Question		Answer	Notes	Marks
1 (a) (i)		Momentum = mass x velocity	Allow abbreviations and rearrangements e.g. p=m mass = $\frac{\text{momentum}}{\text{velocity}}$	1
(ii)		Substitution into correct equation; Calculation; e.g. 17 000 x 13 220 000 (kg m/s)	Allow 221 000	2
(b) (i)		Answers should be in the context of momentum (when the lorry stops) the load still has momentum; Idea that lorry stops in a shorter time; OR Idea that load takes more time to stop;	Allow: (mv-mu) = Ft Allow for TWO marks lorry loses momentum more quickly;; OR load loses momentum more slowly;;	2
(ii)		MP1 Centre of gravity is closer to the front of the lorry; MP2 Clockwise and anticlockwise moments equal; MP3 Increase in force related to decrease in distance (to provide balancing moment);	Ignore action and reaction arguments Allow: centre of mass nearer front of lorry there is more weight near the front of the lorry / near B C of G further from rear (wheel) Allow: • Moments are balanced • total moment = 0	3
(c) (i)1		Pressure = $\frac{\text{force}}{\text{area}}$;	Allow abbreviations and rearrangements, e.g. P=F/A, force = pressure x area	1
(ii)		Substitution into correctly rearranged formula; Calculation; e.g. 53 000 ÷ 390 000 0.14 (m^2)	0.136 0.135897 Allow 1400 cm^2	2

Total for question 1 = 11 marks

Question number	Answer	Notes	Marks
2 (a) (i)	Momentum = mxv;	in words or in recognisable symbols	1
(ii)	Substitution into correct equation; Evaluation; consistent unit; E. Momentum = 0.1 x 3 Solution 0.3 kg m/s	Allow: use of g (→300) but unit *must* match allow: • kg m s^{-1} • N s	3
(iii)	Momentum is conserved	ignore: • because it has the same mass and velocity any discussion of energy	1
(b)	prediction: Two balls at the opposite end of the cradle move up/away; (balls D and E rise up) any one sensible reason: • **idea** that momentum is still conserved in this collision • total momentum of the system is constant • there is twice the momentum of one ball so the momentum is transferred to two balls;	Allow: E moves off with 2v ignore • 'the other balls remain still' • inela tic (collisions) • mention of energy	2
		Total	**7**

Question number	Answer	Accept	Reject	Marks
3 (a) (i)	momentum = mass x velocity;			1
(ii)	Substitution into correct equation; Calculation; e.g. momentum = 0.15 x 6 = 0.9;; Unit: kg m/s;	kg ms^{-1} Ns		3
(iii)	0.9 = (0.15 + 0.05) x v; v = 0.9 ÷ 0.2 = 4.5 (m/s);	Ecf from 8(a) (ii) (i.e. answer for 8aii ÷ 0.2 or answer for 8aii x 5)		2
(b)	The student is wrong; Because variables are not controlled; e.g. mass of cloth different, mass of (other) tins different, cloth velocity not measured	Student is right if the mass of the second cloth is 0.3 kg;; Student is right if the momentum of the second cloth is 1.8 kg m/s;; (assuming all tins are 0.05 kg/ throws new cloth with exactly the same velocity)		2

Total 8 marks

Question number	Answer	Notes	Marks
4	any four from - MP1 momentum reduced; MP2 by same amount; MP3 over longer time; MP4 so force reduced; MP5 use of "force = rate of change of momentum"; MP6 less force means less damage/injuries;	Responses should be in the context of momentum ignore "momentum absorbed" ignore "impact reduced" simple mention of eqn is insufficient	max 4

Total 4 marks

Question number			Answer	Accept	Reject	Marks
5	(a)		Area under the graph (from 0 s to 3 s) ;	6 x 3 or 18 (m); area shaded on graph		1
	(b)	(i)	Momentum = mass x velocity;	*p*= *m x v* ; accept rearrangements		1
		(ii)	Substitution in correct equation; Calculation; e.g. 6.4 x 6 = 38.4 kg m/s ;	Ns;		3

Question number			Answer	ACCEPT	Reject	Marks
5	(c)	(i)	4.8 (m/s) ;			1
		(ii)	Idea that momentum is conserved; Substitution; Calculation; e. $p_1 = p_2$ / $m_1 \times v_1 = (m_1 + m_2) \times v_2$ $6.4 \times 6 = (6.4 + m_2) \times 4.8$ $m_2 = (38.4 \div 4.8) - 6.4 = 8 - 6.4$ $= 1.6$ (kg)	Allow e.c.f. from incorrect momentum calculation in (b)(ii) and /or incorrect velocity reading e.g Idea of conservation of momentum; $m_2 = [(b)(ii) \div (c)(i)] - 6.4$; correct evaluation of this; e.g. 5 m/s → 1.28 kg Allow for one mark - A calculation that only leads to total mass e.g. = 8 k		3
					Total	**9**

Question number	Answer	Notes	Marks
6 (a)	something to measure length; e.g. (metre) rule(r), tape measure, trundle/click wheel, pedometer, step counter	If more than two responses given, each incorrect response negates a correct response Ignore ticker-tape, ticker-timer, video	1
	something to measure time; e.g. stopwatch, stopclock, timer		1
(b)	Correct plotting (ignoring 0,0); Line joins (10,14) to origin; Smooth curve (by eye) to right of (10,14)	 Allow ecf on plotting Ignore any kink at (10,14)	3
(c)	26 (m)	Ecf from graph in (b) Allow ± 0.5 (half a small square)	1
(d) (i)	slowed down	Reject: accelerates <u>and</u> slows down	1
(ii)	graph becomes less steep / levels off	Allow description based on figures from graph	1