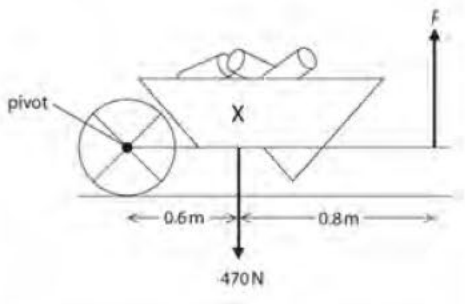
Question number	Answer	Notes	Marks
1 (a) (i)	work done = force × distance (moved);	Accept correct symbols e.g. W = F x d W = F x s	1
(ii)	substitution; evaluation; e.g. (work =) 140 × 39 5500 (J)	 5460	2
(iii)	same answer as 5(a)(ii)	allow 'the same'	1
(b) (i)	X in line with the weight arrow and vertically between the tail of the arrow and the top of the wheelbarrow (not including the logs);  	judge alignment with weight arrow by eye	1
(ii)	moment = force × (perpendicular) distance (from pivot);	condone M = F x d M = F x s	1
(iii)	principle of moments (stated or implied); total distance hand to pivot calculated; substitution showing either correct moment (or both); final rearrangement and evaluation; e.g. (total) clockwise (moment) = (total) anticlockwise (moment) (distance) = 0.6 + 0.8 = 1.4 m 470 × 0.6 = F × 1.4 F = 470 × 0.6 / 1.4 = 200 (N)	 accept 1.4 or 0.6 + 0.8 seen in working accept 282 seen in working allow 201, 201.43 350, 352, 353, 352.5 gets 2 marks	4

Total 10 marks

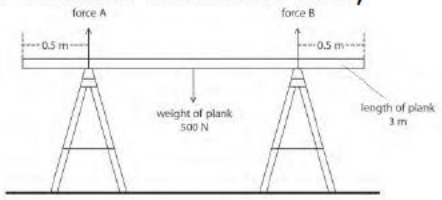
Question number	Answer	Notes	Marks
2 (a) (i)	momentum = mass x velocity;	w rds or correct symbols p = m x v reject M for momentum	1
(ii)	substitution; evaluation; e.g. (p =) 0.50 x 3.1 (p =) 1.6 (kg m/s)	ignore - signs allow 1.55 1 mark max for 1.5	2
(iii)	substitution into correct equation; evaluation; e.g. F = 1.55(- 0) ÷ 0.070 (F =) 22 (N)	no mark for equation as given in paper allow ECF from (ii) ignore - signs allow F in range 22-23 (N) inclusive allow method using F=ma.	2
(b)	any two of: MP1. (forces) equal; MP2. (forces) opposite OR up <u>and</u> down; MP3. mention of Newton's <u>third</u> law;	ignore references to balanced forces 'every action has an equal and opposite reaction' scores 2 marks	2
(c)	any two of: MP1. pressure is force / area; MP2. forces (on wood and hammer) are equal; MP3. smaller area of nail is in contact with wood / ORA;	 allow pressure is inversely proportional to area award if clear which end of the nail has the smaller area	2

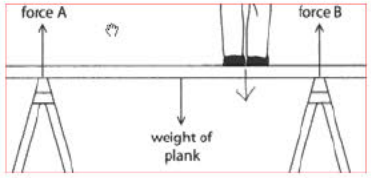
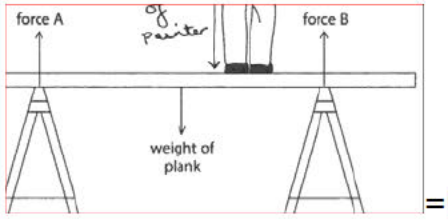
Total 9 marks

Question number	Answer	Notes	Marks
3 (a)	A - Force X 7.5 N, Force Y 7.5 N ;		1
(b)	idea that force X decreases; from 15 (N) / to 0 (N);	ignore references to force Y and moments 'it goes from 15 to 0' gets 2 marks	2

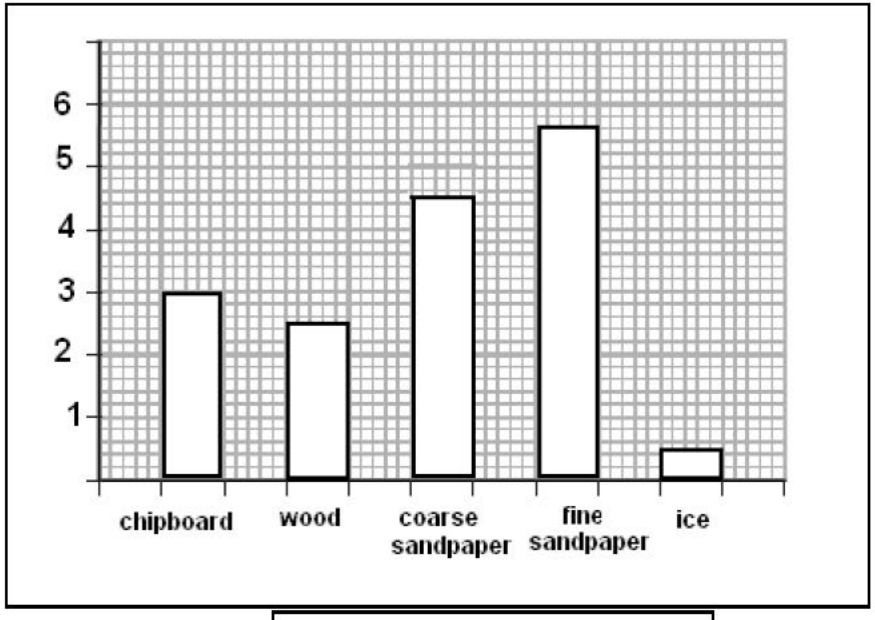
Total 3 marks

Question number			Answer	Notes	Marks
4	a	i	moment = force x (perpendicular) distance (from pivot)	in words or accepted symbols	1
		ii	MP1. calc of 1 correct moment (about the pivot); MP2. stated equivalence of clockwise moment= anticlockwise moment /principle of moments; MP3. final value; e.g. 2 x 60 =120 (one mark) 2 x 60= 10 x F_N (two marks) $F_N = \frac{2 \times 60}{10}$ =12 (N) (three marks)	in words or in numbers allow working in cm or m	3
	b		MP1. Increases (force on newtonmeter); MP2. (because) weight of bar has a moment; MP3. in same direction (clockwise) as 2 N weight;	may be shown by a calculation allow F_N = 62(N) for three marks	3
				total = 7 marks	

Question number	Answer	Notes	Marks
5 (a)	B		1
(b) (i)	#1. states principle of moments ; #2. moment= force X (perpendicular) distance from pivot: #3. calculates **one** moment about either A or B; #4. takes moments at B;  e. moments clockwise = moments anticlockwise • moment = weight x distance • 500 x 1 • 1 x 500 = Ax2	Ignore bald '500/2 =250' Accept for #2: in words or in recognisable symbols or in numbers from the diagram Accept qualitative alternative for last 2 marking points: '2 forces so divide weight in half' OWTTE = 1 mark if then qualified by distance consideration = 2 marks	4
(ii)	Upward Force at point B 250(N);	allow arrow for clockwise or anticlockwise	1

Question number	Answer	Notes	Marks
(c) i	Arrow down from painter; (vertical, below feet)	  =0	1
ii	Both **forces** increase; Force at B larger than force at A / RA ;	ignore: • both moments increase • 'force B is larger'	2
		Total	**9**

Question number	Answer	Notes	Marks
6 (a) i	Any ONE sensible suggestion from ensuring good contact; increasing friction; increasing pressure;	allow: • to prevent slipping sideways • make it easier to control	1
ii	Keep a fair test / controlled variable;	allow: it not an independent variable ignore: all mention of accuracy	1

Question number	Answer	Notes	Marks
6 (b) (i)	(Type of) surface(s);	do not accept: • a (single) named surface • type of block • material of block	1
(ii)	4.5;		1
(iii)	**Axes labelled**- quantity and unit; **Linear scale** such that longest bar occupies at least half the grid; **Plotting---ignore order of bars** 5 bars correctly plotted;; If only 3 bars correctly plotted allow 1 mark for plotting  	allow force (N) force/N tolerance is +/- 0.5 small sq allow ecf from table ALL data plotted correctly as floating "x's" gets only one mark for plotting Reject both **plotting** marks if a **line** graph is drawn (only scale and axes marks are available in this case) Type of surface / Average chipboard 3.0 wood 2.5 coarse sandpaper 4.5 fine sandpaper 5.7 ice 0.5	4

Question number	Answer	Notes	Marks
6 (c)	Any two of the following five ideas: #1 different experimental set-up; e. • different masses/weights • different kind of wooden block • different speed of pull #2 variable friction; e. • the surfaces were not uniformly smooth • the wooden block did not move evenly across the surface #3 errors in the force meter reading; e. • errors recording the force on the N-meter • faulty scale on N-meter • zero errors / different ranges of N-meters used • different angle of N-meter #4 different contact; e. • the weights on the block may not have been evenly placed on the block • the block was not pressed down onto the surface evenly #5 friction reduces as the experiment progresses; e. • the wooden block becomes smoother as the experiment proceeds • it moves over the surface more easily as the experiment progresses • lubricant on block	Ignore: • unqualified 'broken N-meter' • human error • 'strength of pull' • anomalous results • surface area of surface	2

Question number	Answer	Notes	Marks
6 (d)	Any two from: Pressure less; Area larger; Use of formula P =F/A;	Load is the same/wood is thinner	2
(e)	Any TWO sensible suggestions;; e. place a lubricant between the two surfaces make the surfaces smoother decrease weights /masses on block	allow: • named lubricants • change the surfaces so that are not so rough • reduce the area (of contact) • decre se mass of block	2
		Total	**14**