Q 3.1

$M = 1400$ kg

$v = 80$ km/hr $= 80 \cdot \frac{(10^3)}{(60)(60)}$ (m/s)

The energy at the initial is,

$$E_i = K = \frac{1}{2} M v^2 = \frac{1}{2}(1400)\left(80 \cdot \frac{10^3}{60(60)}\right)^2 \text{ (J)}$$

$$= 345,679 \text{ (J)}$$

When it stops, $K = 0$, by energy principle (conservation)

$$\Delta E = W + Q = 0$$

$$\Delta K$$

$$Q = -\Delta K = 345,679 \text{ (J)}$$

Since $Q = mc\Delta T$,

$$\Delta T = \frac{Q}{mc} = \frac{(345,679 \text{ J})}{m\ (0.47 \text{ J/g°C})} \lesssim 120\ ^\circ\text{C}$$

Thus, $m \geq \dfrac{(345,679\ J)}{(20°C)(0.47\ J/g·°C)} = 6129\ (g)$.

Answer:

m should be at least 6.129 kg

Q 3.2.

system. (no W_{ext}). By the energy principle,

$$\Delta E = W + Q$$

(0) (0)

$Q = Q_1$ (unknown) + Q_2 (copper) + Q_3 (water) = 0.

Thus,

	m	c	ΔT	Q
water	300 (g)	4.2 (J/g°C)	54-80 = -26°C	-32760 (J)
copper	25 (g)	0.385 (J/g°C)	54-15 = 39°C	375 (J)
unknown	100 (g)	X	~~54~~-25 = 29°C	2900 X (J)

Therefore, $2900X = 32385\ (J)$, $X = 11.17\ J/g·°C$

Answer: 11.17 $\left(J/g·°C\right)$