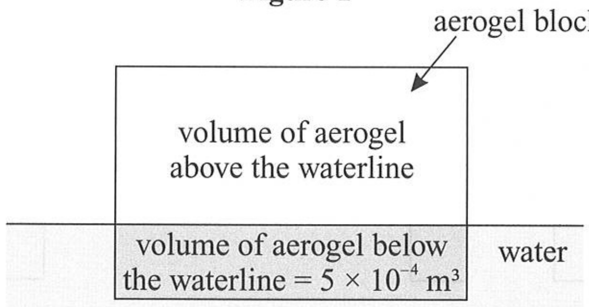
Density

1 Aerogels are synthetic solids with an extremely low density.

A company produces an aerogel with a density of 1.50 kg/m^3. **Figure 1** shows a block of the aerogel floating in some water. The aerogel has a mass of 0.50 kg. The volume of the aerogel below the waterline is 5×10^{-4} m^3.

Figure 1



Not to scale

a) Calculate the percentage of the volume of the aerogel that is below the waterline.

Percentage = ... %
[4]

b) The company can make 0.360 m^3 of the aerogel in 24 hours.
Calculate the average rate of production of the aerogel. Give your answer in grams per minute.

Rate of production = ... g/min
[5]

[Total 9 marks]

Exam Practice Tip

If you're not sure where to start with a problem, try checking the units given in the answer — sometimes they'll offer clues about how the answer is calculated. For example, if it's a mass unit over a volume unit, you'll probably need to divide a mass by a volume.

Score: ___ / **9**

Specific Heat Capacity and Changes of State

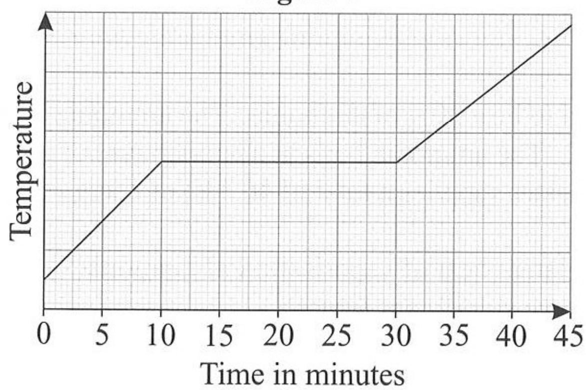
1 Ball A is a 50 g ball made of aluminium. Ball A is heated and then plunged into 1.0 kg of water that has an initial temperature of 27 °C. The water and the ball eventually reach the same temperature of 30 °C.

a) Calculate the temperature of ball A just before it was plunged into the water.
Assume no energy is lost to the surroundings.
The specific heat capacity of water is 4200 J/kg°C.
The specific heat capacity of aluminium is 900 J/kg°C.

Temperature = ... °C
[5]

b) Ball A is removed from the water and then heated at a constant rate for 45 minutes. **Figure 1** shows the temperature-time graph for ball A as it is being heated.

Figure 1



Ball B is another aluminium ball. Ball B has half the mass of ball A.
On **Figure 1**, draw the temperature-time graph of ball B that would be produced if energy was transferred to it at the same rate as ball A. Explain your answer.

....

....

....

....

....

....

[4]

[Total 9 marks]

2 **Figure 2** shows the specific heat capacities of different substances.

An electric heater is used to transfer energy to different substances. It is assumed that no energy is wasted to the surroundings and no energy is transferred from the surroundings to the substances.

Figure 2

Substance	Specific heat capacity in J/kg°C
Tin	217
Ammonia (liquid)	4700
Ammonia (gas)	2060

a) i) The heater is used to transfer 740 J of energy to a piece of tin.
The temperature of the tin increases by 30 °C.
Calculate the mass of this piece of tin. Give your answer to two significant figures.

Mass = ... kg
[4]

ii) The heater continues to heat the tin at a constant rate. Once the tin reaches a certain temperature, the temperature of the tin stops changing. Explain why.

....

....

....
[2]

b) The heater is then used to heat 30 g of ammonia. The ammonia is initially a liquid with a temperature of –60 °C. The ammonia boils at a temperature of –33 °C and then its temperature rises to –10 °C. The heater supplies a total of 46.3 kJ of energy to the ammonia during this time.

Calculate the specific latent heat of vaporisation of ammonia.
Give your answer to three significant figures.

Specific latent heat of vaporisation = ... J/kg
[6]

[Total 12 marks]

Exam Practice Tip

You don't need to learn the equations for specific heat capacity and specific latent heat — they'll be on the equations list in the exam. Make sure you can use and rearrange them like a ninja though, so you can spend less exam time twiddling with equations and have more time for tricky reasoning questions.

Score: ____ / **21**