


Question Number	Answer	Acceptable answers	Mark
1(a)(i)	B it decreases		(1)

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	C it does not change		(1)

Question Number	Answer	Acceptable answers	Mark
1 (b)(i)	horizontal arrow (judge by eye), pointing to the right anywhere on the diagram 		(1)

Question Number	Answer	Acceptable answers	Mark
1(b)(ii)	substitution: (1) $130\,000 \times 75$ evaluation: (1) $9\,750\,000 \text{ (kgm/s) (Ns)}$	give full marks for correct answer, no working Ignore minus sign $9.75 \times 10^6 \text{ (kgm/s) (Ns)}$	(2)

Question Number	Answer	Acceptable answers	Mark
1 (b)(iii)	$9\,750\,000 \text{ kgm/s}$	same value as answer to (b)(ii) Ignore minus sign	(1)

Question Number	Answer	Acceptable answers	Mark
1(c)(i)	An explanation linking two of the following: <ul style="list-style-type: none"> force is smaller/less (1) momentum changes more slowly (1) lower deceleration (1) use of the formula (1) 	pressure is smaller/less slower deceleration force is proportional to rate of change of momentum/ $F = (mv - mu)/t$	(2)

Question Number	Answer	Acceptable answers	Mark
1(c)(ii)	Any two from: (for loaded aircraft) <ul style="list-style-type: none"> • has more mass (1) • has more momentum (1) • has more k.e. (1) • higher velocity • brakes need to do more work (1) 	accept reverse argument for empty aircraft heavier/more passengers/more cargo higher speed/moving faster	(2) expert

Total marks for question 4 = 10 marks

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	substitution (1) work done = 84×0.25 evaluation (1) 21(J)	Full marks for correct answer even if no working is evident	(2)

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	21 J	Ecf from (a)(i)	(1)

Question Number	Answer	Acceptable answers	Mark
2(a)(iii)	substitution (1) $KE = \frac{1}{2} \times 27 \times (2.3)^2$ evaluation (1) = 71.4 (which is approx 71)	V=2.29 gains two marks Reverse argument which shows that V = $\sqrt{5.3}$ gains two marks	(2)

Question Number	Answer	Acceptable answers	Mark
2 (a)(iv)	B		(1)

Question Number	Indicative Content		Mark
QWC	*2(b)	<p>An explanation linking some of the following points</p> <ul style="list-style-type: none"> • kinetic energy varies during swing • kinetic energy maximum at bottom of swing • kinetic energy minimum at top of swing • gravitational potential energy(gpe) varies during swing • gpe maximum at top of swing • gpe minimum at bottom of swing • (continuous) interchange of KE and gpe • total amount of energy is constant during one swing • over a number of swings max KE and max PE decreases • energy is dissipated/'lost' to surroundings • because of air resistance / friction • amplitude/size of swings decrease (as energy 'lost' to surroundings) <p>ignore references to momentum</p>	(6)
Level I	Mark	Descriptor	
	0	No rewardable content	
1	1 - 2	<ul style="list-style-type: none"> • a limited explanation which states some facts e.g. (max) Kinetic energy decreases over time. KE will transfer to GPE. <p>or</p> <p>KE increases and decreases over one swing. The height which the swing reaches gets less over time.</p> <ul style="list-style-type: none"> • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy 	
2	3 - 4	<ul style="list-style-type: none"> • a simple explanation with links between facts; either over one period of oscillation or over several periods of oscillations. Kinetic energy decreases as he gets higher and the GPE increases. There is a continuous interchange of KE and gpe as he swings. <p>or</p> <p>KE is gradually transferred to heat so swing rises to a slightly lower height each time.</p> <ul style="list-style-type: none"> • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy 	
3	5 - 6	<ul style="list-style-type: none"> • a detailed explanation with links between facts over one period of oscillation and over several periods of oscillations e.g. kinetic energy is at a maximum at bottom of swing There is a continuous interchange of KE and gpe. KE (and gpe) reduce over a number of swings as energy is dissipated to the surroundings due to friction. <ul style="list-style-type: none"> • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors 	

Question number	Ans	Mark
3(a)	D	(1)

Question number	Answer	Mark
3(b)	C	(1)

Question number	Answer	Additional guidance	Mark
3(c)(i)	<p>An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark):</p> <ul style="list-style-type: none"> frictional forces increase as more trucks are added (1) <p>Plus one from:</p> <ul style="list-style-type: none"> hence, in order to keep constant speed, the student must increase the force she applies to Z (1) when Y and Z separate, the frictional forces (to the left) are more than magnetic attraction between Y and Z (1) 		(2)

Question number	Answer	Mark
3(c)(ii)	<p>An answer that combines the following points to provide a plan:</p> <ul style="list-style-type: none"> • use of a Newton meter used horizontally (1) • record largest force observed (1) • repeat readings several times under same conditions (1) 	(3)

Question number	Answer	Mark
3(c)(iii)	<p>An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark):</p> <ul style="list-style-type: none"> • the applied force must be resolved horizontally to determine the force that separates the engine from the trucks • and since the (size of) the resolved force is always less than the (size of) the actual force then a larger force (applied at an angle) is needed to separate the trucks from the engine 	(2)