Unit 11

Answers: Quantity of Heat

Quick checks

1 c $ms = 2 \times 910 = 1820$

2 b $0.1 \times 4200 \times (80 - \theta) = 0.3 \times 4200 \times (\theta - 20)$
$80 - \theta = 3\theta - 60 \;\; \theta = 35$

3 b

4 c s

5 d $\Delta\theta = 0 \quad s = Q/(m\Delta\theta)$

6 a

7 b

8 a $10 \times 462 \times 80 = 369\,600 \quad =$
$\dfrac{369\,600}{3.36 \times 10^5} = 1.1$

9 a $s_A(15 - 10) = s_B(25 - 15) \Rightarrow s_A = 2s_B$
$s_B(30 - 25) = s_C(40 - 30) \Rightarrow s_B = 2s_C \quad s_A = 4s_C$
$4s_C(\theta - 10) = s_C(40 - \theta) \Rightarrow 5\theta = 80 \Rightarrow \theta = 16$

10 a $= ms = \rho V s \quad V \; \dfrac{\rho_1 s_1}{\rho_2 s_2} = \dfrac{1 \times 3}{3 \times 1} = 1$

11 d

12 b $1 \times 2100 \times 10 + 1 \times 3.36 \times 10^5 + 1 \times 4200 \times 50 = 21\,000 + 336\,000 + 210\,000 = 5.67 \times 10^5$

13 c

14 d $s_2 = \frac{5}{9}s_1 \quad s_1 > s_2$

15 a $ms\Delta\theta = \frac{1}{2}mgh \Rightarrow \Delta\theta = \dfrac{gh}{2s} = \dfrac{10 \times 84}{2 \times 4200} = 0.10$

16 **b** $ms_1(32-20) = ms_2(40-32) \Rightarrow 12s_1 = 8s_2 \Rightarrow \dfrac{s_1}{s_2} = \dfrac{2}{3}$

17 **a** $10 \times s_i \times 20 = 200s_i$

$10 \times 2s_i \times 10 = 200s_i$

18 **c** $1000 \times 300 = 300\,000 \quad = (1 \times 4200 + C) \times 60 \quad 4200 + C = 5000 \quad C = 800$

16.

$Q = ms\Delta\theta = 80 \times 4200 \times 2.0 = 672\,000$

17.

$-\dfrac{dQ}{dt} = K(\theta - \theta_0)$

$dQ = ms\,d\theta \qquad \ln(\theta - \theta_0) = -\dfrac{K}{ms}t + C \qquad \ln(\theta - \theta_0) \qquad t$

θ_0

$$\frac{60-\theta_0}{100-\theta_0} = \frac{40-\theta_0}{60-\theta_0}$$

$(60-\theta_0)^2 = (100-\theta_0)(40-\theta_0) \Rightarrow 3600 - 120\theta_0 = 4000 - 140\theta_0 \Rightarrow \theta_0 = 20$

$20 + 10 =$

$\frac{40}{5} = k(80-\theta_0) \qquad \frac{20}{5} = k(50-\theta_0) \qquad \theta_0 = 20 \qquad k = \frac{2}{15} \qquad \frac{40-\theta}{5} = \frac{2}{15}\left(\frac{40+\theta}{2} - 20\right)$

$\theta = 30$

18.

$$\frac{\Delta\theta}{Q} = \frac{1}{ms}$$

$396 - 62.7 = 333.3$ $\qquad L_f = \dfrac{333.3}{1.00 \times 10^{-3}} =$

$3080 - 815 = 2265$ $\qquad L_v = \dfrac{2265}{1.00 \times 10^{-3}} =$

19.

$$\tfrac{1}{2} \times 1.80 \times 7.80^2 = 54.76$$

$$0.60 \times 10 \times 54.76 = 328.5$$

$$\Delta\theta = \frac{Q}{ms} = \frac{328.5}{0.008\,00 \times 910} =$$

20.

$2260 + 4.2 \times$

$100 = 2680$ $\qquad 5 \times 336 = 1680$

$$2260 + 1 \times 4.2 \times (100 - \theta) = 2680 - 4.2\theta$$

$$1680 + 5 \times 4.2 \times \theta = 1680 + 21\theta$$

$$2680 - 4.2\theta = 1680 + 21\theta \Rightarrow 25.2\theta = 1000 \Rightarrow \theta = 39.7$$

21.

m_1

m_2 θ_1

θ_2 m_3

$L =$

$\dfrac{(m_1 s_c + m_w s_w)(\theta_1 - \theta_2)}{m_i} - s_w \theta_2$ $L \times 1$

$L = Pt/m$

22. $Pt = 1000 \times 5 \times 60 = 300\,000$

C $300\,000 = (1 \times 4200 + C) \times 60$ $4200 + C = 5000$ $C =$

23. $ms\Delta\theta = 0.40 \times \frac{1}{2}mv^2 \quad \Rightarrow \quad \Delta\theta = \dfrac{0.40 \times 0.5 \times 500^2}{126} = \dfrac{50\,000}{126} =$

24. $Q = 7.4 \times 10^{-3}$

$\dfrac{\Delta\theta}{t} = \dfrac{P}{ms} = \dfrac{7.4 \times 10^{-3}}{23 \times 10^{-6} \times 705} =$

25.

$$0.120 \times 910 \times (\theta - 20.0) = 0.300 \times 4200 \times (70.0 - \theta)$$
$$109.2\theta - 2184 = 88\,200 - 1260\theta$$
$$1369.2\theta = 90\,384 \Rightarrow \theta =$$