

Question number	Answer	Notes	Marks
1 (a) (i)	work done = force \times distance (moved);	Accept correct symbols e.g. $W = F \times d$ $W = F \times s$	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 \times (perpendicular) distance (from pivot);	condone $M = F \times d$ $M = F \times s$	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 $470 \times 0.6 = F \times 1.4$ $F = 470 \times 0.6 / 1.4 = 200$ (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

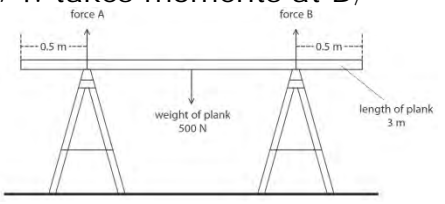
Question number	Answer	Notes	Marks
2 (a) (i)	momentum = mass x velocity;	w rds or correct symbols $p = m \times v$ reject M for momentum	1
(ii)	substitution; evaluation; e.g. (p =) 0.50 x 3.1 (p =) 1.6 (kg m/s)	ignore - signs allow 1.55 1 mark max for 1.5	2
(iii)	substitution into correct equation; evaluation; e.g. $F = 1.55(- 0) \div 0.070$ (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

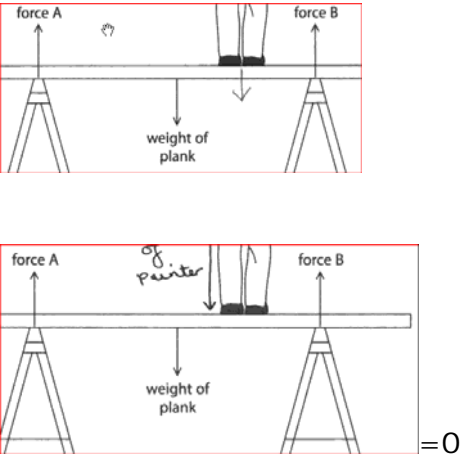
Total 9 marks

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

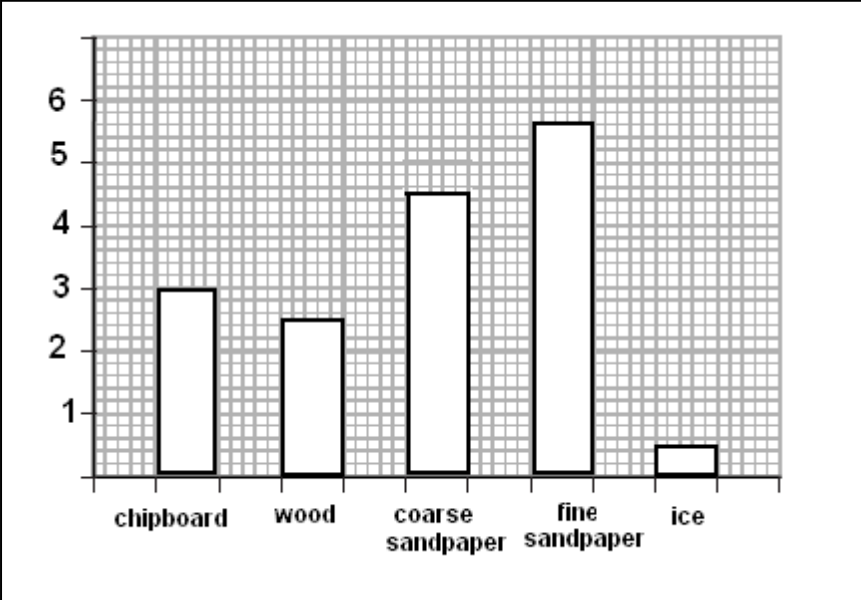
Total 3 marks

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. $2 \times 60 = 120$ (one mark) $2 \times 60 = 10 \times F_N$ (two marks) $F_N = \frac{2 \times 60}{10}$ $= 12 \text{ (N)}$ (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 $F_N = 62 \text{ (N)}$ for three marks	3
				total = 7 marks	

Question number	Answer	Notes	Marks
5 (a)	B		1
(b) (i)	<p>#1. states principle of moments ;</p> <p>#2. moment= force X (perpendicular) distance from pivot:</p> <p>#3. calculates one moment about either A or B;</p> <p>#4. takes moments at B;</p>  <p>e.</p> <p>moments clockwise = moments anticlockwise</p> <ul style="list-style-type: none"> • moment = weight x distance • 500×1 • $1 \times 500 = Ax2$ 	<p>Ignore bald '500/2 =250'</p> <p>Accept for #2: in words or in recognisable symbols or in numbers from the diagram</p> <p>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</p>	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)	 <p>The diagram shows a horizontal plank supported by two sawhorses. Upward arrows from the sawhorses are labeled 'force A' and 'force B'. A downward arrow from the center of the plank is labeled 'weight of plank'. A second diagram below it shows the same setup but with a downward arrow from the painter's feet labeled 'of painter'. To the right of the second diagram is the text '=0'.</p>	1
ii	Both forces increase; Force at B larger than force at A / R_A ;	<p>ignore:</p> <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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)	<p>Axes labelled- quantity and unit;</p> <p>Linear scale such that longest bar occupies at least half the grid;</p> <p>Plotting---ignore order of bars 5 bars correctly plotted;; If only 3 bars correctly plotted allow 1 mark for plotting</p> <div data-bbox="100 784 256 917" style="border: 1px solid black; padding: 5px; width: fit-content;">(Average) force in N</div>  <div data-bbox="598 1298 1033 1351" style="border: 1px solid black; padding: 5px; width: fit-content;">(Type of) Surface</div> <table border="1" data-bbox="1470 987 1906 1304" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Type of surface</th> <th>Average</th> </tr> </thead> <tbody> <tr> <td>chipboard</td> <td>3.0</td> </tr> <tr> <td>wood</td> <td>2.5</td> </tr> <tr> <td>coarse sandpaper</td> <td>4.5</td> </tr> <tr> <td>fine sandpaper</td> <td>5.7</td> </tr> <tr> <td>ice</td> <td>0.5</td> </tr> </tbody> </table>	Type of surface	Average	chipboard	3.0	wood	2.5	coarse sandpaper	4.5	fine sandpaper	5.7	ice	0.5	<p>allow force (N) force/N</p> <p>tolerance is +/- 0.5 small sq</p> <p>allow ecf from table</p> <p>ALL data plotted correctly as floating "x's" gets only one mark for plotting</p> <p>Reject both plotting marks if a line graph is drawn (only scale and axes marks are available in this case)</p>	4
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6 (c)	<p>Any two of the following five ideas:</p> <p>#1 different experimental set-up; e.</p> <ul style="list-style-type: none"> • different masses/weights • different kind of wooden block • different speed of pull <p>#2 variable friction; e.</p> <ul style="list-style-type: none"> • the surfaces were not uniformly smooth • the wooden block did not move evenly across the surface <p>#3 errors in the force meter reading; e.</p> <ul style="list-style-type: none"> • 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 <p>#4 different contact; e.</p> <ul style="list-style-type: none"> • the weights on the block may not have been evenly placed on the block • the block was not pressed down onto the surface evenly <p>#5 friction reduces as the experiment progresses; e.</p> <ul style="list-style-type: none"> • the wooden block becomes smoother as the experiment proceeds • it moves over the surface more easily as the experiment progresses • lubricant on block 	<p>Ignore:</p> <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • named lubricants • change the surfaces so that are not so rough • reduce the area (of contact) • decrease mass of block 	2
		Total	14