

Using physics to make things work

1. (a) point at which its mass (seems to) act **or** point at which gravity (seems to) act 1  
*accept ... its weight acts*  
*accept correct statements if the intent is clear e.g. ... if suspended, the centre of gravity will be directly under the point of suspension e.g.... (if the object is symmetrical), the centre of gravity is on the*  
**or** an axis (of symmetry)  
*do not credit just 'it is a point'*
- (b) The answer to this question requires good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.  
*Maximum of 4 marks if ideas not well expressed*  
 any **five** from: 5
- clamp (steel) rod (horizontally)  
*no marks if method quite unworkable*
  - hang plastic / sheet by rod through (one) hole
  - hang plumb line from rod
  - mark ends of plumb line on the sheet and use the ruler to draw a straight line
  - repeat with other hole
  - centre of mass is where the lines cross
  - check by balancing at this point  
*maximum of 3 marks if no 'repeat with other hole'*
- (c) (i) (turning) effect **or** moment 1  
 force  
 distance  
*all three correct; accept weight; accept length*
- (ii) 17.6 allow  $44 \times 0.4$  **or**  $0.4 \times 44$  for 1 mark 2  
 Nm **or** newton metre(s) 1  
*do not accept N/m or N/cm; 1760 Ncm gains all 3 marks*
- [10]**
2. (a) (i) **P** 1
- (ii) the child's grip / hold / pull (on the roundabout / bar / rail) 1  
*or 'the tension in the child's arms'*  
*accept 'the child's muscles'*  
*accept 'friction between the child and the roundabout'*  
*do not accept just 'friction'*
- (iii) increases 1  
*accept any unambiguous indication that this ending has been selected*
- (b) (i) 360 (Nm) 2  
*credit either  $240 \times 1 \frac{1}{2}$  or  $240 \times 1.5$  with 1 mark*
- (ii) move to(wards) the left / to(wards) the / his end 1  
*or move away from the centre / pivot / axis (of rotation)*  
*or move away from the girl / the child / his daughter*
- (c) (i) **C** 1
- (ii) friction / grip of the car / tyres / wheels (on the road) 1  
*do not accept just 'friction / grip'*
- [8]**

3.	(a)	any <b>two</b> from:	2	
		<ul style="list-style-type: none"> <li>• inversely proportional</li> <li>• as the load gets bigger the (maximum safe) distance gets less <i>allow 'as the mass increases the distance decreases'</i> <i>accept an unspecified response e.g. 'big load at a short distance' for (1)</i></li> <li>• load × distance = 60 (kNm)</li> </ul>		
	(b)	yes, because $30 \times 2 = 60$ (2) <i>accept for (1) a correct but insufficiently explained response</i> <i>e.g. 'yes because it's safe'</i> <i>accept for (2) a correct response which is sufficiently explained</i> <i>e.g. 'yes, because 60 (kNm) at 1 metre is safe and 30 (kNm) is half the load at twice the distance; do <b>not</b> accept 'no' and do not accept just 'yes'; do <b>not</b> accept 'yes, because 30 is between 24 and 40 and 2 is between 2.5 and 1.5'</i> <i>do <b>not</b> accept 'the crane/ cable may break' or other dangers</i>	2	
	(c)	the crane may/will topple over/fall <u>over/forward</u>	1	
	(d)	results of experiments on this mobile crane <i>accept any unambiguous indication</i>	1	
				<b>[6]</b>
4.	(a)	(i) direction <i>accept any unambiguous indication</i>	1	
		(ii) centripetal <i>accept any unambiguous indication</i>	1	
	(b)	<b>A</b> <i>accept any unambiguous indication</i>	1	
	(c)	mass of the passengers is greater <i>accept any unambiguous indication</i>	1	
				<b>[4]</b>
5.	(a)	(line of action of) its weight	1	
		falls inside its wheel base <i>accept 'falls between the wheels'</i> <i>the first <b>two</b> points may be credited by adding a vertical line from the centre of the X on the diagram (1)</i> <i>and labelling it weight / force / with a downwards arrow (1)</i> <i>provided there is no contradiction between what is added to the diagram and anything which may be written</i>	1	
		(so there is) no (resultant / clockwise) moment / turning effect	1	
	(b)	centre of mass should be lower <i>accept '... centre of gravity'</i> <i>accept 'weight / mass low down <b>not</b> just 'lower the roof'</i>	1	
		wheel base should be wider <i>accept 'long axle(s)' for 'wide wheel base'</i> <i>allow bigger / larger wheel base; do <b>not</b> credit '<u>long</u> wheel base'</i> <i>responses in either order</i>	1	
				<b>[5]</b>
6.	(a)	force	1	
	(b)	5 <i>allow 1 mark for correct equation - ie <math>pressure = \frac{force}{area}</math></i> <i>or <math>P = \frac{F}{A}</math>; allow 1 mark for correct substitution - ie <math>\frac{50}{10}</math></i>	3	
	(c)	the same as / equal to <i>accept =</i>	1	
				<b>[5]</b>