Mark scheme for Newton's laws Foundation tier

Separate Physics 2023 Q9

(a)			Substitution: $m = \frac{10\,000}{10}$ (1) = 1 000 [kg] (1)
(b)	(i)		5 000 – 2 000 (1) = 3 000 [N] (1)
	(ii)		Substitution: $\frac{3\,000 \text{ ecf}}{1000 \text{ ecf}}$ (1) = 3 (1) m/s^2 (1)
	(iii)	I	Resultant force decreases (1) because {air resistance / drag / friction / resistive forces} increases (1)
		II	Decreases
(c)	(i)		{Energy losses / energy transfers / work done / heat losses} due to {air resistance / drag / friction / resistive forces} Accept no energy had been lost due to friction [at the top of the hill]
	(ii)		Substitution: $\frac{72\,000}{15}$ (1) = 4 800 [N] (1)
			Question 9 total

Separate Physics 2022 Q5 – part

(a)	(i)		X - weight (1) accept force of gravity **or** gravitational Y – air resistance (1) accept drag
	(ii)		X – stays the same (1) Y – increases (1)
(b)	(i)		Smaller than
	(ii)		Equal to

(a)	(i)		The 3 readings are similar / the 3 readings are repeatable
	(ii)		$\frac{2.82}{3} = 0.94$ (1)
(b)	(i)		**Ticks in boxes 2, 4 and 6** • Cake case 1 and 2 have identical weight (1) • At terminal speed, both cake cases experience identical values of air resistance (1) • At terminal speed, both cake cases have zero acceleration (1)
	(ii)		Terminal speed of CK1 is 1.6 and when doubled is 3.2 m/s (1) which isn't the same as 2.3 m/s for CK2 (1) [so prediction incorrect.] **Alternative:** Terminal speed of CK2 is 2.3 m/s and when halved is 1.15 m/s (1) which isn't the same as 1.6 m/s for CK1 (1) [so prediction incorrect.] **Alternative:** It is not doubled (1) It increases by 0.7 m/s (1) [so prediction incorrect.]
(c)			**Ticks in boxes 2, 4 and 6** • The terminal speed after the parachute is opened is $\frac{1}{10}$th of the terminal speed before the parachute is opened (1) • The parachute is opened 30 s after the skydiver leaves the helicopter (1) • At point **A** the skydiver stops accelerating (1)
			Question 11 total

(a)			Air resistance and weight (1) Don't accept gravity or mass are equal and opposite / balanced / resultant force is zero (1)
(b)	(i)		0.72
	(ii)		Mean time = $\frac{8.42}{7}$ (1) = 1.2[0 s] (1) award 1 mark for an answer of 1.14 arising from including anomaly
	(iii)		Speed = $\frac{1.5}{1.2}$ (**ecf**) = 1.25 [m/s] accept 1.3 [m/s] [1.32 m/s if mean given as 1.14]
(c)	(i)		Mass / weight / number [of cake cases] Don't accept amount of cake cases
	(ii)		Size (or mass or type) of <u>cake case</u> / <u>drop</u> height Accept same cake case
	(iii)		Time over a greater distance (1) to reduce effect of random errors (1) **OR** Use light gates and data logger / record with [slow motion] camera (1) Don't accept lasers or computers to reduce uncertainties in the measurements / reduce human errors (1) **OR** Weigh a larger number of cake cases / each cake case (1) to reduce uncertainties in the mass (1)

(d)			When mass is 0.5 g speed = 1.125 accept 1.1 or 1.15 [m/s] (1) When mass is 1.0 g speed = 1.65 accept 1.55 [m/s] (1) **OR** When mass is 1.0 g speed = 1.65 accept 1.55 [m/s] (1) When mass is 2.0 g speed = 2.25 accept 2.35 [m/s] (1) **For the 3rd mark:** Calculate a ratio correctly and make a conclusion
			Question 8 total

(a)			5 points plotted correctly to within <1 small square division (2) 4 correct (1) 3 or less (0) Straight line drawn [within the range of points] with a ruler through the points <1 small square division from plotted points, avoiding the anomalous point (1)
(b)	(i)		Reading taken from candidate's graph (eg. 5.0 [N]) [<1 small square tolerance]
	(ii)		Use of a pair of complementary values, e.g. m = 5.0 **ecf** from graph ÷ 2.0 (1) [<1 small square tolerance] = 2.5 [kg] (1) NB. Use of (4.0 N, 2.6 m/s^2) only credited for either mark if the candidate's graph passes through the point.
	(iii)		Straight(ish) line with smaller positive gradient (by eye) drawn always below the original one. NB does not need to pass through the origin but cannot meet the existing graph [except at the origin].

(c)			Possible answers: 2 × 3.2 [m/s^2] = 6.4 [m/s^2] (1) ≠ 5.6 [m/s^2] so suggestion not correct (1) 16 [N]/ 5.6 [m/s^2] = 2.9 [kg] (1) ≠ 2.5 [kg] **ecf** from (b)(ii), so suggestion not correct 16 [N] / 2.5 [kg] (ecf from (b)(ii)) = 6.4 [m/s^2] (1) ≠ 5.6 [m/s^2] so suggestion not correct **Alternative:** Adding accelerations from forces adding up to 16 N, e.g. 4.8 + 0.8 + 0.8 = 6.4 (1) ≠ 5.6 [m/s^2] so suggestion not correct (1) NB. Use of (4.0 N, 2.6 m/s^2) not penalised in this part, e.g. from 12 N + 4 N 4.8 [m/s^2] + 2.6 [m/s^2] = 7.4 [m/s^2] (1) ≠ 5.6 [m/s^2] so suggestion not correct. (1) **Alternative:** Showing clearly that a different force, i.e. 14 N **ecf**, gives an acceleration of 5.6 m/s^2 (1) ≠ 16 [N] so suggestion not correct (1)
			Question 4 total

(a)	(i) (ii) (iii)		Number of cake cases (1) Time of fall (1) Speed up (1)
(b)	(i)		0.75 [s] circled
	(ii)		Sum = 0.55 + 0.56 + 0.55 + 0.58 = 2.24 (1) Mean = $\frac{2.24}{4}$ = 0.56 [s] (1) Accept 0.6 s where this calculation is shown **Award only 1 mark** for the mean if 0.75 is included (mean = 0.60 [s]) **Award only 1 mark** if no workings are shown and answer of 0.6 [s] or 0.598 [s] Don't accept 0.59 [s] **Alternative:** $\frac{1.50}{2.7}$ (1) = 0.56 [s] (1) accept 0.555 [s] or 0.6 [s] Award 1 mark for $\frac{150}{2.7}$ = 55.5 or 56

(c)	(i)		All points plotted correctly < 1 small square tolerance award 2 marks (ignore (0,0)) 4 points plotted correctly < 1 small square tolerance award 1 mark 3 or fewer points plotted correctly < 1 small square tolerance award 0 marks Smooth curve passing through the points between 1-5 on the number of cake cases < 1 small square tolerance (1)
	(ii)		Increases (1) Decreasing (1)
			Question 1 total