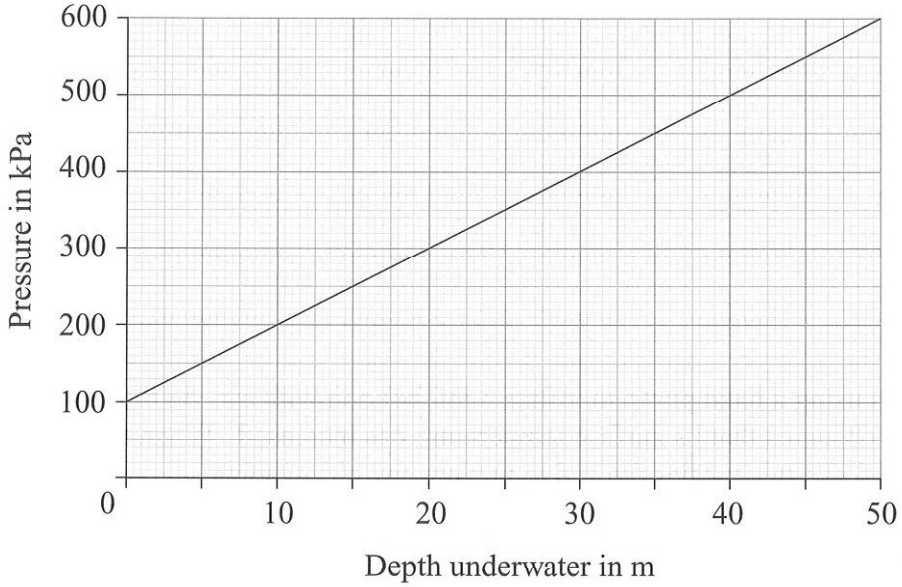
Kinetic Theory, Forces and Pressure

1 **Figure 1** is a graph that shows the relationship between depth underwater and pressure.

Figure 1



a) A bubble produced underwater at a depth of 25 m moves upwards. By the time the bubble reaches 10 m below the surface, it has expanded to a volume of 1000 cm^3. Use **Figure 1** to calculate the volume of the bubble at a depth of 25 m. Assume the bubble maintains a constant temperature as it travels upwards. Give your answer to two significant figures.

Volume = ... cm^3

[4]

b) Explain why the volume of the air bubble increased as its depth decreased. Assume that the temperature of the air and the water remained constant.

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[2]

[Total 6 marks]

2 Helium cylinders are rigid metal containers in which helium is stored. They can be used to inflate foil balloons.

a) Explain why the pressure inside the cylinder decreases as gas is removed from it. Your answer should refer to the particle model.

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[4]

b)* A student is using a hand pump to inflate a foil balloon with air. As the balloon inflates, the student observes that its surface temperature has increased. When the balloon is fully inflated, the student ties the end to prevent any air escaping.

A few minutes later, he notices that the balloon's surface has cooled. He pushes his finger onto the balloon's surface and notices the balloon's shape deforms more easily than when the balloon's surface was warm. The volume of the balloon remains constant and the foil does not stretch.

Explain the student's observations.

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[6]

[Total 10 marks]

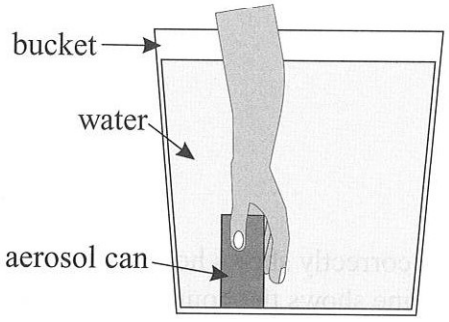
3 The typical internal pressure due to compressed air in an aerosol can is 500 kPa.

a) Calculate the total force exerted on the inside walls of a typical aerosol can by the compressed air.
Give your answer to three significant figures.
Assume that a typical aerosol can is a perfect cylinder of height, $h = 20$ cm and radius, $r = 2.5$ cm.
Surface area of a cylinder = $2\pi r(r + h)$.

Force = ... N
[5]

The aerosol can is placed in a bucket of water and held at the bottom of the bucket, as shown in **Figure 2**.

Figure 2



The average density of the aerosol can and its contents is 375 kg/m^3.
The density of water is 1000 kg/m^3.

b) Explain what happens when the can is released.
You should refer to the forces acting on the can in your answer.

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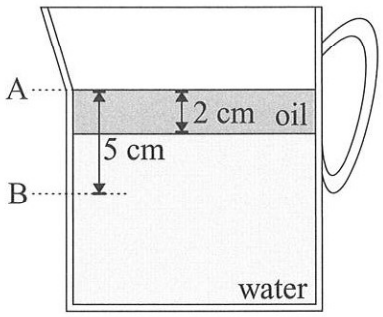
[4]

[Total 9 marks]

4 A jug containing water has oil poured into it. The oil collects on the surface of the water, as shown in **Figure 3**. The layer of oil is 2 cm thick.

Figure 3



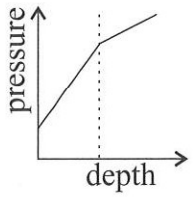
The difference in pressure between point A, at the surface of the oil, and point B, 5 cm below the surface of the oil, is 470.4 Pa. The density of water is 1000 kg/m^3.

a) Calculate the density of the oil.
Gravitational field strength = 10 N/kg.

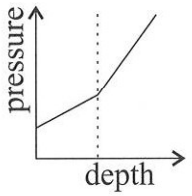
Density = ... kg/m^3
[5]

b) Which of the following graphs correctly shows how the pressure changes with depth below the surface of the oil? The dotted line shows the boundary between the oil and water.
Tick **one** box.

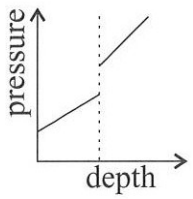
☐ **A**



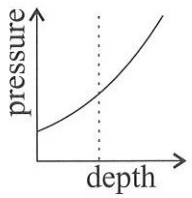
☐ **C**



☐ **B**



☐ **D**



[1]

[Total 6 marks]

Exam Practice Tip

Examiners might try to throw you by presenting information in tricky graphs and tables. Don't let them throw you — they'll only be testing you on the physics you know and love. If you're not sure what to do, think about the relationships that connect the variables mentioned in the question.

Score: ☐ / **31**

☹ ☐ 😐 ☐ 😊 ☐