

|           |                                                                                                                 |
|-----------|-----------------------------------------------------------------------------------------------------------------|
| 2(a)      | change in velocity per unit time <b>OR</b> rate of change of velocity <b>OR</b> ( $a =$ ) $\Delta v / \Delta t$ |
| 2(b)(i)   | 12 s                                                                                                            |
|           | $(\Delta t =) \Delta v / a$ <b>OR</b> 13 / 1.1                                                                  |
| 2(b)(ii)  | 570 000 N                                                                                                       |
|           | $F = ma$ <b>OR</b> ( $F =$ ) $ma$ <b>OR</b> ( $F =$ ) $520\,000 \times 1.1$                                     |
| 2(b)(iii) | (additional force is needed to overcome) friction <b>OR</b> air resistance <b>OR</b> drag                       |

### Multiple Choice Answers

Q2: B

Q6: D

|          |                                                                                                                       |
|----------|-----------------------------------------------------------------------------------------------------------------------|
| 1(a)     | constant speed                                                                                                        |
|          | constant / uniform deceleration                                                                                       |
|          | stationary                                                                                                            |
| 1(b)(i)  | $7.1 \times 10^5$ J <b>OR</b> 710 000 J <b>OR</b> 710 kJ                                                              |
|          | $E_k = \frac{1}{2}mv^2$ <b>OR</b> ( $E_k =$ ) $\frac{1}{2}mv^2$ <b>OR</b> $\frac{1}{2} \times 18\,000 \times (8.9)^2$ |
| 1(b)(ii) | 31 000 N <b>OR</b> 31 kN                                                                                              |
|          | $W = Fd$ <b>OR</b> ( $F =$ ) $W / d$ <b>OR</b> $710\,000 / 23$                                                        |
|          | $F = 710\,000 / 23$                                                                                                   |
| 2(a)     | (Impulse =) force $\times$ time (for which force acts)                                                                |
| 2(b)(i)  | $F\Delta t = \Delta\{mv\}$ <b>OR</b> ( $F =$ ) $\Delta\{mv\} / \Delta t$ <b>OR</b> ( $F =$ ) $\Delta p / t$           |
|          | $\{2800 \times 1400\} (/ 1) = 3\,920\,000$ N <b>OR</b> $\{2800 \times 1400\} (/ 1) = 3920$ kN                         |
| 2(b)(ii) | $4.0 \times 10^5$ kg <b>OR</b> 400 000 kg                                                                             |
|          | (at maximum mass) force = weight of rocket <b>OR</b> $F = mg$                                                         |
|          | ( $m =$ ) $F / g$ <b>OR</b> $3.9 \times 10^6 / 9.8$ <b>OR</b> $4(.0) \times 10^N$ (kg)                                |