Sydney Technical High School

Student Name / Class

Science
2009 Trial School Certificate

General Instructions

- Reading time: 10 minutes
- Working time: 2 hours
- Write using blue or black pen
- You may use a pencil to draw or complete diagrams
- Attempt ALL questions
- Calculators may be used
- Detach Stimulus Booklet provided at the end of this paper and use it where required throughout the test.

Total marks – 100

Section 1
Pages 2 - 26

60 marks
Allow about 1 hour and 10 minutes for this section.

This section has TWO parts
Part A – Questions 1-50 50 marks
Part B – Questions 51-60 10 marks

Section 2
Pages 27-36

40 marks
Allow about 50 minutes for this section

This section has SIX questions

Question 61 6 marks
Question 62 8 marks
Question 63 7 marks
Question 64 8 marks
Question 65 4 marks
Question 66 7 marks

Section 1

60 marks
Allow about 1 hour and 10 minutes for this section.

Part A

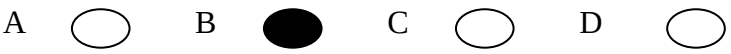
Questions 1 – 50 50 marks

Use the Section 1 Part A Answer Sheet for Questions 1 – 50.

Instructions for answering multiple-choice questions

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

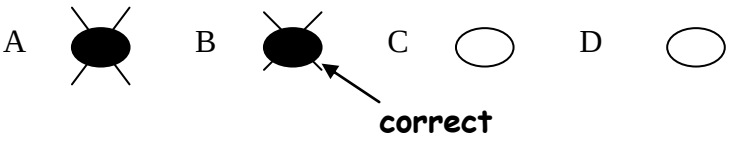
Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9



If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

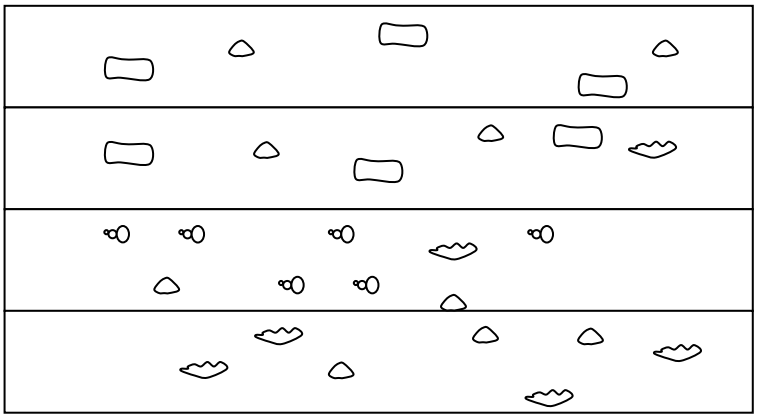


If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word **correct** and drawing an arrow as follows.



Questions 1- 4 relate to the diagram below of a geological profile.

The distribution of four different fossils is shown within the profile.



 sea urchin

 clam sp.1

 sea snail

 clam sp. 2

1. On the evidence here, which one of the species shown is the most recent?

(A) sea urchin

(B) sea snail

(C) clam sp. 1

(D) clam sp. 2

2. An indicator fossil is especially useful to palaeontologists. Because of its short period of existence, its presence in a stratum allows that stratum to be dated with some accuracy.

Which one of the species shown here is most likely to be useful as an indicator fossil?

(A) sea urchin

(B) sea snail

(C) clam sp. 1

(D) clam sp. 2

3. On the evidence here, which species existed for the longest period of time?

(A) sea urchin

(B) sea snail

(C) clam sp. 1

(D) clam sp. 2

4. These fossils all consist of the preserved hard parts of the animals involved.

Which one of the following is the best explanation of this?

(A) These animals, like most marine creatures, only consist of hard parts.

(B) The intense pressures involved in fossilisation destroy all trace of soft parts.

(C) It isn't possible to convert soft tissues into rock.

(D) The soft parts of most marine creatures decay before they can fossilise.

5. Over time, different cultures have found fossils and interpreted them in different ways.

The modern 'scientific' culture sees them as preserved evidence of past life that provides compelling evidence for evolution. Other cultures have seen them as spiritual representations of living things, and still others as the remains of mythical creatures.

Which one of the following best represents the nature of the interpretations which different cultures place on phenomena such as fossils?

(A) Not everyone in a particular culture agrees with the most popular interpretation.

(B) Some cultures are not interested in interpreting natural phenomena.

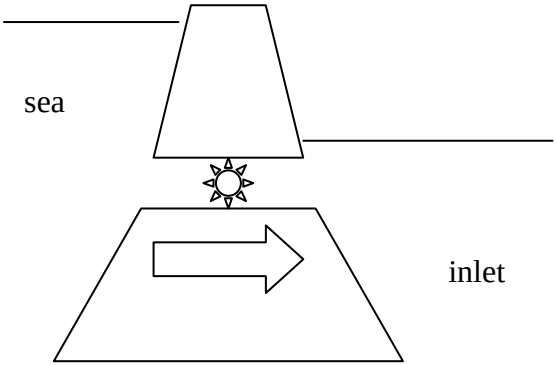
(C) No cultures are willing to change their interpretations as new evidence comes to light.

(D) Every culture's interpretation of natural phenomena reflects the knowledge, understanding and beliefs of the members of that culture.

Questions 6 – 9 relate to the diagrams below, which show the basic principle behind harnessing tidal power.

A dam is built across an inlet or estuary. Turbines are mounted in gaps in the dam so that as water is forced through the gaps, electricity is generated.

Tidal Power.

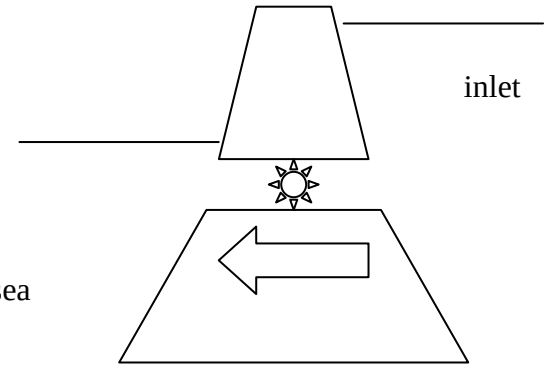


<u>As the tide rises</u>

Water from the sea passes through the dam, turning the turbine.

<u>As the tide falls</u>

Water from the inlet passes through the dam, turning the turbine.



6. When deciding where to site a power station of this type, which one of the following is the most important factor to consider?

(A) The tidal variation.

(B) The depth of the water.

(C) The time between high and low tides.

(D) The annual water temperature variation.

7. The main attraction of this sort of power station, from an environmental point of view, is that once built:

(A) It costs little money to run.

(B) It generates minimal amounts of greenhouse gas.

(C) It prevents access of boats to the inlet and therefore reduces human impact.

(D) It doesn't interfere with movement of fish between the sea and the inlet.

8. One of the best known tidal power stations is near St Malo in France. A dam was built across the mouth of the Rance estuary and turbines installed in the way shown above.

Modern research is leaning towards harnessing tidal power through offshore turbines. These would be like windmills placed to spin as tidal currents flow past them. They would not require the damming of a whole inlet.

Which one of the following is an **economic** advantage of offshore turbines over the older dam based tidal power station?

(A) There would be less erosion of coastal beaches.

(B) There would be no need to construct a very expensive dam.

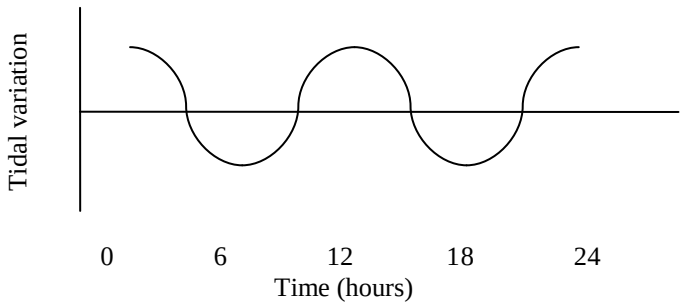
(C) Migrating seabirds wouldn't lose their mudflats.

(D) They would generate less greenhouse gas.

The information below relates to question 9.

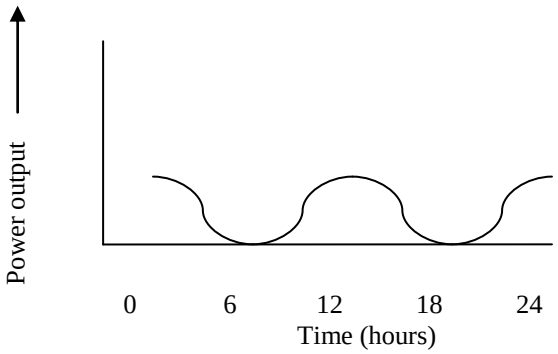
The power generated by tidal power stations is predictable, but not constant. It depends on the tidal rhythm.

The graph below shows how tide level varies over 24 hours

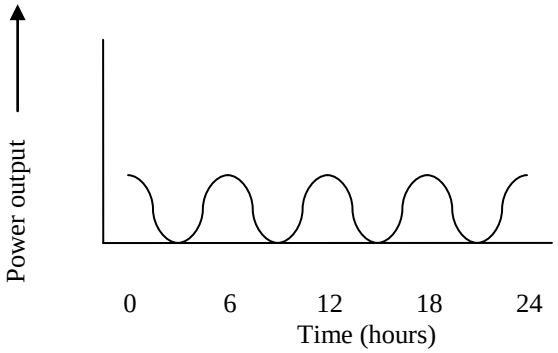


9. Given this pattern of tidal variation, and the fact that the tidal power station would only generate power when there is a difference in water level on the two sides of the dam, which one of the graphs below best represents the pattern of power generation over a 24 hour period?

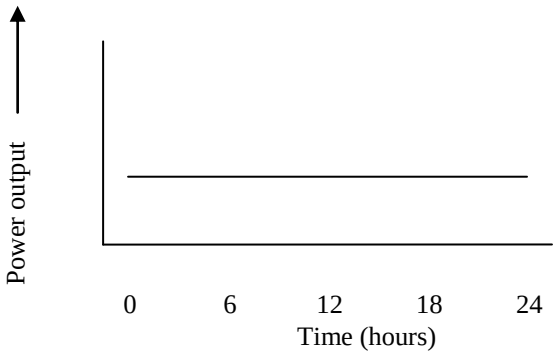
(A)



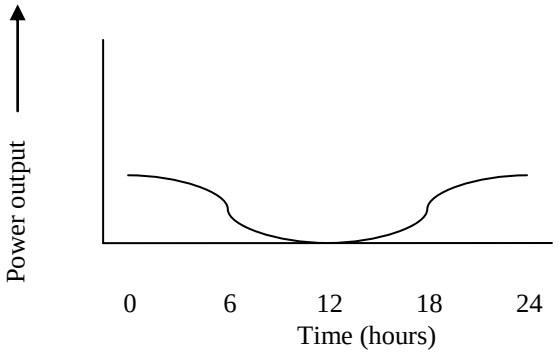
(B)



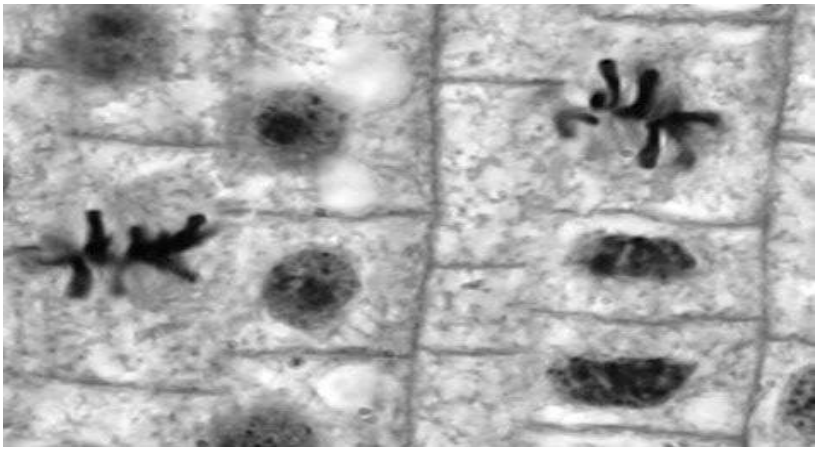
(C)



(D)



10. The photograph below shows cells dividing in the root of an onion. Their nuclei are dividing through the process of mitosis



The main aim of mitosis (the division of the nucleus in body cells) is to produce:

(A) variation between chromosomes

(B) larger cells

(C) gametes (eggs and sperm)

(D) identical copies of the chromosomes

11. Which one of these statements about chromosomes, genes and DNA is correct?

(A) Each gene consists of a number of chromosomes.

(B) A gene is a section of a DNA molecule.

(C) A chromosome consists of genes wrapped around DNA molecules.

(D) Each DNA molecule can be divided into distinct chromosomes.

12. In your study of Science you would have used scientific models.

Scientific models help us to understand a process, they allow connections to be seen and predictions to be made.

Which one of the following is a common disadvantage of scientific models?

(A) They don’t work.

(B) They are too hard to construct.

(C) They are too simple.

(D) They are too complex.

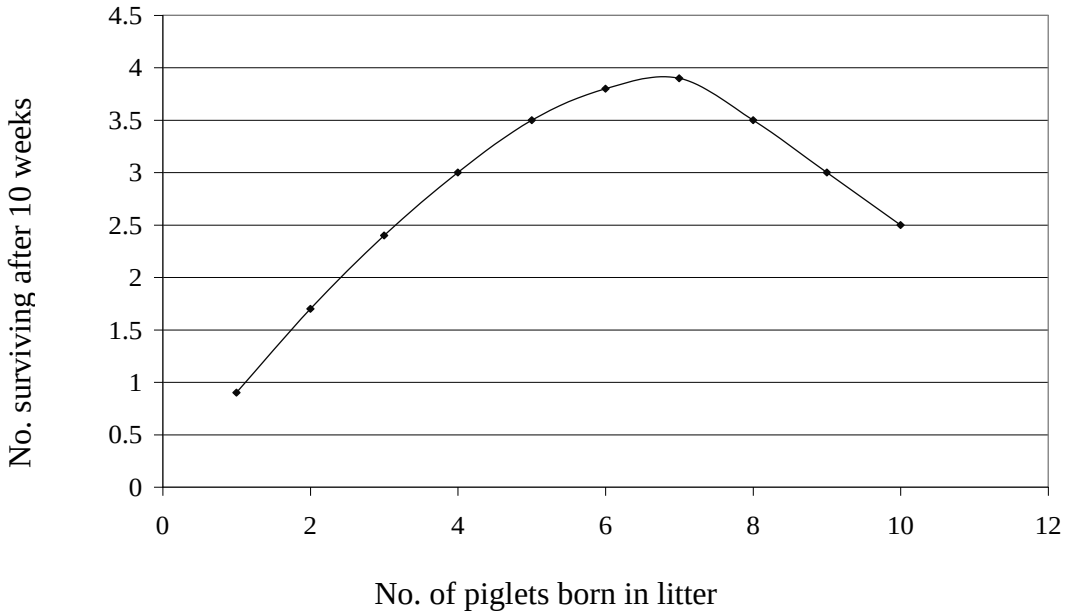
Questions 13 – 17 relate to the information below.

A family of piglets born at one time to the same sow is called a litter. Pigs can give birth to widely differing numbers of young.

A group of scientists set out to determine the effect of the size of a litter of piglets on the survival of those piglets.

They recorded the number of piglets born initially, (the litter size) and then recorded the number still surviving after ten weeks.

Graph to show the effect of litter size on the survival of piglets



13. Which size litter gives the highest number of surviving offspring at 10 weeks?

(A) 1

(B) 6

(C) 7

(D) 10

14. In which size litter does an individual piglet have the worst chance of surviving?

(A) 1

(B) 2

(C) 8

(D) 10

15. Which one of the following is the independent variable (the one whose effect is being investigated) in this experiment?

(A) Litter size.

(B) The length of time that piglets survive.

(C) The number of piglets which survive to 10 weeks.

(D) The amount of milk produced by a sow.

16. There are many variables which might affect the survival of the piglets. The scientists would have tried to control these as best they can.

Which one of the following variables would they **NOT** have controlled in this experiment?

(A) The amount of milk received by each piglet.

(B) The amount of food given to each sow.

(C) The air temperature in the cages.

(D) The breed of pig.

17. This sort of study is useful for pig farmers who want to know how to get maximum productivity.

Farmers would want to be sure that the results of the experiment are reliable, that the effect of chance results has been minimised and that they can trust the conclusion.

Which one of the following aspects of experimental design would best ensure this?

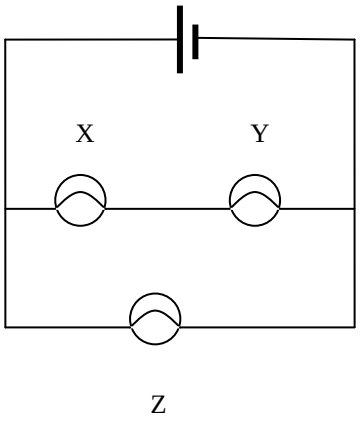
(A) Correct safety procedures were followed throughout the experiment.

(B) The same scientist recorded all the data and it was stored and analysed using a computer.

(C) A very large number of litters were sampled and survival averages calculated for each litter size.

(D) The health of the piglets was monitored throughout the study.

Questions 18 - 20 refer to the circuit diagram drawn below.



Globes X, Y and Z are of exactly the same type.

18. Which one of the following statements about the brightness of the globes is true?

(A) All three globes would have equal brightness.

(B) X and Y would glow more brightly than Z

(C) X would glow most brightly

(D) Z would glow most brightly

19. What would happen if globe Z was removed?

(A) X and Y would go out.

(B) X and Y would glow more brightly

(C) X and Y would glow with the same brightness

(D) X and Y would glow less brightly.

20. Which one of the statements below, about the current flowing in the circuit, is correct?

(A) The amount of current decreases the further it gets from the battery.

(B) There is more current flowing through Z than X and Y.

(C) There is more current flowing through X and Y than Z.

(D) The current is the same at all points in the circuit.

21. DNA fingerprinting works by taking a section of DNA, cutting it using enzymes, and then subjecting the fractions to gel electrophoresis.

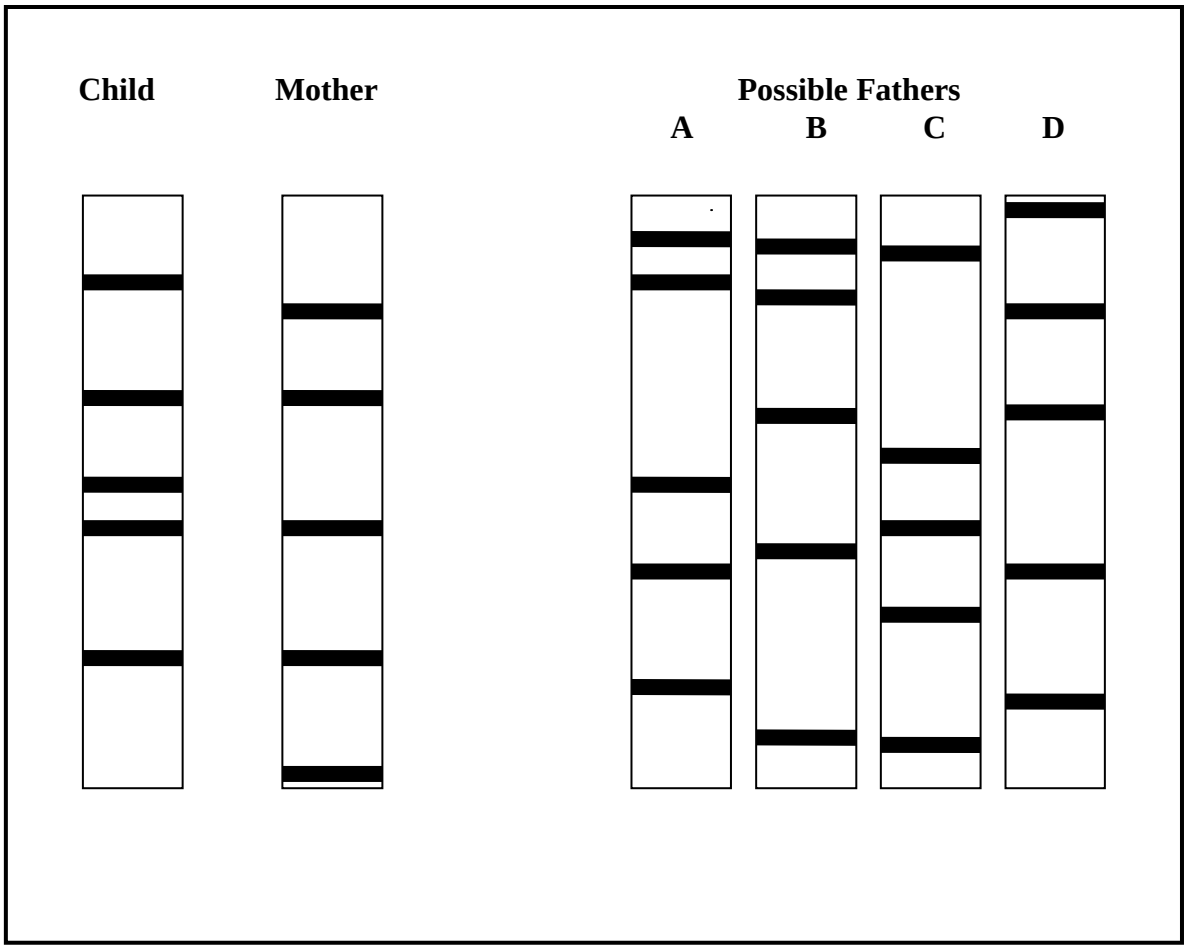
The fragments settle at a point which reflects their relative size, and give a pattern of bands which is unique to each person.

There are many applications of DNA fingerprinting. One is in paternity testing.

A child will show a banding pattern which is a combination of that of its parents.

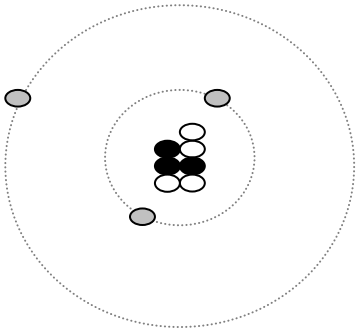
If the mother's and child's 'DNA fingerprints' are known, then the father can be identified.

Which one of the possible fathers below is the actual father of the child?



Questions 22 – 24 refer to the diagrams below.

This diagram represents the arrangement of sub-atomic particles in an atom of lithium.



This diagram shows the positions of the first 20 elements of the Periodic Table.
(The letters do not represent chemical symbols.)

1																	2
3 ***A***	4 ***B***											5	6	7 ***C***	8	9	10 ***D***
11 ***E***	12											13	14	15	16	17 ***F***	18 ***G***
19 ***H***	20																

22. How many neutrons are shown in the drawing of the lithium atom?

(A) 3

(B) 4

(C) 7

(D) 10

23. Which letter on the periodic table represents lithium?

(A) *A*

(B) *B*

(C) *C*

(D) *D*

24. Which letter represents an element with similar properties to G?

(A) *D*

(B) *E*

(C) *F*

(D) *H*

25. Delivery vans should all be fitted with a tough screen separating the driver's compartment from the luggage area.



In the event of an abrupt stop, this protects the driver from being struck by packages obeying one of Newton's Laws of Motion.

Which one of Newton's Laws is principally involved here?

(A) The Law of Universal Gravitation

(B) Newton's 1st Law of Motion – The Law of Inertia.

(C) Newton's 2nd Law of Motion – Force = Mass X Acceleration

(D) Newton's 3rd Law of Motion – Equal and opposite reaction.

26. When nitric acid is added to calcium carbonate, the resulting chemical reaction produces which gas?

(A) nitrogen

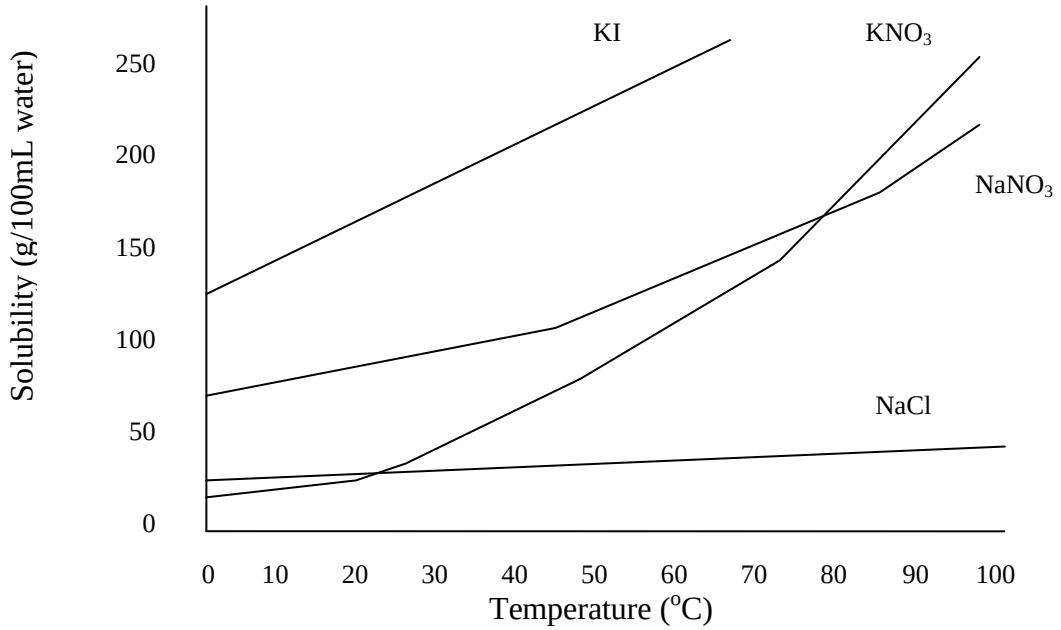
(B) nitrogen dioxide

(C) hydrogen

(D) carbon dioxide

Questions 27 – 30 refer to the graph below.

Graph to show the effect of temperature on the solubility of four compounds in water.



KI = potassium iodide
KNO_3 = potassium nitrate
$NaNO_3$ = sodium nitrate
NaCl = sodium chloride

27. Which general statement below best represents the relationship between temperature and the solubility of the compounds in the graph?

(A) As temperature increases, solubility increases.

(B) As temperature increases, solubility decreases.

(C) As solubility increases, temperature increases.

(D) As solubility increases, temperature decreases.

28. Which one of the four compounds is the least soluble at 60^oC?

(A) KI

(B) KNO_3

(C) $NaNO_3$

(D) NaCl

29. If separate solutions of 25g in 100mL water were prepared for each compound at $50^{o}C$, and they were then cooled down together at the same rate, which one would precipitate first?

(A) KI

(B) KNO_3

(C) $NaNO_3$

(D) NaCl

30. The four solutions from question 29 were mixed with a solution of lead nitrate.

A thick, yellow precipitate formed.

Which one of the following statements is the best explanation for this?

(A) Lead nitrate causes an endothermic reaction, lowering the temperature and causing some of the compounds to precipitate.

(B) The addition of the lead nitrate causes the concentration to rise, causing some of the compounds to precipitate.

(C) The addition of lead and nitrate ions to the mixture allows for an insoluble combination of ions and a precipitate forms.

(D) Lead nitrate is only soluble when in pure solution. The addition of other ions causes it to precipitate.

31. A star the size of our sun goes through a series of stages during its lifetime.

Which one of the following changes does such a star undergo over the course of most of its life?

(A) Its hydrogen is steadily converted into helium.

(B) Its surface temperature steadily increases.

(C) Its size steadily decreases.

(D) Its mass steadily increases.

32. Many plants in the South West of Western Australia produce a highly toxic compound which they store in their tissues.

A possum from the Eastern States would die if it tried to eat these plants, but the West Australian possums can tolerate the poison quite well.

Which one of the following is the best explanation of how this tolerance might have arisen in the West Australian possums?

(A) Through eating small amounts of the plant, each possum slowly builds up a tolerance.

(B) Each possum slowly builds up a tolerance by eating small amounts and then passes this on to its offspring. In this way each generation develops a greater tolerance.

(C) Possums are born with the toxins already in their bloodstreams. This causes them to develop an immunity.

(D) Some possums are just naturally better able to survive the toxin. They survive and reproduce more successfully than the others. In this way resistance to the toxin has become widespread.

33. Which scientist(s) is chiefly responsible for our current understanding of the process of evolution?

(A) Darwin

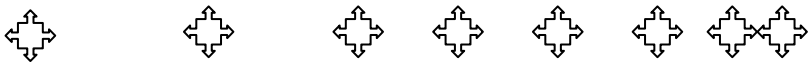
(B) Watson and Crick

(C) Mendel

(D) Newton

34. A truck travelling along a road drops rocks at a constant rate, making small craters.

The drawing below shows the pattern of craters made as the truck travels from left to right.



The motion of the truck would best be described as:

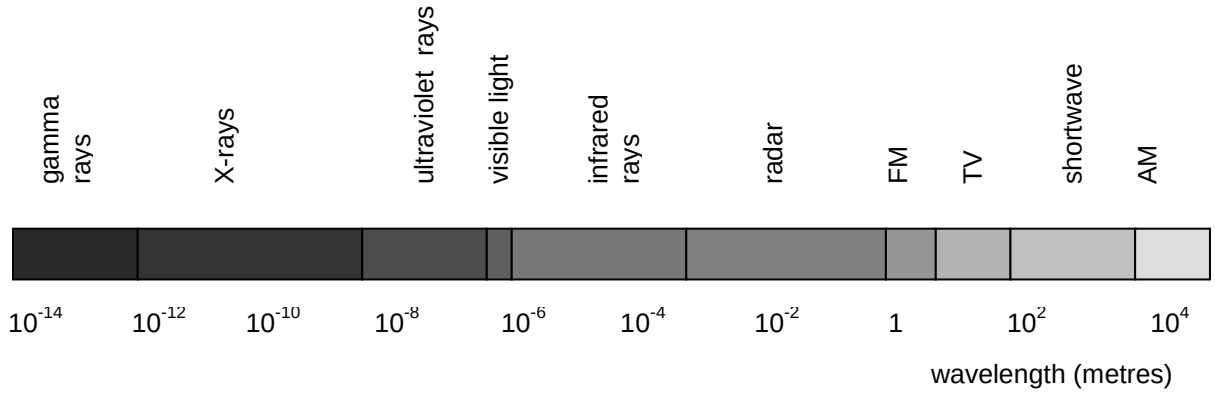
(A) accelerating

(B) decelerating

(C) stationary

(D) travelling at constant speed.

Questions 35 and 36 refer to the electromagnetic spectrum shown below.



35. Which electromagnetic waves have the highest frequency?

(A) gamma rays

(B) UV waves

(C) radar

(D) AM radio waves

36. Which area of technology has most benefitted from advances in our understanding of electromagnetic radiation?

(A) Electric power generation

(B) Transport technology

(C) Biotechnology

(D) Communications

37. A person of mass 60kg weighs approximately 600 N.

If they were to travel to the moon (where gravity is about $1/6^{th}$ of that on Earth) they would have a mass and a weight respectively of:

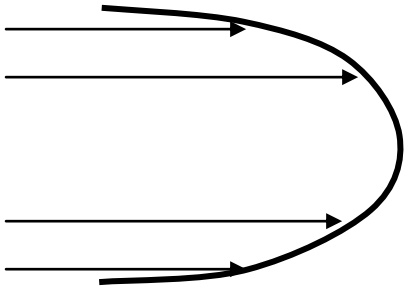
(A) 10kg and 100N

(B) 60kg and 100N

(C) 10kg and 600N

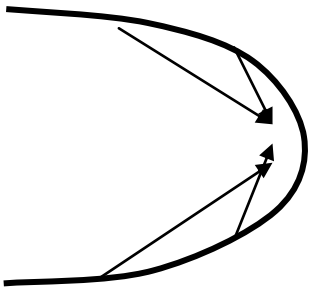
(D) 60 kg and 600N

38. The diagram shows light rays about to reflect off the surface of a parabolic mirror:

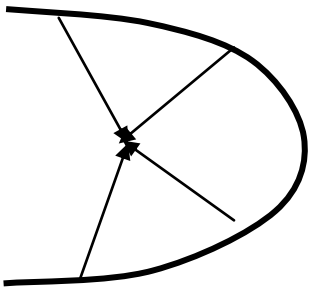


The most likely paths of the light rays after reflecting off the surface of the mirror are shown by:

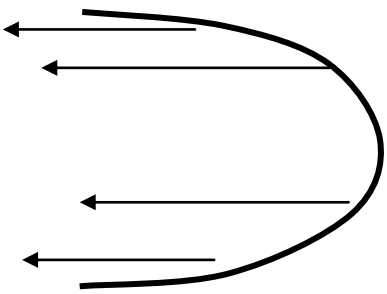
(A)



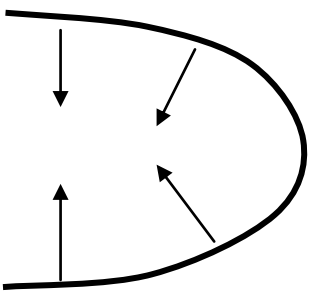
(B)



(C)



(D)



Questions 39 – 50 refer to the Stimulus Booklet. Detach the Stimulus Booklet and use it to help you answer these questions.

Questions 39 and 40 refer to Source A in the Stimulus Booklet.

39. Which one of the following is a food of seals?

(A) krill

(B) seaweed

(C) herbivorous fish

(D) great white sharks

40. The percentage of shark species which are responsible for nearly all shark attacks is closest to:

(A) 1%

(B) 3%

(C) 4%

(D) 37%

Questions 41 - 44 refer to Source B in the Stimulus Booklet.

41. Which one of these metals is the second most abundant in the Earth's crust?

(A) aluminium

(B) iron

(C) potassium

(D) calcium

42. Which metal would you expect to require the most energy to separate from its ore?

(A) potassium

(B) aluminium

(C) iron

(D) gold

43. Which one of the following metals would be most likely to be found in nature as a free element?

(A) sodium

(B) calcium

(C) aluminium

(D) copper

44. The table shows that the more reactive metals were only obtained as pure elements around two hundred years ago.

Which technological advance would most likely be responsible for this?

(A) The development of heat proof glassware.

(B) The development of a source of electricity.

(C) The development of underground mining techniques.

(D) The development of knowledge about the true nature of elements and compounds.

Questions 45 and 46 refer to Source C in the Stimulus Booklet.

45. In genetic engineering it is necessary at times to cut the DNA molecule, and at other times to join DNA molecules together.

Which row below correctly summarises the tools used to perform these functions?

	Cutting DNA	**Combining DNA**
(A)	restriction enzymes	restriction enzymes
(B)	ligases	ligases
(C)	ligases	restriction enzymes
(D)	restriction enzymes	ligases

46. The main advantage of producing human insulin through genetic engineering techniques is that:

(A) it is cheaper than extracting it from the pancreases of slaughtered animals.

(B) it saves diabetics from undergoing painful injections.

(C) it is more effective for humans than insulin from animals.

(D) all of the above

Questions 47 - 50 refer to Source D in the Stimulus Booklet.

47. Why are earthquakes found mainly at plate boundaries?

(A) This is where volcanoes form. Volcanic activity causes earthquakes.

(B) This is where magma is close to the surface. Convection currents in magma cause earthquakes.

(C) Plates move against each other. The stresses caused are stored up and released as earthquakes.

(D) Plates are much thinner near the edges. This makes them more brittle and prone to earthquakes than in the centre.

48. If a primary wave from an earthquake travels at 6.0 km/sec, how long will it take to reach a seismographic station 180 km away?

(A) 8.4 seconds

(B) 30 seconds

(C) 252 seconds

(D) 1080 seconds

49. How much greater is the magnitude of a quake of 7.6 on the Richter scale (in terms of ground displacement), compared to one of 5.6?

(A) 20 x

(B) 64 x

(C) 100 x

(D) 1024 x

50. Which characteristic of a wave measured at a seismographic station would give an indication of the magnitude?

(A) frequency

(B) wavelength

(C) velocity

(D) amplitude

Section 1 (continued)

Part B

Questions 51 – 60 (10 marks)

Use the Section 1 Part B Answer Sheet for Questions 51 – 60.

Instructions on answering Questions 51 – 60

- Write firmly and clearly.
- Use BLOCK LETTERS for words.

Like this:

A	**L**	**P**	**H**	**A**	**B**	**E**	**T**

NOT like this:

a	**l**	**p**	**h**	**a**	**b**	**e**	**t**

- Numbers must be used for numerical answers.
- Decimal points and negative signs must be clearly shown in separate boxes.
- Do NOT let any part of the letter or number touch the sides of the answer boxes.
- Examples:

-3 x 1.5 =

-	**4**	**.**	**5**			

How many days are in a week?

7	

What is the fifth month?

M	**A**	**Y**				

- If you make a mistake, put a line through the incorrect answer, and write the correct answer above the boxes.

		M	**A**	**Y**		
~~**J**~~	~~**U**~~	~~**N**~~	~~**E**~~			

Questions 51 and 52 refer to the Stimulus Booklet.

Question 51 refers to Source A.

51. Which role do sharks perform in marine ecosystems?

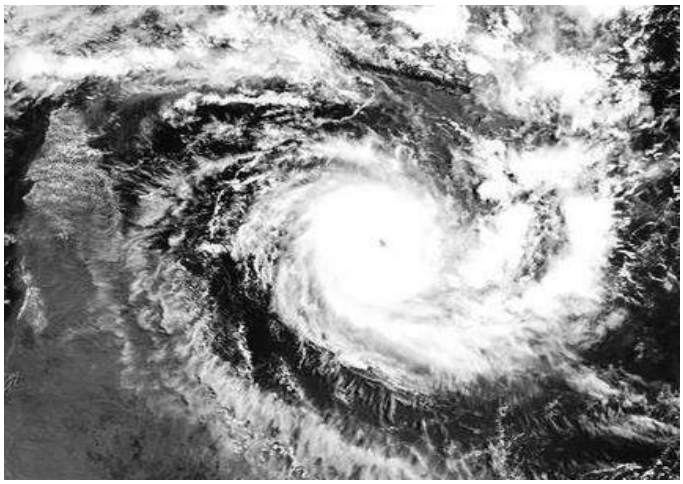
Questions 52 refers to Source C.

52. Bacterial DNA is carried in the bacterial chromosome and what other structure?

53. What name is given to a substance which has a different colour in acidic or basic solutions?

54. What piece of apparatus would you use to obtain a precise volume of 100mL of liquid?

55. What type of natural event is shown off the Queensland coast in the satellite photo below?



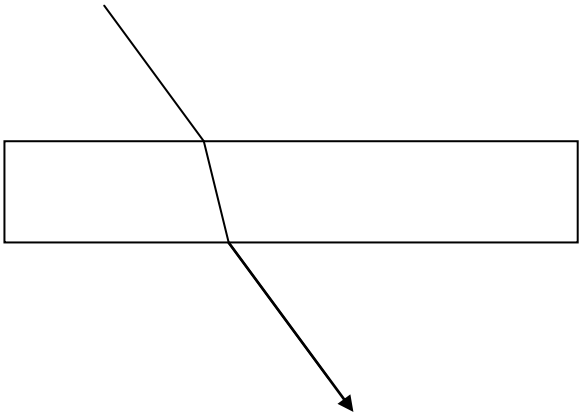
56. A student heats some magnesium ribbon in a crucible, taking care to keep the lid on to prevent any of the products of the reaction from escaping.

The word equation below summarises the reaction.

magnesium + oxygen → magnesium oxide

If he started with 4.8g of magnesium, and finished with 8.0g of magnesium oxide, what mass of oxygen must have reacted?

57. The drawing below shows light passing through a glass block.



What is the name given to this bending of light?

58. Unstable atomic nuclei break down and emit particles and high energy waves.

What is the general term given to these emissions?

59. Organisms which cause disease are called pathogens. One group of pathogens is the bacteria. Name one other group of pathogens.

60. Name the organ of the human male reproductive system where sperm are produced.

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Science

Student Number

Section 2

40 marks
Allow about 50 minutes for this section

Questions 61-66 40 marks

Answer the questions in the spaces provided.

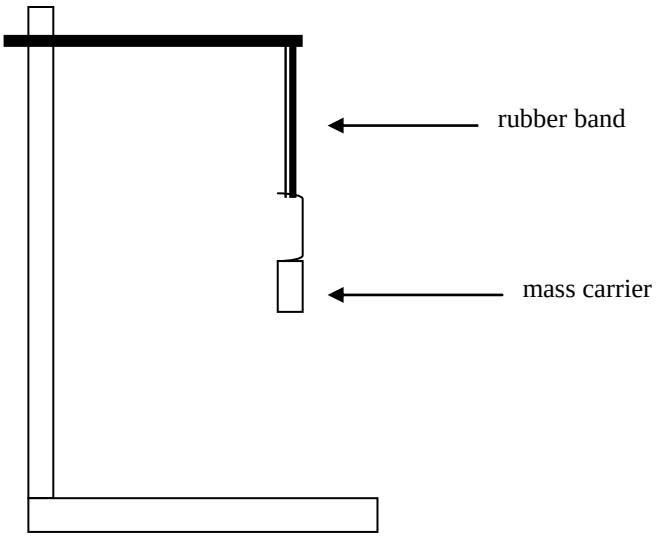
Marks

Question 61 (6 marks)

A student wishes to investigate the following hypothesis.

The greater the mass suspended from a rubber band, the more the rubber band will stretch.

The apparatus used is shown below.



Masses are added to the mass carrier, a ruler is used to measure the length of the rubber band and the amount of stretch is calculated

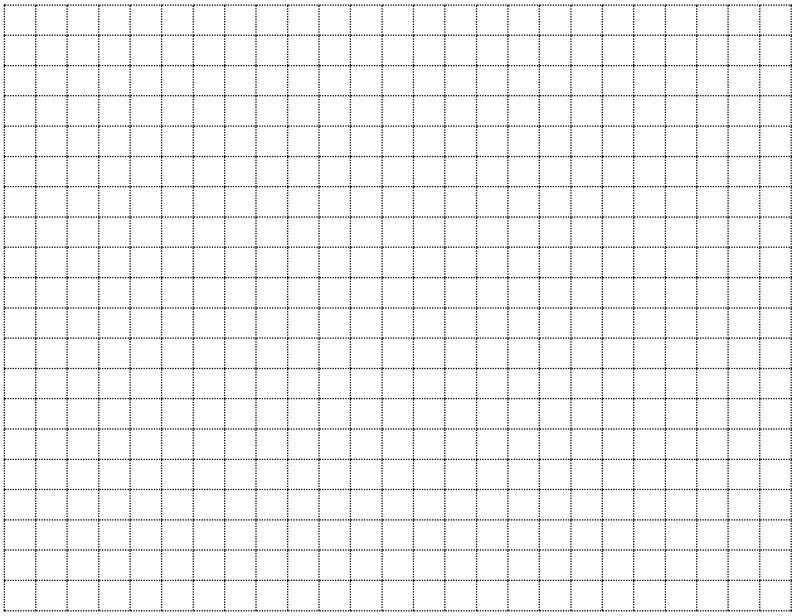
The results are given in the table below:

Mass suspended from rubber band (g)	Length of rubber band (mm)	Amount of stretch (length – original length) (mm)
0	80	0
50	95	
100	110	
200	138	
300	175	

(a) Complete the data table by calculating the amount of stretch produced by each mass. **1**

Question 61 continues on page 29.

(b) Draw a graph in the grid below to show the effect of mass on the amount of stretch produced. **3**



(c) Describe the trend shown in the graph. **2**

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Marks

Question 62 (8 marks)

Refer to Source A in the Stimulus Booklet to help you answer this question.

(a) Name a biotic and an abiotic factor encountered by Great White Sharks. **1**

biotic..……...

abiotic……

(b) Shark fishing is very obviously a threat to worldwide shark numbers. **2**

Choose one of the other threats listed in Source A and explain why it is a threat to sharks.

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Question 62 continues on page 31.

Marks

Question 62 (continued)

(c) The recent shark attacks in New South Wales provoked a wide range of opinions about what should be done from different groups in society.

Conservationists, surfers, businesspeople, indigenous groups, fishers, all expressed opinions. **3**

Choose any two of these groups and, for each, describe one view you would expect them to have.

Group_____
Group_____

(d) There is much disagreement about the extent of the shark problem in New South Wales and about how to keep people safe in the water.

Discuss the importance of involving scientists in any plan to solve these problems.

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Marks

Question 63 (7 marks)

Refer to Source B in the Stimulus Booklet to help you answer this question.

(a) In the box below, construct a flow diagram to show the process by which aluminium is extracted from its ore. **3**

(b) i) Write a word equation for the reaction in which aluminium hydroxide is heated to give aluminium oxide and water.

……... **1**

ii) Identify the type of reaction involved.

……... **1**

(c) Aluminium and iron are the two most widely used metals on Earth.

Aluminium is much more abundant in the Earth's crust than iron, and yet it is much more expensive to buy. Suggest why this might be. **2**

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Marks

Question 64 (8 marks)

Some people believe that if you talk to plants, they will grow faster.

Most scientists would doubt this idea, given our knowledge of the factors which affect plant growth and the ability of plants to detect stimuli in their environment.

However, such ideas can never be rejected completely until they have been tested experimentally.

Describe an experiment that you could perform to test this idea. **8**

You should include:

- the hypothesis that you are testing
- a list of suitable equipment
- the variable that you will change (independent variable)
- the variable that you will measure (dependent variable)
- variables that you must control
- how you will make sure that your results are reliable
- measurements that you will take
- how you will interpret your data.

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Question 64 continues on page 34.

Marks

Question 64 (continued)

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Question 65 (4 marks)

Refer to Source C in the Stimulus Booklet to help you answer this question.

Using one of the examples of GM food given in Source C, or another that you are familiar with, explain one advantage and one disadvantage to society or the environment, that could arise from its use. **4**

Example ……

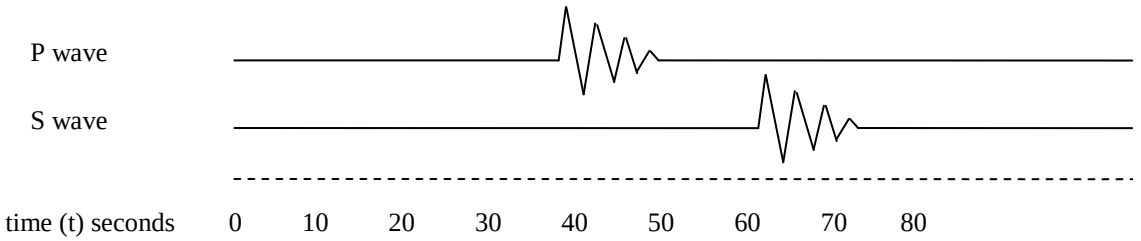
Advantage
Disadvantage

Marks

Question 66 (7 marks)

Refer to Source D in the Stimulus Booklet to help you answer this question.

(a) The seismograph trace below was recorded at a seismographic station after an earthquake.



i. Determine the time difference ($t_s - t_p$) between the time of arrival of the two waves. **1**

……...

ii. Calculate the distance from the seismographic station to the epicentre of the earthquake. **2**

Question 66 continues on page 36

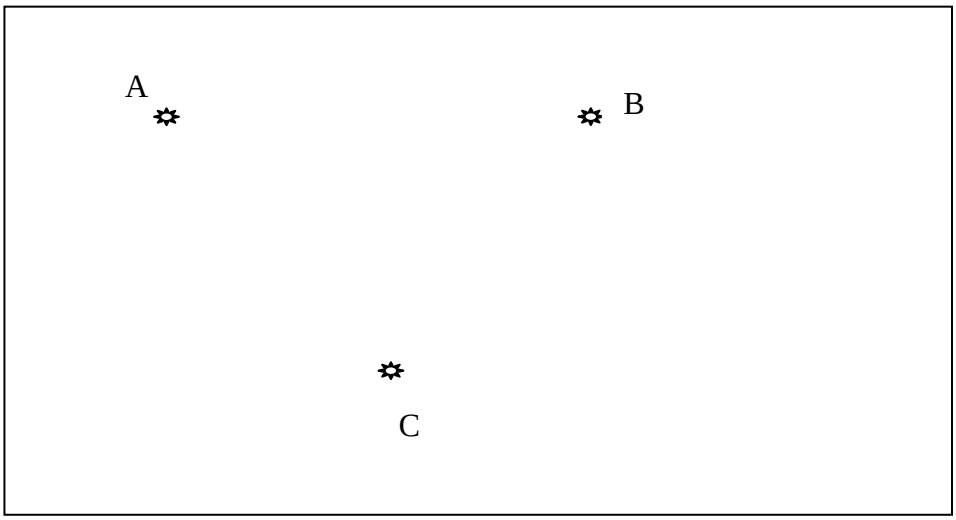
Marks

Question 66 (continued)

(b) The distance from the epicentre of a quake to three different seismographic stations was calculated and found to be as follows:

Seismographic station	Distance to epicentre (km)
A	460
B	250
C	150

The square below represents a map with the three seismographic stations marked on it. Indicate the precise position of the earthquake epicentre on the map using an X. **2**



Scale: 1 cm = 100 km.

(c) A great deal of money is spent every year on research into earthquake and volcanic activity.

State whether you agree with this level of expenditure, and justify your answer. **2**

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Science

Stimulus Booklet

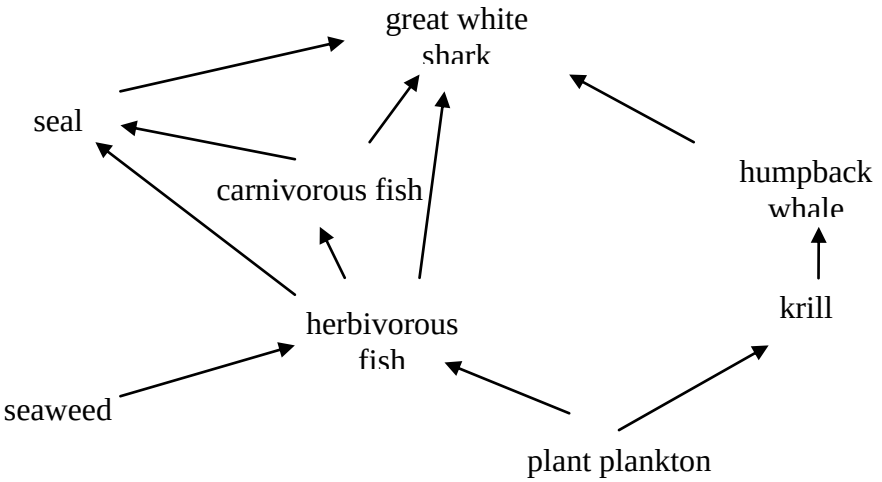
Detach this Stimulus Booklet and use it where required during the test.

Source A – Sharks

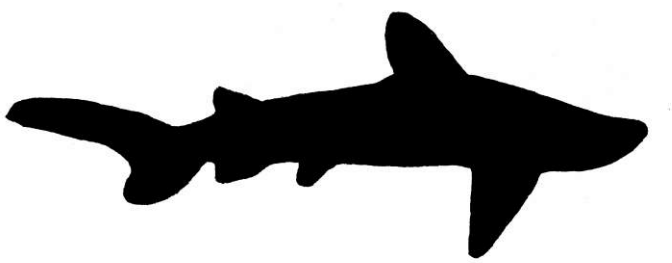
Sharks are the top predators of our marine ecosystems. As such, they have become objects of fear for many people. Every summer we read in the press of increasing shark numbers and danger to swimmers. Last summer there were several shark attacks in NSW.

According to the CSIRO, there are 370 species of sharks worldwide, of these, virtually all shark attacks can be credited to just four species, the Great White Shark, the Tiger Shark, the Bull Shark and the Oceanic White Tip Shark.

The food web below shows some of the feeding relationships in the Southern Ocean



.



Threats to sharks.

- commercial shark fishing (900,000 caught per year)
- habitat destruction
- water pollution
- removal of prey species by over fishing

Source B – Metals

Metals are essential resources in our modern society. Advances in civilisation have gone hand in hand with our ability to extract metals as free elements from their ores. (The compounds in which they are found in nature.)

The table below lists eight metals in decreasing order of chemical activity.

Metal	Symbol	Chemical activity	Abundance in Earth's crust (%)	Date of discovery/isolation as a free element
potassium	K	HIGH	2.4	1807
sodium	Na	↑	2.8	1807
calcium	Ca		3.6	1808
magnesium	Mg		2.2	1808
aluminium	Al		8.0	1825 (impure) 1827 (pure)
iron	Fe		5.0	About 1500 BC (start of iron age)
copper	Cu		0.01	about 9000 BC
gold	Au	LOW	<< 0.000001	before 10,000 BC, probably first metal known to humans

The more active a metal, the more readily it reacts chemically and the harder it is to separate from its compounds.

The Extraction of Aluminium from its Ore (simplified)

The main ore of aluminium is bauxite. This consists of aluminium oxide (Al_2O_3), along with a wide range of impurities.

Bauxite is crushed, subjected to high temperature and pressure, sodium hydroxide is added.

This produces aluminium hydroxide ($Al(OH)_3$) which has been separated from the impurities by such methods as flotation.

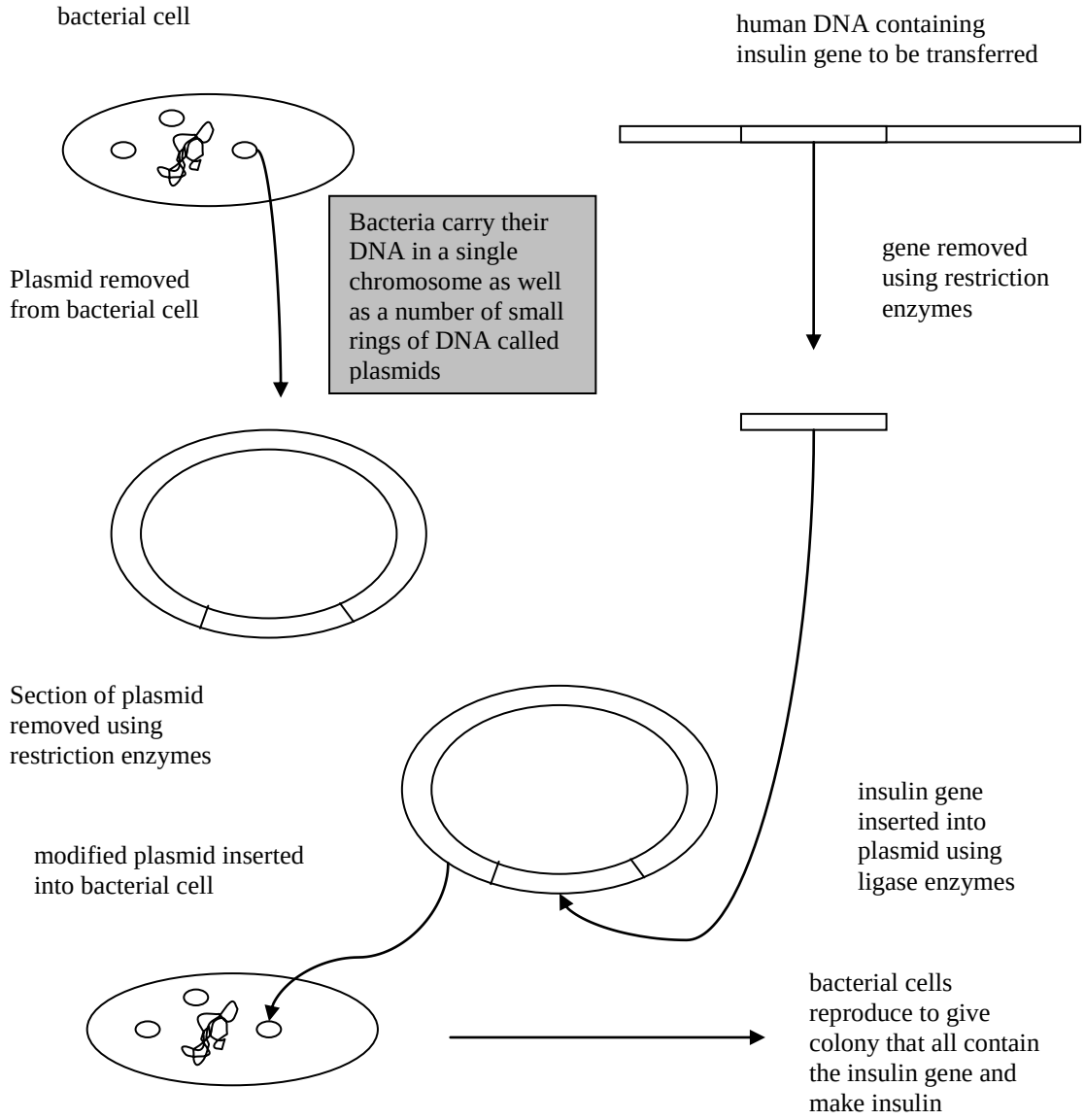
Aluminium hydroxide is then heated to give pure aluminium oxide and water.

Aluminium oxide is mixed at very high temperatures with molten cryolite, and subjected to electrolysis at around 1000^oC. This involves passing a very large electric current through the solution, causing pure molten aluminium to form at the cathode (negative electrode).

Source C – Genetic Engineering

Transgenic organisms are individuals which have had genetic material from other species added to them.

The technology was first developed in bacteria, and one of its first commercial applications was the production of human insulin for diabetics.



GM (genetically modified) Foods.

Since the mid 1990's GM foods have begun to be produced. Examples include:

- Roundup-ready soy beans. A crop that is resistant to herbicides, allowing farmers to use large amounts of herbicides to kill weeds without killing the soy beans.

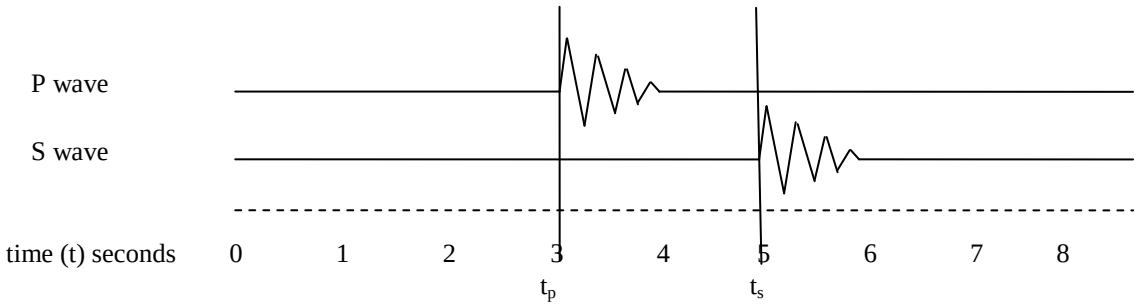
- Golden rice. Rice which contains daffodil genes making it produce extra vitamin A.

Source D - Earthquakes

Hundreds of earthquakes occur around the world each year. They mainly occur at plate boundaries.

Earthquakes produce two different types of waves, primary waves (P waves), which travel at 6.0 km/sec and secondary waves (S waves) which travel at 3.5 km/sec.

Seismometers are instruments which can detect and distinguish between these two types of wave. They produce a graph which looks like this.



t_p = time of arrival of P wave. t_s = time of arrival of S wave

The basic formula relating speed, distance and time is **speed = distance / time.**

From this a formula can be derived to calculate the distance to the epicentre of an earthquake.

Distance to epicentre = 8.4 X $(t_s - t_p)$.

= 8.4 X (5 – 3) = 16.8 km.

In order to pinpoint the epicentre of an earthquake it is necessary to calculate its distance from 3 separate seismometers. Circles, each of a radius the same as the distance to the epicentre, are drawn from each site. The point where all the circles intersect is the epicentre.

Measuring earthquake magnitude.

The Richter scale is the internationally recognised scale of earthquake magnitude. The higher the number on the scale, the greater the magnitude of the quake.

The table below shows how the amount of ground motion differs between two earthquakes which are 1.0 points apart on the Richter scale.

Change in magnitude (Richter scale)	Ground Motion Change (Displacement)
1.0	10 times

Sydney Technical High School

2009 Science Trial SC examination. Marking Guidelines and model Answers.

(It should be remembered that model answers are just that – they don't represent the minimum acceptable answer. Student responses should be marked from the marking criteria.)

Section I. Part A. Multiple Choice

1	**C**	11	**B**	21	**A**	31	**A**	41	**B**
2	**B**	12	**C**	22	**B**	32	**D**	42	**A**
3	**A**	13	**C**	23	**A**	33	**A**	43	**D**
4	**D**	14	**D**	24	**A**	34	**B**	44	**B**
5	**D**	15	**A**	25	**B**	35	**A**	45	**D**
6	**A**	16	**A**	26	**D**	36	**D**	46	**C**
7	**B**	17	**C**	27	**A**	37	**B**	47	**C**
8	**B**	18	**D**	28	**D**	38	**A**	48	**B**
9	**B**	19	**C**	29	**B**	39	**C**	49	**C**
10	**D**	20	**B**	30	**C**	40	**A**	50	**D**

Section I. Part B.

51	**P**	**R**	**E**	**D**	**A**	**T**	**O**	**R**										
52	**P**	**L**	**A**	**S**	**M**	**I**	**D**											
53	**I**	**N**	**D**	**I**	**C**	**A**	**T**	**O**	**R**									
54	**M**	**E**	**A**	**S**	**U**	**R**	**I**	**N**	**G**		**C**	**Y**	**L**	**I**	**N**	**D**	**E**	**R**
55	**C**	**Y**	**C**	**L**	**O**	**N**	**E**											
56	**3**	**.**	**2**	**g**														
57	**R**	**E**	**F**	**R**	**A**	**C**	**T**	**I**	**O**	**N**								
58	**R**	**A**	**D**	**I**	**A**	**T**	**I**	**O**	**N**									
59	**V**	**I**	**R**	**U**	**S**	**E**	**S**											
60	**T**	**E**	**S**	**T**	**I**	**S**												

(alternative answers possible at teacher's discretion)

Section 2.

Question 61.

(a)

Marking criteria	Marks
• correct values	**1**

15, 30, 58, 95.

(b)

Marking criteria	Marks
• Correct axes, mass (X) vs stretch (not length) (Y) • Axes linear • Axes labelled and units indicated • Line graph, • Accurate plot • Curve drawn, not extending beyond data. • Suitable use of space	**3**
• 5 of the above	**2**
• 3 of the above	**1**
• Less than 3 of the above	**0**

(c)

Marking criteria	Marks
• Generally proportional relationship noted with deviation mentioned	**2**
• Proportional relationship noted	**1**

As the mass increases the stretch increases. With higher amounts of mass the increase in stretch is not proportional to the increase in mass.

Question 62.

(a)

Marking criteria	Marks
• One biotic and one abiotic factor named	**1**

Biotic – prey. Abiotic – water temperature.

(b)

Marking criteria	Marks
• Nature of threat outlined • Explanation given of how it is a threat to sharks	**2**
• 1 of the above	**1**

Overfishing of prey species has reduced the natural food of sharks in many areas. This reduces the numbers of sharks that an area can support.

(c)

Marking criteria	Marks
• Plausible views of 2 of the groups given – linked to the known interests of that group. (must suggest a course of action)	**2**
• Plausible view of one group given	**1**

CONSERVATIONISTS These are unfortunate, random incidents. There is no evidence that shark netting or increased shark fishing would prevent them – these generally kill species which don't attack people anyway. No action should be taken against sharks. People should be urged to be more cautious when swimming.

BUSINESSPEOPLE The beaches must be made safe for swimmers and surfers. The economy of the area depends on them. Extra shark netting and increased shark fishing is needed.

(d)

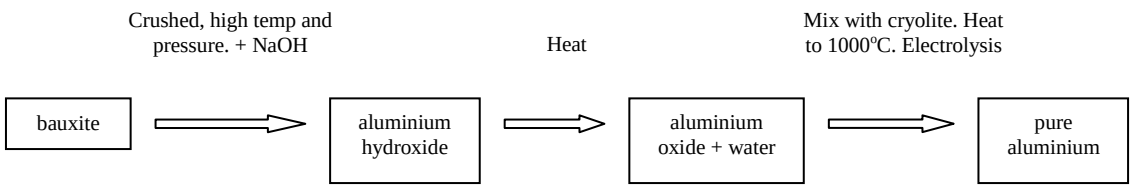
Marking criteria	Marks
• The nature of science outlined • Importance of objective, evidence based solution explained	**3**
• Nature of science outlined without relating it to the problem	**2**
• General statement about value of scientists.	**1**

Scientists are trained to assess evidence objectively and subject it to statistical analysis. They make hypotheses and test them experimentally. This approach will be more effective in identifying realistic solutions to a complex problem such as this, rather than hasty knee-jerk reactions.

Question 63

(a)

Marking criteria	Marks
• 4 steps with 3 processes in order	**3**
• At least 3 steps with 2 processes in correct order	**2**
• 2 steps with one process in correct order	**1**



(b)i)

Marking criteria	Marks
• Correct word equation given	**1**

Aluminium hydroxide → aluminium oxide + water

(b)ii)

Marking criteria	Marks
• Type of reaction correctly identified	**1**

Decomposition

(c)

Marking criteria	Marks
• Difference between Fe and Al stated • Plausible justification given for why Al is more expensive than Fe, linked to this difference	**2**
• Difference between Fe and Al stated	**1**

Aluminium is more reactive than iron. This means that much more energy is required to separate it from its ore, making it a more expensive process. Hence the higher cost of pure aluminium.

Question 64.

Marking criteria	Marks
• Hypothesis stated proposing response of one variable to a change in the other. • At least 3 pieces of suitable equipment given • Independent variable and dependent variable named • Control group used • At least 2 controlled variables identified • Multiple tests • Measurements to be taken of de[pendent outlined (must be consistent with hypothesis) • Outline of how data will be interpreted	**8**
• One to seven of the above	**1-7**

Hypothesis: Plants that are spoken to will grow faster.

Materials: 2 containers, each containing 20 pea seedlings.
Ruler
Potting mix
water

- The independent variable is whether or not plants are spoken to.
- The dependent variable is the rate of growth of the plants.

Method:

- Plant out 20 pea seedlings in one seedling container and 20 in another. Make sure that all seedlings are of the same type, age and general condition. Use the same potting mix. (20 seedlings in each group ensures that results are reliable)
- Give each group the same conditions of sunlight, temperature and water throughout the experiment.
- Group A will be spoken to for half an hour, four times a day. They will be kept in silence at other times.
- Group B (the control) will be kept in silence.
- Every 2 days the height of each seedling will be measured using the ruler and the average for each group calculated.
- Graphs will be drawn of time against height, using the averages. Any difference in growth rates will be apparent from any divergence of the 2 lines on the graph.

Question 65.

Marking criteria	Marks
• Advantage explaned • Disadvantage explained	**4**
• One of the above explained, the other stated	**3**
• One of the above explained OR • Both stated	**2**
• One stated	**1**

Roundup ready soy beans.
Advantage – This will increase the productivity of soy bean crops. Providing more food for needy people.
Disadvantage – This will encourage heavy use of round up which could contaminate local ecosystems, killing plants and thereby reducing biodiversity.

Question 66.
(a)i)

Marking criteria	Marks
Time difference correctly determined (+ or – 3 seconds)	**1**

23 seconds

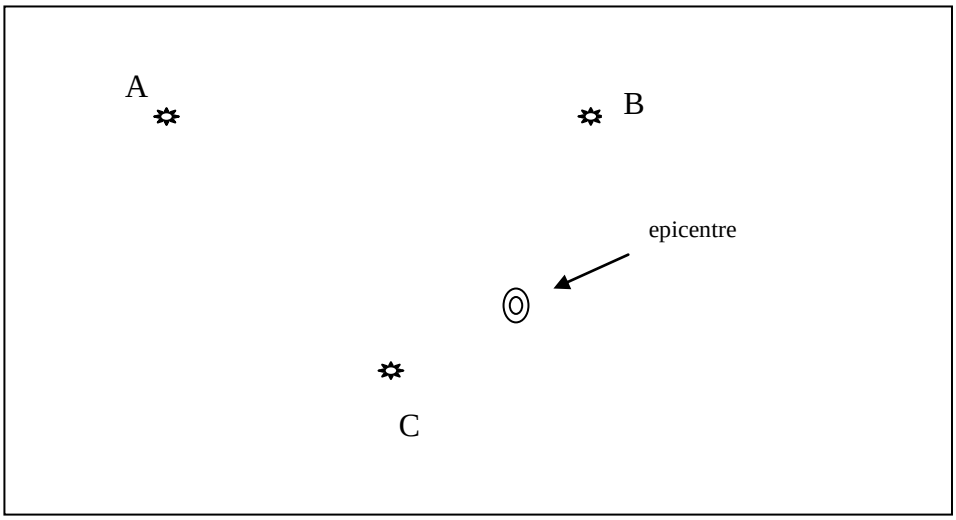
(a)ii)

Marking criteria	Marks
• Distance correctly calculated	**2**
• Correct formula used to obtain incorrect answer	**1**

Distance = 8.4 x ($t_s - t_p$) = 8.4 x 23 = <u>193.2 km</u>

(b)

Marking criteria	Marks
• Position correctly determined	**2**
• Incorrect position, but evidence of correct method	**1**



(c)

Marking criteria	Marks
• Justification given, linking research into earthquakes with benefits for society	**2**
• Justification given without making links	**1**

The level of expenditure is justified as the research will help us better understand which areas are more prone to earthquakes. This will allow more stringent building codes to be applied in these areas, which will save lives in the event of subsequent earthquakes.