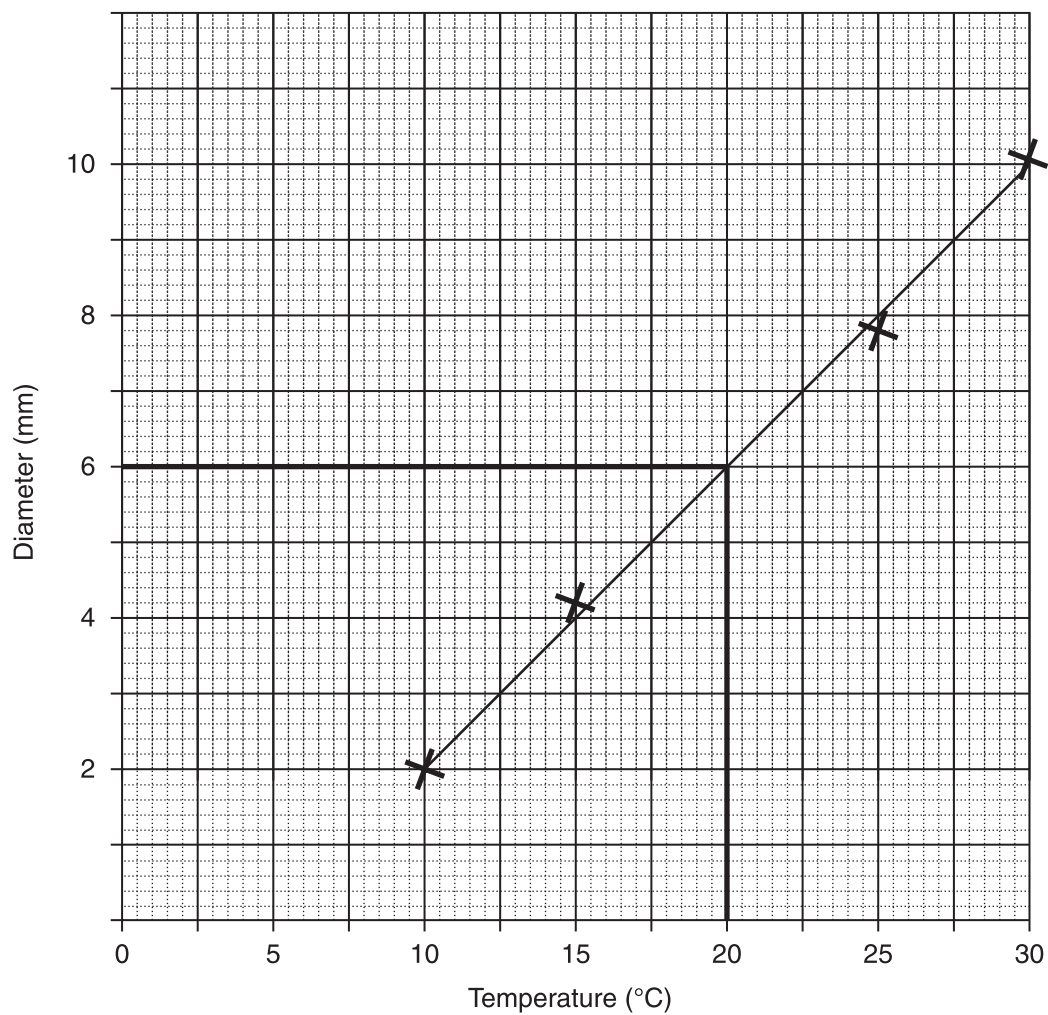
Plastics can have additives included, which can allow them to be flame retardant, more stable and long lasting. Additives can also be used to change the appearance, such as colour and texture, making it attractive to consumers.

Plastics are also used widely since they can be recycled and reused a number of times, such as drink bottles being reused or turned into fleece jackets.

Plastics are also useful since they are inert and do not react quickly with sunlight or varying environmental conditions.

Question 32 (a)***Sample answer:***

Cheeses and yoghurts have microorganisms that produce their own natural preservatives (bacteriocins) that inhibit the growth of other organisms.

Question 32 (b) (i)*Sample answer:***Question 32 (b) (ii)***Sample answer:*

When Temperature = 20°C
Diameter = 6 cm

Question 32 (c)***Sample answer:***

Negative labelling such as ‘cholesterol free’ on olive oil is a misleading term (since all olive oils are cholesterol free). Such negative labelling can be used to convince people to buy the product when they don’t have the scientific knowledge to know otherwise.

Similarly, products have labels such as ‘no added sugar’, but still contain a high amount of sugar from the natural products that are included in the food. This is often the case for many fruit juices. Consumers may believe that the product is more healthy or low in sugar because of the labels, but this may not be the case. The manufacturers may be exploiting ignorance.

Question 32 (d) (i)***Sample answer:***

Ensure that the information was valid by checking that the sources were reputable (such as a .gov or .edu website or information that includes the author, statement of bias, feedback mechanism for errors or is peer reviewed). The source also needs to be up to date. The information can also be confirmed by using a range of quality sources and checking that the information correlates in each source.

Question 32 (d) (ii)***Sample answer:***

Some food additives can cause allergic reactions or be unsafe for certain people to use, eg diabetics shouldn’t consume certain products with added sugar. Some additives can improve the texture of the food, eg yoghurt.

Answers could include:

Additives can be difficult to add to the product and may alter the taste. For some products, legislation does not allow additives to be included without changing the name of the product. Food additives can also cause the product to taste better or last longer.

Question 32 (e)***Sample answer:***

Microorganisms only reproduce and grow in a limited range of temperatures. Therefore both high and low temperatures will kill or inhibit growth, eg a technology such as pasteurisation involves heating to a temperature that kills microbes, while refrigeration lowers the temperature and slows the growth of microbes.

Altering the pH of the food will prevent or restrict the growth and reproduction of microbes, eg pickling lowers the pH of the food and therefore reduces microbial spoilage. Pickling is commonly used to preserve onions.

Water availability affects the growth and reproduction of microbes as water is essential for their growth and reproduction. A technology such as salting reduces the available water and will restrict microbial growth and reproduction.

Question 33 (a)***Sample answer:***

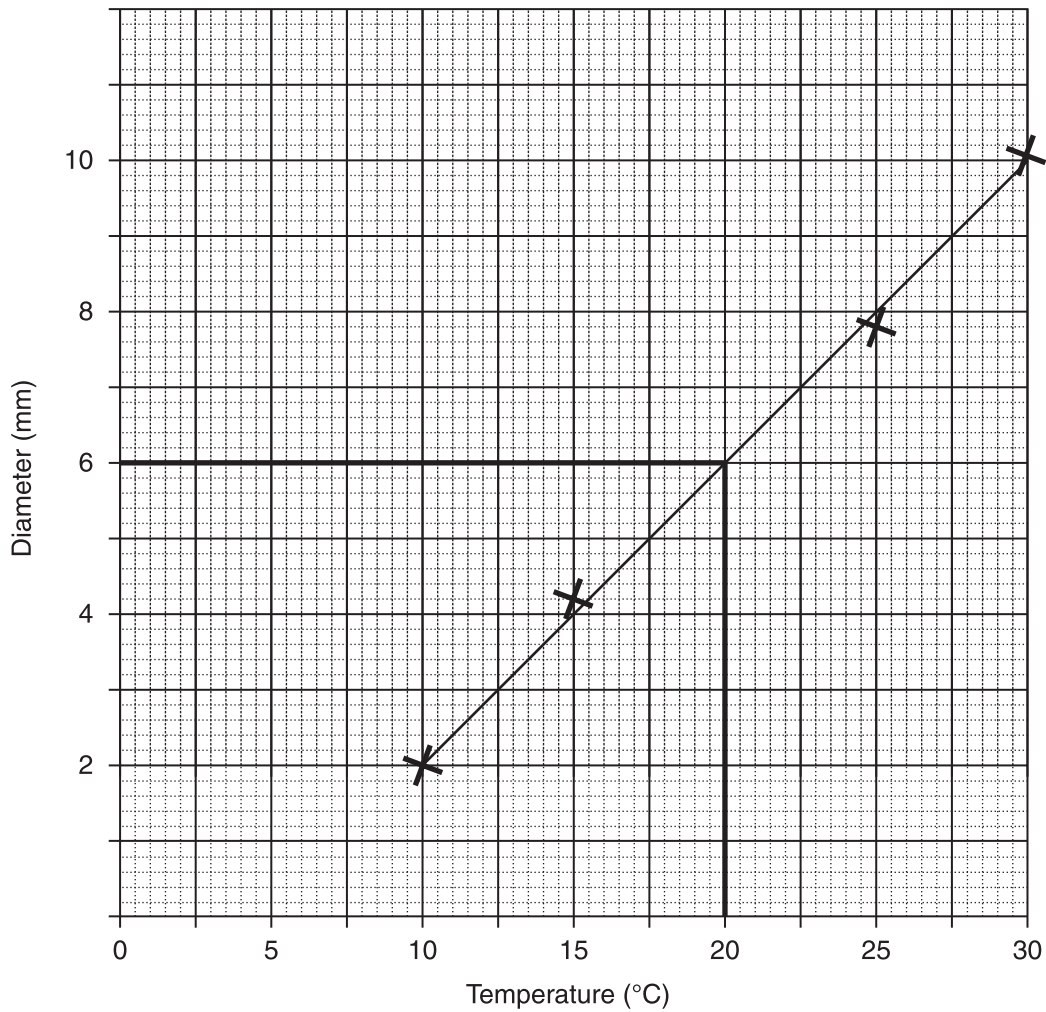
It is important to have a range of different types of antibiotics since many bacteria have developed antibiotic resistance. Where this has occurred these antibiotics no longer function to kill pathogens. In addition, some antibiotics are specific to a particular type of bacteria while others are broad spectrum and can affect many types of bacteria.

Answers could include:

They have different modes of action, eg affecting cell wall during reproduction or inhibiting enzymes for respiration.

Because we have a range of antibiotics we can treat a broad range of diseases.

Using a combination of antibiotics can help reduce the rate at which antibiotic resistance is developing.

Question 33 (b) (i)*Sample answer:***Question 33 (b) (ii)***Sample answer:*

When Temperature = 20°C
Diameter = 6 mm

Question 33 (c)***Sample answer:***

Arteries have thick walls so they can withstand high-pressure blood. They are also elastic so they can expand and contract with each pulse of blood travelling through them.

Capillaries have very thin walls that are permeable to allow the exchange of gases and nutrients. The capillaries are arranged in networks with a large surface area to increase the rate of exchange of gases and nutrients.

Answers could include:

Capillaries also have variable permeability of the wall so that, if an injury occurs, white blood cells can pass through the capillary to reach the affected area.

Question 33 (d) (i)***Sample answer:***

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Question 33 (d) (ii)***Sample answer:***

The circulatory system includes capillaries that are permeable to white blood cells. This allows the white blood cells to reach inflamed tissue and kill pathogens. The circulatory system also carries antibiotics around the body. The antibiotics then help kill bacteria.

Question 33 (e)***Sample answer:***

Pasteur is famous for his swan-necked flask experiment where he disproved spontaneous generation and showed that microbes could only grow from something that already existed. This has helped us to understand that disease comes from pre-existing microbes and thus diseases can be prevented by stopping the transfer of microbes. Such things as pasteurisation (heating to high temperatures) will kill any existing microbes and therefore prevent the growth of microbes that can cause food poisoning.

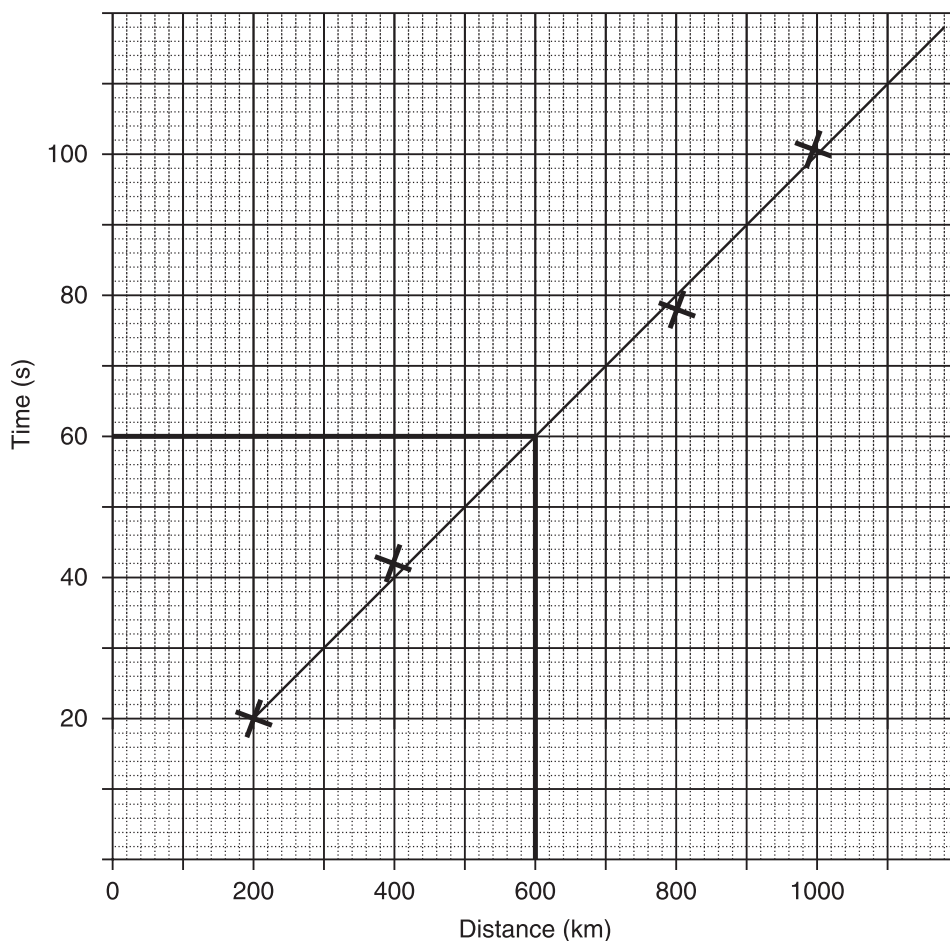
Lister is famous for noting that disease can be transferred on hands or medical technologies, and thus encouraged the use of sterilisation (eg with carbolic acid) of surgical instruments and cleaning of wounds and hands, which led to reduced post-operative infections and made surgery safer for patients.

Question 34 (a)**Sample answer:**

Radar is important since it can be reflected off water droplets and used to produce a map to show where the rain is and how heavy it is. Radar can also be used to measure wind speed. It is important for monitoring weather since it can track the direction and rate of movement of clouds from a long distance and predict when and where particular weather patterns will occur.

Answers could include:

Radar is an important technology since it is fairly inexpensive, so many weather stations can be set up around the globe to provide rapid and easy access to weather information.

Question 34 (b) (i)**Sample answer:**

Question 34 (b) (ii)***Sample answer:***

When distance = 600 km
Time = 60 s

Question 34 (c)***Sample answer:***

The effects of bushfires can include the loss of property, life, habitats. These effects can be decreased by back-burning and clearing of scrub. The likelihood of bushfires occurring, and affecting people and habitats, can increase when people throw cigarette butts into bushy areas or light campfires during hot, dry, windy weather.

Floods can also affect property, life and habitats. Human activities can increase the effects of flooding if dams are not managed correctly (eg if the spillway is not opened) or if houses are built on floodplains or low-lying areas. Humans can decrease the effects of flooding by building levees around the banks of rivers.

Question 34 (d) (i)***Sample answer:***

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Question 34 (d) (ii)***Sample answer:***

Transfer of heat and light energy (lightning/cigarette butt) or heat energy (hot day) into fuel. Fuel then converts chemical potential energy in plants/animals → heat, light, sound, kinetic energy of the fire.

Answers could include:

Radiant heat from fuel transferred to more fuel
Also affecting the fuel is kinetic energy of air (winds)

Question 34 (e)***Sample answer:***

Scientific advances have led to the development of equipment to monitor earthquake activity, and this can help to predict when and where earthquakes will occur. However, our capacity to predict when an earthquake will occur is very limited due to the complexity of the processes involved.

A scientific advance that has contributed to helping us predict where and when earthquakes will occur is the seismograph. Seismographs measure movement of the crust and can detect different types of earthquake waves travelling through the ground. Collating the data from seismographs, including the time difference between each type of earthquake wave, has provided a better understanding of the structure and dynamic nature of the earth and rocks in local areas. This has led to knowing where plate boundaries and fault lines exist. With this knowledge we can usually predict where earthquakes will occur (eg along the Ring of Fire, San Andreas Fault) and give a general prediction of when they are likely to occur. We can also predict the likely magnitude of the earthquake and whether it may have a deep or shallow epicentre, eg earthquakes at divergent boundaries such as the Mid-Atlantic Ridge are usually shallow earthquakes, while those at convergent plate boundaries such as between the Nazca and South American plate can range from deep to shallow.

The scientific advances of satellite, GPS and radar technology have also improved our ability to predict when, where and the magnitude of earthquakes which may occur as we can now get measurements of tiny movements that occur over long periods of time (both horizontally and vertically) at fault lines. We can combine this information with the scientific analysis of historical records of patterns of earthquakes to help us to make earthquake predictions.

Scientific advances have therefore allowed us to predict with reasonable accuracy where earthquakes occur. However, despite advanced technology, we are still often unable to predict exactly when an earthquake will occur.

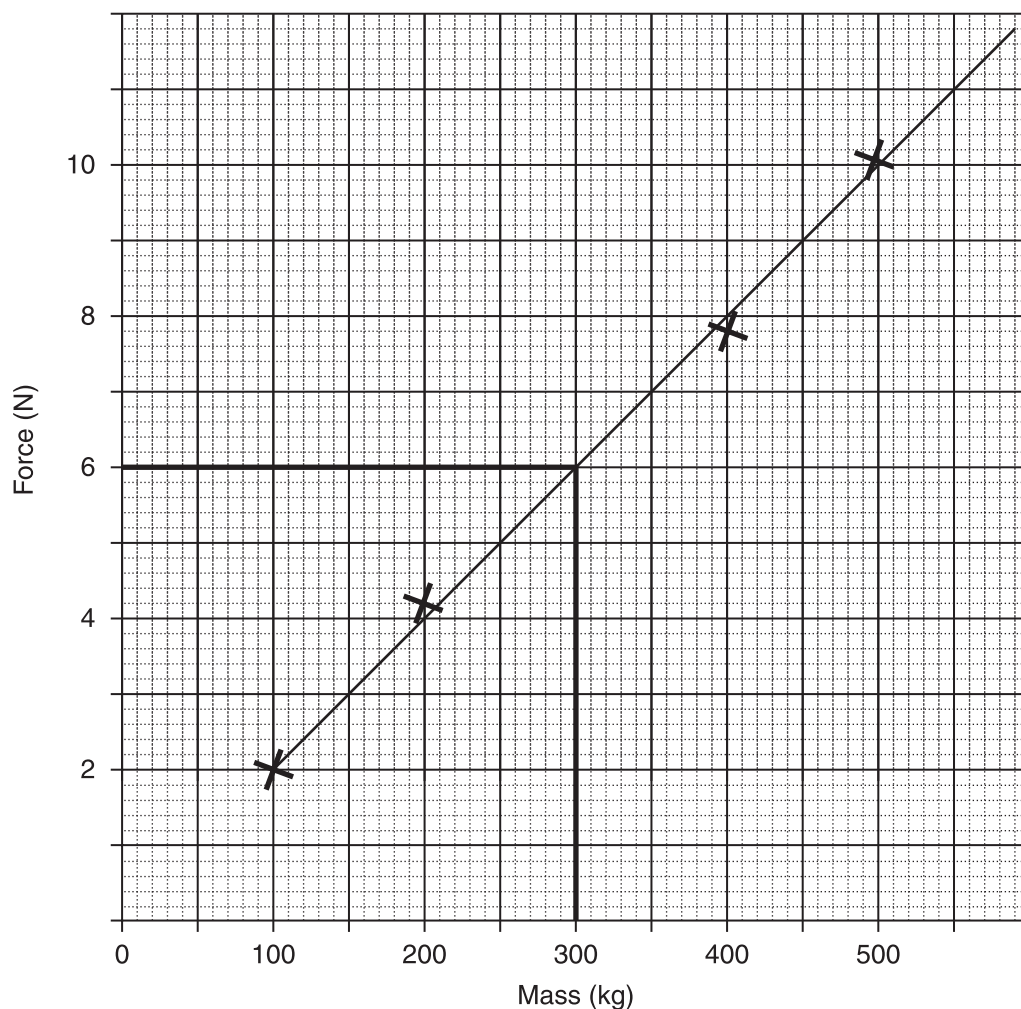
Answers could include:

Another scientific advance has been the use of detection of radon gas to help predict when earthquakes occur. The release of radon is an indicator of earth movement as the radon moves through pores in the rocks formed from the moving earth. Unusual animal behaviour may also be used as a possible indicator of an impending earthquake.

An understanding of the processes that occur can allow us to have an idea of the energy stored in fault systems and hence the possible magnitude of damage.

Question 35 (a)**Sample answer:**

Booster rockets are used to provide the extra thrust required to reach the desired velocity for orbit. Booster rockets are only used during lift-off then are dropped off within minutes of their use, since the mass of the rocket would have decreased significantly due to the fuel being used making the booster rocket unnecessary. Booster rockets are usually used on heavy mass rockets.

Question 35 (b) (i)**Sample answer:**

Question 35 (b) (ii)***Sample answer:***

Mass = 300 kg

Force = 6 N

Question 35 (c)***Sample answer:***

Optical telescopes are placed on high mountains so that the light has less atmosphere to pass through from space to the telescope, therefore providing more light for the formation of an image in the telescope.

By placing the telescope at high altitude, it is above most of the atmospheric instabilities, eg due to thermal effects, and therefore the image is less likely to be distorted.

Answers could include:

The reduced risk of cloud interference with the telescope's operation. Cold temperatures mean that there is less distortion of the telescope mirror due to temperature changes.

Question 35 (d) (i)***Sample answer:***

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Question 35 (d) (ii)***Sample answer:***

Humans in space have many effects on their health, such as the loss of muscle mass and bone density. Also, humans are exposed to higher radiation levels and can therefore be more prone to cancers. Humans normally have circadian rhythms, eg sleep patterns. These are disturbed by time spent in space.

Question 35 (e)***Sample answer:***

The development of technologies such as satellites has increased our understanding of the atmospheres and magnetic properties of the outer planets. Australia has assisted in the tracking of satellites such as the Voyager satellites through tracking stations such as Tidbinbilla. Signals have been monitored from satellites using the Parkes and other radio telescopes. Large optical telescopes operate at Siding Springs.

Large telescopes have been built to gather more light from more distant objects, eg Gemini telescope in Hawaii.

Because we have developed rocket technology, we have been able to produce space telescopes. These have allowed us to monitor different wavelengths of the electromagnetic spectrum by using radio telescopes and infra-red and X-ray space telescopes, eg Chandra. Countries other than Australia operate the Hubble Space Telescope and the International Space Station which are used to gather information about the universe, eg Hubble has been used to photograph distant galaxies at different wavelengths to increase our understanding of the origin and evolution of the universe.

Other improvements in technology have allowed us to change from using film to capture images to the use of charge coupled devices (CCD) which provide improved data since it is in an electronic form that can be more easily analysed. Improvements in computer technology and communication technology have made the analysis and gathering of data more efficient.