School	*Candidate's Name (PLEASE PRINT)*

WINCHESTER
COLLEGE

Entrance Examination

SCIENCE 2022

Total time allowed: 1 hour 30 minutes

This paper is divided into **THREE** sections.

Section A	Biology
Section B	Chemistry
Section C	Physics

Each Section carries 30 marks.
The mark for each question is given in brackets [ ].
All sections are composed of a number of short answer questions.

Candidates should attempt **ALL** the questions in these sections, answering in the spaces provided on the question paper. Calculators may be used.

Candidates will be penalized for giving answers to too many significant figures.

1 Bobby and George wanted to investigate how temperature affects the rate of respiration in yeast.

They set up the apparatus pictured below:

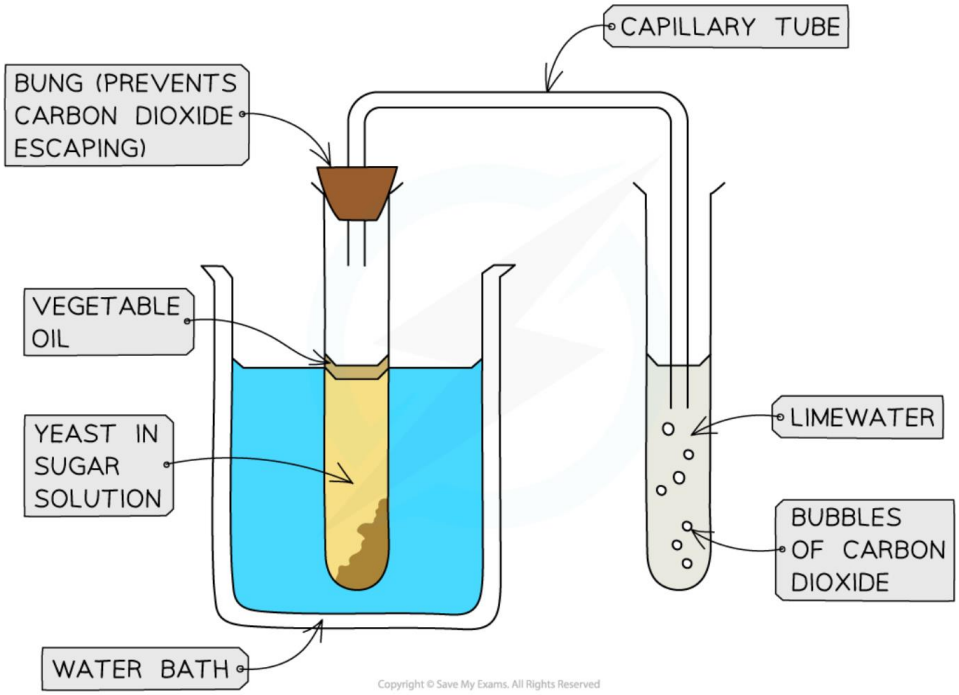


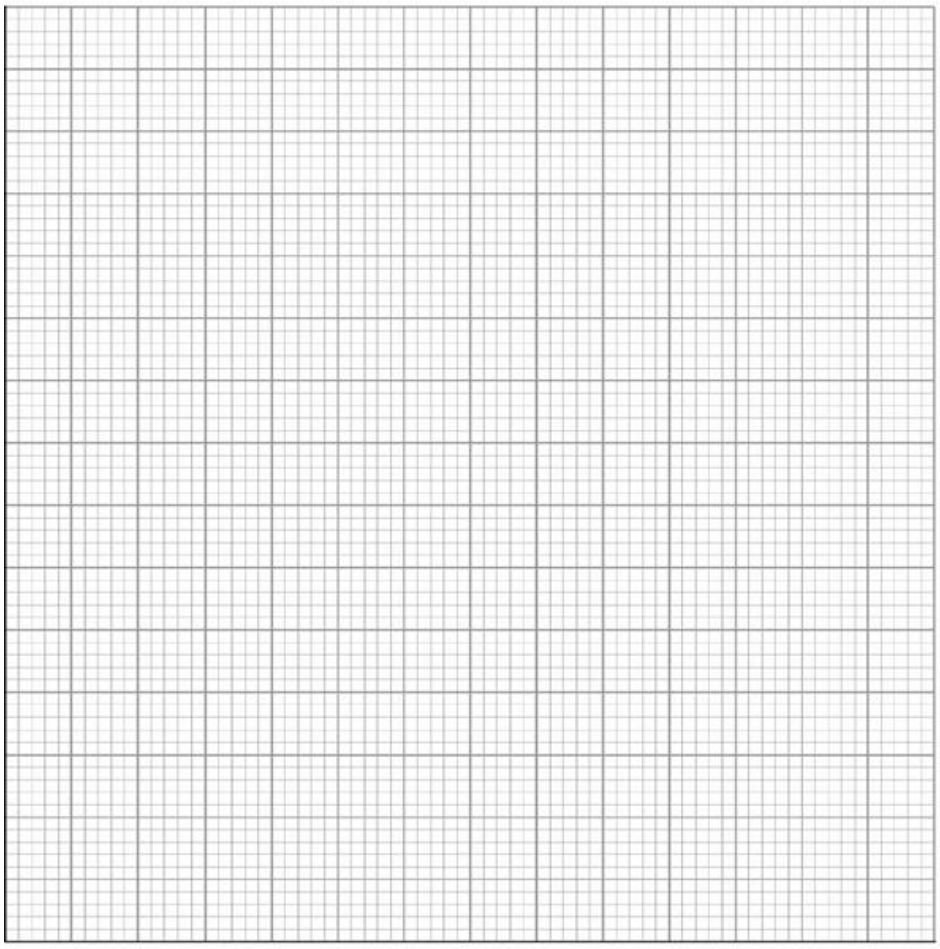
Fig. 1

Bobby and George decided to count the number of bubbles of carbon dioxide produced by the yeast in 1 minute. They repeated this using a range of different temperatures and then recorded the data in a table:

Temperature (°C)	Number of Bubbles (per minute)			
	Repeat 1	Repeat 2	Repeat 3	Mean
5	2	5	5	4
10	12	16	8	12
15	16	17	18	17
25	37	45	50	
30	49	56	51	

(a) Complete the table with the correct mean figures for the data. [1]

(b) Plot Bobby and George's data for the **mean** number of bubbles at different temperatures onto a line graph on the grid below.



[5]

(c) Unfortunately, the water bath set at 20°C was not turned on in time and so the pupils weren't able to collect data for that temperature. Use your graph to make an estimate of how many bubbles you would expect to see at 20°C.

.....

..... [2]

(d) Suggest one way in which this experiment could be improved.

.....

..... [1]

(e) Can you name two other variables that Bobby and George would need to keep constant during this experiment.

.....

.....

..... [2]

(f) What type of respiration is shown in this experiment? Explain your answer.

.....

.....

..... [2]

(g) Suggest and explain what might happen to the rate of production of carbon dioxide if you continued to increase the temperature beyond 30°C.

.....

.....

..... [2]

2 Fig 2.1 shows a green leaf:

Fig 2.1

(a) Describe how this leaf is adapted for the process of photosynthesis.

.....

.....

.....

..... [3]

(b) Name the little pores on the leaf's lower surface, which exchange gases from the air.

..... [1]

(c) Which gases are exchanged through these pores and name the processes for which they are required.

(i) Gas A:

.....

..... [2]

(ii) Gas B:

.....

..... [2]

(d) An important product of photosynthesis is glucose. Explain why plants are considered to be fundamental to almost all food chains and food webs.

.....

.....

.....

..... [2]

(e) What are the negative impacts of deforestation?

.....

.....

.....

.....

.....

..... [3]

(f) Suggest two ways in which humans can protect living things and the environment to enable more sustainable development.

.....

.....

.....

.....

.....

..... [2]

[Total: 30 marks]

End of Section A

References:

Fig. 1 Anaerobic Respiration in Yeast (5.1.4) | Edexcel IGCSE Biology: Double Science Revision Notes 2019 | Save My Exams

Fig. 2.1 Single Green Leaf Images – Browse 519,220 Stock Photos, Vectors, and Video | Adobe Stock

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SECTION B - CHEMISTRY

1 Select from the options below the technique which is best for separating pure water from a solution of sodium chloride in water.

A crystallisation

B chromatography

C filtration

D distillation [1]

2 A mixture of salt, sand and water is created and filtered. Select the option which correctly lists the component(s) found in the filtrate.

A sand

B salt

C water

D salt and water

E sand and water

F salt, sand and water [1]

3 Select the statement below which is **in**correct.

A carbon dioxide dissolves in water to give an alkaline solution

B carbon can be used to extract copper from copper(II) oxide

C universal indicator solution is yellow at pH 5-6

D the "safety flame" is the term used to describe a Bunsen burner giving out a yellow flame [1]

4 A current Wykehamist claims that in order of decreasing reactivity, the reactivity series of metals goes: “magnesium, lead, copper, zinc, silver”. Select the metal which is incorrectly located in this series.

A copper

B lead

C magnesium

D silver

E zinc [1]

5 Magnesium powder is added to dilute nitric acid in a beaker. Select the option below which best describes the observations.

A there is no visible change

B the powder dissolves, the temperature of the solution rises and no gas is produced

C the powder dissolves, the temperature of the solution rises and lots of bubbles of gas are produced

D the magnesium powder dissolves to give a milky suspension [1]

6 Select the option below which lists only correct chemical formulae.

			✓
A	methane CH_4 hydrochloric acid HCl	water H_2O copper(II) sulfate $CuSO_4$	
B	iron Fe lead Le	copper(II) sulfate Cu_2SO_4 sodium chloride NaCl	
C	magnesium Mg oxygen O_2	copper(II) sulfate $CuSO_4$ sodium hydroxide SoOH	
D	carbon dioxide CO_2 calcium carbonate $CaCO_3$	methane CH_3 sulfuric acid H_2SO_4	

[1]

7 a) Complete the table below using ticks (✓) and crosses (✗) to describe the properties of solids, liquids and gases.

state of matter	particles are touching	particles have random movement	particles are regularly arranged
gas			
liquid			
solid			

[3]

b) Boiling and evaporation both change a liquid into a gas. State two properties of boiling that are different from evaporation.

1. .....

.....

2. .....

..... [2]

c) i) Name the change of state when a gas becomes a liquid

.....

ii) Name the change of state when a solid becomes a gas

..... [2]

d) Changes of state are described as physical processes. Gives two ways in which chemical processes such as combustion and displacement differ from physical processes.

1. .....

.....

2. .....

..... [2]

8 A student investigated what happened when dilute nitric acid reacted with aqueous solutions of two different alkalis, solutions X and Y. Two experiments were carried out.

Experiment 1

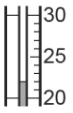
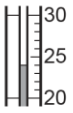
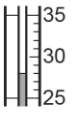
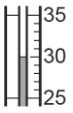
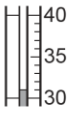
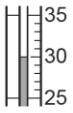
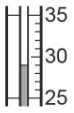
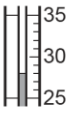
- A measuring cylinder was used to pour 50 cm^3 of solution X into a polystyrene cup. The initial temperature of the solution was measured.
- A burette was filled with nitric acid and used to add nitric acid to solution X in the polystyrene cup in 5.0 cm^3 increments.
- After each addition of nitric acid, the solution was stirred and the maximum temperature of the solution was measured.
- This process continued until a total of 40.0 cm^3 of nitric acid had been added.

Experiment 2

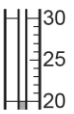
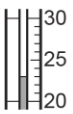
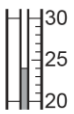
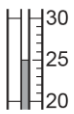
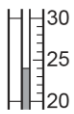
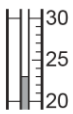
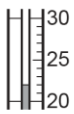
- Experiment 1 was repeated using solution Y instead of solution X.

a) The thermometer diagrams for the two experiments are included in the tables below. Complete both tables.

Experiment 1

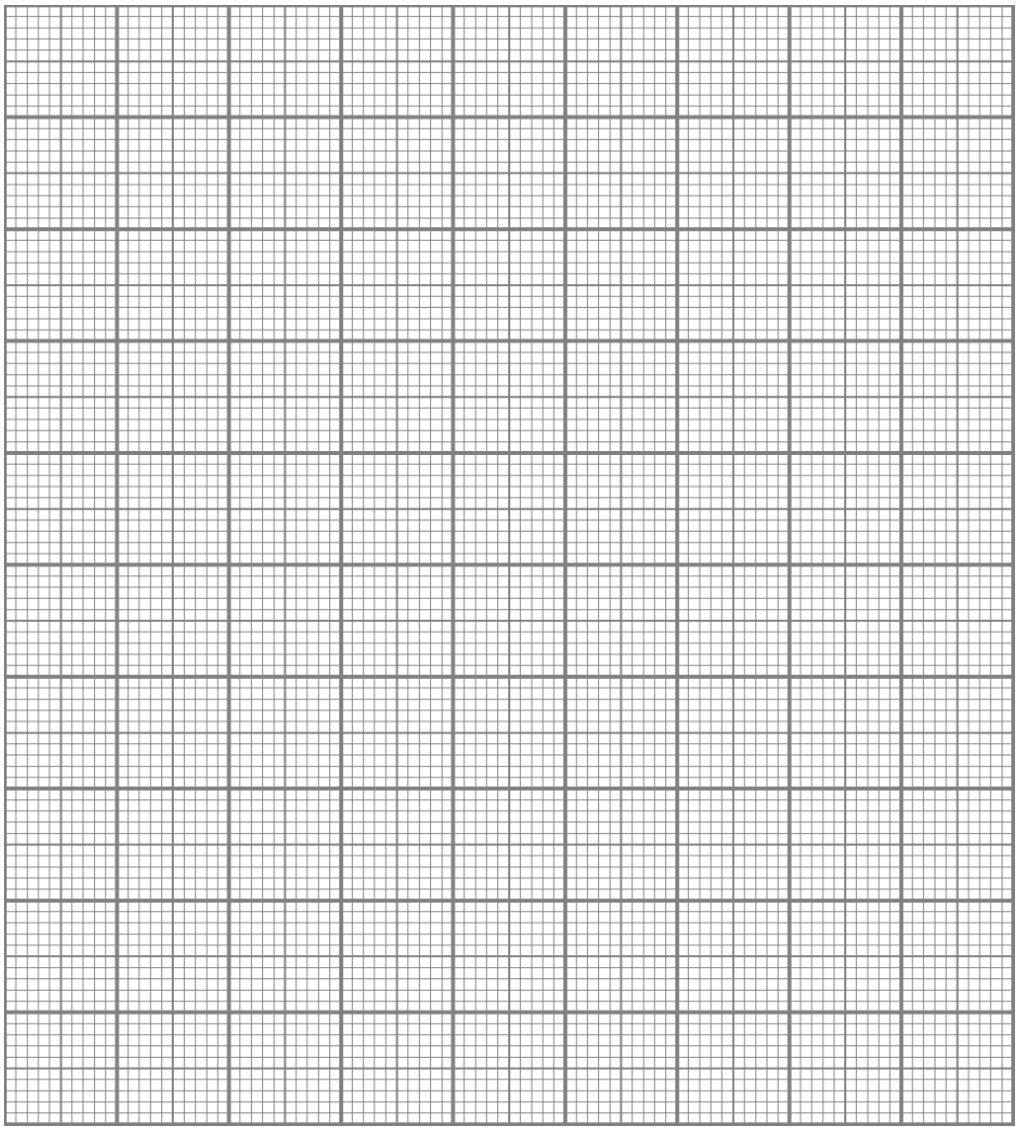
volume of nitric acid added / cm^3	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0
thermometer diagram									
maximum temperature of the solution in the polystyrene cup / °C									

Experiment 2

volume of nitric acid added / cm^3	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0
thermometer diagram									
maximum temperature of the solution in the polystyrene cup / °C									

[3]

b) Plot the results for experiments 1 and 2 on the grid below and draw a **smooth** line for each experiment on the same graph. You should clearly label your graphs for X and Y, put 'the maximum temperature of the solution' on the y-axis, and choose appropriate scales and labels for the axes. [5]



c) **Use your graph** to estimate the maximum temperature recorded if 13 cm^3 of nitric acid were added to 50 cm^3 of solution X in experiment 1. Show clearly on the grid how you worked out your answer.

.....

[2]

d) How would the results differ in experiment 1 if 100 cm^3 of solution X were used?

.....

.....

[2]

e) Suggest why a polystyrene cup was used and **not** a copper can.

.....

.....

[1]

f) State one source of error in the experiments. Suggest an improvement to reduce this source of error.

Source of error

.....

.....

Improvement

.....

.....

[2]

[Total: 30 marks]

End of Section B

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SECTION C - PHYSICS

1 This question is about electrical circuits.

(a) Ernest wishes to investigate the time it takes a cell to 'run out'. He has 5 identical small cells; similar to the type you may find in a watch.

- To test the first cell, he connects it to a light bulb. He records that it takes 288 seconds for the light bulb's filament to stop glowing.

- To test the second cell, he adds an additional light bulb to the circuit in parallel with the first, and records that the light bulbs' filaments both stop glowing after 151 seconds.

- To test the third cell, he adds a third light bulb in parallel. This time the three filaments stop glowing after 98 seconds.

(i) In the space below, draw a results table that Ernest could use to record his data. Add the data from the information given above to the results table.

[3]

(ii) Ernest has two more cells to test, but only has a total of three light bulbs. In the space below, draw two **additional different** circuit diagrams he could use to test the cells.

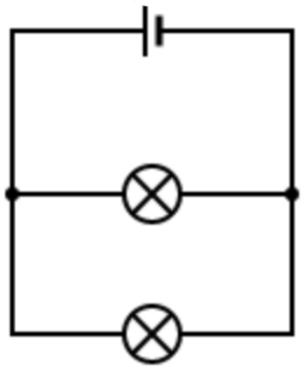
[2]

(b) Agatha suggests that it would be a better experiment if they recorded the time it takes the electrical current in a circuit to decrease to 50% of its initial value.

(i) Name the device used to measure electrical current.

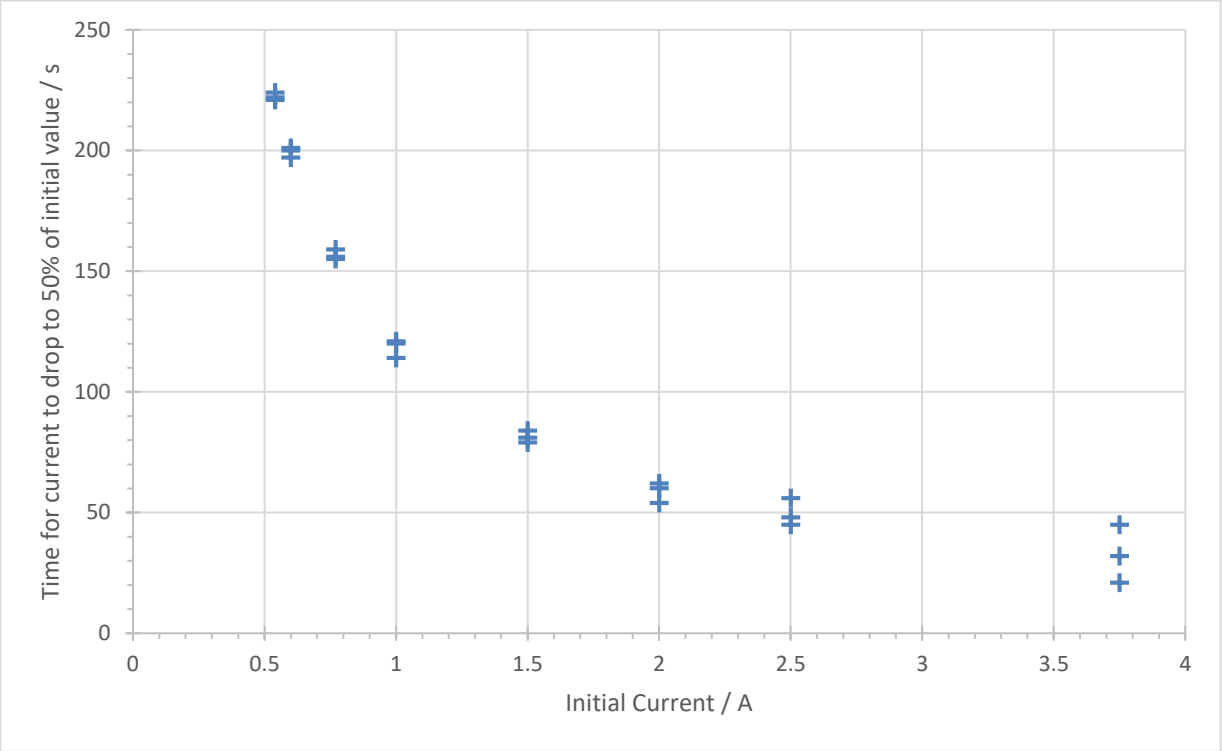
..... [1]

(ii) Using the standard circuit symbol, add the current measuring device in the circuit below so it is measuring the current in the cell.



[2]

(iii) The graph below shows the data that Agatha obtained in her experiment. She repeated each reading three times and plotted all of the data points. Add a line of best fit to the graph.



[2]

(iv) Ernest suggests Agatha should have taken the average of each data set and plotted one point instead of plotting all three. Give one advantage and one disadvantage of Ernest's approach.

Advantage: .....

.....

.....

Disadvantage: .....

.....

..... [2]

(v) Agatha's teacher asks her to write a conclusion after she has finished her graph. Write your conclusion in the space below.

.....

.....

.....

.....

.....

.....

.....

..... [2]

2 This question is about the Earth and space.

(a) The planets in the solar system are listed in order below. Add the missing planets.

Mercury
Earth
Saturn
Neptune

[2]

(b) On Earth we experience night and day. Describe what causes night and day. You may draw a diagram as part of your answer.

.....

.....

.....

..... [2]

(c) The Earth orbits the Sun.

(i) The Earth takes 365.25 days to complete one orbit of the Sun. Show that 365.25 days is approximately 32 million seconds (32 000 000 s).

[2]

(ii) The distance the Earth travels around the Sun in one year is 933 billion metres (933 000 000 000 m). Calculate the average distance between the centre of the Earth and the centre of the Sun.

You may assume the Earth's orbit is circular.
The circumference C of a circle is given by the equation:

$$C = 2\pi r$$

where $\pi = 3.14$
and r is the radius of the circle.

[2]

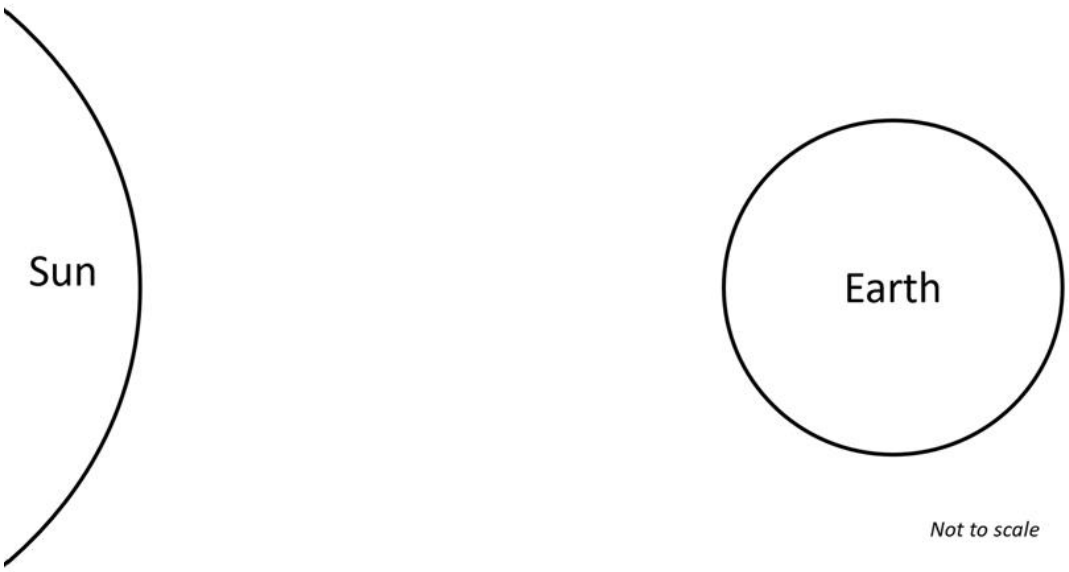
(iii) Calculate the average speed of the Earth as it orbits the Sun in m/s.

[2]

(d) The radius of the Earth is 6.37 million metres (6 370 000 m). Show that the speed of a point on the equator as the Earth **rotates** is about 1700 km/hour.

[3]

(e) In January the northern hemisphere experiences winter while the southern hemisphere experiences summer. Annotate the diagram below to show why this is the case.



[3]

[Total: 30 marks]

End of Section C

End of this paper