



ST PAUL'S SCHOOL  
Est. 1509

# **JUNIOR SCHOLARSHIP EXAMINATION**

**MAY 2018**

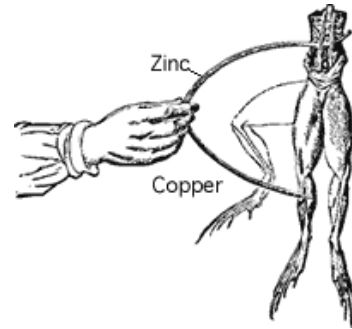
**PHYSICS**

**30 minutes**

**Answer the questions in the spaces provided**

**Name.....**

1. Luigi Galvani found that a freshly dissected frog's leg twitched when touched with two different metals. Galvani thought the effect intrinsic to life; Alessandro Volta disagreed and built the first battery of copper and zinc to prove it.



a) What are the initial and final forms of energy in the case of the frog's leg twitching?

[2]

b) Draw a circuit diagram that would allow you to test this situation, replacing the metals with a cell, and replacing the frog's leg with a resistor. Add further components so that you can easily see that a current is flowing, and so that you can measure the current.

[3]

c) Why might two metals like zinc and copper be used in a battery? Can you use knowledge of static charge to think of a simple reason?

[1]

d) Explain qualitatively, in terms of size, shape, and material, how the resistance is likely to differ between a frog's leg and a resistor.

[2]

The image below shows a picture of lightning.



e) If the clouds are positively charged and the ground negatively charged, in which direction will a positively charged particle in the air move? Explain your answer.

[3]

f) A lightning strike happens very suddenly. Use your knowledge of heating and cooling, and ideas about current, to explain why lightning can be so damaging.

[2]

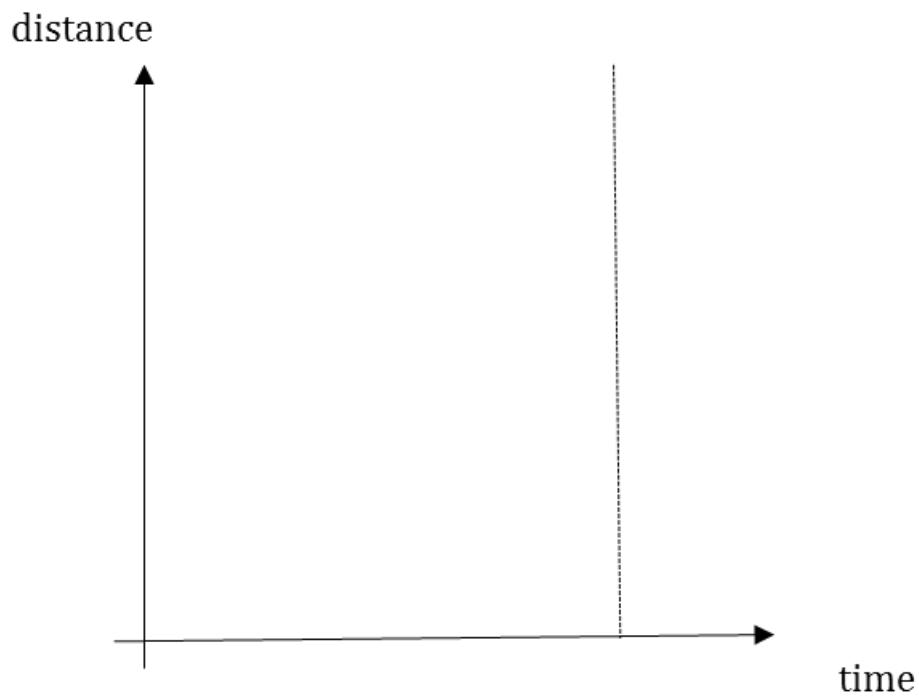
[13 marks]

2. A car and a motorbike leave from a junction at the same time, the motorbike with a constant speed  $u$ , and the car, starting from rest, has a constant acceleration,  $f$ .

a) The vehicles travel 2 kilometres, taking 2 minutes. Calculate the motorbike's speed  $u$  in kilometres per hour.

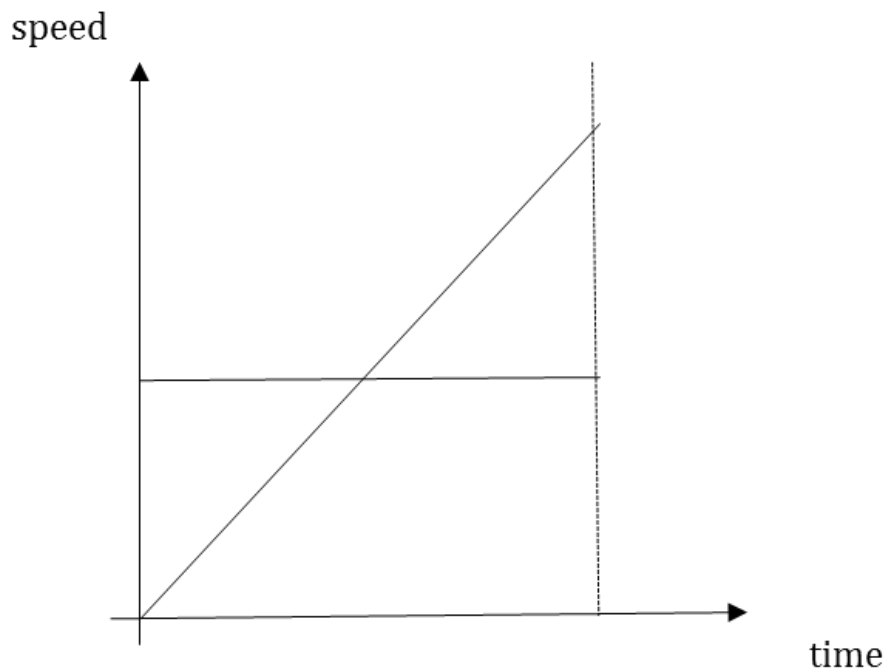
[2]

b) Sketch two different distance-time graphs on the axes below, one of the distance travelled by the car, and one for the motorbike, from the start until they meet at the time shown by the dotted line. Label each clearly.



[3]

Two speed-time graphs are drawn for you on the same time axis below. They are the speeds of the car and the motorbike before they meet at the time shown by the dotted line.



c) Label the diagram, making it clear which graph refers to the motion of the car and which refers to the motion of the motorbike.

[1]

d) Circle and label regions on the graph where the motorbike is increasing its lead (label with an M), and the region where the car is catching up (label with an C).

[1]

e) Using both graphs to help you, label the second graph with the time T, on the time axis, when they are furthest apart.

[1]

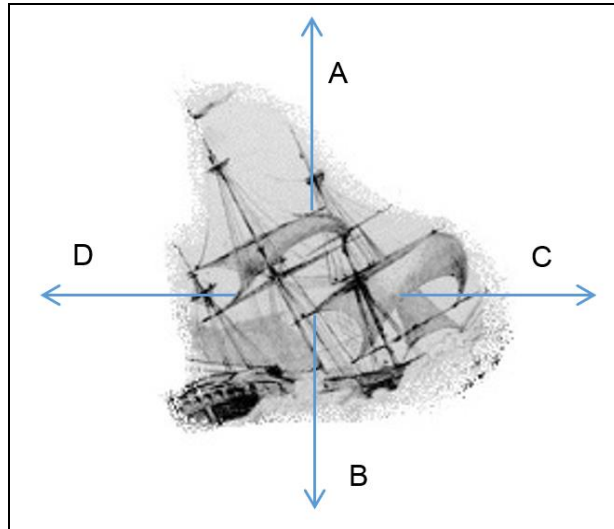
f) What is the car's speed when it eventually catches the motorbike?

[1]

[10 marks]

3. The picture shows a ship.

a) Label the 4 forces and circle the correct comparison of the vertical and horizontal pairs whilst it is sailing forward, in direction C, at a constant speed.

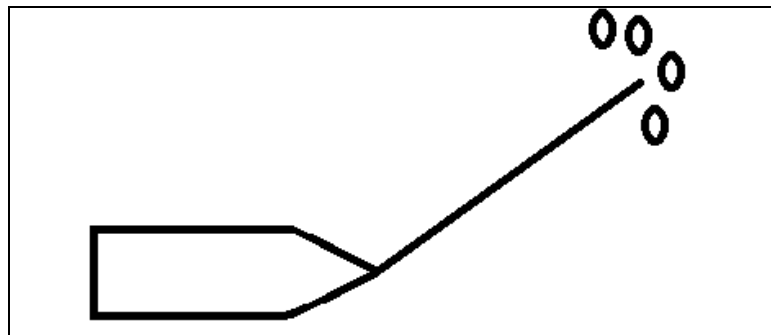


Force A is:     greater than / equal to / smaller than Force B

Force C is:     greater than / equal to / smaller than Force D

[4]

b) In the diagram below, a ship is depicted being pulled through ice by four crew. Identify the pull force in the rope, known as tension, by adding an arrow head and label to the diagram. Comment on the fact that the ship nonetheless moves to the right. You might use further additions to the diagram to assist you.



[2]

c) One of the crew must check the rope. He takes a 0.4 m piece of the rope on the deck and hangs a 10 N weight on the rope and finds it extends 0.25 cm. In general the applied weight  $F$  and extension  $x$  are related by  $F=kx$ , where  $k$  is the spring constant for the rope. Calculate  $k$ , giving appropriate units.

[3]

d) How far would a 40 m rope made of the same material as in c) extend if 4 men weighing 800 N each put their full weight into pulling the boat?

[4]

e) In reality when the men jerk the rope, the maximum extension of the rope will be greater than the answer calculated above. Why?

[1]

[14 marks]

4. Are there some scientific advancements that are not worth the cost? What do you think? Can you give an example from physics and argue the costs and benefits?

[2]

**[Total for paper: 42 marks]**

**END OF PAPER**