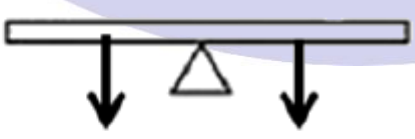
Q1.

Question Number	Answer	Mark
	The only correct answer is B: force Q **A is incorrect** because the moment of force P about the axle is zero. **C is incorrect** because moment of force R about the axle is zero. **D is incorrect** because moment of force S about the axle is zero.	**(1)**

Q2.

Question number	Answer	Additional guidance	Mark
	B arms provide an upward force and feet act as a pivot A and C are incorrect because the rotation is not around the hands. D is incorrect because the legs are not providing an upward force that causes rotation		**(1)** **AO3**

Q3.

Question number	Answer	Mark
	B  A,C and D are incorrect as the forces would cause the seesaw to turn	**(1)**

Q4.

Question number	Answer	Additional guidance	Mark
	(sum of) the clockwise moments = (sum of) the anticlockwise moments	moment of magnet = moment of modelling clay moments are equal (size)	**(1)** **AO1**

Q5.

Question number	Answer	Additional guidance	Mark
	substitution (1) (moment =) 4(.0) x 5(.0) (/100) evaluation (1) (moment =) 0.2(0) (Nm)	 2 to any incorrect power of ten scores 1 mark e.g. 20 or 2000 etc award full marks for the correct answer without working	**(2)** **AO2**

Q6.

Question number	Answer	Additional guidance	Mark
	substitution (1) (moment) = 200 x 3(.0) evaluation (1) 600 (Nm) unit (1) Nm	award full marks for correct answer without working independent mark ignore J / Joules	**(3)** **AO2**

Q7.

Question number	Answer	Additional guidance	Mark
i	substitution (1) (moment=) 0.40 × 70 evaluation (1) 28 Nm (1)	independent mark award full marks for the correct answer without working	**(3)**

Question number	Answer	Additional guidance	Mark
ii	an explanation linking the effort is at a bigger distance (1) from fulcrum (than the load) (1)	allow reverse argument for load (magnitudes of) moments are the same allow wheel/axle/pivot for fulcrum	**(2)**

Question number	Answer	Additional guidance	Mark
iii	(there will be more) friction (between the axle and wheel)	inside the bearing	**(1)**

Q8.

Question number	Answer	Additional guidance	Mark
(i)	substitution (1) 40 × 1.7 evaluation (1) 68 Nm (1)	 award full marks for correct answer without working independent mark do not accept J (joules)	(3)

Question number	Answer	Additional guidance	Mark
(ii)	 substitution (1) 68 = W × 1.3 rearrangement (1) $\frac{68}{1.3}$ evaluation (1) 52 (N)	award full marks for correct answer without working substitution and rearrangement in either order ecf moment from 4(c)(i) 52.3 (N)	(3)

Q9.

Question number	Answer	Additional guidance	Mark
(i)	substitution (1) moment of force = 150 x 1.8 evaluation (1) moment of force = 270 (N m)	 award full marks for the correct answer without working	**(2)** **AO2**

Question number	Answer	Additional guidance	Mark
(ii)	substitution (1) W x 0.95 = 270 rearrangement and evaluation (1) W =($\frac{270}{0.95}$)= 280 (N) any answer to 2 sf (1)	ecf from (i) any number that rounds to 280 (N) e.g. 284.2 (N) award 2 marks to here for the correct answer without working	**(3)** **AO2**

Q10.

Question number	Answer	Additional guidance	Mark
	any correct moment (1) 450 x 0.50 or 225 or 0.80 x F_2 substitution into prin. of moment equation (1) 450 x 0.50 = 0.80 x F_2 evaluation (1) 280 (N) (for question at end)	 allow 450 x 0.3 moment taken about B allow statement of prin. of moments accept numbers which round to 280 such as 281.25 award full marks for correct answer without working.	**(3)**

Q11.

Question number	Answer	Additional guidance	Mark
	rearrangement (1) force up = (force down × distance of force down from pivot)/distance of force up from pivot substitution into correct equation (1) $F = \frac{120 \times 1.3}{0.40}$ answer (1) 390 (N)	award full marks for correct numerical answer without working	**(3)**

Q12.

Question number	Answer	Additional guidance	Mark
(i)	substitution and rearrangement (1) (force = $\frac{\text{moment}}{\text{distance}}$) = $\frac{0.6}{3(\times 10^{-1})}$ evaluation (1) 2(.0) (N)	 reject 0.6 x 3 = 1.8 award full marks for the correct answer without working ignore significant figures 2(.0) to any other power of ten scores 1 mark maximum	**(2)** **AO2.1**

Question number	Answer	Additional guidance	Mark
(ii)	 correct calculation of one moment (1) correct calculation of second moment and adding of moments seen (1)	**show that** question either 2x0.1 or 1x0.5 seen 2(.0)x0.1(0) + 1(.0)x0.5 scores 2 marks 0.2+0.5 scores 2 marks accept calculations in alternative units (e.g. N cm) if correct conversion(s) seen if no other marks scored, the addition of two other moments can score 1 mark maximum	**(2)** **AO2.1**

Question number	Answer	Additional guidance	Mark
(iii)	explanation linking **three** from: **{sum** of / **total }** clockwise moments = **{sum** of / **total }** anticlockwise moments (1) for a system in equilibrium / balance (1) clockwise and anticlockwise moments compared (1) **so** rod not in equilibrium (1)	 about the same point / about a point e.g. clockwise moment > anticlockwise moment or reverse argument 0.7 > 0.6 0.7 ≠ 0.6 rod will **rotate clockwise** MP4 can only be scored if MP3 awarded	**(3)** **AO3.2**

Q13.

Question Number:	Answer	Additional Guidance	Mark
	recall clockwise moment = anticlockwise moment (1) moment = force x (perpendicular) distance (1) substitution (1) $m \times 17 = (6 \times 15) + (4.6 \times 10)$ rearrangement and evaluation (1) m = 8.0 (g)	calculations need not include *g* (which cancels out from all terms) substitution and rearrangement in either order $m \times 17 = 90+46$ $m = \frac{(6\times15)+(4.6\times10)}{17}$ $m = 136/17$ award full marks for correct answer without working	**(4)** AO 1 1 AO 2 1

Q14.

Question number	Answer	Additional guidance	Mark
(i)	calculation of both moments (1) moments are equal (size) and opposite direction (1)	4 x 92 and 16 x 23 seen comparison of both moments 368 (=) 368 **or** 4 x 92 = 16 x 23 **or** $16=\frac{4\times92}{23}$ **or** $4=\frac{16\times23}{92}$ accept calculations in Nm	**(2)** **AO1, AO2**

Question number	Answer	Additional guidance	Mark
(ii)	calculation of moment of ball (1) 480 (Ncm) calculation of total clockwise moment (1) 848 (Ncm) calculation of bicep force needed (1) 212 (N) **OR** calculation of moment of ball (1) 480 (Ncm) calculation of additional force from bicep (1) 120 (N) calculation of total bicep force (1) 212 (N)	 15 x 32 seen 368 + 480 seen 848/4 seen 15 x 32 seen 480/4 seen 120 + 92 seen award full marks for correct answer without working. accept conversion of cm to m throughout	**(3)** **AO2**

Q15.

Question Number	Answer	Additional guidance	Mark
(i)	recall of moment = force x distance (1) (moment of force from person =) 600 x 0.5 **and** (moment of weight of rock =) 1800 x 0.2 (1) **moment** of force from person is less than **moment** of weight of rock. (1)	may be implied in a calculation 300 (Nm) 360 (Nm) independent mark accept reverse argument	**(3)**

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that links increase distance between person and pivot/ reduce distance between rock and pivot / increase force from person (1) increase the moment of the force from the person / decrease the moment of the weight of the rock (1)	use longer lever / hold lever nearer the end / move pivot nearer to rock / get someone to help to push value of new distance and calculation of new moment	**(2)**

Q16.

Question Number:	Answer	Additional guidance	Mark
(i)	substitution(1) (moment) =650 x 0.75 evaluation(1) 490 unit (1) Nm	 accept any value that rounds to 490 e.g. 487.5 allow a maximum of 1 mark out of the first two marking points for a power of ten error independent mark award full marks for the correct answer without any working	(3) AO 1 1 AO 2 1

Question Number:	Answer	Additional guidance	Mark
(ii)	(sum of the) clockwise moments (about a point) = (sum of the) anticlockwise moments (about that point) (1)	idea that moments on each side of a pivot can be balanced	(1) AO 1 1

Question Number:	Answer	Additional guidance	Mark
(iii)		substitution and rearrangement in either order	**(1)** AO 2 1
	substitution(1) 160 x distance of effort from pivot = 490	accept 160 x distance of effort from pivot = 487.5 160 x distance from pivot =650 x 0.75	
	rearrangement (1) distance of effort from pivot = $\frac{490}{160}$	accept $\frac{650 \times 0.75}{160}$ $\frac{487.5}{160}$	
	evaluation (1) 3.1(m)	accept any value which rounds to 3 maximum of two marks for a power of ten error award full marks for the correct answer without working	

Q17.

Question number	Answer	Additional guidance	Mark
	identification of clockwise and anticlockwise moment (1) 3(.0) x 5(.0) (/100) 6.0 x 2.5 (/100) values (of both moments) are equal (1)	 15 and 15 seen or 0.15 and 0.15 seen Accept Y is half the force (as Z) but twice the distance (from the pivot as Z) for this mark may be implied by = sign (turning effect) of the two forces are equal	**(2)** **AO2**

Q18.

Question number	Answer	Additional guidance	Mark
	an explanation linking distance from hinge/pivot increased (1) (therefore) smaller force needed (to close door)	 P further from hinge than Q accept the greater distance gives greater moment for 2 marks	**(2)**

Q19.

Question number	Indicative content	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • benefit → easier with a lever (AO2) • crowbar easier to lift/move (AO2) • (applied force) is less (AO1) • distance to pivot from (applied) force is (considerably) bigger than distance of load/weight to pivot (AO2) • labelled distances in figure xx (AO2) • force (applied) x x = load x y i.e. principle of moments used (AO1) • relevant mention of clockwise and anticlockwise moments (AO1) • specific application to crowbar (AO2)	**(6)** **AO1, AO2**

Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)

Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance elements of physics understanding with some linking to scientific ideas/practical application two isolated statements	Possible candidate responses easier to lift big distance to pivot you can apply your weight onto the crowbar
Level 2	3–4	Additional guidance mostly relevant physics understanding with application of scientific ideas makes some link between force and distance OR some reference to moments	Possible candidate responses less force needed as there is a bigger distance to pivot OR because of moments you need less force
Level 3	5–6	Additional guidance accurate and relevant physics understanding with detailed application of scientific ideas Some reference to crowbar. makes links between force and distance AND refers to moments	Possible candidate responses If moment of weight = moment of crowbar, then the further away you are, you need less force to move the weight the bigger the distance to the pivot, the less force you need to provide the same moment