Question number			Answer	Accept	Reject	Marks
1	a)	(i)	Substitution; Calculation; e.g. m x g = 0.454 x 10 = 4.54 (N)			2
		(ii)	Centre of gravity;	Centre of mass;		1
	(b)	(i)	force upwards; from top of nail;	Near vertical by eye In line with F_2		2
		(ii)	Any two from: increase F_1 OR increase force (from hand); Increase d_1 OR increase distance of hand from pivot; Keep F_1 perpendicular to hammer;	use two hands use longer handle use longer hammer Ignore: references to d_2 distance from nail to pivot idea of bigger [rather than longer] hammer		2
					Total	**7**

Question number			Answer	Notes	Marks
2	(a)		A method involving a suitable measurement or comparison; An appropriate check for horizontality; e.g measure height between ruler and bench in several places; height readings consistent; OR set a marker level with pivot; same height as end of ruler; OR place spirit level on ruler; bubble should be central; OR measure angle between stand and ruler; check for right angle	Allow assumption that bench is horizontal and /or stand is vertical Allow alternative methods and checks that would work	2
	(b)	(i)	moment = force x (perpendicular) distance (from pivot)	or equivalent	1
		(ii)	2 x 60 / 2 x 0.6; 120 / 1.2; N cm / N m;		3
	(c)	(i)	mass / weight of ruler; weight acts downwards /increases (clockwise) moment;	 Allow: idea that forcemeter also supports ruler	2
		(ii)	off scale on the forcemeter		1

Question number	Answer	Notes	Marks
2 (d	Explanation including: clockwise and anticlockwise moments equal; (and fish are) closer to A; <u>so</u> to get same moment for smaller distance (force must be larger);	Accept similar points made using mathematical symbols e. taking moments – $F_A x = F_B y$ reworking – $F_A = (y/x)F_B$ $y > x$ (so $F_A > F_B$) i.e idea that force and distance are inversely proportional	3

Question number	Answer	Notes	Marks
3 (a) (i)	$p = m \times v$	accept answer in words, standard symbols or rearranged	1
(ii)	statement of conservation of momentum; calculation of momentum before seen; use of correct mass for momentum after; evaluation of velocity; e.g. $m_1v_1 = m_2v_2$ 43.2 x 4.10 OR 177(.12) seen (m_2=) 45.7 (v=) 3.88 (m/s)	 allow in words 3.9, 3.876	4
(b)	MP1. boy and skateboard move backwards/in opposite direction to the ball; Either MP2. because of conservation of momentum/eq; MP3. because of Newton's 3rd law/eq;	 total marks = 7	2

Question number	Answer	Notes	Marks
4 (a) (i)	lever arm / bolt moves to the left;		1
(ii)	to return the metal bar (and lever) to the right/eq	allow pulls it back (again)	1
(b) (i)	$F_1d_1 = F_2d_2$;	accept answer in words, standard symbols or rearranged clockwise (moments) = anticlockwise (moments	1
(ii)	substitution; rearrangement; evaluation; e.g. $110 \times 22 = 38 \times F_2$ $F_2 = \frac{110 \times 22}{38}$ 63.7 (N)	rearrangement and substitution in either order 63.684 (N) -1 for incorrect rounding	3
(iii)	any two from MP1 (since distance to A greater) moment is greater; MP2 distance to B is constant / still 110 cm; MP3 (hence) force will increase;	allow correct re-calculation with d_B	2
		total marks = 8	

Question number	Answer	Notes	Marks
5 (a) (i)	Work done = force x distance moved;	Allow W = F x d and rearrangements	1
(ii)	Substitution into correct equation; Calculation; e.g. 13 x 110 1430 (J)	Correct answer without working scores 2 marks	2
(iii)	Same response as for 3(a)(ii)	1430 (J) or ecf	1
(b)	Any two of - MP1 Idea that GPE depends on height OR Statement that GPE = mgh; MP2 Idea that h is reduced; MP3 Idea that centre of gravity (is now) lower;	 Allow centre of mass for centre of gravity	2
(c) (i)	Moment = force x (perpendicular) distance (from the pivot);	Allow moment = F x d and rearrangements	1
(ii)	Calculate given moment; Equate moments; Calculation; e.g. (150 x 0.32) = 48 for one mark 150 x 0.32 = F x 0.87 for two marks F (= 150 x 0.32 / 0.87) = 55 (N) for three marks	If no other mark gained, allow a statement that "clockwise moment = anticlockwise moment" for one mark 55.172 (N)	3

Total 10 marks