MYP MAY 2016
INTEGRATED SCIENCES
ON-SCREEN EXAMINATION

Exemplar Marked Candidate Responses

This document contains exemplar material which demonstrates how the markscheme was applied to two student responses for the May 2016 session. Teachers should consider the application of the marksheme and in particular the assessment of longer, open ended responses. Teachers may wish to mark the student response themselves using the published markscheme and then compare their marking to the standard demonstrated in this document.

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Question 1 (5 marks)

Artists use and apply their scientific knowledge and understanding to paint beautiful portraits and produce art work like the portrait shown on the right.

Watch the video below to answer the following questions.

©
Steve Spangler Science

©
Roger Oncoy

Question 1a (1 mark)

Write down what you see happening to the colours in the video when the liquid is added.

When the liquid is added to the colours, the colours expand, the ink gets carried away with the liquid, and make a circle.

1/1 Implies spread out.

Question 1b (1 mark)

State the name of the physical process affecting the colours in the video.

Dilution

0/1

Question 1c (3 marks)

Explain how the rate of the process in part (b) could be changed by altering the temperature.

Prediction If the temperature rises, the rate of the process in dilution would be faster.

Error carried forward

Explanation If temperature rises, the molecules would be more active and it will cause the process to happen faster.

1/3 Not referred to as speed

Question 2 (7 marks)

Skin is a living organ that needs care to remain healthy. The skin contains natural oils that limit evaporation of water. Many people use cosmetic products and creams to replace the natural oil lost from the skin as part of the aging process. New creams and techniques are being developed to increase oil levels in skin.

© Galvanic facial treatment_istock

Recently, a new technique in skin care is being developed in which dermatologists use small electric currents to improve the absorption of creams. This is called galvanic facial treatment.

Question 2a (1 mark)

Skin is naturally regenerated as old cells are replaced by new ones.

State the name of the cell division process by which these cells are replaced.

Mitosis

1/1

Question 2b (3 marks)

In galvanic facial treatment a cream containing a positively charged active ingredient is applied to the skin. A positively charged electrode is put in contact with the skin.

Explain how galvanic facial treatment can improve the absorption of the active ingredient into the skin.

When the skin is charged it the cells begins to absorb the material at a faster rate due to the fact that they are dividing.

1/3

Question 2c (3 marks)

Electroporation is a technique used to introduce bioactive molecules into cells. In electroporation, a voltage is applied across skin cells, which allows a small electric current to pass through cells. This current changes the characteristics of the outer layer of skin cells. If a voltage of 2 kV is applied across the face, the current passing through the skin is 250 mA.

Use the formula sheet to **calculate** the resistance of human skin.

250000000÷2000
125000

250M/2K = 125000R

0/3

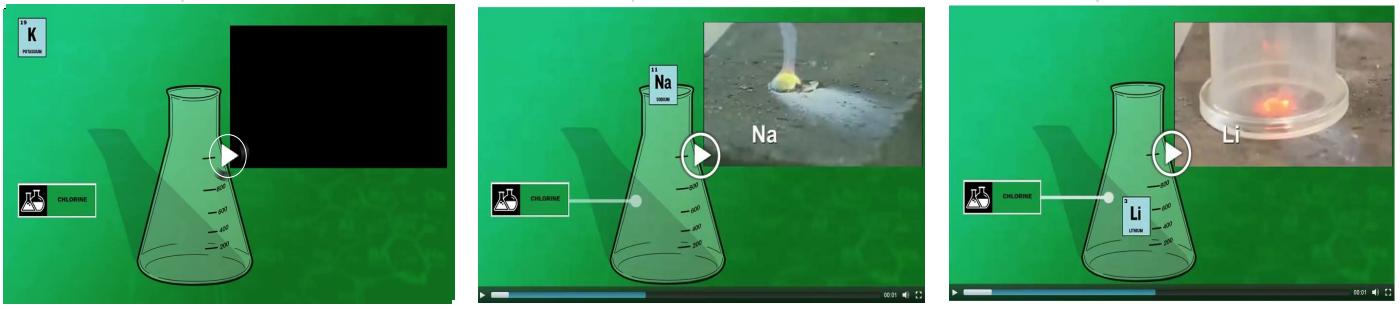
Question 3 (10 marks)

Scientists have used their creativity to produce dazzling firework displays. One of the uses of group one elements is to produce bright colours in fireworks.

The flask in the simulation contains chlorine gas. Click on the video in each tab to observe the reaction of each element with chlorine.

Question 3a (2 marks)

Potassium | Sodium | Lithium



© Footage by Royal Society Of Chemistry

Group one elements are highly reactive.
Outline the reason for the high reactivity of group one elements.

Group one elements only have one valence electron. They are able to easily give away this electron and therefore they are able to re act easily with elements that need another electron.

1/2 No reference to achieve stability/ noble gas configuration.

Question 3b (3 marks)

Select one reaction from the videos above and **write down** a balanced chemical equation for this reaction. Include state symbols in your answer.

$Li_{(s)}+CL_{(g)}--->LiCl_{(s)}$

1/3
- *Incorrect reactant*
- *No error carried forward for balancing*
- *Correct state symbols*

Caesium (Cs) is another group one element. It will also react with chlorine.

Question 3c (2 marks)

Using your knowledge of periodic trends, **compare and contrast** the reactions between caesium and chlorine, **and** lithium and chlorine.

As ceasium is a far larger element than litium with a many more shells, it also has a larger atomic radius than litium. This means that the electrostatic bonds between its valence and its neuclues are far weaker making it much more reactive than lithium. Therefore lithi um's reaction with chlorine will be far less violent than that of caesium and chlorine.

1/2

Question 3d (3 marks)

Francium (Fr) is also a group one element. Francium is very rare and it is never found in nature as an uncombined element.

Apart from being rare, **explain** why francium is never found as an uncombined element.

Francium has a even larger atomic radiums than caesium. This means that it is even more reactive with many other elements in natu re, because the electro static forces are weaker between its nucleus and its valence eletrons. Because of this reactivity it is very likle y to react with the things in nature and will therefore not be found as an uncombined element usually.

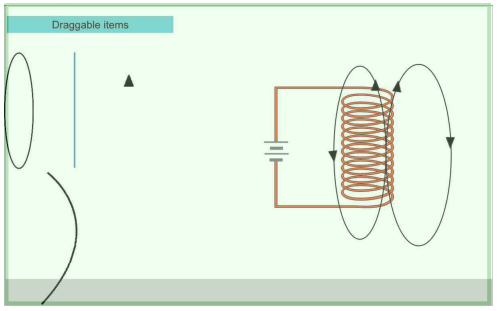
1/3
- " (...) its valence electrons" M2/explanation
- "the things in nature": not clear/water/oxygen/other elements.

Question 4 (9 marks)

When a current flows through a wire it generates a magnetic field. If the wire is coiled around a core a electromagnet can be formed.

Question 4a (3 marks)

Select shapes to **construct** a diagram showing the magnetic field lines around and through the coil of wire below.

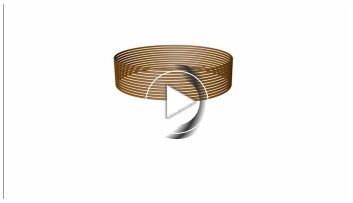


1/3

Question 4b (3 marks)

The flow of the direct current through the coil generates a force.

Select what happens to the coil when a direct current flows and **explain** why the generated force has this effect on the coil.



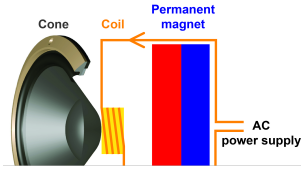
◉ Compression ○ Extension

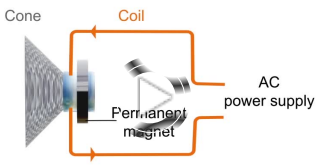
The current creates a magnetic force throughout the coil which cause it to compress and push together because of the magnetic effe ct on the wire, which is made of metal.

1/3

Music is one of the most common ways people express their ideas and feelings. The enjoyment of the beauty of music relies on electrical speakers which convert electrical signals into sound waves.

The generation of the sound wave depends on the back and forth vibrational movement of the cone.





Question 4c (3 marks)

Explain how this motion could be obtained by allowing an alternating current to pass in the coil.

if the current is alternating then it causes the magnet to switch polarities with the flow of the current. The magnetic force created by th e magnet which is made to alternate pulls the cone in or pushes it away depending on the direction of the current which cause the alt ernating motion of the cone itself.

1/3

- M2.

- "pulls the cone in (...)": not enough for M3.

Question 5 (15 marks)

A bioassay is a kind of biosensor that uses sensitive living material (cells, tissues or organisms) to measure the effects of environmental conditions or chemicals, including drugs and toxins.The LD50 (Lethal Dose 50 %) is the concentration at which 50 % of a test population of cells or organisms is killed within a specified period.

Question 5a (2 marks)

Suggest meanings for the initials in LD25.

Lethal Dose 25%

1/2 No reference to kill 25 % of population.

A student designed a scientific investigation to study the effect of sodium chloride (NaCl) on germination rates in mung beans.Groups of 30 seeds were placed on absorbent material wetted with a range of sodium chloride solutions in six covered petri dishes. The numbers of germinated seeds were checked daily over 5 days.

Question 5b (3 marks)

Formulate and **explain** a hypothesis that the student's experiment may have been testing.

To what extend does sodium chloride (NaCl) have on germination rates in mung beans.

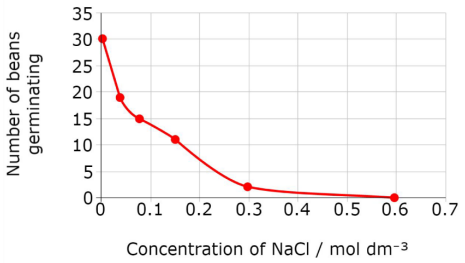
This hypothesis is to find out how sodium chloride effects the rates in ming beans. The beans are counted every day to see whether i t killed some been or made more beans grow, wether it decreased the rate of germination, increased the rate of germination or staye d thesame.

0/3

Question 5c (2 marks)

The number of beans that had germinated at the end of the investigation are shown in the graph.

Use the graph to determine the LD50 from the student's results.



0.07 mol dm^{-3}

2/2 Within range.

Question 5d (4 marks)

Water must move into cells for germination to start. The concentration of NaCl in seawater is about 0.5 mol dm^{-3}.

Use your answer to part (c) to **explain** why seawater cannot be used to water agricultural crops.

Seawater cannot be used because it germinates almost all the seads. Seawater has a concentration of 0.05 mol dm $^{-3}$ wiht this conc entration almost all the seeds get germinated. It is better not to use this because we don't want our crops to be germinated.

0/4

Question 5e (4 marks)

Explain how the student could improve **and** extend the investigation method.

Improvement

The student could improve the investigation by doing the experiment again but with a different number of seeds on each plate.

Repeat

Explanation

The student could have done the experiment again with maibe 10 seeds on each plate instead of 30 ad then checked if the results w ere still thesame. This could inprove the accuracy and how reliable the results of teh experiment are.

Extension

The student could have exteneded the investigation by trying out differnet concentrations of another kind of chemical.

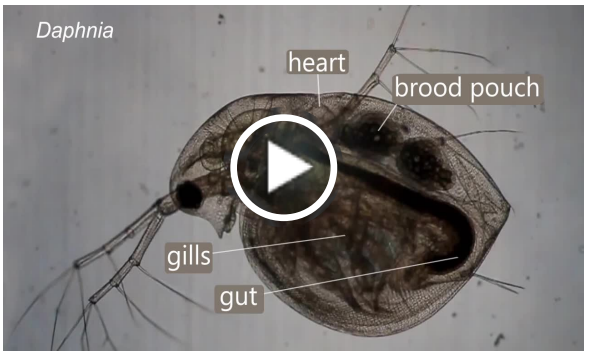
Explanation

The student could have chekced whether another simular chemical has thesame effect on the germination of hte seeds. She could h ave tried thesame concentration levels as the last chemical (NaCl) and checked whether cncentrations of a differnet chemical alos h ad thesame effect.

3/4 Not specific enough

Question 6 (15 marks)

Daphnia are fresh-water organisms between 1 – 5 mm in length. They are found all around the world in water temperatures up to 40°C. Daphnia are transparent organisms, and their feeding, egg production and heart rates are easily observed. They mature and breed very rapidly. In the wild Daphnia are an important source of food for pond organisms. Most Daphnia will be eaten soon after hatching.



©
Chris Moody - Daphnia heartbeating, recorded using a Canon EOS 7D

Question 6a (12 marks)

Design a scientific investigation to observe *Daphnia*'s response to varying water temperature within the range of its natural environment. In your answer you should include:

- a list of suitable equipment
- the independent, dependent and control variables
- how you will manipulate the variables
- how you will collect sufficient data
- a description of the method
- any relevant safety or ethical considerations.

We will investigate different groups of daphnia in different water pools of different temperature.

We will need daphnia, 5 different pools of river water of different temperatures large enough to hold 5 daphnia each. A microscope to observe them in the pools.

The independent variable will the temperature of the water they are in, the dependant variables will be how many were born and how many died as well as the way the behave in the water and the control being the amount initially in the pond and the time they have been in the environment(5 days)

They will need to be checked on regularly to see how the numbers are fluctating and we will see how the tempurature affects their ha bits and reproductive cycle by observing their heartrate and their mating speed in each tempurature. As time goes on we will see the different changes in them as the newer generations are born into the environment of a different tempurature.

4/13

- Temperature is identified as IV.

- Dependent variable identified/ difficult to measure.

- Control variable identified/ 5 days.

- Some equipment is listed: microscope.

A student suggested that Daphnia's response to increasing temperature is a useful model to understand human responses to temperature.

Question 6b (3 marks)

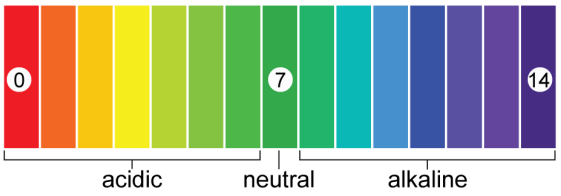
Discuss whether or not this conclusion is valid.

I think it is a rather valid conclusion as all organisms react to temperature and react to the changes they are subject too. Though we are extremely different from Daphnia, we will also as humans change the way we behave based on the environment we are in. For e xample, humans who were born into a cold environment and had parents who were resistant to the cold will have a strong resistance to cold and thus will be able to perform better in colder temperatures because of their conditioning and genetic background. This is tr ue for all organisms as temperature has an effect on everything to a certain degree.

2/3

Question 7 (14 marks)

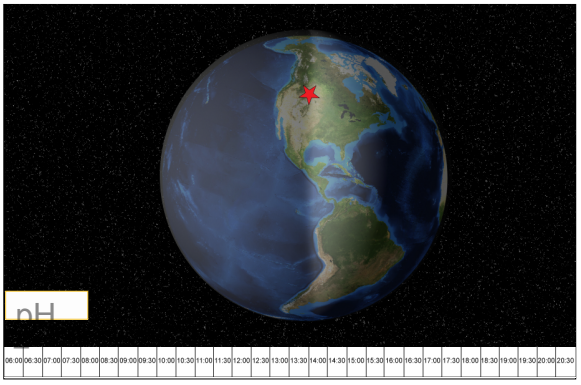
The pH scale is used to measure acidity. Solutions with pH values less than seven are acidic, solutions with pH values greater than seven are alkaline.



Question 7a (2 marks)

The freshwater organisms in a pond are part of a complex food web. *Daphnia* feed on single celled plants called algae.A student wanted to investigate whether the algae and Daphnia living in a pond changed the pond's environment during a 12 hour period. Use the simulation to collect values of pH. **Select** appropriate times of day and record the data in the table below.

Time of day	pH
6:00	7.56
7:30	7.64
9:00	7.81
10:30	8.02
12:00	8.25
13:30	8.47
15:00	8.64
16:30	8.74
18:00	8.74



2/2

Question 7b (6 marks)

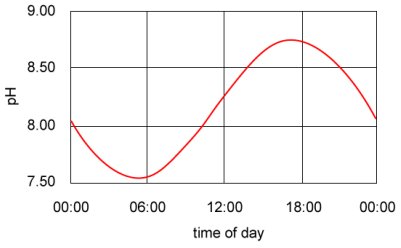
By interpreting your data from part (a), **explain** your results using scientific knowledge from your MYP studies.

Yes, the algae and organisms living in the pond clearly changed it's pH within the 12 hour time period. The pH as of sunrise continued to increase until it started getting darker again.

1/6 Only one interpretation point.

Question 7c (6 marks)

The graph below shows how the pH of the pond changes over a 24 hour period in the summer.



Describe how the shape of the graph would change in winter and **explain two** reasons for any differences.

Description

During the winter the shape of the graph would be extended more horizontally in the decreasing sections but shorten horizontally in the increasing sections.

Both refer to same point, amplitude not mentioned.

Reason 1

During the winter nights are longer this being said with less hours of sun the decrease of pH on the scale wold go on for a longer period of time as it is night for longer.

Reason but not justification.

Reason 2

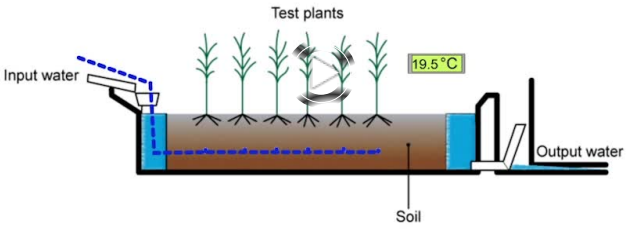
Another reason is because it is colder causing a lower production of algae.

- Fewer active algae in winter

3/6

Question 8 (16 marks)

Storm water comes from rainfall that collects in paved and built up areas. As the water collects it picks up nutrients from the surroundings. Sometimes storm water is deliberately drained through an area of land covered with plants that tolerate flooding before it reaches a pond or river. The "ecologically enhanced" storm water treatment system limits the amount of nutrients that are carried by the water and so reduces the over fertilization of the pond. Your school has access to a plant test bed used to model treatment systems that remove nutrients from storm water. An animation of this test bed is shown.



Question 8a (4 marks)

Identify the variables that you could test in the model plant test bed.

Independent variable the input water

Dependent variable the growth and the response of the plant

Control variable 1 the temperature of the surroundings

Control variable 2 the plant that is being tested

2/4

Question 8b (2 marks)

Formulate a testable hypothesis to investigate the effect of the independent variable on the dependent variable from part (a).

I predict that as the nutrient intake of the plant through the processes of osmosis and active transport will increase, there would be better growth of the plants. However, this is only until a limit, as too many nutrients can lead to over fertilization of the soil.

1/2

- IV not stated in previous answer.

- "(...) growth of the plants": DV stated and considered.

Question 8c (10 marks)

Describe how you would use the model test bed to collect data that would help you test the hypothesis you gave in part (b). You may wish to include additional equipment in your method.

The most important aspect of my investigation would be **observation.**

However, the most important steps in my method would include observing the response and the stimulus of the test plants over a con tinous period of time, in regards to the amounts of nutrients in the input water.

Therefore, my investigation method would include maintaining a constant surrounding temperature (using a thermometer) and then fi nding out the effect of the in out water on the plants.

The input water would be changed during a period of 1 month with different amounts of nutriwents, beginning with the least amount o f nutrients and so on.

However, the most important goal of my investigation would be to find out the ideal amount of nutrients for the best growth of plant a nd at the same time, the amount of nutrients, which start causing over fertilization of the soil and therefore affecting the growth of the plants in a negative manner.

Overall, the most important purposes of this investigation would be to find out the ideal amount of nutrients in the input water and the limit after which, the soil become over-fertilized.

3/10

- "(...) a constant surrounding temperature (...)" : CV.

- "(...) different amounts of nutriments (...)": state the amount of nutriments as IV.

- "(...) the best growth (...)" : Dv is the growth of plant.

- Attempt a method but incomplete.

- Basic equipment is listed.

- No safety concerned is mentioned.

Question 9 (13 marks)

A disease outbreak may occur in a certain geographical area, or may extend over several countries. The outbreak may last for a few days or weeks, or for several years.

The World Health Organization also points out that an outbreak can be a re-appearance of a long absent disease caused by a pathogen. Any suspected outbreak should be reported and investigated.

The graphic shows some different disease outbreaks that have occurred over the years around the world.

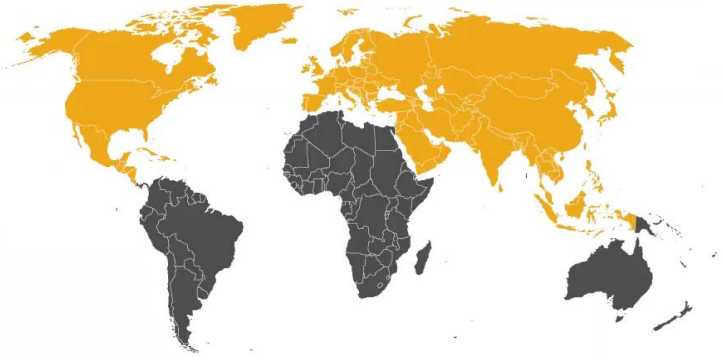
541 - 542: The plague of Justinian (Bubonic Plague) It ravaged areas of modern-day Europe, Northern Africa, and Russia, killing 5,000 people a day at its peak.

Areas affected/pandemic

1829 - 1851: The second cholera pandemic

This pandemic began, like the first, with outbreaks along the Ganges River delta in India. From there, the disease spread along trade routes to Asia, Europe and North America in 1829, lasting 20 years. Symptoms included vomiting, dehydration and diarrhea. The disease is thought to have killed over 100,000 people.

Areas affected/pandemic



1918 - 1923: The flu pandemic (Spanish flu)

The 1918 Spanish Flu Pandemic coincided with the end of the First World War and struck worldwide. It was a one of the worst influenza pandemics in history, killing at least 75 million people between 1918 and 1923.

Areas affected/pandemic

2002 - 2003: SARS (Severe Acute Respiratory Syndrome)

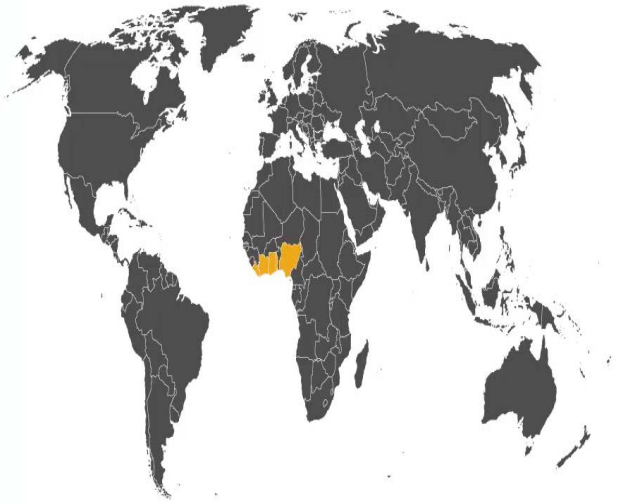
Severe Acute Respiratory Syndrome (SARS) struck in 2002. It started in mainland China and spread throughout Asia in a 12-month period, killing around 775 people. It was caused by the corona virus.

Areas affected/pandemic

2014: West Africa Ebola virus

There were 3,069 confirmed cases as of September 2014, and the figure is now said to exceed 3,800. The outbreak has a mortality rate of around 50 percent.

Areas affected/pandemic



Question 9a (2 marks)

State two ways in which pathogens could enter the body**.**

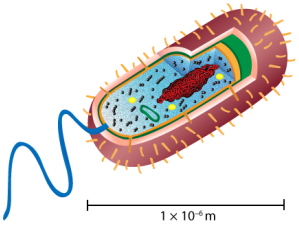
1. Contact of bodily fluids. For e.g. Sharing needles, because of which blood of an infected person may affect a non-infected one.

2. Contact with toxic and harmful material. This could be sewage, as pathogens are normally present in water products and rubbish materials.

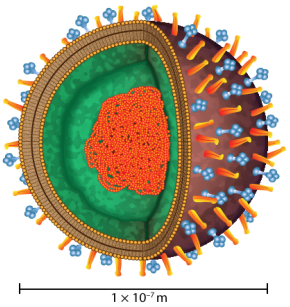
2/2

The images below show the structure of bacteria and viruses.

Bacteria



Viruses



Question 9b (2 marks)

List two differences in structure between bacteria and viruses**.**

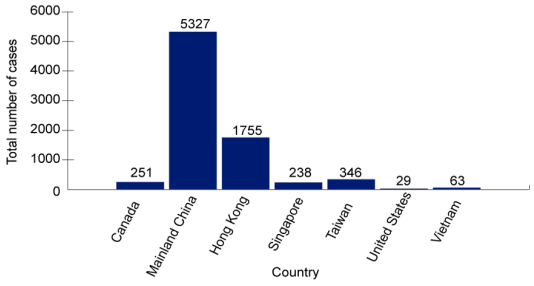
1. Bacteria have hairs.

2. The bacteria also has a DNA, whilst the virus is just a simple molecule surrounding a piece of RNA.

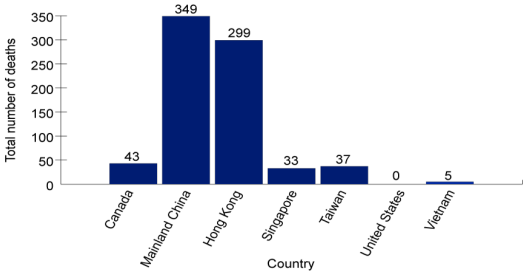
0/2

Severe acute respiratory syndrome, commonly referred to as SARS, is a respiratory illness that is contagious and sometimes fatal. SARS was first identified in mainland China in November 2002 and within only a few months, the disease spread across the world.

Total number of cases of SARS



Total number of deaths from SARS



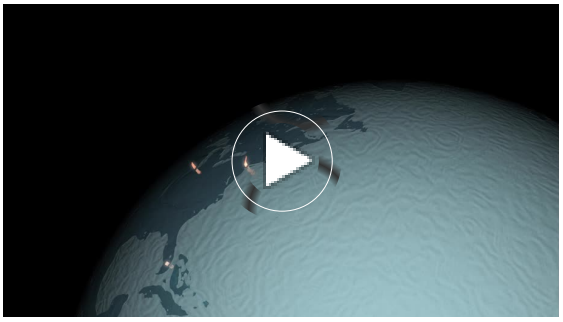
Question 9c (4 marks)

A journalist reported that mainland China had a higher death rate than Hong Kong from this outbreak of SARS. Use the information in the graphs to **explain** if this report is accurate.

Yes it is accurate. This is because there have been more number of cases of SARS ini China than in Hong Kong. It would only be na tural that the death rate in mainland China would be higher than in Hong Kong.

0/4

The animations below show how a disease can spread rapidly around the world.



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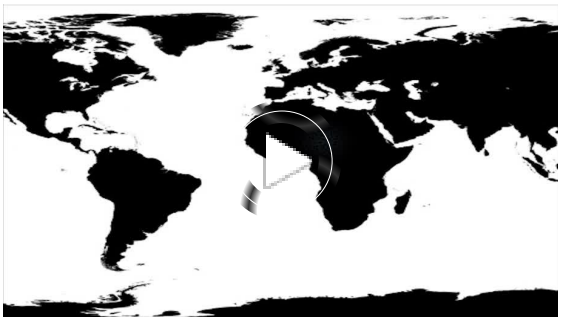

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Question 9d (2 marks)

Outline how a disease can move quickly around the world.

There can be many ways. Some are:

1. The pathogen may have entered water supplies and may spread throughout the country.
2. People may travel unknowingly while infected and may take the pathogens abroad together with them. This causes the hazard to become international.
3. Poeple may share hankerchiefs which may have come in contact with pathogens.

2/2

2. Infected person / travelling around world.

Question 9e (3 marks)

Describe the social effects on your local community that could be caused by a worldwide disease outbreak.

There woudl be discrimination against those infected any people may avoid touching them or making contact with them in anyway. In creased infections would lead to more deaths and over-flooding of hospitals. This would cause more grief throughout the society.

2/3

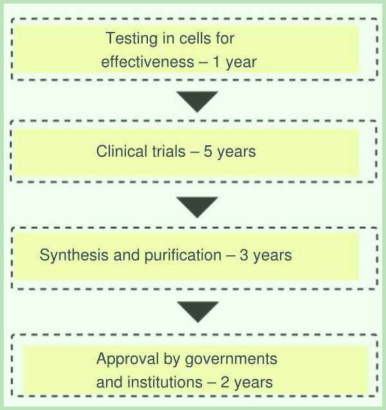
Question 10 (16 marks)

Local governments are responsible for ensuring access to healthcare for their populations. They should do their best to give access to quality health services for all. However, around two billion people worldwide – more than 80 % of them in low-income countries – have inadequate or no access to essential medicines and vaccines, and many have difficulty paying for medical care. The death toll due to limited access to medicines is estimated at ten million people a year.

The research, development and testing of new drugs is a lengthy, very costly process which is rigidly controlled by governments in many countries. In most countries, drugs must be subjected to thorough laboratory and clinical studies that demonstrate their usefulness and safety. Before studies on humans are permitted, the drugs are extensively tested on animals and cell cultures.

Question 10a (2 marks)

Organize the stages of the drug development process into the correct order.



1/2

Question 10b (14 marks)

Once a pharmaceutical company develops a new drug or medicine, they have the exclusive right to produce and sell it for up to 20 years. No other companies or governments are legally allowed to copy and produce the drug. After 20 years the drug may be made by any company more cheaply.

Discuss and **evaluate** the consequences of the 20 year timescale when developing drugs to control disease outbreaks. In your answer you should consider:

- the impact of drugs on pathogen transformation
- the ethical issues of limiting access to expensive new drugs on an individual and a community
- the economic considerations of the company investing in research
- the relationship between the factors you have discussed.

Medical discoveries are getting better with time, and new drugs and medicines can be the solution for diseases that affect our world today. In the case of a highly spread disease outbreak, these drugs would be needed to control the pathogens causing the outbreak, to diminish the number of deaths caused by the disease, and to decrease and prevent the number of cases itself. But what are these medical discoveries worth for, if only a few people can have access to them?

When there is an emergency like a disease outbreak affecting hundreds or thousands of people, it is not ethical nor it is right to limit the access to the new drugs and medicines that could save many, many lives. Some new drugs are very effective but they are also very expensive, and they are certainly not affordable for everyone. People affected by a disease would already be economically stressed enough because of the special medical care, and the alterations they have to make in their lives, and this would only worsen if the medicine that was their only hope was not available to them. Some of these drugs would be impossible to obtain in some LEDCs, which is precisely where disease outbreaks strike the hardest.

Of course, the company developing and selling this medicine would have a huge economic benefit from people buying the new drug. However, I believe it is not worth it at all to limit access to a product that could save people's lives for the sake of the economic development of your own company. In case of a disease outbreak, this 20 year timescale would not be convenient for any community, especially those in low-income countries and communities, those who do not have adequate access to healthcare, those who would need treatment the most.

5/14

- Ethics stated and explained.

- Economics stated and explained.

- " (...) this 20 year timescale (...) ": implied long timescale.

Question 1 (5 marks)

Artists use and apply their scientific knowledge and understanding to paint beautiful portraits and produce art work like the portrait shown on the right.

Watch the video below to answer the following questions.

©
Steve Spangler Science

©
Roger Oncoy

Question 1a (1 mark)

Write down what you see happening to the colours in the video when the liquid is added.

The colours are spreading out

1/1

Question 1b (1 mark)

State the name of the physical process affecting the colours in the video.

Diffusion

1/1

Question 1c (3 marks)

Explain how the rate of the process in part (b) could be changed by altering the temperature.

Prediction

If the temperature in which the reaction takes place increases, the amount of time for the process to occur will decrease, thus increasing the rate of reaction

Explanation

This is because the higher the temperature is the more energy each particle in the paint will have and if it has more energy it will move around much faster therefore spreading out quicker than what it would have done with a lower temperature

3/3

Question 2 (7 marks)

Skin is a living organ that needs care to remain healthy. The skin contains natural oils that limit evaporation of water. Many people use cosmetic products and creams to replace the natural oil lost from the skin as part of the aging process. New creams and techniques are being developed to increase oil levels in skin.

© Galvanic facial treatment_istock

Recently, a new technique in skin care is being developed in which dermatologists use small electric currents to improve the absorption of creams. This is called galvanic facial treatment.

Question 2a (1 mark)

Skin is naturally regenerated as old cells are replaced by new ones.

State the name of the cell division process by which these cells are replaced.

Mitosis

1/1

Question 2b (3 marks)

In galvanic facial treatment a cream containing a positively charged active ingredient is applied to the skin. A positively charged electrode is put in contact with the skin.

Explain how galvanic facial treatment can improve the absorption of the active ingredient into the skin.

Because the treatment and the skin have the same kind of charged electrodes, which is positive, then it allows the active ingredients to absorb much easier and faster. The positively charged electrodes are attracted to each other.

1/3 Active ingredient absorbed faster.

Question 2c (3 marks)

Electroporation is a technique used to introduce bioactive molecules into cells. In electroporation, a voltage is applied across skin cells, which allows a small electric current to pass through cells. This current changes the characteristics of the outer layer of skin cells.

If a voltage of 2 kV is applied across the face, the current passing through the skin is 250 mA.

Use the formula sheet to **calculate** the resistance of human skin.

V = 2 kV = 2000 V, I = 250 mA = 250000 A , R = ?
V = IR
2000 = 250000R
2000 / 250000 = 250000R / 250000

Ω
R = 0.008

2/3

- Incorrect conversion.
- Incorrect units due to conversion used.

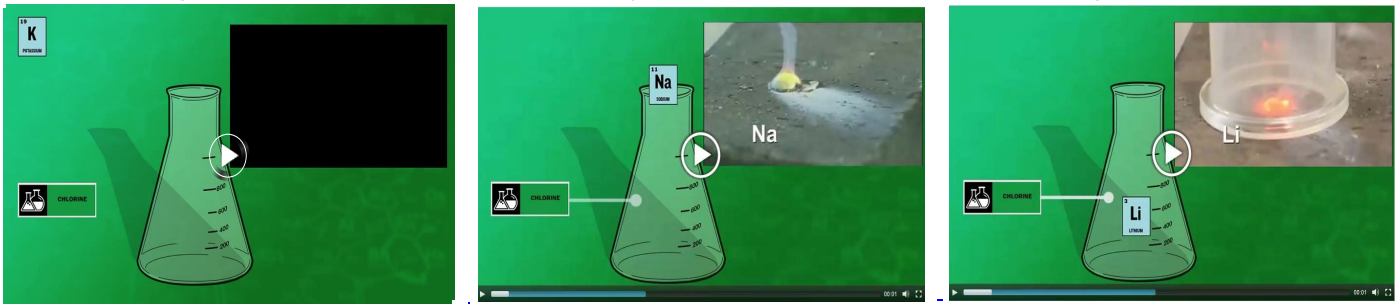
Question 3 (10 marks)

Scientists have used their creativity to produce dazzling firework displays. One of the uses of group one elements is to produce bright colours in fireworks.

The flask in the simulation contains chlorine gas. Click on the video in each tab to observe the reaction of each element with chlorine.

Question 3a (2 marks)

Potassium | Sodium | Lithium



© Footage by Royal Society Of Chemistry

Group one elements are highly reactive.
Outline the reason for the high reactivity of group one elements.

The first group of the elements, which are the alkali metals, are highly reactive. The reason for this is that the atoms of these metals h ave only 1 electron at their outer shells, so they are very prone to lose electrons and produce a compound with another element in or der to reach the state of having 8 electrons in the outer shell. Alkali metals are very easy to have reactions especially with halogens, which have 7 electrons in their atoms in the outer shell.

2/2

Question 3b (3 marks)

Select one reaction from the videos above and **write down** a balanced chemical equation for this reaction. Include state symbols in your answer.

$2Na+Cl_2-->2NaCl$

2/3

Caesium (Cs) is another group one element. It will also react with chlorine.

Question 3c (2 marks)

Using your knowledge of periodic trends, **compare and contrast** the reactions between caesium and chlorine, **and** lithium and chlorine.

Caesium and lithium both have one electron in the outer shell of their atoms, so the mole ratio between caesuim and clorine and lithi um and chlorine is the same. However, becase in the first group, the reactivity of an element increases when the periodic trend goes down, so caesium would have higher reactivity than lithium, which would result in that caesium would have a more 'violent' reaction with chlorine than lithium.

1/2

Question 3d (3 marks)

Francium (Fr) is also a group one element. Francium is very rare and it is never found in nature as an uncombined element.

Apart from being rare, **explain** why francium is never found as an uncombined element.

Francium is the most reactive element in the metal reactivity sequence, which means it could react with other elements rapidly to for m compounds instead of being an uncombined elements. Besides, Francium could decay very quickly (26 minutes). When it decays, it becomes a new element.

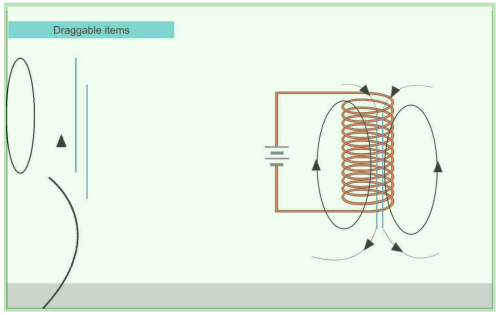
1/3

Question 4 (9 marks)

When a current flows through a wire it generates a magnetic field. If the wire is coiled around a core a electromagnet can be formed.

Question 4a (3 marks)

Select shapes to **construct** a diagram showing the magnetic field lines around and through the coil of wire below.



3/3

Question 4b (3 marks)

The flow of the direct current through the coil generates a force.

Select what happens to the coil when a direct current flows and **explain** why the generated force has this effect on the coil.

○ Compression

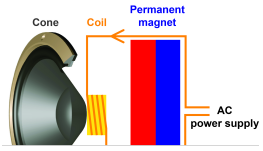
◉ Extension

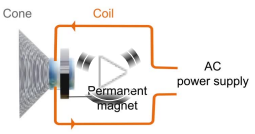
The force that is created due to the direction fo the magnatic field asnd the direction fot he flow of current will push downwards at the bottom of the coil and push up at the top of the coil. This will lead tot eh coild being pushed away form each other, thus expansing.

0/3

Music is one of the most common ways people express their ideas and feelings. The enjoyment of the beauty of music relies on electrical speakers which convert electrical signals into sound waves.

The generation of the sound wave depends on the back and forth vibrational movement of the cone.





Question 4c (3 marks)

Explain how this motion could be obtained by allowing an alternating current to pass in the coil.

As a aternating current is passed through the circuit the coil attached tot eh cone will ecome and electromagnet that attracts to the pe rmanant magnet when it the power is supplied. Like this the cone is streched inwars. however, as the currect is alternating, when it s withes direction the coil will create a magnetic field the otherway, this wilkl cause the electronmagnet to repel and therefore push out. Like this the montion of the cone can be controlled and sound can be created.

2/3 M1 & M3.

Question 5 (15 marks)

A bioassay is a kind of biosensor that uses sensitive living material (cells, tissues or organisms) to measure the effects of environmental conditions or chemicals, including drugs and toxins.The LD50 (Lethal Dose 50 %) is the concentration at which 50 % of a test population of cells or organisms is killed within a specified period.

Question 5a (2 marks)

Suggest meanings for the initials in LD25.

Lethal Dose 25% is the concentration at which 25% of a test a population of cells or organsims is killed within a specified period.

2/2

A student designed a scientific investigation to study the effect of sodium chloride (NaCl) on germination rates in mung beans.Groups of 30 seeds were placed on absorbent material wetted with a range of sodium chloride solutions in six covered petri dishes. The numbers of germinated seeds were checked daily over 5 days.

Question 5b (3 marks)

Formulate and **explain** a hypothesis that the student's experiment may have been testing.

My hypothesis for this experiment is as the concentration of NaCl increase the germination rates in mung beans will decrease.

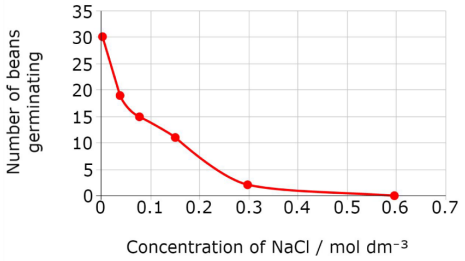
NaCl is a toxin which is produced by enviromental issues and which decreases the rate of germination as the toxin gets into the bean s not letting water and other mineals come inside which is important for the growth of the mung beans.

3/3

Question 5c (2 marks)

The number of beans that had germinated at the end of the investigation are shown in the graph.

Use the graph to determine the LD50 from the student's results.



The LD50 is the concentration at which 50 % of a test population of cells or organisms is killed within a specified period which in this graph clearly shows is 0.3 mol dm-3 of NaCl.

1/2 Incorrect value/correct units.

Question 5d (4 marks)

Water must move into cells for germination to start. The concentration of NaCl in seawater is about 0.5 mol dm^{-3}.

Use your answer to part (c) to **explain** why seawater cannot be used to water agricultural crops.

Seawater can not be used to water agricultural crops as the salt blocks the water and other minerals getting into the cells for germina tion which decreases the number of beans germinating.

0/4

Question 5e (4 marks)

Explain how the student could improve **and** extend the investigation method.

Improvement

The student can imporve the experiment by using different range of beans

Unclear.

Explanation

To see the efffect on different kinds of beans.

Accept as an extension.

Extension

increase or decrease the temperature of the room it is done in to see the effect of it on germination.

Accept.

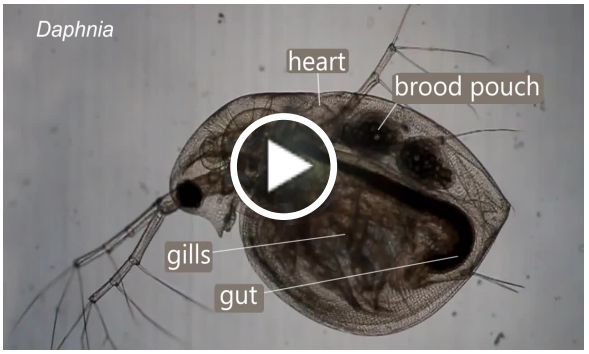
Explanation

increase or decrease the temperature of the room it is done in which will help to know at what temperature will the rate be more slow or high.

2/4

Question 6 (15 marks)

Daphnia are fresh-water organisms between 1 – 5 mm in length. They are found all around the world in water temperatures up to 40°C. Daphnia are transparent organisms, and their feeding, egg production and heart rates are easily observed. They mature and breed very rapidly. In the wild Daphnia are an important source of food for pond organisms. Most Daphnia will be eaten soon after hatching.



© Chris Moody - Daphnia heartbeating, recorded using a Canon EOS 7D

Question 6a (12 marks)

Design a scientific investigation to observe *Daphnia*'s response to varying water temperature within the range of its natural environment. In your answer you should include:

- a list of suitable equipment
- the independent, dependent and control variables
- how you will manipulate the variables
- how you will collect sufficient data
- a description of the method
- any relevant safety or ethical considerations.

Suitable equipment for this scientific investigation would include-

Thermometer

Safety goggles

The different variables for this investigation would include-

Independent- the temperature of water

Manipulation- Daphnia present in different water temperatures would be found within the range of its natural environment to study the investigation.

Dependent- respionse of the organism (rate of the heart beat), which is Daphnia

Manipulation- This is dependent on the independent vairable, which means the response of this organism would be dependent on th e temperature of the water. \

Control- organism (Daphnia), the thermometer

Manipulation- The organism that is being investifgated upon would remain same throughout the experiment, which means in all the di fferent temperatures of water.

The thermoter with the same calliberations would be used throughout the experiment to measure the temperature of the water.

Method Description-

Firstly, the temperature of the water must be found. After this is found out, the response of Daphnia needs to be carefully **observed.** Observation plays a very important role over here, as this is the aspect on which the entire investigation is based.

The aspects of the response, which need to be found out, include the rate at which their heart beats, wheter it is slow, fast or really fa st, in terms of the varying temperature.

The data needs to be collected in a way such that appropriate tables with appropriate rows and columns needs to be made and a ba r chart needs to be plotted against the raw data collected. The tabel would have three columns: 1) Senior number, 2) Temperature of the water, 3) Response of Daphnia (rate of the heart beat). The bar chart with x-axis being the water temperature and y-axis being th e rate of heart beat needs to be plotted.

The most important safety consideration would include wearing safety goggles while conducting the observation.

6/12

- Some equipment is listed/incomplete.

- Temp as IV.

- Rate of heart beat as DV.

- CV/ daphnia.

- Range of temperature is not stated.

- How the data will be collected although incomplete.

- Safety concern is stated/weak.

A student suggested that Daphnia's response to increasing temperature is a useful model to understand human responses to temperature.

Question 6b (3 marks)

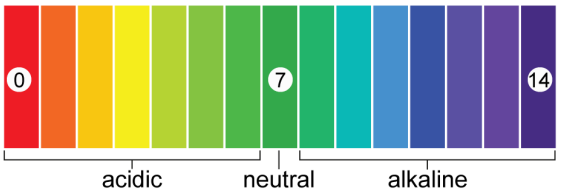
Discuss whether or not this conclusion is valid.

This conclusion doesn't seem valid to me at all. This is because a **conclusion** cannot be made on basis of assumptions, as humans are not being observed, in terms of varying temperature and only an assumption is being made. This is also not valid because humans and Daphnia are two very different organisms and **might** have very different ways in which the respond to the stimulus. Therefore,I conclude that this conclusion is not valid, because no concrete data collection is done to reach this conclusion, but an **assumption**, which does not make sense in **scientific conclusions.**

2/3

Question 7 (14 marks)

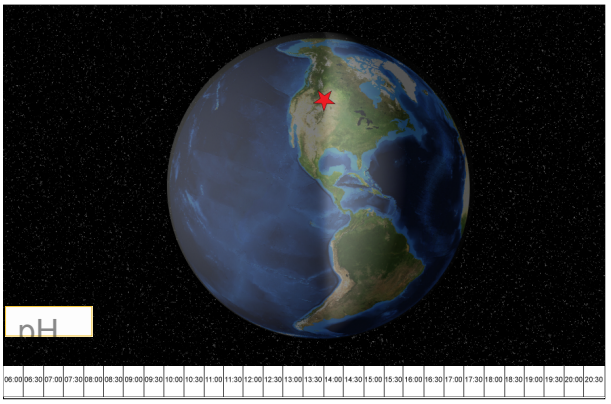
The pH scale is used to measure acidity. Solutions with pH values less than seven are acidic, solutions with pH values greater than seven are alkaline.



Question 7a (2 marks)

The freshwater organisms in a pond are part of a complex food web. *Daphnia* feed on single celled plants called algae.A student wanted to investigate whether the algae and Daphnia living in a pond changed the pond's environment during a 12 hour period. Use the simulation to collect values of pH. **Select** appropriate times of day and record the data in the table below.

Time of day	pH
06:00	7.56
07:30	7.64
09:00	7.81
10:30	8.02
12:00	8.25
13:30	8.47
15:00	8.64
16:30	8.74
18:00	8.72



2/2

Question 7b (6 marks)

By interpreting your data from part (a), **explain** your results using scientific knowledge from your MYP studies.

My results conclude that throughout the 12 hour day period when the time increases the pH increases but when the 12 hours is over i n the night time the pH starts to decrease again.

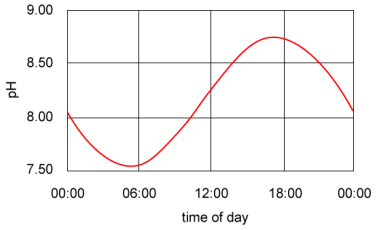
2/6

- "The pH increases(...)": rises during day.

- "(...) the pH starts to decrease again.": fails at night.

Question 7c (6 marks)

The graph below shows how the pH of the pond changes over a 24 hour period in the summer.



Describe how the shape of the graph would change in winter and **explain two** reasons for any differences.

Description

In winter the days are shorter, so the pH levels will not rise as high as they do in summer, and also the climate is colder. So the graph will not rise as high as it is now and the pH will decrease more in the night time.

Lower peak

Reason 1

The days are shorter, so less sunlight.

Less duration of daylight.

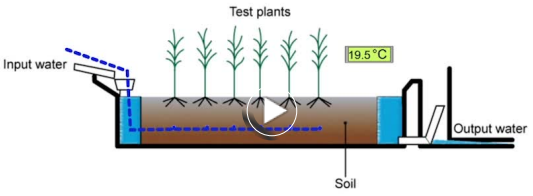
Reason 2

Climate is colder, diffrent reaction.

3/6 Lower temp.

Question 8 (16 marks)

Storm water comes from rainfall that collects in paved and built up areas. As the water collects it picks up nutrients from the surroundings. Sometimes storm water is deliberately drained through an area of land covered with plants that tolerate flooding before it reaches a pond or river. The “ecologically enhanced” storm water treatment system limits the amount of nutrients that are carried by the water and so reduces the over fertilization of the pond.
Your school has access to a plant test bed used to model treatment systems that remove nutrients from storm water. An animation of this test bed is shown.



Question 8a (4 marks)

Identify the variables that you could test in the model plant test bed.

Independent variable

Amount of input water added

Dependent variable

Growth of the plant

Control variable 1

Outside temperature

Control variable 2

Type of soil

3/4

Question 8b (2 marks)

Formulate a testable hypothesis to investigate the effect of the independent variable on the dependent variable from part (a).

The more input water added to the bed, the more the plant will grow.

2/2 Hypothesis linked to part (a).

Question 8c (10 marks)

Describe how you would use the model test bed to collect data that would help you test the hypothesis you gave in part (b). You may wish to include additional equipment in your method.

To test my hypothesis by collecting data, I would use the model test bed by adding 5 different amounts of input water to the bed ever yday for 10 days. In every bed will be 10 plants of the same species. After the 10 days, I will record the growth in every bed, for every plant and make an average growth number, per amount of water given to each of the 5 different beds.

Materials: ruler, plant seeds, shovel, soil, model tests beds

I will create a graph with the average growth per amount of input water given.

4/10
- Method linked to IV and DV/justified.
- Method linked to one CV/days.
- Some equipment is listed.
- Range for data collection is stated.

Question 9 (13 marks)

A disease outbreak may occur in a certain geographical area, or may extend over several countries. The outbreak may last for a few days or weeks, or for several years.

The World Health Organization also points out that an outbreak can be a re-appearance of a long absent disease caused by a pathogen. Any suspected outbreak should be reported and investigated.

The graphic shows some different disease outbreaks that have occurred over the years around the world.

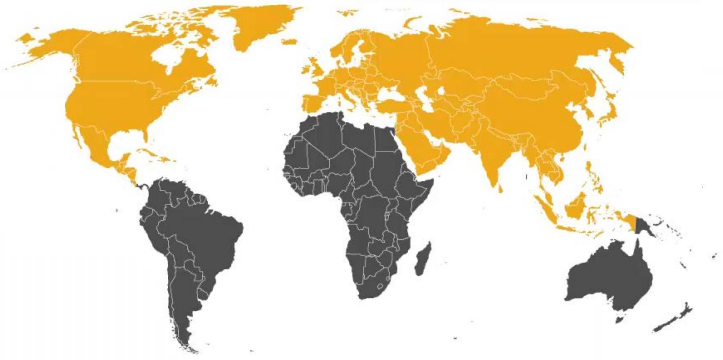
541 - 542: The plague of Justinian (Bubonic Plague) It ravaged areas of modern-day Europe, Northern Africa, and Russia, killing 5,000 people a day at its peak.

Areas affected/pandemic

1829 - 1851: The second cholera pandemic

This pandemic began, like the first, with outbreaks along the Ganges River delta in India. From there, the disease spread along trade routes to Asia, Europe and North America in 1829, lasting 20 years. Symptoms included vomiting, dehydration and diarrhea. The disease is thought to have killed over 100,000 people.

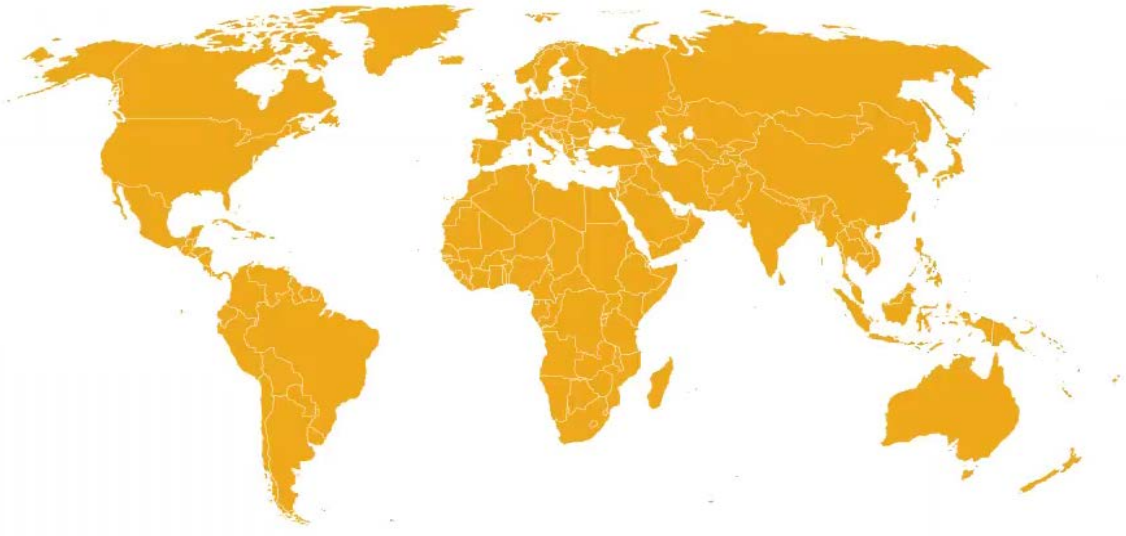
Areas affected/pandemic



1918 - 1923: The flu pandemic (Spanish flu)

The 1918 Spanish Flu Pandemic coincided with the end of the First World War and struck worldwide. It was a one of the worst influenza pandemics in history, killing at least 75 million people between 1918 and 1923.

Areas affected/pandemic



2002 - 2003: SARS (Severe Acute Respiratory Syndrome)

Severe Acute Respiratory Syndrome (SARS) struck in 2002. It started in mainland China and spread throughout Asia in a 12-month period, killing around 775 people. It was caused by the corona virus.

Areas affected/pandemic

2014: West Africa Ebola virus

There were 3,069 confirmed cases as of September 2014, and the figure is now said to exceed 3,800. The outbreak has a mortality rate of around 50 percent.

Areas affected/pandemic

Question 9a (2 marks)

State two ways in which pathogens could enter the body.

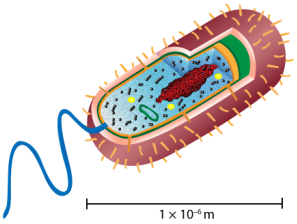
Through the air that we breathe.

Through the water that we used to drink and for our food.

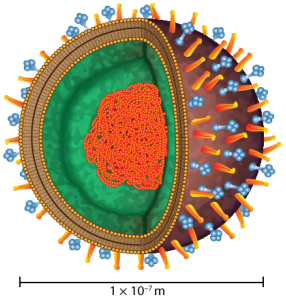
2/2

The images below show the structure of bacteria and viruses.

Bacteria



Viruses



Question 9b (2 marks)

List two differences in structure between bacteria and viruses.

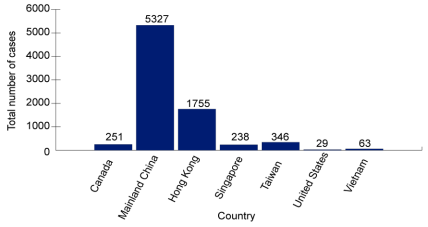
Bacteria have a tail-like structure which help it to move while viruses do not.

Bacteria have many components within their cell while viruses simply have a tangle of chromosomes.

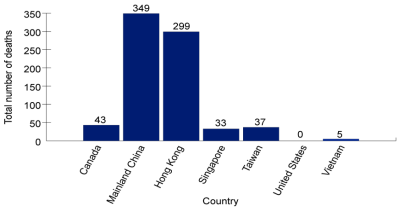
0/2 First sentence not accepted.

Severe acute respiratory syndrome, commonly referred to as SARS, is a respiratory illness that is contagious and sometimes fatal. SARS was first identified in mainland China in November 2002 and within only a few months, the disease spread across the world.

Total number of cases of SARS



Total number of deaths from SARS



Question 9c (4 marks)

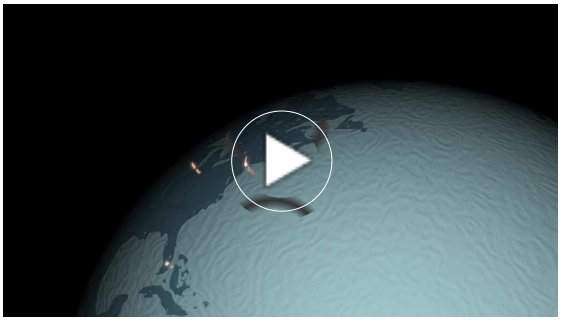
A journalist reported that mainland China had a higher death rate than Hong Kong from this outbreak of SARS. Use the information in the graphs to **explain** if this report is accurate.

In Mainland China, there were 349 deaths from SARS while in Hong Kong, there were 299 deaths from SARS. In Mainland Chine th ere were 5327 cases of SARS while in Hong Kong there were 1755 cases. The death rate in Mainland China was roughly 0.066 whil e the death rate in Hong Kong was roughly 0.170. This shows that the report from the journalist is inaccurate as the death rate in Hon g Kong was higeher than that of Mainland China.

349÷5327 299÷1755
0.065515299 0.17037037

4/4

The animations below show how a disease can spread rapidly around the world.



© istock - brojo

© istock - proBAKSTER

Question 9d (2 marks)

Outline how a disease can move quickly around the world.

A disease can move very quickly around the world when people travel from one country to another or when livestock or even food is t ransported across countries and continents. A disease spreads around in the country itself and is then transported to other parts of t he world where it also begins to spread.

2/2

Question 9e (3 marks)

Describe the social effects on your local community that could be caused by a worldwide disease outbreak.

When a worldwide disease outbreak occurs, contact between the people within the community starts to drop as people make attempt s to evade the disease. This would reduce social events as well as social relationships. People would be wary of spending time in th e open or surrounded by other people as the possiblity of contracting the disease would consequentlly increase.

1/3

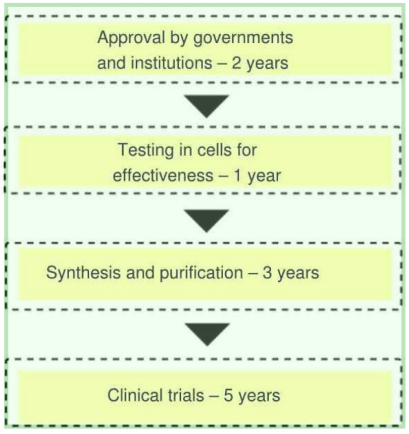
Question 10 (16 marks)

Local governments are responsible for ensuring access to healthcare for their populations. They should do their best to give access to quality health services for all. However, around two billion people worldwide – more than 80 % of them in low-income countries – have inadequate or no access to essential medicines and vaccines, and many have difficulty paying for medical care. The death toll due to limited access to medicines is estimated at ten million people a year.

The research, development and testing of new drugs is a lengthy, very costly process which is rigidly controlled by governments in many countries. In most countries, drugs must be subjected to thorough laboratory and clinical studies that demonstrate their usefulness and safety. Before studies on humans are permitted, the drugs are extensively tested on animals and cell cultures.

Question 10a (2 marks)

Organize the stages of the drug development process into the correct order.



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Question 10b (14 marks)

Once a pharmaceutical company develops a new drug or medicine, they have the exclusive right to produce and sell it for up to 20 years. No other companies or governments are legally allowed to copy and produce the drug. After 20 years the drug may be made by any company more cheaply.

Discuss and **evaluate** the consequences of the 20 year timescale when developing drugs to control disease outbreaks. In your answer you should consider:

- the impact of drugs on pathogen transformation
- the ethical issues of limiting access to expensive new drugs on an individual and a community
- the economic considerations of the company investing in research
- the relationship between the factors you have discussed.

It is widely known that "once a pharmaceutical company develops a new drug or medicine, they have the exclusive right to produce a nd sell it for up to 20 years." This could be problematic, especially in the case of a pandemic. Pathogens have the ability to evolve an d make themselves immune to drugs such as the Tubercolosis pathogen has done in certain prisons in Russia. The clear problem w ould be that if a pathogen becomes resistant to the drug, the government can't do anything other than ask the pharmaceutical compa ny to make a new one. This could cause problems, especially because the whole processfor releasing a drug to the market can take 11 years and especially if the pharmaceutical companies might want some incentive to hurry the process up.

Also, the 20 years rule allows for a pharmaceutical company to privatise the drug and sell it for much more than it's worth in cases w here people need them. The law doesn't prohibit them from doing this but these are seen as ethical decisions. One recent example w as the CEO Martin Shikrelli, the person who hiked up the price of an aids drug 100 fold. These actions would not much affect the hig her class, but more the middle and lower class communities that need these drugs to survive.

These companies invest alot of time, manpower and money into the development of a drug so this rule would be there to protect thei r idea and give them and them alone the rights to make the drug. This is good from tha companies perspective because they can be allowed to gain a profit but it is ethically and morally wrong to raise the price of the drug even further as the need gets higher.

Overall, even though I agree that the 20 year rule is useful in giving pharmaceutical companies a chance to gain profit on the drug th ey spent their money on, I do not think that it should be allowed for these companies to hike up the prices depending on the peoples needs for the drugs as it is ethically and morally wrong.

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- Pathogens evolve and become resistant to drug. An attempt to link it to time scale.

- Ethical issue stated but economic is further explained.

- Final appraisal.