

4728 Mechanics 1

1	70 x 9.8 or 70g 70 x 0.3 686 + 21 707 N	B1 B1 M1 A1 [4]	=686 =21 + cvs [70(9.8+0.3) gets B1B1M1]
2	+/- (40 x 4 - 60 x 3) +/- ([40 + 60] v +/- (40 x 4 - 60 x 3) = +/- ([40 + 60] v Speed = 0.2 ms ⁻¹ Same as heavier or opposite lighter/"she"	B1 B1 M1 A1 B1 [5]	Difference of terms, accept with g Sum of terms, accept with g. Accept inclusion of g in equation. Not if g used. SR 40x4-60x3=[40 + 60] v; v=0.2, as heavier, award 5 marks "Left" requires diagram for B1 If same direction before collision award B0B1M1A0B0
3i	$\sqrt{12^2 + 15^2}$ 19.2 N $\tan\theta = 12/15$, $\tan\theta = 15/12$, $\sin\theta = 12/19.2$, $\cos\theta = 15/19.2$ Bearing = 038.7°	M1 A1 A1 M1 A1 A1 [6]	Applies Pythagoras, requires +. trig and R included between X and Y Accept cv 19.2 Accept 039 or 39 or art 39 from below (not given if X and Y transposed)
3ii	E = 19.2 Bearing = 180 + 38.7 = 219°	B1ft B1ft [2]	ft cv 19.2 180+cv 38.7(-360) or correct answer
4i	v = dx/dt v = 4t ³ - 8 x 2t v(2) = 4x2 ³ - 8x2x2 = 0 x(2) = 2 ⁴ - 8 x 2 ² + 16 = 0 AG AG	M1 A1 M1 A1 B1 [5]	Uses differentiation, may be seen in (ii) Accept with +c Substitutes 2 in cv v, explicit A0 if +c Substitutes 2 in displacement, explicit
4ii	a = dv/dt a = 12t ² - 16 a(2) = 12 x 2 ² - 16 = 32 ms ⁻²	M1 A1 A1 [3]	Uses differentiation of v formula Accept with +c A0 with +c
5ia	250a = -150 a = -0.6 ms ⁻² AG	M1 A1 [2]	Values used in N2L for trailer F= +/-150 Or -ve convincingly argued
5ib	900 x -0.6 = D -600 or (900+250)x-0.6 = D -600 -150 D = 60 N	M1 A1 A1 [3]	Applies N2L to car or car/trailer with correct number of forces (including T if T=0 used later)
5ic	15 ² = 18 ² + 2x (-0.6)s s = 82.5 m	M1 A1 [2]	Uses v ² = u ² + 2(+/-0.6)s with 15, 18 Positive, allow from 18 ² = 15 ² + 2x0.6s
5iia		M1	Applies N2L to car+trailer with F(driving) F(resisting), F(wt cmpt-allow without g), or each part, as above and T.
5iib	(900+250)a = 980 - 600 -150 + /-(900+250)x9.8sin3 a = 0.713 ms ⁻² 250 x 0.713 = T - 150 + 250x9.8sin3 T = 200 N	A1 A1 A1 [4] M1 A1 A1 [3]	900a = 980 - 600 +/- 900x9.8sin3 - T 250a = T - 150 +/- 250x9.8sin3 Allow (art) 0.71 from correct work N2L for trailer, cv a, with correct number of forces of correct type. Or for car 900x0.713 = -T-600 + 900x9.8sin3 + 980 Anything rounding to 200 (3sf)

6i	$4.9 = \mu \times 14.7$ $\mu = 1/3$	AG	M1 A1 [2]	Uses $F = \mu R$ Allow 0.333 or 0.3 recurring
6iia	$R + 4.9\sin 30 = 14.7$ $R = 12.25 \text{ N}$ $F = 12.25 \times 1/3$ $F = 4.08(333..) \text{ N}$ [or 49/12 N]		M1 A1 A1 M1 A1 [5]	3 force vertical equation Accept 12.2 or 12.3 Uses $F = \mu R$ with new R { may be seen in {part b
6iib	$m = 14.7/9.8 = 1.5\text{kg}$		B1 M1	N2L horizontally with 2 relevant forces, including 4.9sin/cos30
6iic	$4.9\cos 30 - 4.08(333..) = 1.5a$ $a = 0.107 \text{ ms}^{-2}$		A1 A2 [5]	Allow cv(F) SR Award A1 if $m=14.7$ used SR A1 for 0.11, 0.109 or art 0.011 from $m = 14.7$
6iic	$\mu R = (14.7 - 4.9\cos 30)/3$ Horizontal component of force = $4.9\sin 30$ Horizontal component of force < $\textcircled{3}R$ Friction = 2.45 N		B1 B1 M1 A1 [4]	3.49, accept 3.5 2.45, accept 2.4 or 2.5 Comparing two values Not 2.4 or 2.5; Explicit (M1 essential)
7i	$s = 0.5 \times 1.4 \times 0.8^2$ $s = 0.448 \text{ m}$ $v = 1.4 \times 0.8$ $v = 1.12 \text{ ms}^{-1}$		M1 A1 M1 A1 [4]	Uses $s = 0.5 \times 1.4t^2$ Not 0.45 Uses $v = 1.4t$
7ii	$0^2 = 1.12^2 - 2 \times 9.8s$ $s = 0.064 \text{ m}$ $0 = 1.12 - 9.8t$ (t = 0.114s) $t = (0.114 + 0.8) = 0.914\text{s}$		M1 A1 M1 A1 [4]	Uses $0^2 = u^2 - 2gs$ or $u^2 = 2gs$ Allow verification or $0.064 = 1.12t - 4.9t^2$ Allow 0.91 {or $0 = 1.12t - 4.9t^2$ and halve t
7iii	Scalene triangle, base on t axis right edge steeper and terminates on axis, or crosses axis at $t = 0.91$		B1 B1 [2]	NB Award A1 for 0.91 on t axis if total time not given in (ii)
7iv			M1	Uses N2L for A or B with attempt at 2 forces
7va	$1.4xA = 9.8xA - 5.88$ or $1.4xB = 5.88 - 9.8xB$ $A = 0.7$ $B = 0.525$		A1 A1 A1 [4]	Either Not 0.53
7vb	$T = 0.5 \times 9.8 + 2 \times 5.88$ $T = 16.66 \text{ N}$ $T = 4.9 \text{ N}$		M1 A1 [2] B1 [1]	Uses tension and 0.5g without particle weights Allow 16.7