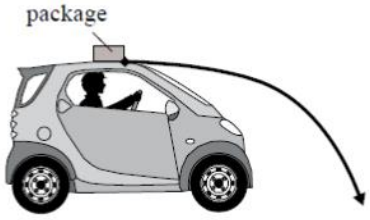
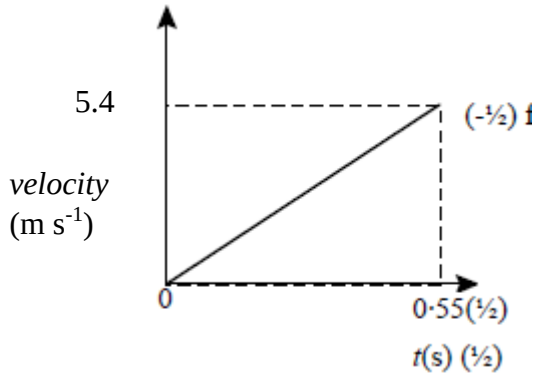
PROJECTILE MOTION				
1	(a)		1	(1) mark or zero. Sketch should show a reasonable **curve** from the package (to ground level). Straight line – zero marks.
		It moves with constant velocity in the horizontal direction (1) while accelerating due to the force of gravity in the vertical direction (1)	2	Answer should be based on the following two points: • Statement relating to horizontal motion, eg 'package moves forward', or 'package continues at a constant velocity' (1) • Statement relating to vertical motion eg'package falls towards the road/Earth', or 'force of gravity acts/pulls downwards' (1) **Not** an answer referring to 'gravity' alone.
	(b)	$g = 9.8$ (m s^{-2}) (1) data $a = \frac{v - u}{t}$ (1) $9.8 = \frac{v (– 0)}{0.55}$ (1) $v = 5.4$ m s^{-1} (1) If incorrect relationship stated (eg $a = v/t$, $v = at$ *or* $v = gt$) stop marking and award (0) marks but can still get (1) for data. Candidates who start with $v = 0{\cdot}55 \times 9.8$ have not shown an incorrect relationship so should not be penalised eg $v = 0{\cdot}55 \times 9.8$ (1) for implied formula, (2) for substitution & data mark $v = 5{\cdot}4$ m s^{-1} (1)	4	(1) data mark for correct selection of ***g*** from table. Accept 5.39

2	(a)	s = vt (1) 11 = 20 x t (1) = 0·55 s Accept 0·6 s (1)	3	
	(b)	a = $\frac{v - u}{t}$ (1) 9.8 = $\frac{v - 0}{0.55}$ (1) v = 5.4 m s^{-1} (1)	3	
	(c)		2	Figures on axis must be consistent with parts (a) and (b) above s vs t → No marks
	(d)	s = area under graph **or** $s = \bar{v}t$ **(1)** s = ½ x 0.55 x 5.4 s = $\frac{(5.4)}{2}$ x 0.55 (1) s = 1·5 m s = 1·5 m (1)	3	Must be $s = \bar{v}t$ No other symbols
3	(a) (i)	s= vt (1) s = 2 × 0·76 (1) s = 1·52 m (1)	3	
	(ii)	a = $\frac{v - u}{t}$ (1) 9.8 = $\frac{v - 0}{0.76}$ (1) v = 7.45 m s^{-1} (1)	3	

	(b) (i)	Same	1	Must have explanation to get first mark
	(ii)	All objects fall with the same (vertical) acceleration.	1	Will take the same time to reach the water
4		C	1	
5		D	1	
6		$a = (v - u)/t$ (1) $10 = (v - 0)/0.2$ (1) $v = 2\ ms^{-1}$ (1)	3	
7	(a)	Answer should be based on the following two points: statement relating to vertical motion, eg 'falling (towards the moon)', or force (of gravity) (1) statement relating to horizontal motion, eg 'probe moves forward', or curvature of Ganymede, eg 'surface curves away' (1)	2	NOT 'gravity' alone
	(b)	Newton III: The thrusters force gas one way (1) So the gas exerts an equal and opposite force on the probe.(1)		Explanations in terms of Newton I and Newton II are also acceptable. Newton I: mention of balanced forces (1) would not slow down/indication of constant speed (1) Newton II: unbalanced force (1) in the opposite direction/opposing motion (1) Quoting NI, NII or NIII alone is insufficient, the answer must relate to the thrusters/probe
8		A	1	
9	(a)	$d = v \times t$ (1) $= 30 \times 6$ (1) $= 180m$ (1)	3	
	(b)	$a = \frac{v - u}{t}$ (1) $4 = \frac{v\ (-0)}{6}$ (1) $v = 24ms^{-1}$ (1)	3	
10	(a)	$d = v \times t$ (1) $= 4{\cdot}8 \times 0{\cdot}65$ (1) $= 3{\cdot}12$ m (1)	3	
	(b)	$a = \frac{v - u}{t}$ (1) $10 = \frac{v - 0}{0.65}$ (1) $v = 6{\cdot}5$ m/s (1)	3	
11		C	1	