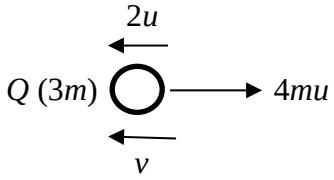
Question Number	Scheme	Marks
1.		
1(a)	$-4mu = 3m(v-2u)$ **or** $4mu = 3m(-v+2u)$ **or** $-4mu = 3m(-v-2u)$ **or** $4mu = 3m(v+2u)$	M1A1
	speed is $\frac{2}{3}u$, $0.67u$ or better	A1
		(3)
1(b)	Same as its original direction or direction is unchanged or just 'unchanged' or 'same direction' or 'it is the same'.Allow 'opposite to *P*'s original direction' or 'towards *P*' Apply isw if they add 'east' or 'to the left' etc ('motion of *Q* is unchanged'is B0)	DB1
		(1)
		(4)
	Notes for question 1	
1(a)	M1 impulse-momentum equation, dimensionally correct, correct no. of terms, condone sign errors but must be attempting a difference of momenta. Allow if they use *m* instead of 3*m*.	
	A1 Correct equation (v may be replaced by $-v$)	
	A1 cao (must be positive)	
1(b)	DB1 Dependent on obtaining either $\frac{2}{3}u$ or $-\frac{2}{3}u$ for v in (a).	

Question Number	Scheme	Marks
2(a)	$220 = (28\times 10) - \frac{1}{2}a\times 10^2$	M1 A1
	Other possible equations, any 2 of which could be used to obtain an equation in a **only**: $28 = u + 10a$ $220 = \frac{(u+28)}{2}\times 10$ $220 = 10u + \frac{1}{2}a\times 10^2$ $28^2 = u^2 + 2a\times 220$	
	a = 1.2 (m s^{-2})	A1
		(3)
2(b)	Any ONE of these: $28 = u_4 + 1.2\times 6 \Rightarrow u_4 = 20.8$ $28 = u_5 + 1.2\times 5 \Rightarrow u_5 = 22$ $s_4 = 16\times 4 + \frac{1}{2}\times 1.2\times 4^2 = 73.6$ $s_5 = 16\times 5 + \frac{1}{2}\times 1.2\times 5^2 = 95$ Allow distances from Q e.g. $s_6 = 28\times 6 - \frac{1}{2}\times 1.2\times 6^2 = 146.4$ $s_5 = 28\times 5 - \frac{1}{2}\times 1.2\times 5^2 = 125$	M1A1**ft**
	e.g. $s = 20.8\times 1 + \frac{1}{2}\times 1.2\times 1^2$ **OR** $s = 22\times 1 - \frac{1}{2}\times 1.2\times 1^2$ **OR** $s = 95 - 73.6$ **OR** $22^2 = 20.8^2 + 2\times 1.2s$ **OR** $s = 146.4 - 125$	M1
	21.4 (m) Allow 21 (m).	A1 (4)
		(7)
	Notes for question 2	
	N.B. Use of an incorrect *suvat* formula is M0.	
2(a)	M1 Complete method to find an equation in a **only** (note that u = 16) **N.B.** Allow $220 = (28\times 10) + \frac{1}{2}a\times 10^2$ ($s = ut + \frac{1}{2}at^2$ for 'reverse' motion) leading to a = -1.2 M1A0A0 but if they then change a to 1.2, then it becomes M1A1A1 retrospectively) M0 if they assume u = 0	
	A1 Correct equation	

	A1 cao	
2(b)	M1 Complete method to find the speed at $t = 4$ or 5 **OR** a distance at $t = 4$ or 5 M0 if they assume $u = 0$	
	A1**ft** A correct speed or distance, follow through on their a and u but only if u has been **used** to find a in part (a).	
	M1 Complete method to find the required distance	
	A1 cao	