

Year 2 Applied Chapter 7: Connected Particles – Exam Questions (Answers)

Q1.

Question Number	Scheme	Marks
(a)	$R = 0.3g \cos \alpha$ $= 0.24g = 2.35 \text{ (3sf)} = 2.4 \text{ (2sf)}$	M1 A1 (2)
(b)	$mg - T = 1.4m$ $T - 0.3g \sin \alpha - F = 0.3 \times 1.4$ $F = 0.5R$ Eliminating R and T $m = 0.4$	M1 A1 M1 A2 M1 DM1 A1 (8)
(c)	$v = 1.4 \times 0.5$ $-0.3g \sin \alpha - F = 0.3a$ $a = -9.8$ $0 = 0.7 - 9.8t$ $t = 0.071 \text{ s or } 0.0714 \text{ s (1/14 A0)}$	B1 M1 A1 A1 M1 A1 (6) 16

Q2.

Question Number	Scheme	Marks
(a)	$F = \frac{1}{3}R$ $R = 1.5g$ $T - F = 1.5a$ $3g - T = 3a$ $T = 1.2g \text{ or } 11.8 \text{ N or } 12 \text{ N}$	M1 B1 M1 A1 M1 A1 DM1 A1 (8)
(b)	$R = \sqrt{T^2 + T^2} \text{ or } 2T \cos 45^\circ \text{ or } \frac{T}{\cos 45^\circ}$ $= 16.6 \text{ (N) or } 17 \text{ (N) or } \frac{6g\sqrt{2}}{5}$ Direction is 45° below the horizontal oe	M1 A1 A1 B1 (4) 12

Q3.

Question Number	Scheme	Marks
(a)	$R = 4g \cos \alpha$ $T - 0.5g = 0.5a$ $4g \sin \alpha - T - F = 4a$ $(OR: 4g \sin \alpha - F - 0.5g = 4.5a)$ $F = \frac{1}{2}R; \quad \sin \alpha = \frac{4}{5} \quad \text{or} \quad \cos \alpha = \frac{3}{5}$ Eliminating a or finding a Solving for T (must have had an a) $T = \frac{2g}{3} \text{ N or } 6.5 \text{ N or } 6.53 \text{ N}$	M1 A1 M1 A1 M1 A1 B1; B1 M1 M1 A1 (11)
(b)	$\text{Magnitude} = 2T \cos\left(\frac{90 - \alpha}{2}\right)$ $= 2 \times \frac{2g}{3} \times \frac{3}{\sqrt{10}} (0.94868\dots)$ $= 12 \text{ N or } 12.4 \text{ N} \left(\frac{4g}{\sqrt{10}}\right)$	M1 A1 A1 ft on T A1 (4) 15

Q4.

Question Number	Scheme	Marks
(a)	Use of $v^2 = u^2 + 2as$ $14^2 = 20^2 - 2a \times 100$ Deceleration is $1.02(\text{m s}^{-2})$	M1 A1 A1 (3)
(b)	Horizontal forces on the car: $\pm T \cos \theta - 300 = 750 \times -1.02 = -765$ $T = -1550/3$ The force in the tow-bar is $1550/3$, 520 (N) or better (allow -ve answer)	M1A2 f.t. A1 (4)
(c)	Horizontal forces on the truck: $\pm T \cos \theta - 500 - R = 1750 \times -1.02$ Braking force $R = 1750$ (N) ALT: Whole system: $800 + R = 2500 \times 1.02$ $R = 1750$	M1A2 f.t. A1 (4) [11] M1A2 f.t. A1