Mechanics 1 Modelling Questions

3 (a) A small stone is dropped from a height of 25 metres above the ground.

(i) Find the time taken for the stone to reach the ground. *(2 marks)*

(ii) Find the speed of the stone as it reaches the ground. *(2 marks)*

(b) A large package is dropped from the same height as the stone. Explain briefly why the time taken for the package to reach the ground is likely to be different from that for the stone. *(2 marks)*

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1 A stone is dropped from a high bridge and falls vertically.

(a) Find the distance that the stone falls during the first 4 seconds of its motion. *(3 marks)*

(b) Find the average speed of the stone during the first 4 seconds of its motion. *(2 marks)*

(c) State one modelling assumption that you have made about the forces acting on the stone during the motion. *(1 mark)*

(ii) Make one criticism of the assumption that the resistance force on the trolley is constant. *(1 mark)*

(iv) In reality, air resistance affects the motion of the box. Explain how its acceleration would change if you took this into account. *(2 marks)*

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3(a)(i)	$s = ut + \frac{1}{2}at^2$ $25 = 0 + 4.9t^2$ $t = 2.26\,\text{sec}$ (2.236) $(\text{if } g = 10)$ (2.259)	M1 A1	2	full method
(ii)	$v^2 = u^2 + 2as$ $v^2 = 0 + 2\times 9.8\times 25$ $v = 22.1\,\text{m s}^{-1}$ (21.913) (22.14)	M1 A1	2	
(b)	(Time longer) air resistance slows down motion, links with motion, no contradictions	M1 A1	2	(or Time less) package large so less distance to travel
	Total		**6**	

1(a)	$s = 0 + \frac{1}{2}\times 9.8\times 4^2$	M1 A1		Full method Correct subs, accept ±9.8
	$s = 78.4$ metres	A1	3	CAO (need positive)
(b)	Average speed $= \frac{78.4}{4}$	M1		Also accept full method with use of velocities at $t = 0$ and 4, or at $t = 2$
	$= 19.6\ \text{ms}^{-1}$	A1F	2	FT distance
(c)	Only force acting is weight	B1	1	Acc resistance forces negligible or ignored, (not friction, or air friction)
	Total		**6**	

(d)	You would expect P to vary with the speed of the car.	B1	1	Correct explanation

(iv)	Reduce a, as the air resistance would reduce the magnitude of the resultant force or because the air resistance increases as the velocity increases towards its terminal value	B1 B1	2	Reduces Explanation Second B1 dependent on the first B1 mark