SECTION A: CHEMISTRY

A student heats a piece of copper metal having a mass of 1.32 g in a Bunsen flame until no further change takes place. He then records the mass of the copper after the experiment and finds that it has increased to 1.65 g.

Answer the questions that follow about this experiment.

1. What would you expect to see happen to the copper in this experiment? (2)

2. In this experiment, copper is reacting with the oxygen in the air and the weight of the copper increases. When hot air is placed in a hot air balloon, it makes the balloon rise since the weight of the balloon is decreasing. Explain this difference in behaviour of the air in each case. Your answer should make reference to particles. (5)

3. Write down the mass of oxygen in the 1.65 g sample of copper oxide. (2)
(Hint: remember that the mass of copper = 1.32 g).

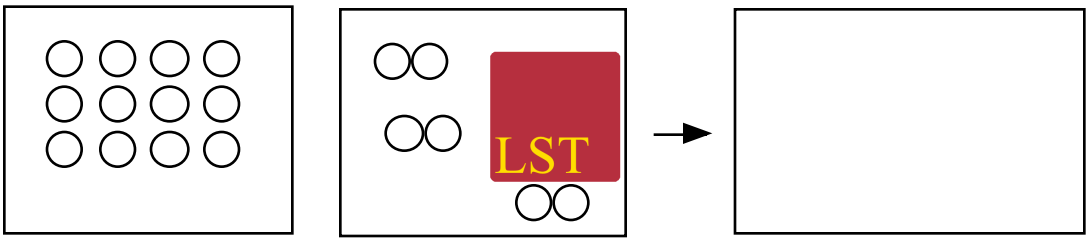
Chemists know that the masses of copper atoms and oxygen atoms are not the same. Elements are given a number that shows how heavy the atom is; this is called the relative atomic mass (RAM). The relative atomic mass of copper is 64 and the relative atomic mass of oxygen is 16.

Chemists also know that when the mass of an element is divided by the relative atomic mass another number is produced that gives us a measure of how many atoms there are in the element.

4. Use the information above to calculate the relative numbers of atoms present in simplest possible ratio. Hint: use your answer to part 3 and then follow the instructions. (4)

5. Write down a formula for copper oxide that is consistent with the results from your answer to part 4. (2)

6. The following diagram shows how copper atoms are arranged in solid copper. There is also a diagram showing how oxygen atoms are arranged in gaseous oxygen. Draw a diagram to show how the atoms may be arranged in the product of this reaction that is also consistent with the results from your answer to part (3)



7. Another experiment is carried out and it is found that 1.32 g of copper metal forms 1.65 g of copper oxide. Using the same method as that above, calculate a formula for this oxide of copper. (5)

8. Explain why the copper oxide formed in part f) is different from that in the first experiment.

(25 marks)

SECTION B – DESIGN AND TECHNOLOGY

A group of Biologists need to trap and tag field mice as part of a study on the feeding habits of Barn Owls. The information will be used to find out where owls feed and how often they catch their food.

You have been asked to design a device for trapping the field mice so they can be tagged by the scientists, before they are returned into the wild.

1. Before designing your trap you need to investigate the problem in order to gather useful information. Make a list of the things you would need to find out before you started designing. (5)

2. List four design specifications for a suitable mouse trap. (4)

3. Sketch a design for a trap which would meet the criteria you have listed for Question 2. Use notes and diagrams to explain how the trap would work. (6)

4. Suggest two materials from which the trap could be made and explain why you think they would be suitable. (4)

5. Briefly explain how you would manufacture your trap. Pay particular attention to the sequence of operations and any special equipment (tools) you might use. (6)

1. In the film 'The Hunt For Red October', a Russian submarine sends a pulse of sound, or ping' that reflects off an American submarine and is received back on the Russian submarine.

   a. It takes 1.2 s between sending the ping and the Russians hearing the echo. The speed of sound in water is 1500 m/s. How far apart are the two submarines? (2)

   b. The atmosphere inside each submarine is at a pressure of 10N/cm^2. The sea outside is at a pressure of 130N/cm^2. The entrance hatch to one submarine has an area of 106 cm^2. What is the force acting on the outside of the hatch? (2)

   c. Do you think the hatches should be designed to open inwards or outwards? (Explain your answer with a diagram.) (2)

   The pressure in water increases by 0.98 N/cm^2 for every metre of depth.

   d. How deep is the submarine? (2)

   e. Why does the pressure increase as you go deeper? (2)

2. A recent space probe crashed into the surface of Mars, because some of the data for the pressure of the rocket thrusters was given in pounds per square inch, rather than N/cm^2.

   a. 2.4 cm is equal to one inch. How many cm^2 is 1 inch^2 (2)

   b. 1 pound is equivalent to a mass of 0.454 kg. How many Newtons are exerted by the weight of 1 pound. (2)

   c. So what is the thruster pressure in N/cm^2 of 100 pounds per square inch? (2)

3 a. Why does hot air rise? (2)

   b. Why do midges often circle around above a person's head? (2)

   c. How do clothes help to keep us warm? (2)

   d. Why do astronauts only need to wear shorts and a t-shirt on a space station which is kept at a temperature that would require them to wear more clothing on Earth? (3)

SECTION B

Describe and explain in scientific terms one threat to the global environment or certain species that interests you. Suggest remedial action that might be taken.

(25 marks)