Physics Y11

Answers p24 -25

Q1 to Q10

1 Aluminium. All other variables being the same, aluminium has the highest value for specific heat capacity so it will absorb the highest amount of thermal energy.

2 $T = 20.6°C$

$Q_{\text{lost by hot}} = Q_{\text{gained by cold}}$

$m_h c\Delta T = m_c c\Delta T$

$m_h \Delta T = m_c \Delta T$

$10.0 \times (65.0 - T) = 80.0 \times (T - 15.0)$

$650.0 - 10.0T = 80.0T - 1200.0$

$90.0T = 1850.0$

$$T = \frac{1850.0}{90.0}$$

$= 20.56°C$

$=$ 20.6°C (to 3 significant figures)

3 $Q_{\text{lost by copper}} = Q_{\text{gained by water}}$

$m_c c_c \Delta T = m_w c_w \Delta T$

$20.0 \times 390 \times (100.0 - T) = 5.00 \times 4180 \times (T - 20.0)$

$7.80 \times 10^5 - 7.80 \times 10^3 T = 2.09 \times 10^4 T - 4.18 \times 10^5$

$2.87 \times 10^4 T = 1.198 \times 10^6$

$$T = \frac{1.198 \times 10^6}{2.87 \times 10^4 T}$$

$= 41.7°C$

4 $Q_{\text{cooling}} = Q_{\text{warming}}$

$mc_{\text{water}} \Delta T = mc_{\text{water}} \Delta T$

$m_{\text{cooled}} \Delta T = m_{\text{heated}} \Delta T$

$m_{\text{cooled}} \times (45.0 - 36.0) = 12.0 \times (36.0 - 19.0)$

$m_{\text{cooled}} \times 9.0 = 204$

$$m_{\text{cooled}} = \frac{204}{9.0}$$

$= 22.7\,\text{kg}$

5

$$Q_{\text{lost by iron}} = Q_{\text{gain by water}}$$

$$m_i c_i \Delta T = m_w c_w \Delta T$$

$$598 \times 440 \times (1250 - T) = 938 \times 4180 \times (T - 21.0)$$

$$3.289 \times 10^8 - 2.631 \times 10^5 T = 3.9208 \times 10^6 T - 8.2338 \times 10^7$$

$$4.1839 \times 10^6 T = 4.1124 \times 10^8$$

$$T = \frac{4.1124 \times 10^8}{4.1839 \times 10^6}$$

$$= 98.3°C$$

6

$$Q_{\text{iron}} + Q_{\text{aluminium}} = Q_{\text{water}}$$

$$m_i c_i \Delta T + m_a c_a \Delta T = m_w c_w \Delta T$$

$$10.0 \times 440 \times (20.0 - T) + 10.0 \times 900 \times (20.0 - T) = 100 \times 4180 \times (T - 12.0)$$

$$8.80 \times 10^4 - 4.40 \times 10^3 T + 1.80 \times 10^5 - 9.00 \times 10^3 T = 4.18 \times 10^5 T - 5.016 \times 10^6$$

$$4.18 \times 10^5 T + 4.40 \times 10^3 T + 9.00 \times 10^3 T = 8.80 \times 10^4 + 1.80 \times 10^5 + 5.016 \times 10^6$$

$$4.314 \times 10^5 T = 5.284 \times 10^6$$

$$T = \frac{5.284 \times 10^6}{4.314 \times 10^5}$$

$$= 12.2°C$$

7 $Q_{\text{total}} = Q_{\text{heating}} + Q_{\text{steam}}$

$$= mc\Delta T + mL_v$$
$$= 50.0 \times 4180 \times (100 - 20.0) + 50.0 \times 2.25 \times 10^6$$
$$= 1.672 \times 10^7 + 1.125 \times 10^8$$
$$= 1.29 \times 10^8 \text{ J}$$

8

$$Q_{\text{steam}} + Q_{\text{water}} = Q_{\text{potatoes}}$$
$$m_s L_v + m_s c_w \Delta T = m_p c_p \Delta T$$
$$m_s \times 2.25 \times 10^6 + m_s \times 4180 \times (100 - 85.0) = 3.00 \times 3430 \times (85.0 - 12.5)$$
$$2.25 \times 10^6 m_s + 6.27 \times 10^4 m_s = 7.46 \times 10^5$$
$$2.3127 \times 10^6 m_s = 7.46 \times 10^5$$
$$m_s = \frac{7.46 \times 10^5}{2.3127 \times 10^6}$$
$$= 0.323 \text{kg}$$

9 $Q_{\text{total}} = mc\Delta T + mL_{\text{fusion}}$

$= 1.25 \times 233 \times (961 - 20.0) + 1.25 \times 1.11 \times 10^3$

$= 2.74 \times 10^5 + 1.39 \times 10^3$

$= 2.75 \times 10^5 \text{ J}$

10 $Q_{\text{total}} = mc_s\Delta T + mL_v + mc_w\Delta T$

$= 0.755 \times 2000 \times (110 - 100) + 0.755 \times 2.25 \times 10^6 + 0.755 \times 4180 \times (100 - 25.0)$

$= 1.51 \times 10^4 + 1.70 \times 10^6 + 2.367 \times 10^5$

$= 1.95 \times 10^6 \text{ J}$