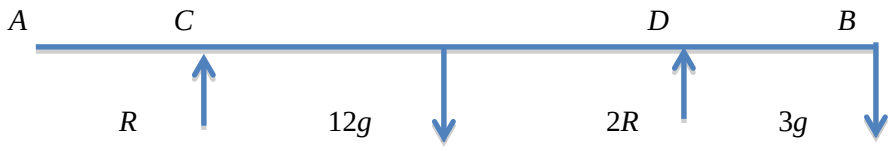
edexcel

Mark Scheme(Results)

October 2016

Pearson Edexcel International A Level in Mechanics 1 (WME01/01)

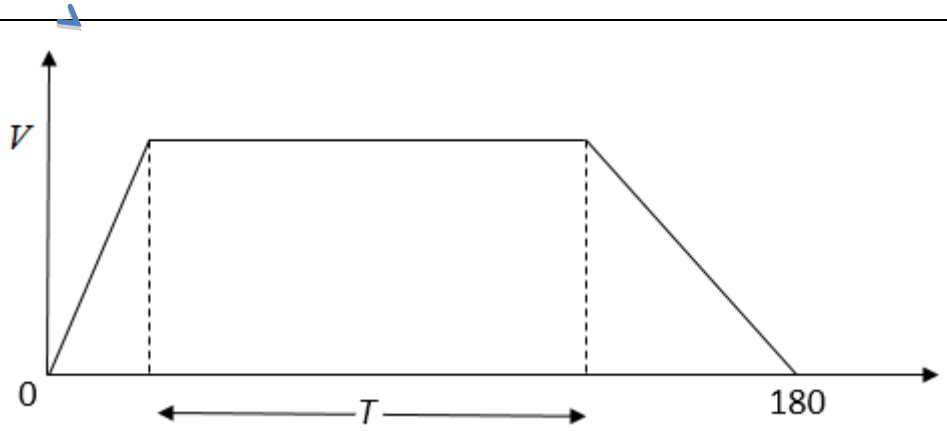
Question Number	Scheme	Marks
2(a)	$(-10\mathbf{i}+a\mathbf{j})+(b\mathbf{i}-5\mathbf{j})+(2a\mathbf{i}+7\mathbf{j}) = 3(3\mathbf{i}+4\mathbf{j})$ $a-5+7=12 \Rightarrow a=10$ $-10+b+2a=9 \Rightarrow b=-1$	M1 M1 A1 M1 A1 (5)
(b)	$20\mathbf{i}+20\mathbf{j}=\mathbf{u}+4(3\mathbf{i}+4\mathbf{j})$ $\mathbf{u}=(8\mathbf{i}+4\mathbf{j})$ $u=\sqrt{8^2+4^2}=\sqrt{80}=8.9$ (or better)	M1 A1 M1 A1 **(**4) **9**
	Notes	
2(a)	First M1 for applying **F** = *m***a**; need all terms but allow slips and allow *m* instead of 3 Second M1 (independent but M0 if they have **0** instead of *m***a**) for equating *coefficients* of **j** First A1 for $a = 10$ Third M1 (independent but M0 if they have **0** instead of *m***a**) for equating *coefficients* of **i** Second A1 for $b = -1$	
(b)	First M1 for applying **v** = **u** + *t***a**; need all terms and must be vector **u** First A1 for 8**i** + 4**j** Second M1 (independent) for finding magnitude of their vector **u** Second A1 for $\sqrt{80}$ or 8.9 or better	

Question Number	Scheme	Marks
3.	 $(\uparrow)\quad R+2R=12g+3g$ $M(A),\quad 2Rx+3R=12g.4+3g.8$ $x=5.7$	M1 A2 M1 A2 A1 **7**
	Notes	
	First M1 for either a vertical resolution (with correct of terms) or a moments equation (all terms dim correct and correct no. of terms) First A1 and Second A1 for a correct equation in R (or S where $S = 2R$) only or R and x only or S and x only. (-1 each error , A1A0 or A0A0) Second M1 for either a vertical resolution (with correct of terms) or a moments equation (all terms dim correct and correct no. of terms) Third A1 and Fourth A1 for a correct equation in R (or S where $S = 2R$) only or R and x only or S and x only. (-1 each error, A1A0 or A0A0) Fifth A1 for $x = 5.7$ oe **N.B. On ePen, first 3 marks are for a vertical resolution, if it appears, second 3 marks are for a moments equation.** **If no vertical resolution, award marks as they appear for the (two) moments equation(s).** **(i)** In a moments equation, if R and $2R$ (or S and $0.5S$) are interchanged, treat as 1 error. **(ii)** Ignore diagram if it helps the candidate. **(iii)** If an equation is correct but contains both R and S, treat as 1 error. **(iv)** Full marks possible if all g's omitted. **(v)** For inconsistent omission of g, penalise each omission. $M(B),\ R\times 5+S(8-x)=12g\times 4$ $M(C),\ S(x-3)=12g\times 1+3g\times 5$ $M(D),\ R(x-3)+3g(8-x)=12g(x-4)$ **N.B. If they use a different variable, other than *x, for a length, with it clearly marked on the diagram,* they can score all the marks for any moments equation.**	

Question Number	Scheme	Marks
4.(a)	$\mathbf{p} = (-5\mathbf{i} + 9\mathbf{j}) + t(\mathbf{i} - 2\mathbf{j})$	M1 A1 (2)
(b)	$2 = 9 - 2t$ $t = 3.5$ $\mathbf{p} = (-5\mathbf{i} + 9\mathbf{j}) + 3.5(\mathbf{i} - 2\mathbf{j}) = (-1.5\mathbf{i} + 2\mathbf{j})$	M1 A1 M1 A1 (4)
(c)	$\frac{2b-1}{5-2b} = \frac{1}{-2}$ $b = -1.5$	M1 A1 **DM1** A1 (4) **10**
	Notes	
4.(a)	M1 for clear attempt at $\mathbf{p} = (-5\mathbf{i} + 9\mathbf{j}) + t(\mathbf{i} - 2\mathbf{j})$ (allow slips but must be ' + ') A1 if correct	
(b)	First M1 for equating the **j** *component* of their **p** to 2 First A1 for $t = 3.5$ Second M1 (independent) for substituting their t value into their **p** Second A1 for (-1.5**i** + 2**j**)	
(c)	First M1 for $\frac{2b-1}{5-2b} = \pm\frac{1}{2}$ or $\frac{2b-1}{5-2b} = \pm\frac{2}{1}$ (must be in b only but allow slips) First A1 for a correct equation in b only Second M1 (dependent on first M1) for solving for b Second A1 for b = -1.5	

Question Number	Scheme	Marks
5(a)	(□), $R = 8\cos 50^o + 0.5g\cos 30^o$ (□), $F = 8\cos 40^o - 0.5g\sin 30^o$ $F = \mu R$ $\mu = 0.39$ or 0.392	M1 A2 M1 A2 B1 **DM1** A1 **9**
	Notes	
	First M1 for resolving perpendicular to the plane with usual rules and 8 must be used with 40^o or 50^o and 0.5(g) must be used with 30^o or 60^o First A1 and second A1 for a correct equation – 1 each error (A1A0 or A0A0) Second M1 for resolving parallel to the plane with usual rules and 8 must be used with 40^o or 50^o and 0.5(g) must be used with 30^o or 60^o Third A1 and fourth A1 for a correct equation – 1 each error (A1A0 or A0A0) B1 for $F = \mu R$ seen Third M1 dependent on both previous M marks for solving for μ Fifth A1 for 0.39 or 0.392 **N.B. If they resolve in any other directions e.g. horizontally or vertically, apply similar rules to the above for the M mark in each case.**	

Question Number	Scheme	Marks
6.	$s_A = 35t + \frac{1}{2}0.4t^2; s_B = 44t + \frac{1}{2}0.5t^2$ $44t + \frac{1}{2}0.5t^2 = 200 + 35t + \frac{1}{2}0.4t^2$ $\frac{1}{20}t^2 + 9t - 200 = 0$ $(t-20)(t+200) = 0$ $t = 20$ $v = 44 + \frac{1}{2}.20 = 54 \text{ ms}^{-1}$	M1 A1 A1 M1 A1 M1 A1 **DM1** A1 **9**
	Notes	
	First M1 for use of $s = ut + \frac{1}{2}at^2$ for either *A* or *B* First A1 for a correct equation for *A* Second A1 for a correct equation for *B* Second M1 for producing a quadratic in *t* only from their s_A = their $s_B \pm 200$ Third A1 for a correct '3 term = 0' equation Third M1 (can be implied by one correct answer) for attempt to solve their quadratic (M0 if linear). Must include 200, must be 3 terms and must have come from using both distance expressions. Fourth A1 for $t = 20$ Fourth M1 dependent on third M1 for correctly using their *t* value to find *v* Fifth A1 for 54 **N.B. SC for trial and error to find *t* ; can score max M1A1A1M1A0M0A0M1A1 6/9**	

Question Number	Scheme	Marks
7.(a)		B1 shape B1 figs. (V,T,180) (2)
(b)	Time accelerating = $V/1 = V$ Time decelerating = $V/0.5 = 2V$ Time at constant speed, $T = 180 - (2V + V)$ $T = 180 - 3V$ **Printed answer**	 M1 A1 (2)
(c)	$\frac{1}{2}(180+180-3V)V = 4800$ $V^2 - 120V + 3200 = 0$ $(V-40)(V-80) = 0$ $V = 40$ or 80 or both, since $(180 - 3 \times 80) < 0$	M1 A1 A1 A1 **DM**1 A1, M1 (7) **11**
	Notes	
7.(a)	First B1 for a trapezium, starting at the origin and finishing on the t-axis. Second B1 for V, T with delineators or marked on the top of the trapezium or oe and 180 correctly positioned.	
(b)	M1 for both Time accelerating = $V/1 = V$ and Time decelerating = $V/0.5 = 2V$ M0 if no working for the $2V$ as it's a 'Show that' or if they use $V/-0.5$ and fudge the –ve sign A1 for $T = 180 - (2V + V) = 180 - 3V$ **Printed answer**	

(c)	First M1 for attempt at using area under graph = 4800, with appropriate terms, to produce an equation in V only; must have used $\frac{1}{2}$ somewhere. (M0 if one *suvat* formula used) First A1 and second A1 for a correct equation (A1A0 one error) Third A1 for a correct quadratic expression = 0 Second M1 dependent on first M1 for solving their quadratic (can be implied by 1 correct answer) Fourth A1 for $V = 40$ or $V = 80$ or both Third M1 for a correct reason for rejecting $V = 80$. (only available if both correct values have been obtained) Allow: "Since $T > 0$, $V = 40$" oe	

Question Number	Scheme	Marks
8(a)	$1.4^2 = 2a \times 0.5 \Rightarrow a = 1.96 \text{ ms}^{-2}$ $3g - T = 3a \text{ or } -3a$ $T = 23.5 \text{ N or } 24 \text{ N}$	M1 A1 M1 A1 A1 (5)
(b)	$F = \mu R$ $R = 2g\cos\alpha$ $T - 2g\sin\alpha - F = 2a \text{ or } -2a$ $\mu = 0.5$	B1 M1 A1 M1 A1 A1 **DM**1 A1 (8) **13**
	Notes	
8(a)	First M1 for using one or more *suvat* formulae to produce an equation in *a* only First A1 for 1.96 (or -1.96 but only if correctly used in the second equation, in which case they *could* score 5/5) Second M1 for resolving vertically for *Q* (correct no. of terms but condone sign errors) Second A1 for a correct equation provided *a* used consistently in their two equations (but *a* does not need to be substituted) **N.B.** If they haven't found a value for *a*, the A1 can be scored for either 3*a* or – 3*a* in the equation of motion. Third A1 for 23.5 or 24	
(b)	B1 for $F = \mu R$ seen First M1 for resolving perpendicular to the plane (correct no. of terms with 2*g* resolved) First A1 for a correct equation (M1A0 for $R = mg\cos\alpha$) Second M1 for resolving parallel to the plane (correct no. of terms with 2*g* resolved but condone sign errors) Second A1 and third A1 for a correct equation (A1A0 for one error) N.B. Neither *T* nor *F* nor *a* needs to be substituted. Third M1 dependent on both previous M marks, for solving for μ(a *numerical* value) Fourth A1 for μ= 0.5 (A0 for 0.499)	

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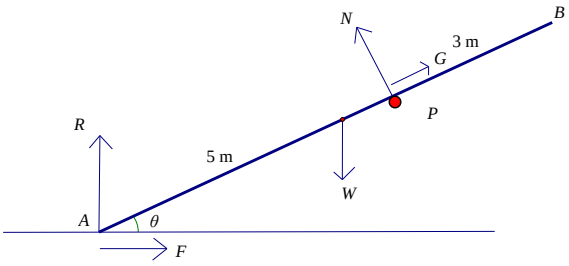
Mark Scheme(Results)

October 2016

Pearson Edexcel International A Level in Mechanics 2 (WME02/01)

Q	Scheme	Marks	Notes
	Change in energy $= \pm\left(\frac{1}{2}\times 4\times 6^2 - 4g\times 10\sin\alpha\right)$	A2	-1 each error
	$= 72 - 40g\times\frac{1}{7} = 16\,(\text{J})$ ***given answer***	A1	-16 is A0. Condone -16 becoming +16
		(4)	
3a alt	Complete strategy using *suvat* and N2L to find the work done	M1	
	$v^2 = u^2 + 2as \Rightarrow 36 = -20a \quad (a = -1.8)$	A1	
	$Fr + 4g\sin\theta = 4\times(\text{their } 1.8)$ $(Fr = 1.6)$	A1	
	Work Done = $1.6\times 10 = 16\,(\text{J})$ ***given answer***	A1	
		(4)	
	NB: For 3(b) must be using work-energy		
3b	Considering the whole journey: $\frac{1}{2}\times 4v^2 = \frac{1}{2}\times 4\times 36 - 2\times 16$	M1	Requires all 3 terms. Must be dimensionally correct. Condone sign errors
		A1	Correct unsimplified equation
	$v^2 = 20, \quad v = 4.47\,(\text{m s}^{-1})$ (4.5)	A1	Accept $2\sqrt{5}$
		(3)	
3b alt	Working from B to A: $\frac{1}{2}\times 4\times v^2 + 16 = 40g\sin\alpha$	M1	Requires all 3 terms. Must be dimensionally correct. Condone sign errors
		A1	Correct unsimplified equation
	$v^2 = 20, \quad v = 4.47\,(\text{m s}^{-1})$ (4.5)	A1	Accept $2\sqrt{5}$
		(3)	
		[7]	
4a	Differentiate **p** to obtain **v**:	M1	
	$\mathbf{v} = \left(3t^2 - 9t - 24\right)\mathbf{i} + \left(-3t^2 + 6t + 12\right)\mathbf{j}$	A1	
	Equate coefficients and obtain quadratic in	DM1	Dependent on preceding M1

Q	Scheme	Marks	Notes
	T: $3T^2-9T-24=-3T^2+6T+12$ $6T^2-15T-36=0$		
	Solve for T: $3(2T+3)(T-4)=0$,	M1	Independent. Solve a 3 term quadratic in T
	$T=4$	A1	
		(5)	
4b	Differentiate **v** to obtain **a**:	M1	
	$\mathbf{a}=(6t-9)\mathbf{i}+(-6t+6)\mathbf{j}$	A1	
	Use their T: $\mathbf{a}=(6T-9)\mathbf{i}+(-6T+6)\mathbf{j}=15\mathbf{i}-18\mathbf{j}$	DM1	Dependent on the preceding M1
	Use Pythagoras: $\lvert\mathbf{a}\rvert=\sqrt{15^2+18^2}$	M1	
	$=\sqrt{549}=23.4\,(\text{m s}^{-2})$	A1	23.4 or better
		(5)	
		[10]	

Q	Scheme	Marks	Notes
5a			
	Take moments about A:	M1	Must be dimensionally correct. Condone sin/cos confusion
	$5N = 4\cos\theta W$	A1	
	$N = \frac{12}{25}W = 0.48W$ ***Given Answer***	A1	
		(3)	
5b	$G = \frac{1}{4}N = 0.12W$	B1	Seen or implied
	Resolve vertically	M1	Needs all terms. Condone sin/cos confusion and sign errors
	$\updownarrow: R + N\cos\theta + G\sin\theta = W$	A1	$(R = 0.616W)$
	Resolve horizontally	M1	Needs all terms. Condone sin/cos confusion and sign errors
	$\leftrightarrow: F + G\cos\theta = N\sin\theta$	A1	$(F = 0.312W)$
	$\mu = \frac{N\sin\theta - G\cos\theta}{W - N\cos\theta - G\sin\theta}$	DM1	Use $F = \mu R$ to find μ Dependent on 2 preceding M marks
	$= \frac{0.48W \times 0.8 - 0.12W \times 0.6}{W - 0.48W \times 0.6 - 0.12W \times 0.8} = \frac{0.312}{0.616}$		
	$= 0.51 \quad (0.50649\ldots) \quad \left(\frac{39}{77}\right)$	A1	
		(7)	
		[10]	
	NB, One of the two equations required for part (b) could be a moments equation: M(P) $1\times W\cos\theta + 5F\sin\theta = 5R\cos\theta$ M(B) $3N + 8R\cos\theta = 4W\cos\theta + 8F\sin\theta$		