

4728 Mechanics 1

1(i)	900a = 600 - 240 a = 0.4 ms ⁻² AG	M1 A1 [2]	N2L with difference of 2 forces, accept 360
(ii)	9 = 5 + 0.4t t = 10 s 9 ² = 5 ² + 2x0.4s s = 70 m	M1 A1 M1 A1 [4]	v = u + 0.4t or v = u + (cv 0.4)t or s=(u+v)t/2 or s=ut+0.5xcv(0.4)t ²
2(i)	Resolves a force in 2 perp. directions Uses Pythagoras R ² = (14sin30) ² + (12+14cos30) ² {or R ² = (12sin30) ² + (14+12cos30) ² } R = 25.1 AG	M1* D*M1 A1 A1	Uses vector addition or subtraction Uses cosine rule R ² = 14 ² + 12 ² - 2x14x12cos150
(ii)	Trig to find angle in a valid triangle tanB=7/24.1, sinB=7/25.1, cosB=24.1/25.1 B = 016, (0)16.1° or (0)16.2°	A1 [5] M1 A1 A1 [3]	cso (Treat R ² = 14 ² + 12 ² + 2x14x12cos30 as correct) Angle should be relevant sinB/14 = sin150/25.1. Others possible. Cosine rule may give (0)16.4, award A1
3(i)	a = 6/5 a = 1.2 ms ⁻²	M1 A1 [2]	Acceleration is gradient idea, for portion of graph Accept 6/5
(ii)	s = (6x10/2) x2 s = 60 m	M1 M1 A1 [3]	Area under graph idea or a formula used correctly Double {Quadruple} journey
(iii)	v = -6 + 1.2(17-15) v = -3.6 ms ⁻¹	M1 A1 A1 [3]	v=u+at idea, t not equal to 17 (except v=1.2t-24) 0 = v + cv(1.2)(20-17), v ² -2.4v -21.6 = 0, etc SR v=3.6 neither A1, but give both A1 if final answer given is -3.6
4(i)	F = 15sin50 - 15sin30 = 3.99 N Left	M1 A1 B1 [3]	Difference of 2 horizontal components, both < 15 Not 4 or 4.0 Accept reference to 30 degree string May be given in ii if not attempted in i
(ii)	R = f(30, 15cos50, 15cos30) R = 30-15cos50-15cos30 μ = 3.99/7.36(78) μ = 0.541 or 0.542 or 0.543	M1 A1 M1 A1 A1 [5]	Equating 4 vertical forces/components 30g is acceptable =7.36(78..), treat 30g as a misread Using F = μR, with cv(3.99) and cv(7.36(78..)) Accept 0.54 from correct work, e.g. 4/7.4
5(i)	2400x5 - 3600x3 2400v + 3600v 2400x5 - 3600x3 = 2400v + 3600v v = 0.2 ms ⁻¹ B	B1 B1 M1 A1 B1 [5]	Award if g included Award if g included Equating momentums (award if g included) Not given if g included or if negative.
(ii)(a)	+/-(-2400v + 3600v) 2400x5 - 3600x3 = -2400v + 3600v v = 1 ms ⁻¹	B1 M1 A1	<i>No marks in (ii) if g included</i> Equating momentums if "after" signs differ Do not accept if - sign "lost"
(b)	I = 2400 x (5+/-1) or 3600 x (3+/-1) I = 14400 kgms ⁻¹	M1 A1 [5]	Product of either mass and velocity change Accept -14400

<p>6(i) $x = 0.01t^4 - 0.16t^3 + 0.72t^2$ $v = dx/dt$ $v = 0.04t^3 - 0.48t^2 + 1.44t$ $v(2) = 1.28 \text{ ms}^{-1}$</p>	<p>AG</p>	<p>M1 A1 A1 [3]</p>	<p>Uses differentiation, ignore +c or $v = 4(0.01t^3) - 3(0.16t^2) + 2(0.72t)$ Evidence of evaluation needed</p>
<p>(ii) $a = dv/dt$ $a = 0.12t^2 - 0.96t + 1.44$ $t^2 - 8t + 12 = 0$</p>	<p>AG</p>	<p>M1 A1 A1 [3]</p>	<p>Uses differentiation or $a = 3(0.04t^2) - 2(0.48t) + 1.44$ Simplifies $0.12t^2 - 0.96t + 1.44 = 0$, (or verifies the roots of QE make acceleration zero)</p>
<p>(iii) $(t - 2)(t - 6) = 0$ $t = 2$ $t = 6$ $v(6) = 0 \text{ ms}^{-1}$</p>		<p>M1 A1 A1 B1 [4]</p>	<p>Solves quadratic (may be done in ii <u>if used to find v(6)</u>) Or <i>Factorises v into 3 linear factors</i> M1 $v = 0.04t(t-6)^2$ A1 <i>Identifies t=6</i> A1 Evidence of evaluation needed</p>
<p>(iv) Away from A</p>		<p>B1 B1 B1 B1 [4]</p>	<p>Starts at origin Rises to single max, continues through single min Minimum on t axis, non-linear graph</p>
<p>(v) $AB = 0.01x6^4 - 0.16x6^3 + 0.72x6^2$ $AB = 4.32 \text{ m}$</p>		<p>M1 A1 [2]</p>	<p>Or integration of v(t), with limits 0, 6 or substitution, using cv(6) from iii</p>

<p>7(i) $(R=)0.2x9.8\cos45$ $F=1xR=1x.2x9.8\cos45=1.386 \text{ N}$</p>	<p>AG</p>	<p>M1 A1 [2]</p>	<p>Not $F = 0.2x9.8\cos45$ or $0.2x9.8\sin 45$ unless followed by (eg) $Fr = 1x F = 1.386$ when M1A1</p>
<p>(ii) Any 1 application of N2L // to plane with correct mass and number of forces $0.4a = 0.2g\sin45 + 0.2g\sin45 - 1.38(592..)$ $a = 3.465 \text{ ms}^{-2}$ AG $0.2a = 0.2g\sin45 - T$ or $0.2a = T + [0.2g\sin45 - 1.38(592..)]$ $T = 0.693 \text{ N}$ OR Any 1 application of N2L // to plane with correct mass and number of forces $0.2a = 0.2g\sin45 - T$ or $0.2a = T + [0.2g\sin45 - 1.38(592..)]$ Eliminates a or T $a = 3.465 \text{ ms}^{-2}$ AG $T = 0.693 \text{ N}$</p>		<p>M1 A1 A1 M1 A1 [5] M1 A1 M1 A1 A1</p>	<p>Must use component of weight Accept with 3.465 (or close) instead of a Accept omission of [term] for M1 Accept 0.69 Must use component of weight Either correct Both correct. Accept omission of [term] for A1 only</p>
<p>(iii) $v^2 = 2 \times 3.465 \times 0.5$ $v = 1.86 \text{ ms}^{-1}$</p>		<p>M1 A1 [2]</p>	<p>Using $v^2 = 0^2 + 2xcv(3.465)s$</p>
<p>(iv) For Q $(0.2)a = (0.2)g\sin45 - (1)(0.2)g\cos45$ $a=0$ [AG] $T = (3/1.86) = 1.6(12)$ For P $a = 9.8\sin45$ $2.5 = 1.86(14..)t + 0.5 \times (9.8\sin45)t^2$ $t = 0.6(223)$ time difference $1.612 - 0.622 = 0.99(0) \text{ s}$</p>		<p>M1 A1 B1 B1 M1 A1 A1 [7]</p>	<p>Attempting equation to find a for Q Accept from $0.2g\sin45 - 1.386$ Accept 2 sf $a = 6.93$ Using $2.5 = cv(1.86)t + 0.5cv(6.93)t^2$ [not 9.8 or 3.465] Accept 1sf Accept art 0.99 from correct work</p>