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Surname	Other names
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Pearson Edexcel
International
Advanced Level

Centre Number

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Candidate Number

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Mechanics M1

Advanced/Advanced Subsidiary

Wednesday 22 January 2014 – Morning
Time: 1 hour 30 minutes

Paper Reference

WME01/01

You must have:

Mathematical Formulae and Statistical Tables (Blue)

Total Marks

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Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Whenever a numerical value of g is required, take $g = 9.8 \text{ m s}^{-2}$, and give your answer to either two significant figures or three significant figures.
- When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information

- The total mark for this paper is 75.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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Question Number	Scheme	Marks
1. (a)	$12MU - 2MU = 5MV$ $2U = V$	M1 A1 A1 (3)
1. (b)	$I = 2M(V - -U) \text{ OR } I = 3M(-V - -4U)$ $= 6MU$	M1 A1 A1 (3) 6
Notes		
1. (a)	M1 for attempt at CLM equation, with correct no. of terms, dimensionally correct. Allow consistent extra g's and cancelled M's and sign errors. First A1 for a correct equation. Second A1 for $2U$ (-2U A0) N.B. Allow U's to be dropped or omitted in the equation if U is inserted in answer at the end. (Full marks can be scored). However, if U is not inserted then M0.	
1. (b)	M1 for attempt at impulse = difference in momenta, for either particle, (must be considering <i>one</i> particle) (M0 if g's are included or if mass omitted or if equation is dimensionally incorrect) Allow $\pm 2M(V - U)$ or $\pm 3M(-V - 4U)$ where V is their speed which does <i>not</i> need to be substituted. First A1 for $\pm 2M(2U - -U)$ or $\pm 3M(- 2U - -4U)$ A1 for $6MU$ cao (- $6MU$ is A0) Allow change of sign at end to obtain magnitude.	

Past Paper Question Number	(Mark Scheme)	This resource was created and owned by Pearson Edexcel	WME01 Marks
Scheme			
2. (a)	$v = \sqrt{2^2 + (-3)^2} = \sqrt{13} = 3.61 \text{ ms}^{-1}$		M1 A1 (2)
(b)	$\mathbf{a} + 4(2\mathbf{i} - 3\mathbf{j}) = (\mathbf{i} - 4\mathbf{j})$ $\mathbf{a} = (-7\mathbf{i} + 8\mathbf{j})\text{m}$		M1 A1 DM1 A1 (4) 6
Notes			
2. (a)	M1 for $\sqrt{\text{(sum of squares of cpt.s)}}$ allow $\sqrt{2^2+3^2}$ A1 for $\sqrt{13}$, 3.6 or better		
(b)	First M1 for $\mathbf{a} \pm 4(2\mathbf{i} - 3\mathbf{j}) = (\mathbf{i} - 4\mathbf{j})$ oe A1 for $\mathbf{a} + 4(2\mathbf{i} - 3\mathbf{j}) = (\mathbf{i} - 4\mathbf{j})$ oe Second DM1, dependent, for solving for a A1 for $(-7\mathbf{i} + 8\mathbf{j})$ A0 for $\begin{pmatrix} -7\mathbf{i} \\ 8\mathbf{j} \end{pmatrix}$ or $(-7\mathbf{i}, 8\mathbf{j})$		

Past Paper Question Number	(Mark Scheme) This resource was created and owned by Pearson Edexcel	WME01
	Scheme	Marks
3.	$M(X), 25g(14 - x) + 100g. 12 = 2009 \times 6$ $x = 12.8, 13 \text{ (m)}$	M1 A1 A1 DM1 A1 5
Notes		
3.	First M1 for producing an equation in a relevant unknown length <i>only</i> . Usual rules, correct no. of terms, dim correct. (If more than one equation is used, rules apply to <i>each</i> equation) First A2 for a correct equation; -1 each error (omission of <i>g</i> 's counts as one error) Second DM1, dependent, for solving for AG. Third A1 for 12.8, 13 oe. S.C. If they use <i>M</i> in their equation(s) and never find it or just assume a value for it e.g. 100, can score max M1A0A0M0A0	

Past Paper Question Number	(Mark Scheme)	This resource was created and owned by Pearson Edexcel	WME01 Marks
	Scheme		
4.	<p>Use of $F = \mu R$; $\cos \alpha = \frac{4}{5}$ or $\sin \alpha = \frac{3}{5}$</p> $kmg \cos \alpha - mg \sin \alpha = F$ $mg \cos \alpha - kmg \sin \alpha = R$ <p>equation in k and μ only</p> $k = \frac{3+4\mu}{4+3\mu}$		<p>B1 ; B1</p> <p>M1 A1 A1 M1 A1 A1 DM1</p> <p>DM1 A1</p> <p style="text-align: right;">11</p>
Notes			
4.	<p>First B1 for use of $F = \mu R$ i.e. seen on the diagram or in an equation. Second B1 for $\cos \alpha = 0.8$ or $\sin \alpha = 0.6$ seen. First M1 for resolving parallel to the plane (usual rules) First A2 for a correct equation; -1 each error (omission of both g's is 1 error) Second M1 for resolving perpendicular to the plane (usual rules) Second A2 for a correct equation; -1 each error (omission of both g's is 1 error) N.B. In each equation, if they write $\cos 4/5$ or $\sin 3/5$ (or both) treat as 1 A error but allow recovery if they actually use the correct trig. ratios. Third DM1, dependent on first two M marks, for producing an equation in k and μ only. Fourth DM1, dependent on third M1, for solving for k, in terms of μ only. Fifth A1 for $k = \frac{3+4\mu}{4+3\mu}$ oe N.B. The first two M1A2 marks can be for two resolutions in any two directions.</p>		

Past Paper Question Number	(Mark Scheme)	This resource was created and owned by Pearson Edexcel	WME01 Marks
		Scheme	
5.		$48 = 3u + \frac{1}{2}9a$ $248 = 8u + \frac{1}{2}64a$ $a = 6 \text{ ms}^{-1}$ $u = 7 \text{ ms}^{-1}$	M1 A1 M1 A1 A1 M1 A1 7

Notes

5.	<p>First M1 for producing an equation in u and a only. First A1 for a correct equation Second M1 for producing an equation in u and a only. (M0 for $200 = 5u + 0.5a \cdot 5^2$) Second A1 for a correct equation Third M1 independent for solving <i>simultaneous</i> equations, in u and a only, for either u or a Third A1 for $a = 6$ Fourth A1 for $u = 7$</p> <p><u>Alternative using speed v at $t = 3$:</u> First M1 for attempt at: $48 = 3v - 0.5a \cdot 3^2$ First A1 for a correct equation Second M1 attempt at : $200 = 5v + 0.5a \cdot 5^2$ Second A1 for a correct equation Third M1 independent for solving <i>simultaneous</i> equations, in u and a only, for either u or a Third A1 for $a = 6$ Fourth A1 for $u = 7$</p> <p><u>Alternative, using average speed = actual speed at half-time</u> $v = 48/3$ at $t = 1.5$ (must be used/stated) M1 A1 $v = 200/5$ at $t = 5.5$ (must be used/stated) M1 A1 $a = (40 - 16)/(5.5 - 1.5) = 6$ DM1 A1 $u = 16 - (6 \times 1.5) = 7$ A1</p>
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Past Paper Question Number	(Mark Scheme)	This resource was created and owned by Pearson Edexcel	WME01 Marks
		Scheme	
6. (a)		$0.75 = \frac{1}{2} a(0.5)^2$ $a = 6$ $0.5g \sin \theta - T = 0.5a$ $T = 0.92 N$	M1 A1 A1 M1 A1 A1 (6)
(b)		$R = 0.1g$ $T - \mu R = 0.1a$ $0.92 - \mu 0.1g = 0.1 \times 6$ $\mu = 0.327 \text{ or } 0.33$	B1 M1 A1 M1 A1 (5) 11
Notes			
6. (a)		First M1 for use of $s = ut + \frac{1}{2}at^2$ (or use of 2 <i>suvat</i> formulae AND eliminating v) with $u = 0$, to give equation in a <i>only</i> . First A1 for a correct equation Second A1 for $a = 6$ Second M1 for resolving parallel to the plane, up or down, for Q <i>only</i> . Third A1 for a correct equation (a does not need to be substituted) Fourth A1 for $T = 0.92$ (N)	
(b)		B1 for $R = 0.1g$ First M1 for resolving horizontally for P only First A1 for a correct equation (neither T , R nor a need to be substituted) Second M1 for substituting for T , R and a and solving for μ . Second A1 for $\mu = 0.327$ or 0.33 (16/49 A0)	
		<u>Alternative:</u> B1 for $R = 0.1g$ First M1 for a 'whole system' equation: $0.5g \sin \theta - \mu R = 0.6a$ First A1 for a correct equation (neither R nor a need to be substituted) Second M1 for substituting for R and a and solving for μ . Second A1 for $\mu = 0.327$ or 0.33	

Past Paper Question Number	(Mark Scheme)	This resource was created and owned by Pearson Edexcel	WME01 Marks
Scheme			
7. (a)		$\tan \theta = \frac{9}{13}$ $\theta = 34.7^\circ$	M1 A1 A1 (3)
(b)		$a(2\mathbf{i} - \mathbf{j}) + b(\mathbf{i} + 3\mathbf{j}) = (9\mathbf{i} + 13\mathbf{j})$ $2a + b = 9$ $-a + 3b = 13$ $a = 2, b = 5$ $\mathbf{P} = (4\mathbf{i} - 2\mathbf{j})\text{N}; \mathbf{Q} = (5\mathbf{i} + 15\mathbf{j})\text{N}$	M1 A2 M1 M1 A1 A1 A1 A1 (9) 12
Notes			
7. (a)	<p>M1 for $\tan \theta = 9/13$ or $13/9$ First A1 for a correct equation (allowing for a correct adjustment to their angle in the subsequent working) Second A1 for $\theta = 35^\circ$ or better or 325° or better</p>		
(b)	<p>First M1 for $\mathbf{P} + \mathbf{Q} = 9\mathbf{i} + 13\mathbf{j}$ or $\mathbf{P} + \mathbf{Q} = \mathbf{F}$ (can occur anywhere) First A2; Treat as <u>B1</u> for $a(2\mathbf{i} - \mathbf{j})$ seen or implied; <u>B1</u> for $b(\mathbf{i} + 3\mathbf{j})$ seen or implied. If they use the same a and b, they lose one of the B marks. Second M1 for equating their \mathbf{i}- cpts and their \mathbf{j}- cpts to produce two equations in two unknowns Third independent M1 for eliminating one unknown from 2 simultaneous equations Third A1 for $a = 2$ oe Fourth A1 for $b = 5$ oe Fifth A1 for $\mathbf{P} = (4\mathbf{i} - 2\mathbf{j})$ (N) Sixth A1 for $\mathbf{Q} = (5\mathbf{i} + 15\mathbf{j})$ (N) N.B. Can score all the marks if they 'spot' the answers.</p>		

Past Paper (Mark Scheme)

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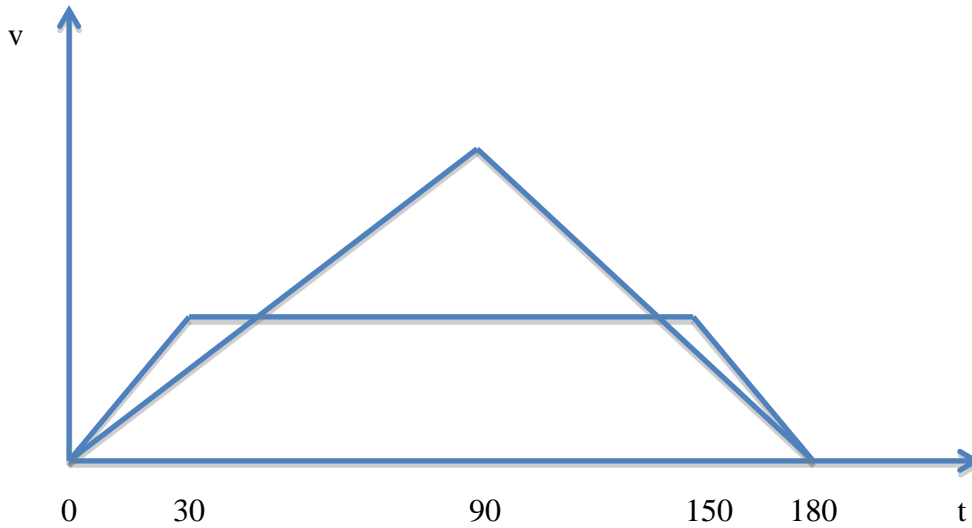
WME01

Question Number

Scheme

Marks

8. (a)



B1
trapezium

B1 triangle
& overlap
B1 figs

(3)

(b)

$$\frac{1}{2}(90 + 60) \cdot 20 = 1500$$

$$1500 = \frac{1}{2} a \cdot 90^2$$

$$a = \frac{10}{27} \text{ ms}^{-1} \text{ or decimal}$$

M1 A1

M1 A1 ft

A1

(5)

(c)

$$\frac{10t}{27} = 20$$

$$t = 54 \text{ s}$$

$$t = 126 \text{ s}$$

M1 A1

A1

A1 ft

(4)

(d)

$$\frac{10}{27} \times 90 \left(= \frac{100}{3} \right)$$

$$\frac{100}{3} \times 6 - \frac{1}{2} \cdot \frac{10}{27} \cdot 6^2 \left(= \frac{580}{3} \right)$$

$$d = \frac{580}{3} - (20 \times 6)$$

$$= \frac{220}{3} \text{ m or decimal}$$

M1

DM1 A1

DM1

A1 (5)

17

Notes	
8. (a)	<p>First B1 for isosceles (approx.) trapezium, from the origin, finishing on the t-axis. Second B1 for isosceles (approx.) triangle, from the origin, finishing on the t-axis at the same point <i>and overlapping twice</i>. Third B1 for 30, 90, 150, 180 placed correctly. Allow delineators</p>
(b)	<p>First M1 for complete method to find distance (or half the distance) between the stations First A1 for a correct expression (may not be evaluated) Second M1 for a complete method to find a (M0 if they use s = the full distance in any <i>suvat</i> equation) Second A1 ft on their distance Third A1 10/27 oe, 0.37 or better</p>
(c)	<p>First M1 for (their a) $\times t = 20$ (or their v max for A) First A1 for a correct equation Second A1 for 54 (t_1) (54.1 A0) Third A1 ft for $(180 - t_1)$, provided $30 < t_1 < 90$</p>
(d)	<p>First M1 for finding max speed of B e.g. their $a \times 90$ (ans 100/3) (may have been found in (b) but must be seen in (d)) Second M1 for a complete method (must have found a max V) to find distance moved by B between $t = 90$ and $t = 96$ (or between 84 and 90) First A1 for a correct expression Third DM1, dependent on first and second M marks, for a complete method to find the required distance Second A1 for 220/3 m oe, 73 m or better</p>