

Question Number:	Answer	Additional Guidance	Mark
3(a)	substitution (1) $(KE =) \frac{1}{2} \times 68 \times 12^2$ evaluation (1) 4900 (J)	$\frac{1}{2} \times 68000 \times 12^2$ scores 1 mark accept values that round to 4900(J) e.g. 4896(J) award full marks for correct answer without working	(2) AO 2 1

Question Number:	Answer	Additional Guidance	Mark
3(b)	a description to include: kinetic energy (store) (of cyclist and /or bicycle) decreases / is transferred into(1) thermal energy (store) (of brakes / surroundings) increases (1)	KE for kinetic energy allow heat for thermal allow brakes get hotter ignore sound energy accept kinetic (energy) to heat (energy) for 2 marks in this context	(2) AO 1 1

Question Number:	Answer	Additional Guidance	Mark
3(c)	<p>recall and substitution (1)</p> $1600 = \text{force} \times 28$ <p>rearrangement (1)</p> $(\text{force}) = \frac{1600}{28}$ <p>evaluation (1)</p> <p>57 (N)</p>	<p>substitution and rearrangement in either order</p> <p>accept f, F or ? for force</p> <p>accept values that round down to 57 e.g. 57.14</p> <p>award full marks for correct answer without working</p> <p>award 1 mark for answers of 44800 or 0.0175 and a correct expression relating work, force and distance</p>	(3) AO 2 1

Question Number:	Answer	Additional Guidance	Mark
3(d)	<p>an explanation linking:</p> <p>over the same time / in 300s, more work done / energy transferred in session 1 than in session 2 (1)</p> <p>(therefore) more power (developed) in session 1 (1)</p>	<p>allow reverse argument</p> <p>power in session 1 = $\frac{45.2}{300} = 0.15$ (kW) or 150(W)</p> <p>allow statement that power = $\frac{\text{work}}{\text{time}}$ or power = $\frac{\text{energy(transferred)}}{\text{time}}$</p> <p>for MP1</p> <p>power in session 2 = $\frac{37.9}{300} = 0.13$ (kW) or 126(W)</p>	<p>(2) AO 3 2a AO 3 2b</p>

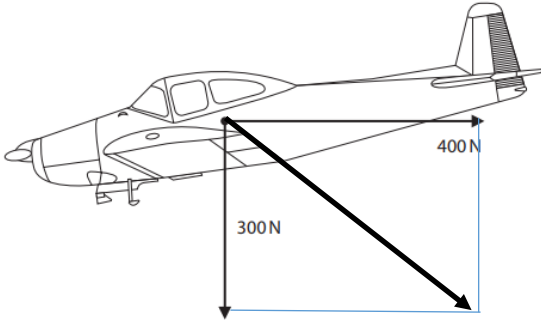
(Total for Question 3 = 9 marks)

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

Question Number:	Answer	Additional Guidance	Mark
6(c)	<p>an explanation linking:</p> <p>use of $P = \frac{F}{A}$ (1)</p> <p>area of piston Y is less than area of piston Z (1)</p> <p>(therefore) force K is less than force L (1)</p>	<p>accept answers in terms of work = force x distance</p> <p>accept reverse arguments</p> <p>accept K for piston Y and L for piston Z</p>	<p>(3) AO 3 2a AO 3 2b</p>

(Total for Question 6 = 10 marks)

Question Number:	Answer	Additional guidance	Mark
7(a)(i)	0.9 (k N) (1) up / upwards / ascending (1)	accept .9 or 0.90 north N ↑	(2) AO 3 2a AO 3 2b

Question Number:	Answer	Additional guidance	Mark
7(a)(ii)		<p>judge length and direction by eye</p> <p>construction lines need not be shown</p> <p>magnitude need not be stated</p> <p>allow missing arrowhead if direction and length are correct</p> <p>reject answers which have any additional vectors drawn</p>	(1) AO 3 2b

Question Number:	Answer	Additional Guidance	Mark
7(a)(iii)	<p>recall and substitution (1)</p> <p>GPE = $750 \times 10 \times 1300$</p> <p>evaluation (1)</p> <p>(energy =) 9 800 000 (J)</p>	<p>no POT error (could have missed out g)</p> <p>allow answers in standard form 9.8×10^6</p> <p>allow answers that round to 9 800 000 e.g. 9 750 000 J</p> <p>allow 9800 kJ or 9.8MJ</p> <p>allow 9 555 000 J</p> <p>allow negative values</p> <p>award full marks for correct answer without working</p>	<p>(2) AO 2 1</p>

Question Number:	Answer	Additional Guidance	Mark
7(b)(i)	<p>recall efficiency equation (1)</p> $\text{efficiency} = \frac{\text{useful output}}{\text{input}}$ <p>rearrangement (1)</p> <p>output energy = 0.70 x 6500</p> <p>recall power equation (1)</p> $\text{power} = \frac{\text{energy}}{\text{time}}$ <p>evaluation (1)</p> <p>(power =) 76 (kW)</p>	$\text{efficiency} = \frac{\text{power output}}{\text{power input}}$ <p>4550 (kJ) seen scores 2 marks (from 0.7 x 6500 (kJ))</p> $\frac{4550}{60}$ <p>accept ecf from output energy</p> <p>accept values that round up to 76 (kW) e.g. 75.8</p> <p>award full marks for correct answer without working</p>	<p>(4) AO 1 1 AO 2 1</p>

Question Number:	Answer	Additional Guidance	Mark
7(b)(ii)	<p>an explanation linking:</p> <p>(useful) output energy is less than input energy (1)</p> <p>some energy is transferred to less useful forms (1)</p>	<p>input energy is greater than output energy</p> <p>(only) 70% of the input energy is useful</p> <p>energy is dissipated / wasted / lost (to surroundings)</p> <p>energy is lost / transferred as thermal / heat</p> <p>30% is lost /dissipated / wasted / lost for 2 marks</p>	<p>(2) AO 1 1</p>

(Total for Question 7 = 11 marks)

Question Number	Answer	Additional guidance	Mark
9(a)(i)	a description to include: add weight / mass (1) to the weight hanger (1)	ignore references to friction here by inclining runway allow (component of) gravity to act on trolley	(2) AO 1 2

Question Number	Answer	Additional guidance	Mark
9(a)(ii)	a description to include: transfer mass (1) between trolley and hanger (1)	allow weight(s) for mass mass removed from trolley = mass added to hanger for 2 marks	(2) AO 1 2

Question Number	Answer	Additional guidance	Mark
9(a)(iii)	<p>an explanation that links:</p> <p>raise one end of the runway (1)</p> <p>(so that) trolley (not attached to weight hanger) rolls at constant speed / just starts to move / (force of) gravity (on the trolley) balances forces of friction (1)</p>	<p>credit methods for reducing friction directly (e.g. oil wheels, runway etc.)</p> <p>to reduce (effects of) friction</p> <p>allow credit for identifying magnitude of frictional forces and subtracting or using graph</p>	<p>(2)</p> <p>AO 3 3b</p>

Question Number	Answer	Mark
9(b)*	<p>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.</p> <p>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.</p> <p style="text-align: center;">AO1 (6 marks)</p> <ul style="list-style-type: none"> • momentum = mass × velocity • action and reaction are equal and opposite (N 3) • force of R on Q = -force of Q on R • $\frac{\text{change in momentum of Q}}{\text{time}} = -\frac{\text{change in momentum of R}}{\text{time}}$ • time of collision same for both • change in momentum of Q = - change in momentum of R • no overall change in momentum • R accelerates because of force from Q • transfer of momentum between Q and R 	<p>(6)</p> <p>AO 1 1</p>

Level	Mark	Descriptor
	0	<ul style="list-style-type: none"> No rewardable material.
Level 1	1-2	<ul style="list-style-type: none"> An explanation that demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) <p>Presents an explanation with some structure and coherence. (AO1)</p>
Level 2	3-4	<ul style="list-style-type: none"> An explanation that demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	<ul style="list-style-type: none"> An explanation that demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

(Total for Question 9 = 12 marks)
