

Mark Scheme

Q1.

Question Number	Answer	Mark
	<p>The only correct answer is B: work done= force x distance moved in direction of force</p> <p>A is incorrect because the equation would be dimensionally inconsistent</p> <p>C is incorrect because the equation would be dimensionally inconsistent</p> <p>D is incorrect because the direction of the distance moved is incorrect</p>	(1)

Q2.

	Answer	Acceptable answers	Mark
	C when the bungee cord is stretched the most		(1)

Q3.

	Answer	Acceptable answers	Mark
	<input checked="" type="checkbox"/> B conservation of energy		(1)

Q4.

Question Number:	Answer	Additional guidance	Mark
	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

Q5.

	Answer	Acceptable answers	Mark
(i)	B it decreases		(1)
(ii)	C it does not change		(1)

Q6.

Question Number	Answer	Additional guidance	Mark
	A description to include: as the bounce number increases the height decreases/negative correlation (1) non-linear (1)	allow not in even steps / not proportional / not a straight line height/it (nearly) halves each time scores 2 marks	(2)

Q7.

	Answer	Acceptable answers	Mark
(i)	an explanation linking two of the following points <ul style="list-style-type: none"> • electric(al)(energy) (1) • (is converted) to heat / thermal (energy) (1) • (is converted) to light (1) 	electricity	(2)

Q8.

Question Number:	Answer	Additional guidance	Mark
	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

Q9.

	Answer	Acceptable answers	Mark
	Description including 3 of the		(3)

<p>following:</p> <ul style="list-style-type: none"> • (Gravitational) potential energy (transferred) to KE(1) • Idea of energy transfer to heat/sound whilst descending (1) • Chemical energy is transferred to heat energy in Andrew (1) • Idea of energy dissipated on stopping (1) 		<p>(G)PE (transferred) to KE Allow gravitational energy for GPE</p> <p>Energy transferred to heat because of air resistance/ friction</p> <p>The energy goes to heat as he stops. Energy is transferred to the surroundings</p>	
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Q10.

Question Number:	Answer	Additional guidance	Mark
	<p>recall and substitution (1)</p> <p>$1600 = \text{force} \times 28$</p> <p>rearrangement (1)</p> <p>$(\text{force}) = \frac{1600}{28}$</p> <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>	<p>(3) AO 2 1</p>

Q11.

	Answer	Acceptable answers	Mark
	substitution: 0.6×20 evaluation 12 (1) J (1)	(1) give 2 marks for correct answer no working unit is an independent mark joules, Nm, kgm^2/s^2 , Ws	(3)

Q12.

	Answer	Acceptable answers	Mark
(i)	A line connecting a train part with a useful energy transfer as shown below (1) <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>Train part transfer</p> <div style="display: flex; flex-direction: column; gap: 10px;"> <div style="border: 1px solid black; padding: 2px 5px;">diesel engine</div> <div style="border: 1px solid black; padding: 2px 5px;">generator</div> <div style="border: 1px solid black; padding: 2px 5px;">motor</div> </div> </div> <div style="text-align: center;"> <p>useful energy</p> <div style="display: flex; flex-direction: column; gap: 10px;"> <div style="border: 1px solid black; padding: 2px 5px;">chemical to electrical</div> <div style="border: 1px solid black; padding: 2px 5px;">chemical to kinetic</div> <div style="border: 1px solid black; padding: 2px 5px;">electrical to kinetic</div> <div style="border: 1px solid black; padding: 2px 5px;">kinetic to chemical</div> <div style="border: 1px solid black; padding: 2px 5px;">kinetic to electrical</div> </div> </div> </div>	Lines need not be straight Ignore any arrow heads drawn Note: if more than one line is drawn from a train part then zero mark for that train part.	(3)
(ii)	(transfer of energy to) thermal (1)	heat/sound	(1)

Q13.

	Answer	Acceptable answers	Mark
(i)	Substitution: (1)		(3)

	60 × 10 × 50 or 600 × 50 Evaluation: (1) 30 000 Unit: (1) J / Nm	give two marks for correct answer no working j / joule 30 kj for full marks	
(ii)	After falling 50 m / when the cord becomes straight/when cord starts to stretch	tension starting to increase at terminal velocity ignore maximum velocity/speed	(1)
(iii)	An explanation linking any two of not all GPE is transferred to KE (1) some {of the GPE transfers to thermal energy /work is done} (1) due to drag (1)	not all GPE goes to KE maximum energy is same (value) as GPE before falling /speed does not reach the speed at which he should fall some lost as heat/sound (of rope or movement through air) (air) resistance / friction ignore wind	(2)

Q14.

Question Number	Answer	Acceptable answers	Mark
(a)	D driving for a long time without taking a break		(1)

Question Number	Answer	Acceptable answers	Mark
(b)(i)	substitution $1200 \times 8(.0)$ (1)	Give full marks for correct answer with no working.	(2)
	evaluation 9600 (J) OR 9.6×10^3 (J) (1)	9.6 x any other power of 10 = 1 mark	

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	substitution $0.5 \times 1400 \times 25^2$ (1)	Give full marks for correct answer with no working.	(3)
	evaluation of v squared $0.5 \times 1400 \times 625$ (1)	accept 625 seen anywhere for this mark e.g. 875 000 gets 1 mark (forgot $\frac{1}{2}$)	
	evaluation 4.4×10^5 (J) (1) OR 440 000	437 500 (J) 4.4 x any other power of 10 = 2 marks	

Q15.

Question Number	Answer	Acceptable answers	Mark
(a)	D driving for a long time without taking a break		(1)

Question Number	Answer	Acceptable answers	Mark
(b)(i)	substitution $1200 \times 8(.0)$ (1)	Give full marks for correct answer with no working.	(2)
	evaluation 9600 (J) OR 9.6×10^3 (J) (1)	9.6 x any other power of 10 = 1 mark	

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	substitution $0.5 \times 1400 \times 25^2$ (1)	Give full marks for correct answer with no working.	(3)
	evaluation of v squared $0.5 \times 1400 \times 625$ (1)	accept 625 seen anywhere for this mark e.g. 875 000 gets 1 mark (forgot $\frac{1}{2}$)	
	evaluation 4.4×10^5 (J) (1) OR 440 000	437 500 (J) 4.4 x any other power of 10 = 2 marks	

Q16.

Question Number	Answer	Acceptable answers	Mark
(ai)	B momentum (1)		(1)

Question Number	Answer	Acceptable answers	Mark
(aii)	power (1)		(1)

Question Number	Answer	Acceptable answers	Mark
(bi)	Substitution: $\frac{1}{2} \times 0.8 \times 25^2$ (1) Evaluation 250 (1) 0.25 <u>k</u> J scores 3 marks J bod j (1)	Allow both marks for correct answer with no method shown. Ignore power of 10 until evaluation e.g. 2 marks for 25 J 1mark for 25 W Nm ignore kg (m/s) ² Unit mark is independent of numerical answer.	(3)

Question Number	Answer	Acceptable answers	Mark
(bii)	250 (1) Ignore any unit given by the candidate	Allow ecf from 1(bi)	(1)

Question Number	Answer	Acceptable answers	Mark
(biii)	A suggestion to include: work done = force x distance (1) (force) used over a longer distance (1)	ignore references to more power, greater speed, longer time, larger force, momentum and how far javelin travels. the longer they are pushing (it/the javelin) [bod distance] they can push the javelin (forward) for longer [bod distance] the arm can move further	(2)

(Total for Question =8 marks)

Q17.

Question Number	Answer	Additional guidance	Mark
(i)	substitution (1) ($\Delta GPE =$) $(0.0)46 \times 10 \times 2.05$ evaluation (1) 0.94(3) (J)	allow $g=9.8(1) \text{ m/s}^2$ 0.9 (J) values that round to 0.92 or 0.93 (from using $g = 9.8$ or 9.81) do not award for 1(J) no POT error in evaluation award full marks for the correct answer without working.	(2)

Question Number	Answer	Additional guidance	Mark
(ii)	recall (1) $(KE =) \frac{1}{2} \times m \times v^2$ substitution (1) $(KE =) \frac{1}{2} \times (0.0)46 \times 3.5^2$ evaluation (1) 0.28 (J)	allow answers that round to 0.28 e.g. 0.28175 (J) allow max 2 marks for POT error e.g. 0.00028 award full marks for the correct answer without working	(3)

Question Number	Answer	Additional guidance	Mark
(iii)	Any value between 0.8 (m) and 0.95 (m) inclusive		(1)

Question Number	Answer	Additional guidance	Mark
(iv)	An explanation linking (the ball) has lost energy (1) identification of what has happened to that energy (1)	accept (energy) dissipated or (transferred to) surroundings / ground or thermal energy or heat / sound or system is not 100% efficient or bounce is not (100%) elastic or squashing (the ball or the ground)	(2)

Q18.

	Answer	Acceptable answers	Mark
(a)	C when the bungee cord is stretched the most		(1)
(b)	A 600 kg m/s		(1)
(c)(i)	Substitution: (1) 60 × 10 × 50 or 600 × 50 Evaluation: (1) 30 000 Unit: (1) J / Nm	give two marks for correct answer no working J / joule 30 kJ for full marks	(3)
(c)(ii)	After falling 50 m / when the cord becomes straight/when cord starts to stretch	tension starting to increase at terminal velocity ignore maximum velocity/speed	(1)
(c)(iii)	An explanation linking any two of not all GPE is transferred to KE (1) some {of the GPE transfers to thermal energy /work is done} (1) due to drag (1)	not all GPE goes to KE maximum energy is same (value) as GPE before falling /speed does not reach the speed at which he should fall some lost as heat/sound (of rope or movement through air) (air) resistance / friction ignore wind	(2)

Q19.

	Answer	Acceptable answers	Mark
(a)	Description including 3 of the following: <ul style="list-style-type: none"> (Gravitational) potential energy (transferred) to KE(1) Idea of energy transfer to 	(G)PE (transferred) to KE Allow gravitational energy for GPE Energy transferred to heat because of air resistance/ friction	(3)

	<p>heat/sound whilst descending (1)</p> <ul style="list-style-type: none"> • Chemical energy is transferred to heat energy in Andrew (1) • Idea of energy dissipated on stopping (1) 	<p>The energy goes to heat as he stops. Energy is transferred to the surroundings</p>	
(b)(i)	<p>substitution (1) 67×31</p> <p>evaluation (1) 2077 (kg m/s)</p>	<p>2080, 2100</p> <p>working backwards using 2000 (v=) 29.85, 30 (m=) 64.52, 65</p> <p>67 X 31=2000 scores only one mark</p>	(2)
(b)(ii)	<p>substitution (1) $2000 \div 2.3$</p> <p>evaluation (1) 870 (N)</p>	<p>answer to (b)(i)) $\div 2.3$</p> <p>900, 869.6, 869.5 903</p>	(2)
(b)(iii)	<p>an explanation linking two of the following</p> <ul style="list-style-type: none"> • Force on Andrew is quite small (1) • Because impact time is long (1) • The acceleration/deceleration is quite small (1) • Because impact distance is far (1) 	<p>force is reduced/ less /not as strong</p> <p>slows down/changes momentum gradually</p> <p>acceleration = 1.35 'g' or 13.5 m/s²</p> <p>slows down (rate of) change of momentum scores 2 marks</p>	(2)

Total question = 8 marks