


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	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. or • KE increases and decreases over one swing. The height which the swing reaches gets less over time. • 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. or • KE is gradually transferred to heat so swing rises to a slightly lower height each time. • 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. • 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)