Question Number	Answer		Mark
20(a)(i)	Use of appropriate equation of motion $t = 2.9$ (s) <u>Example of calculation</u> $s = ut + \frac{1}{2}at^2$ $\therefore -41.5\text{ m} = 0.5 \times (-9.81\text{ m s}^{-2})\, t^2$ $t = \sqrt{\frac{-41.5\text{ m}}{-0.5 \times 9.81\text{ m s}^{-2}}} = 2.91\text{ s}$	(1) (1)	2
20(a)(ii)	Use of $V = \frac{4}{3}\pi r^3$ Use of $\rho = \frac{m}{V}$ Use of $\Delta E = mc\Delta\theta$ Use of $\Delta E = L\Delta m$ Use of $P = \frac{\Delta W}{\Delta t}$ $P = 1.6$ W (allow ecf from (a)(i)) <u>Example of calculation</u> $V = \frac{4}{3}\pi(1.2 \times 10^{-3}\text{ m})^3 = 7.24 \times 10^{-9}\text{ m}^3$ $m = 7.24 \times 10^{-9}\text{ m}^3 \times 1.13 \times 10^4\text{ kg m}^3 = 8.18 \times 10^{-5}\text{ kg}$ $E = 8.18 \times 10^{-5}\text{ kg} \times 130\text{ J kg}^{-1}\text{ K}^{-1} \times (615\text{ K} - 370\text{ K}) = 2.61\text{ J}$ $E = 8.18 \times 10^{-5}\text{ kg} \times 2.47 \times 10^4\text{ J kg}^{-1} = 2.02\text{ J}$ $P = \frac{(2.61\text{ J} + 2.02\text{ J})}{2.9\text{ s}} = 1.60\text{ W}$	(1) (1) (1) (1) (1) (1)	6
20(b)(i)	Change in gravitational potential energy of the lead shot and change in internal energy are both proportional to the mass of lead shot **Or** E_k $(= \frac{1}{2}mv^2)$ and $\Delta E = mc\Delta\theta$ both include the same mass **Or** E_{grav} $(= mg\Delta h)$ and $\Delta E = mc\Delta\theta$ both include the same mass So, mass cancels and $\Delta\theta$ is independent of the mass (if no energy is transferred to the surroundings) (dependent upon MP1)	(1) (1)	2
20(b)(ii)	Not all the energy will be used to increase the temperature of the lead shot **Or** some energy will be transferred to the surroundings **Or** not all the lead shot will fall through a distance d The method will not be accurate, as it will give a value of c that is too large **Or** The method will not be accurate as the (measured) temperature change will be too small	(1) (1)	2
	Total for question 20		**12**