Name: …… **School: ……**

TONBRIDGE SCHOOL

Scholarship Examination 2018

Science II

Wednesday 2nd May 2018

9.30 am

Time allowed: 1 hour 15 minutes

Please write your name at the top of this page and at the start of the Biology and Physics sections, as indicated.

*Answer **ALL** of the Questions.*

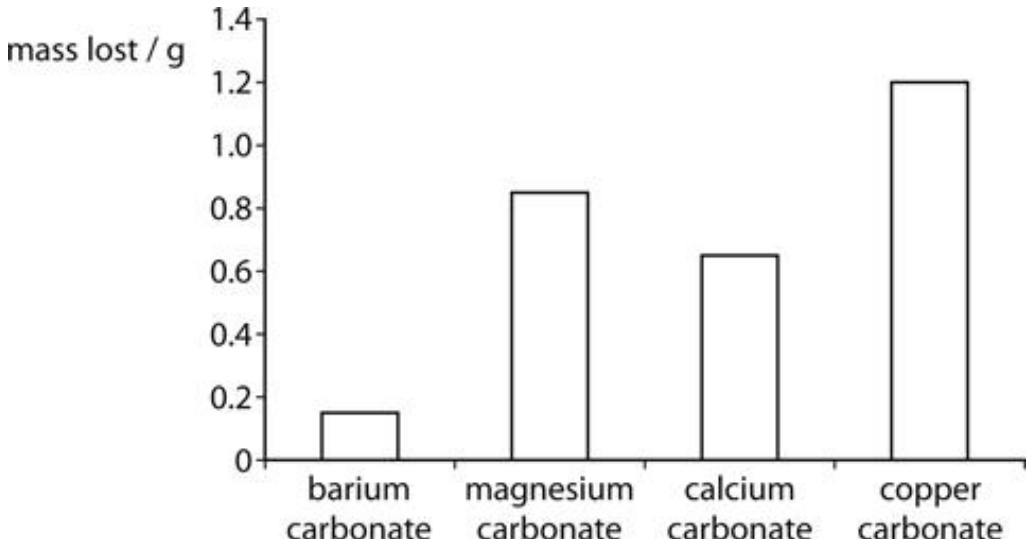
Total marks: 60

You may use a calculator.

Section A: Chemistry

1. Most metal carbonates decompose when they are heated. The products are the solid metal oxide and carbon dioxide gas.

A student heated 3.4 g of different metal carbonates using the same Bunsen burner flame in each case. The bar chart shows the mass lost by each metal carbonate after it had been heated for two minutes.



a) This incomplete equation shows the reaction occurring when copper carbonate is heated. It includes a state symbol, "(s)", to indicate the two reagents shown are solid.

$$CuCO_3(s) \rightarrow CuO(s) + ...(.....)$$

Finish the equation by adding the correct formula of the second product, and suggest a suitable state symbol for it in the brackets. (2)

b) What is the full name given to a reaction in which a substance breaks down while being heated? (1)

.....

c) Explain why the mass decreased during the experiment. (1)

.....

.....

d) Use the bar chart above to suggest which of the metal carbonates is the most thermally stable. (2)

Most thermally stable metal carbonate.....

Explanation.....

.....

e) The student repeated the experiment using 1.7 g of magnesium carbonate.

i. Calculate the mass of solid that should remain after he had heated the magnesium carbonate for two minutes. (2)

Mass of solid remaining = ... g

ii. How could the student show that the reaction was complete? (2)

.....

.....

.....

f) When heated, magnesium silicate undergoes the following chemical change.

$$MgSiO_3(s) \rightarrow MgO(s) + SiO_2(s)$$

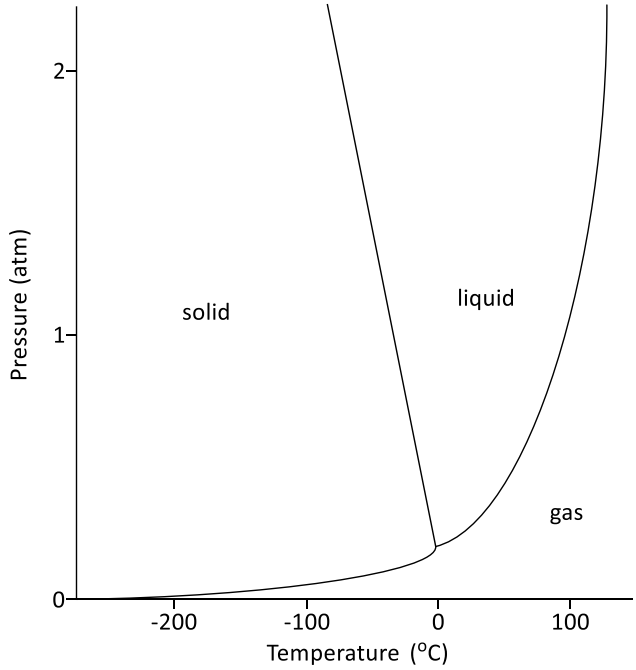
Predict the mass lost when 3.4 g of magnesium silicate is heated strongly for two minutes. Explain your reasoning. (2)

Mass lost……

Explanation……

(Total for Question 4 = 12 marks)

2. The physical state of water depends not only on temperature but also on pressure. The state of water at different temperatures and pressures is shown in the graph below, which is called a phase diagram.



a) What state will water be in at -50°C and 0.5 atm pressure? (1)

……

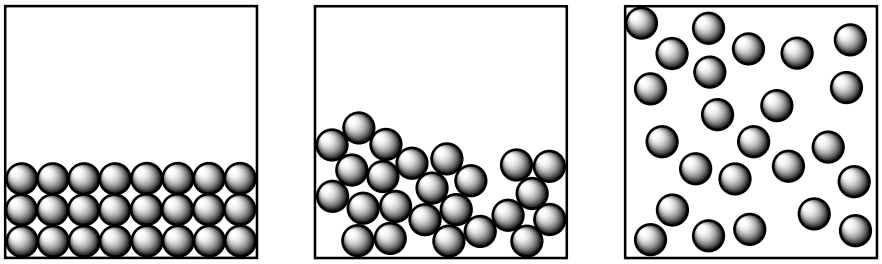
b) What state will the water be in if you maintain the same temperature but increase the pressure to 2 atm? (1)

……

c) What name is given to the state change that takes place? (1)

……

This diagram shows the arrangement of particles in solids, liquids and gases.



solid **liquid** **gas**

d) Explain, using the information in the diagram, why it is expected that increasing pressure, at a constant temperature, will convert a gas into a liquid. (2)

.....

.....

.....

e) Explain, using the information given above, why it comes as a surprise that increasing pressure, at a constant temperature, will convert ice into water. (1)

.....

.....

f) An ice cube has a volume of 6.00 cm^3 and a mass of 5.50 g. The density of water is 1.00 g/cm^3. Explain why the ice cube floats on the surface of the water. Include a calculation in your answer. (2)

.....

.....

.....

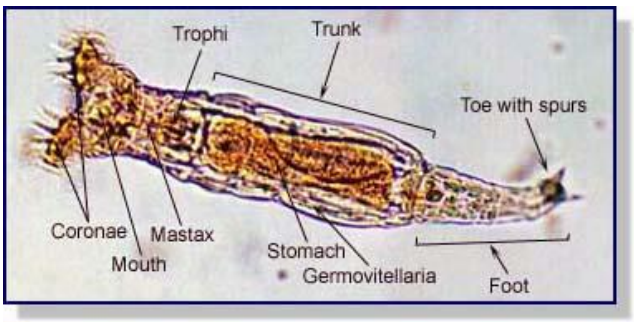
(Total for Question 5 = 8 marks)

Name:……

Section B: Biology

3. Bdelloid rotifers are strange microscopic animals that very few people have heard of. A picture of one is shown on the right.

Rotifers are unusual because they have not reproduced sexually for 80 million years.



a) Explain what asexual reproduction is. (2)

……

……

……

b) Suggest an advantage of asexual reproduction to bdelloid rotifers. (1)

……

……

c) Suggest a reason why sexual reproduction is more common in the animal kingdom. (2)

……

……

……

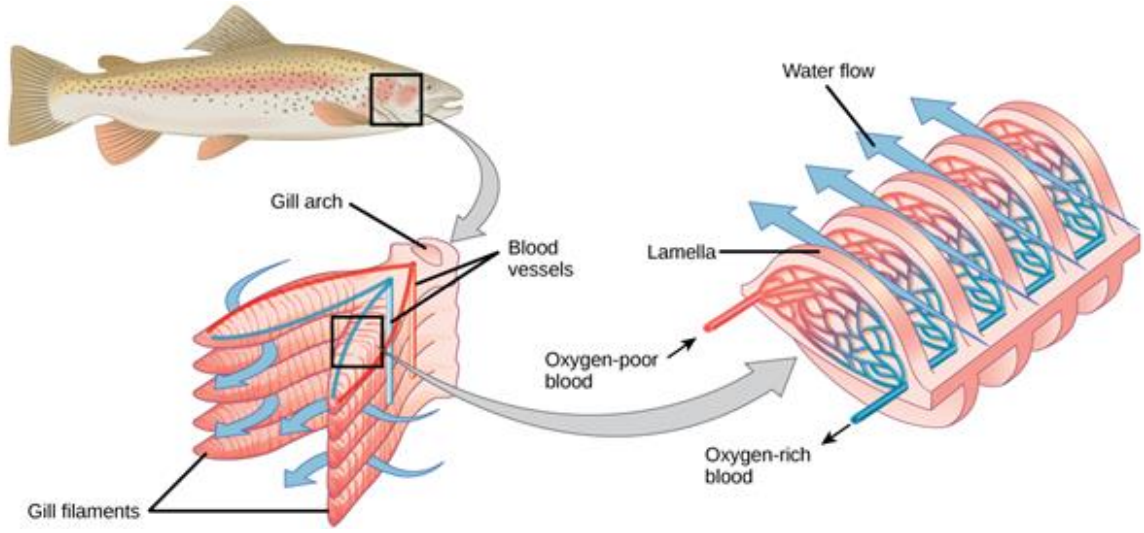
d) Give an example of **plants** reproducing asexually. (1)

……

……

(Total for Question 1 = 6 marks)

4. The diagram below shows some details of the structure of the gills of a fish.



a) Give **two** ways in which the structure of the gills is similar to that of human lungs. (2)

1. ……

……

2. ……

……

b) What process moves the oxygen from the water into the blood of the fish? (1)

……

c) Gills and lungs are both part of an important organ system in fish and mammals. Explain what is meant by the term 'organ system' and explain which organ system they are part of. (2)

……

……

……

(Total for Question 2 = 5 marks)

5. John Snow (1813 – 1858) was a doctor who stopped an outbreak of the disease cholera in London, in 1854. At this time, people obtained their drinking water from pumps in the street. Snow used a map, shown below, to determine that one particular pump was the source of the problem.

The pumps and a brewery have been ringed to make them more obvious (there are seven). Black marks are cholera cases. The area in the dashed box has been enlarged.

a) What is the evidence that the pump on Broad Street was the source of the epidemic? (2)

……

……

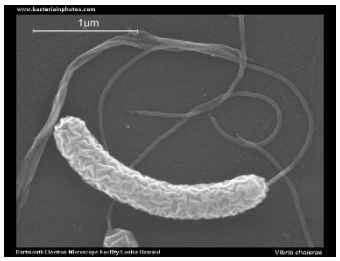
b) The Broad Street brewery is unusual. Suggest a reason why. (2)

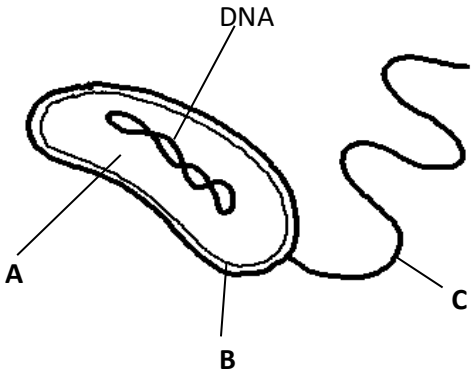
……

……

Snow's work helped to provide evidence for the **germ theory** of disease which states that certain diseases are caused by infectious microorganisms, not "bad air" or evil spirits.

Cholera is caused by a bacterium called *Vibrio cholerae*. Below is an electron microscope image of *Vibrio cholerae* and a highly simplified diagram.





c) Complete this table which refers to TWO of A, B and C in the diagram. (2)

Letter	Name of Structure	Function
		Site of chemical reactions.
	Cell membrane	

d) Why does a bacterial cell need DNA? (1)

……

……

e) Many people in 19th Century London suffered from scurvy. Suggest why diseases like scurvy made people reluctant to accept the germ theory of disease. (2)

……

……

……

(Total for Question 3 = 9 marks)

Name:…….

Section C: Physics

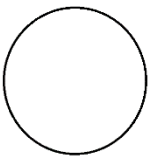
6**.** The effect of forces on the movement of objects was described by Isaac Newton in his three "laws of motion", stated in simple terms below.

Newton's Laws of Motion

1. ***An object remains at rest or moves with constant speed unless acted on by an unbalanced force.***
2. ***When an object is acted on by an unbalanced force it accelerates in the direction of the force at a rate proportional to the force.***
3. ***When a force is exerted on an object the object exerts an equal force in the opposite direction.***

A boy is throwing a ball into the air and catching it again. (You should ignore air resistance throughout all of question 6).

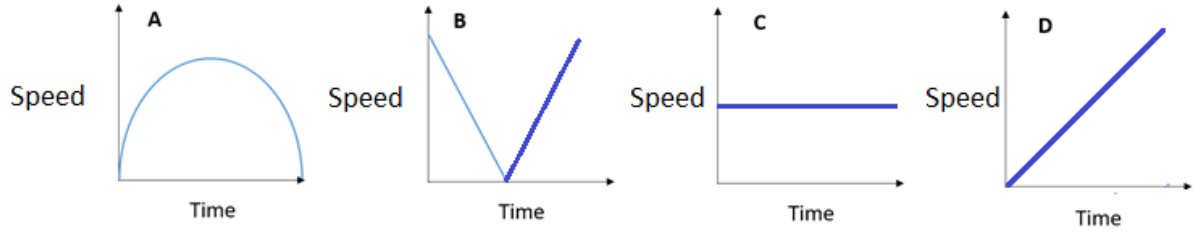
a) Show the forces acting on the ball after the ball has left his hand. (1)



b) Write the number of the law that explains why the ball continues upwards immediately after he lets go. (1)

……..

c) Which of the 4 graphs best describes the ball's speed after it has left his hand? Ring the letter of the correct graph; A, B, C or D (1)



d) Write the number of the law that explains how you chose the graph: ……. (1)

As the ball gets higher, kinetic energy is transferred into gravitational potential energy. When the ball starts to fall again, gravitational potential energy is transferred back into kinetic energy.

e) When does the ball have the largest amount of kinetic energy? Ring the letter of the best answer. (1)

A Just after he has thrown it.

B Just before he catches it.

C At the top of its flight.

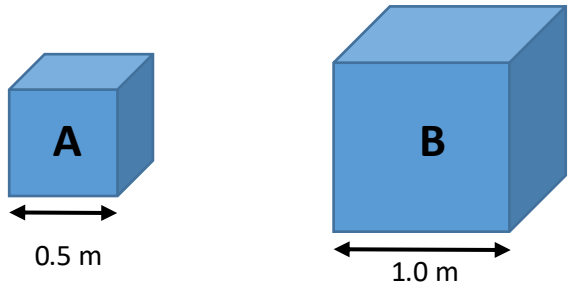
D Both A and B

f) The boy throws the ball up in the air at 5m/s. What speed will the ball be moving at just before he catches it? (1)

Answer: …… m/s

(Total for Question 6 = 6 marks)

7. This question is about two large cubes, A and B. Their dimensions are shown in the diagram below.



a) Calculate the surface area of one face of cube A. (1)

Surface area = ... m^2

A pressure of 101,000 Pa is applied to cube A. 1 Pa = 1 N/m^2. Calculate the force exerted on one face of cube A (2)

Force = ... N

b) A pressure of 50,500 Pa is applied to cube B. Ring the letter that shows the force on one face of Cube B: (1)

A Half that of Cube A

B The same as Cube A

C Double that of Cube A

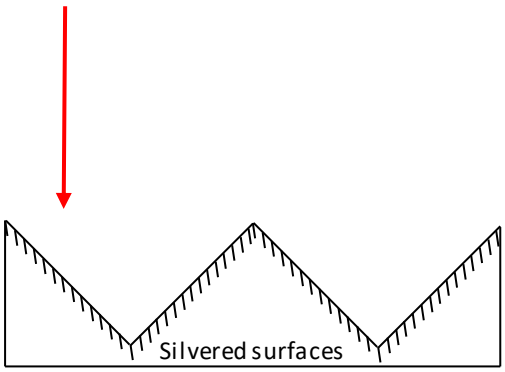
D 4x that of Cube A

c) Both cubes are made of the same material, with the same density. How much more mass is in cube B compared to cube A? (2)

(Total for Question 7 = 6 marks)

8. In 1969 the USA landed astronauts on the moon. They left behind a device that helps scientists calculate the distance to the moon. It works by reflecting light.

a) Complete the path of a light ray reflecting off the instrument (2)



b) A scientist on Earth wants to calculate the distance to the moon. He shines a laser at the device on the moon and records how long it takes for the light to return after being reflected; it takes 2.55 seconds.

If light travels at 300,000 km/s, calculate the distance to the moon. Show your working. (3)

Distance to the moon: …….km

c) A scientist is concerned that the astronaut didn't place the instrument completely flat on the surface of the moon so it won't work. A second scientist said the instrument will work anyway. Which one is correct, and why?

(Add extra light rays to the diagram if you wish) (3)

……

……

……

(Total for Question 8 = 8 marks)

END OF QUESTION PAPER