AUSTRALIAN SCIENCE INNOVATIONS

ASO School ID:					

AUSTRALIAN SCIENCE OLYMPIADS

NATIONAL QUALIFYING EXAM

BIOLOGY - SECTION C

TO BE COMPLETED BY THE STUDENT USE CAPITAL LETTERS

School Name: ……..**State:** ……..

Student Name: ……

Home Address: ……

…… **Post Code:** ……..

Telephone: (…….) …… **Mobile:** ……

E-Mail: …….. **Date of Birth:** ……/……/……

□ **Male** □ **Female** **Year 10** □ **Year 11** □ **Other:** …….

Students competing in the 2010 National Qualifying Examinations must be in Year 11 or an earlier year in 2010.

The Australian Olympiad teams in Biology, Chemistry and Physics will be selected from students participating in the Science Summer School. To be eligible for selection in one of the teams, students must have been schooled in Australia for the last two years, or hold an Australian passport.

Students who have finished their school examinations in the year of the competition can be members of the team as long as they have not commenced their university studies. Students must be under the age of twenty on 30 June of the year of the competition, and must not have started study at university as regular students.

☐ I have been schooled in Australia for the last two years

☐ I hold an Australian passport, or am able to obtain one by 30/07/2011

Signature: …… **Date:** ……..

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Examiner's use only

58. (10 marks) The rate of oxygen consumption in mammals shows a clear relationship with animal mass. The calculation of the rate of O_2 consumption per unit body mass, or specific oxygen consumption, allows for comparison of oxygen consumption between animals of varying sizes.

Shown below are the body mass (M_b) and total O_2 consumption ($\dot{V}_{o_2}$) for a variety of mammals.

a. Calculate the O_2 consumption per kilogram for each animal (to two decimal places) and write your answer in the table below.

Animal	**Body mass M_b (kg)**	**Total O_2 consumption $\dot{V}_{o_2}$ (litre O_2 h^{-1})**	**O_2 consumption per kilogram, $\dot{V}_{o_2}/M_b$ (litre O_2 kg^{-1} h^{-1})**
Shrew	0.0048	0.0355	
Harvest mouse	0.0090	0.0225	
Mouse	0.025	0.041	
Rat	0.290	0.25	
Cat	2.5	1.70	
Sheep	42.7	9.59	
Man	70	14.76	
Elephant	3833	268.00	

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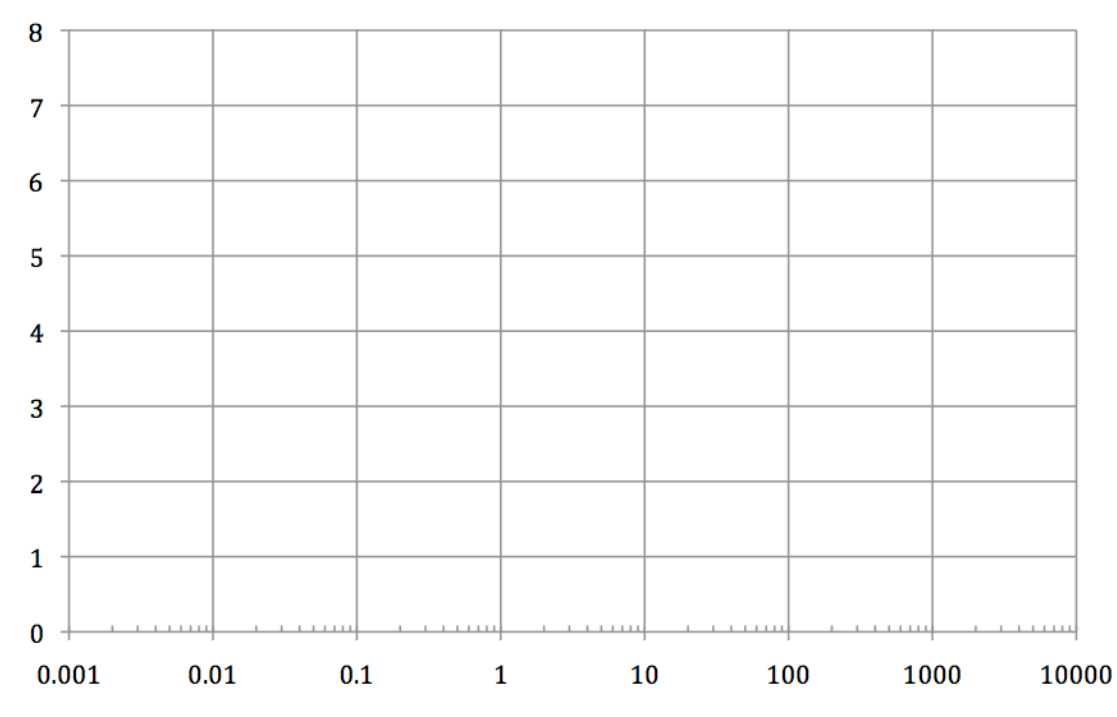
b. Plot the O_2 consumption per kilogram and the body mass on the axes below, giving an appropriate title and labelling the axes.



c. Describe the trend in the graph.

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d. A kangaroo rat has a specific oxygen consumption of 1.80 litre O_2 kg^{-1} h^{-1}. Use your graph to determine the approximate mass of a kangaroo rat.

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e. Provide an explanation for the relationship between mammal size and oxygen consumption.

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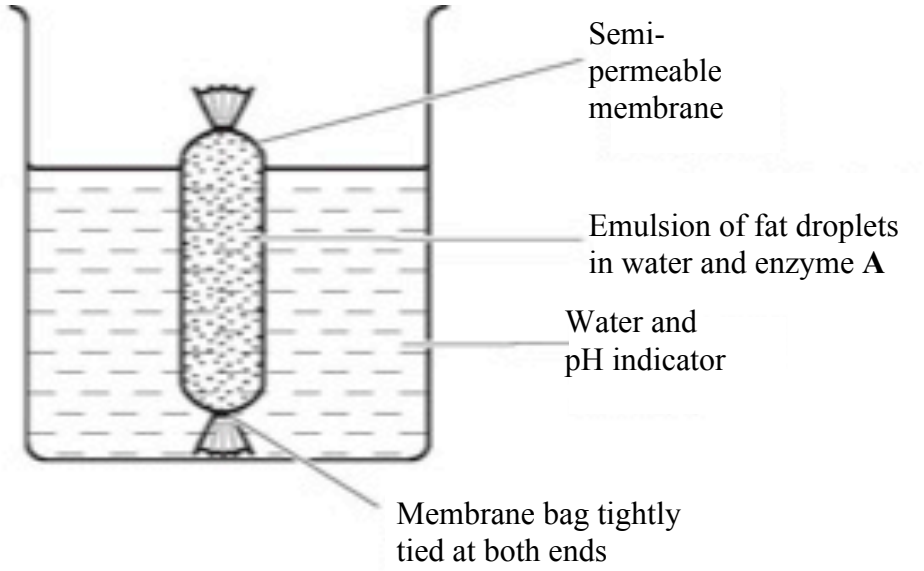
Examiner's use only

59. (4 marks) A biology student, Sam, was performing an investigation as part of a school assignment on digestion. He is exploring the digestion of an emulsion of fat droplets in water by Enzyme A. The diagram below shows the apparatus Sam used at the start of the experiment. It consists of a bag of Visking tubing (permeable to water and salts) containing an emulsion of fat droplets in water and enzyme A. The Visking bag is suspended in a beaker of water and pH indicator solution.



The pH indicator is green in a pH of 7, blue when the pH is above 7 and red when it is below 7. The apparatus is kept at 40°C for 20 minutes during which time the indicator changes from green to red.

a. What is enzyme **A**?

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b. Why did Sam keep the apparatus at 40 °C?

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c. What products did Sam find after digestion of the emulsion by enzyme **A**?

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d. Explain the change in pH in the beaker.

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Examiner's use only

60. (8 marks) New strains of potentially useful bacteria and plants have been produced by genetic modification (for example, most of the insulin that diabetics use is produced by genetically modified bacteria). However there are concerns about releasing genetically modified (GM) organisms into the environment and much research has been carried out concerning aspects of safety.

In 2009/2010, the northern hemisphere experienced the most severe winter of recent years and many farm crops were lost as a result of ice damage.

Pseudomonas syringae is a common bacterium that lives on the surface of leaves. A naturally occurring strain is called Ice+ because in cold weather, the bacterium promotes the formation of ice crystals and this causes frost damage in crop plans. Deletion of a single gene produces the genetically modified Ice– strain. This strain does not result in the formation of ice crystals.

It is thought that the presence of the Ice- strain of *P. syringae* on crop plants might reduce frost damage caused to crops caused by the Ice+ strain during severe cold.

a. Explain the ecological assumption on which this idea is based. (2 marks)

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b. The Ice- strain grows on the surface on the leaves of crop plants. It also grows on the leaves of other plants in the area in which it is released. Suggest how spraying a field with the Ice- strain may have an adverse effect on the crop yield. (3 marks)

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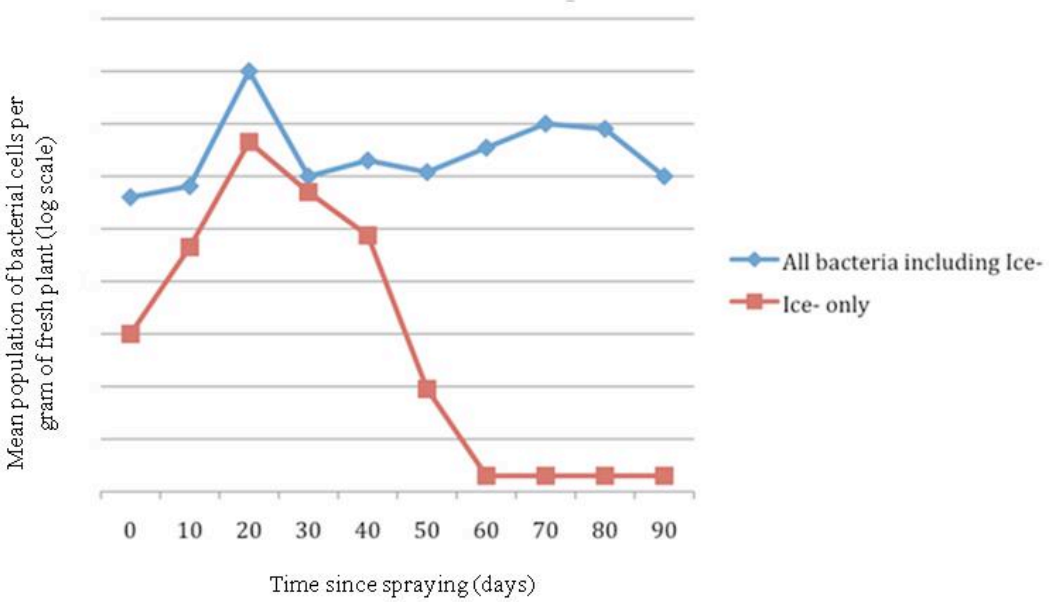
Examiner's use only

An investigation was carried out into the survival of the Ice- strain under natural conditions. Ice- bacteria were suspended in a carrier solution and sprayed on the leaves of potato plants. The population densities of the Ice- strain of *P. syringae* and all bacteria on the leaves were then monitored. Results are shown in the graph below.



c. Suggest a suitable control to be used in this investigation. (1 mark)

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d. Suggest the advantage in plotting data such as these on a log scale. (1 mark)

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e. Explain whether or not the results of this investigation indicate that the Ice- strain would be likely to spread to plants other than the crop plants on which they were sprayed. (1 mark)

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Examiner's use only

61. (10 marks) 12 rabbits were released in Australia in 1859. They reproduced rapidly and started to spread quickly, so that by 1886 they were advancing at about 100km per year. By 1905 they had spanned the continent. Rabbit proof fencing was inadequate to halt their progress.

In an attempt to control the huge rabbit population myxomatosis was introduced in 1950. Myxomatosis is a viral disease in rabbits transmitted from rabbit to rabbit by rabbit fleas. The virus causes blindness and then death.

This spread through the rabbit population resulted in a 99.9% mortality rate. However over the next few years the rabbit population recovered, although not to the pre-myxomatosis numbers. At present, the mortality rate due to myxomatosis in rabbits is at around 40%.

a. What caused the spread of rabbits in Australia between 1859 and 1905? (2 marks)

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b. What caused the high mortality rate in the rabbit population just after myxomatosis was introduced in 1950? (2 marks)

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c. How did the rabbit population recover from the effect of myxomatosis? (4 marks)

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d. How would you explain the current mortality rate of 40%? (2 marks)

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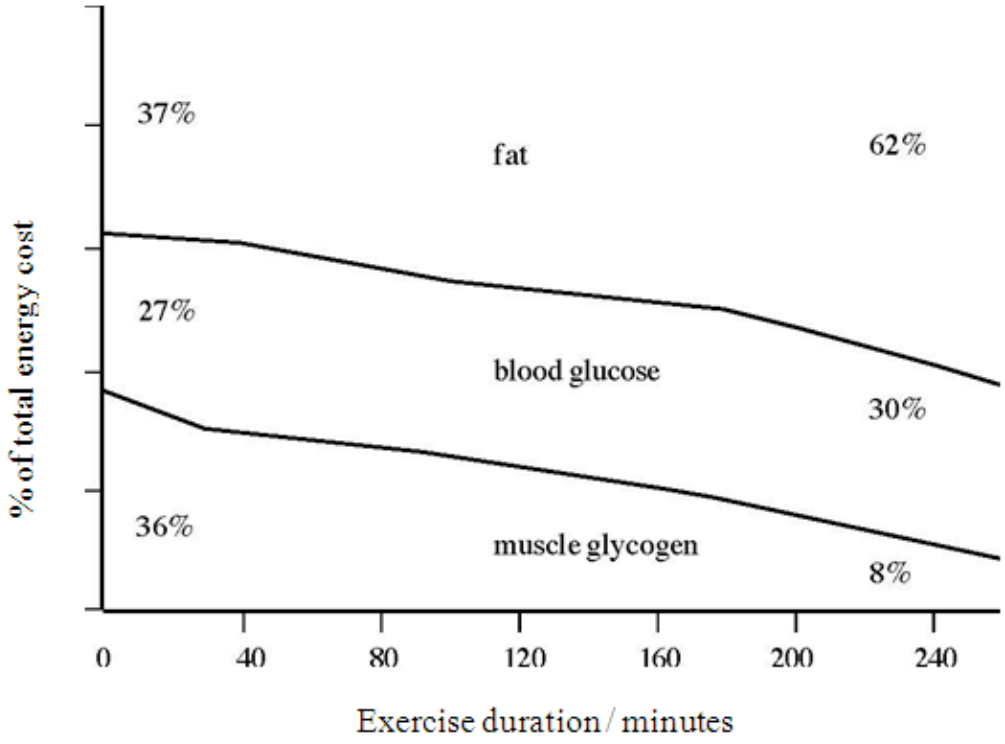
Examiner's use only

62. (5 marks) The graph below shows changes in the relative contribution of different sources of energy during a period of exercise.



a. What is the greatest source of muscle energy after 20 minutes exercise? (1 mark)

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b. Suggest why prolonged exercise may help an individual lose weight. (2 marks)

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c. Why are Australians urged to consume more complex carbohydrates rather than simple carbohydrates? (2 marks)

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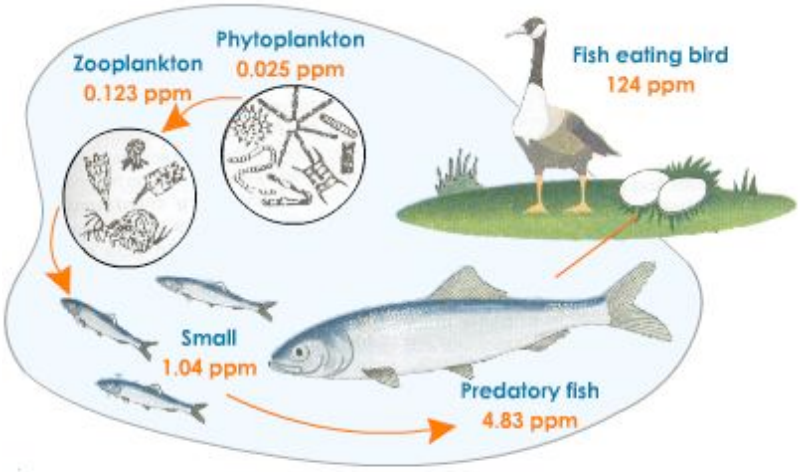
Examiner's use only

63. (3 marks) Dichloro-Diphenyl-Trichloroethane (DDT) was a widely used synthetic pesticide before its use was banned in many countries due to concerns about its affects on the environment. The use of **DDT** in Australia has been banned since 1987.



The figure shows the DDT concentrations (ppm) in an aquatic food chain.

a. Using the food chain above explain what is occurring between trophic levels. (1 mark)

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b. Explain what consequence/s the presence of DDT in the environment could have on the human population. (2 marks)

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Examiner's use only