

A level Physics A
H556/03 Unified physics

Question Set 13

- 1 A toy rocket is made from a 1.5 litre plastic bottle with fins attached for stability.

The bottle initially contains 0.30 litres of water, leaving 1.2 litres of trapped air at a temperature of 17 °C.

A pump is used to increase the pressure of the air within the plastic bottle to $2.4 \times 10^5 \text{ Pa}$ at the start of lift-off.

Fig. 1.1 shows the rocket at the start of lift-off.

1 litre = 10^{-3} m^3

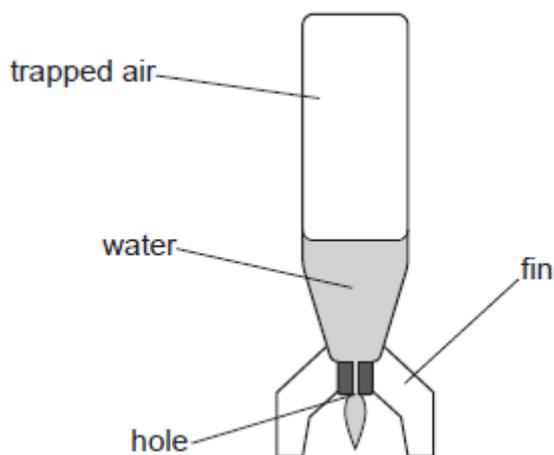


Fig. 1.1

- (a) Calculate, in moles, the amount of trapped air in the bottle at the start of lift-off.

amount of air = mol [2]

- (b) The trapped air pushes the water downwards out of the hole, causing the rocket to rise. The temperature of this air remains constant.

Calculate the final pressure of the trapped air just before all the water has been released.

final pressure = Pa [3]

- (c) Here is some data on the toy rocket.

mass of empty bottle and fins = 0.050 kg
 area of cross-section of hole = $1.1 \times 10^{-4} \text{ m}^2$
 initial pressure of trapped air = $2.4 \times 10^5 \text{ Pa}$
 atmospheric pressure = $1.0 \times 10^5 \text{ Pa}$
 density of water = $1.0 \times 10^3 \text{ kg m}^{-3}$

- (i) Use the data above to show that the **upwards** force on the rocket at the start of lift-off is about 15 N.

[2]

(ii) Hence calculate the initial vertical acceleration of the rocket.

initial acceleration = m s^{-2} [3]

(d) Discuss whether adding more water initially would enable the rocket to reach a greater height. [3]

Total Marks for Question Set 13: 13

OCR

Oxford Cambridge and RSA

Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact The OCR Copyright Team, The Triangle Building, Shaftesbury Road, Cambridge CB2 8EA.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge