PHYSICS CHALLENGE
2002

Time allowed: one hour

Attempt all questions. It is often helpful to include diagrams in your explanations.

Marks allocated in each question are shown on the right in brackets.

1. An oil company has oilrigs in a part of the North Sea where there are icebergs in winter. To eliminate the danger of collision with the rigs, the company decided to try to melt the icebergs by coating them with soot.

   (a) Explain why the company thought that coating the icebergs with soot might work. (2)

   (b) Give THREE reasons why it might not work. (3)

2. At midday last winter, it was foggy and cars had their headlights on, even though the Sun was shining. It was only just possible to see the headlights when the cars were 50m away whereas the Sun could easily be seen although it is 150 million km away. Give TWO reasons why you think the Sun was so visiblebut the car headlights were not so easy to see. (5)

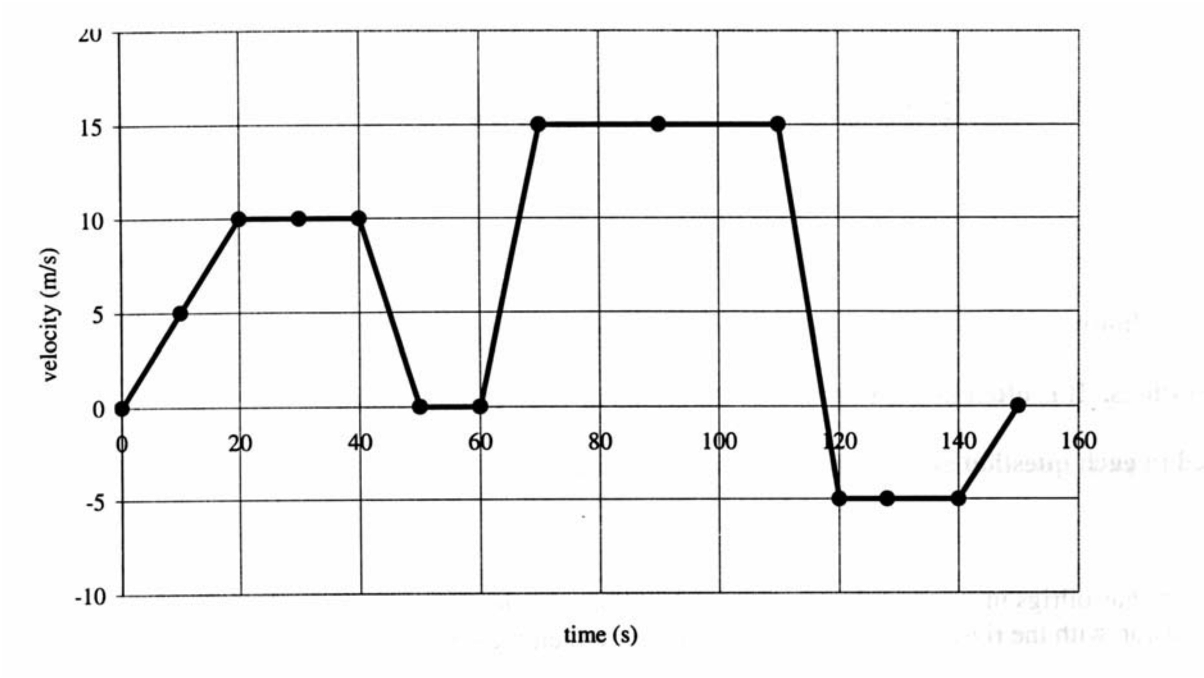
3. In America, the mains electricity supply is 110 volts instead of 240 volts. As a consequence, kettles take longer to boil in the USA compared with the UK. A British tourist takes his kettle to the USA and uses it there. Calculate how much longer you think it may take to boil the same mass of water in the USA compared with the UK. You should include your reasoning and give any assumptions you make. (7)

4. The graph shows how the velocity of a delivery van varies during part of a journey along a straight road.

   (a) Plot another graph to show how the van's acceleration varies with time. (6)

   (b)How far from the starting point is the van when it has finished its journey? (4)

   (c)Explain why it must be impossible in practice, with current gear boxes, for the van's velocity to vary as shown on the graph between the times of 110s and 120s (2)



5. A water rocket is made of an old lemonade bottle fitted with fins. It is half filled with water and air is pumped in using a bicycle pump. When the pressure is sufficiently great, the rocket is released, and travels vertically.

(a) Explain, using forces, how the rocket lifts off. (3)

(b) What happens to the size of the driving force as it gains height? Why does the force change in this way? (2,2)

(c) What energy changes take place after pumping in sufficient air? (3)

(d) In repeating the experiment, <u>the same bottle could be used with the same initial compressed-air pressure but with different volumes of water.</u> Assuming you could measure the heights with reasonable accuracy, explain how you would expect the height it reaches to depend on the volume of water in the bottle? Sketch a possible graph. (3,2)

6. (a) A lamp is rated 6.0V, 0.20A. Calculate its resistance and the power dissipated when running normally. (8)

(b) Inside an electric heater there is a heating coil and an indicator bulb. The bulb fails and an electrician removes it. She finds it is rated 6.0V and 1.0A. This bulb is in series with the heating element. The only replacement she can find is the one in part (a) of this question and decides to use it with a suitable resistor. The heater runs off two car batteries of 12V each. Draw a circuit diagram to show a switch, the heater, the bulb and the resistor. (4)

(c) Calculate the value of the resistor she needs (4)