GCE

Mathematics A

H230/02: Pure Mathematics and Mechanics

AS Level

Mark Scheme for June 2024

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING

RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **number of required** standardisation responses.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. **Annotations**

Annotation	Meaning
✓and ✗	
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working
M0, M1	Method mark awarded 0, 1
A0, A1	Accuracy mark awarded 0, 1
B0, B1	Independent mark awarded 0, 1
SC	Special case
^	Omission sign
MR	Misread
BP	Blank Page
Seen	
Highlighting	

Other abbreviations in mark scheme	Meaning
dep*	Mark dependent on a previous mark, indicated by *. The * may be omitted if only one previous M mark
cao	Correct answer only
oe	Or equivalent
rot	Rounded or truncated
soi	Seen or implied
www	Without wrong working
AG	Answer given
awrt	Anything which rounds to
BC	By Calculator
DR	This question included the instruction: In this question you must show detailed reasoning.

5. **Subject Specific Marking Instructions**

a. Annotations must be used during your marking. For a response awarded zero (or full) marks a single appropriate annotation (cross, tick, M0 or ^) is sufficient, but not required.

For responses that are not awarded either 0 or full marks, you must make it clear how you have arrived at the mark you have awarded and all responses must have enough annotation for a reviewer to decide if the mark awarded is correct without having to mark it independently.

It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

Award NR (No Response)
- if there is nothing written at all in the answer space and no attempt elsewhere in the script
- OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
- OR if there is a mark (e.g. a dash, a question mark, a picture) which isn't an attempt at the question.

Note: Award 0 marks only for an attempt that earns no credit (including copying out the question).

If a candidate uses the answer space for one question to answer another, for example using the space for 8(b) to answer 8(a), then give benefit of doubt unless it is ambiguous for which part it is intended.

b. An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct solutions leading to correct answers are awarded full marks but work must not always be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly. Correct but unfamiliar or unexpected methods are often signalled by a correct result following an apparently incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, escalate the question to your Team Leader who will decide on a course of action with the Principal Examiner.

If you are in any doubt whatsoever you should contact your Team Leader.

c. The following types of marks are available.

M
A suitable method has been selected and applied in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.
A method mark may usually be implied by a correct answer unless the question includes the DR statement, the command words "Determine" or "Show that", or some other indication that the method must be given explicitly.

A
Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

B
Mark for a correct result or statement independent of Method marks.

Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

d. When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation 'dep*' is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.

e. The abbreviation FT implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A and B marks are given for correct work only – differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, what is acceptable will be detailed in the mark scheme. If this is not the case please, escalate the question to your Team Leader who will decide on a course of action with the Principal Examiner.

Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be 'follow through'. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

f. We are usually quite flexible about the accuracy to which the final answer is expressed; over-specification is usually only penalised where the scheme explicitly says so.
   - When a value is **given** in the paper only accept an answer correct to at least as many significant figures as the given value.
   - When a value is **not given** in the paper accept any answer that agrees with the correct value to **3 s.f.** unless a different level of accuracy has been asked for in the question, or the mark scheme specifies an acceptable range.
     NB for Specification B (MEI) the rubric is not specific about the level of accuracy required, so this statement reads "2 s.f".

   Follow through should be used so that only one mark in any question is lost for each distinct accuracy error.
   Candidates using a value of 9.80, 9.81 or 10 for g should usually be penalised for any final accuracy marks which do not agree to the value found with 9.8 which is given in the rubric.

g. Rules for replaced work and multiple attempts:
   - If one attempt is clearly indicated as the one to mark, or only one is left uncrossed out, then mark that attempt and ignore the others.
   - If more than one attempt is left not crossed out, then mark the last attempt unless it only repeats part of the first attempt or is substantially less complete.
   - if a candidate crosses out all of their attempts, the assessor should attempt to mark the crossed out answer(s) as above and award marks appropriately.

h. For a genuine misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for some units. This is achieved by withholding one A or B mark in the question. Marks designated as cao may be awarded as long as there are no other errors. If a candidate corrects the misread in a later part, do not continue to follow through. Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

i. If a calculator is used, some answers may be obtained with little or no working visible. Allow full marks for correct answers, provided that there is nothing in the wording of the question specifying that analytical methods are required such as the bold "In this question you must show detailed reasoning", or the command words "Show" or "Determine". Where an answer is wrong but there is some evidence of method, allow appropriate method marks. Wrong answers with no supporting method score zero. If in doubt, consult your Team Leader.

j. If in any case the scheme operates with considerable unfairness consult your Team Leader.

Question			Answer		Marks	AO	Guidance	
1	(a)		$3[(x+4)^2-16]+5$ ...	$a = 3$	**B1**	**1.1**	No marks until attempt to complete the square Must be of the form $3(x\pm\propto)^2\pm\cdots$ where $\propto\neq 0$	If they compare coefficients $a = 3$ **B1**, $b = 4$ **B1**, $c = -43$ **B1**
				$(x+4)^2$	**B1**	**1.1**	Allow $(x+\frac{8}{2})^2$	
			$3(x+4)^2-43$	$c = -43$	**B1**	**1.1**	If expression set to 0, ignore = 0	$3(x^2+4)^2-43$ scores **B0 B0 B1**
					[3]			
1	(b)		$y \leqslant 0$ $y \geqslant 3x^2+24x+5$		**B1** **B1**	**1.1** **1.1**	Accept $-43 \leq y \leq 0$ If **B0 B0** then **SC B1** if both 'correct' but with strict inequalities	
					[2]			

Question			Answer	Marks	AO	Guidance	
2	(a)		$14(5\sin\theta) = 50$	M1*	1.1	Correct method for finding either the supplement of the required angle *DAB* (e.g. $2\left(\frac{1}{2}\times 5\times 14\times\sin\theta\right) = 50$) **or** the angle ($\alpha$) between *DA* and the vertical (e.g. $14(5\cos\alpha) = 50$)	Where θ is the supplement to the required angle *DAB*
			$\theta = \sin^{-1}\frac{5}{7} = 45.6$ or better or $\alpha = \cos^{-1}\frac{5}{7} = 44.4$ or better	M1dep*	1.1	For either obtuse or acute angle	
			Angle *DAB* = 134.4	A1 [3]	1.1	awrt 134.4	134.4153086…
2	(b)		$(BD^2 =) 5^2 + 14^2 - 2(5)(14)\cos('134.4')$	M1	1.1	Correct application of cosine rule with their *DAB* or other complete method	Allow this mark even if angle *DAB* is acute
			(BD =) 17.9	A1 [2]	1.1	awrt 17.9	For ref: If using 1 d.p. from **(a)** then 17.8592516…, if using 'exact' value then should obtain 17.85999971…

Question			Answer	Marks	AO	Guidance	
3	(a)		$kx^2 + 2kx - 3x + 2k + 1$ oe	B1	2.1	Correctly moves all terms to one side of the equation	
			$(2k-3)^2 - 4(k)(2k+1)$	M1*	1.1	Use of $b^2 - 4ac$ with $a = \pm k,\ b = \pm 2k \pm 3,\ c = \pm 2k \pm 1$. Allow with any inequality or equals	Therefore, allow sign errors only **M0** if $b^2 - 4ac$ appears **only** in the quadratic formula
			$(2k-3)^2 - 4(k)(2k+1) < 0$	M1dep*	1.1	Setting discriminant < 0	
			$4k^2 - 12k + 9 - 8k^2 - 4k < 0$ $-4k^2 - 16k + 9 < 0$ $\Rightarrow 4k^2 + 16k - 9 > 0$	A1 [4]	2.2a	**AG -** sufficient working must be shown (e.g. at least one line of working from $(2k-3)^2 - 4(k)(2k+1) < 0$ to given answer)	All inequality work must be correct throughout for this mark
3	(b)		c.v. are 0.5 and –4.5	B1	1.1	**BC** – correct critical values of k	
			$\{k : k > 0.5\} \cup \{k : k < -4.5\}$	B1FT [2]	2.5	FT their critical values k_1, k_2 from the given correct inequality e.g. $\{k : k > k_1\} \cup \{k : k < k_2\}$ where $k_1 > k_2$	Answer must be in set notation for this mark

Question			Answer	Marks	AO	Guidance	
4	(a)			M1	1.1	x in $\sqrt{2x-1}$ replaced with either $4x$ or $\frac{1}{4}x$	
			$y = \sqrt{8x-1}$	A1	1.2	cao	Must have $y =$ …
				[2]			
4	(b)		(1, 3)	B1 B1	3.1a 1.1	Correct x-coordinate Correct y-coordinate Accept $x = 1$, $y = 3$	$(1, \pm 3)$ scores **B1B0** unless -3 is rejected. $\binom{1}{3}$ scores **SC B1**
				[2]			

Question			Answer	Marks	AO	Guidance	
5	(a)		$\left(\frac{dy}{dx} =\right) 3e^{3x} - 21$	B1	1.1	Correct derivative	
			$3e^{3x} - 21 = 3 \Rightarrow e^{3x} = 8$	M1*	1.1	Setting derivative equal to 3 and re-arranging to $e^{3x} = k$ where $k > 0$	
			$\ln e^{3x} = \ln 8$	M1dep*	1.1	Correctly taking the natural log of both sides of an equation of the form $e^{3x} = k$ or $e^{x} = \sqrt[3]{k}$ where $k > 0$	
			$x = \frac{1}{3}\ln 8 \therefore x = \ln 2$	A1	1.1	cao – not necessary to explicitly state $a = 2$	
				[4]			
5	(b)		$y = e^{3\ln 2} - 21\ln 2 - 8$	B1FT	1.1	Substitute their x involving "ln" to find the corresponding exact y-coordinate	Need not be simplified
			$y - \left(e^{3\ln 2} - 21\ln 2 - 8\right) = 3(x - \ln 2)$	M1	1.1	Tangent must be of the of the form $y - (e^{3x_1} - 21x_1 - 8) = 3(x - x_1)$ Could use $y = mx+c$ to obtain $c = e^{3x_1} - 24x_1 - 8$	Allow non-exact working
			$y = 3x - 24\ln 2$	A1	1.1	oe c must be exact	
				[3]			

Question			Answer	Marks	AO	Guidance	
6			$\frac{dy}{dx} = 20x^3 + 3ax^2 + b$	**M1***	**2.1**	Attempt to differentiate (at least two terms correct)	
			$12a + b = -160$	**M1dep***	**1.1**	Substitutes $x = 2$ into their derivative and set derivative equal to zero (need not be simplified)	
				M1*	**1.1**	Attempt to integrate (all terms with powers increased by 1 and at least one term correct)	
			$\int (5x^4 + ax^3 + bx)\,dx = \frac{5x^5}{5} + \frac{ax^4}{4} + \frac{bx^2}{2}(+c)$	**A1**	**1.1**	cao (need not be simplified)	
			$\int_0^2 (5x^4 + ax^3 + bx)\,dx$ $= (2)^5 + \frac{a}{4}(2)^4 + \frac{b}{2}(2)^2 = -48$	**M1dep***	**3.1a**	Correct use of limits $x = 0$ and $x = 2$ in their integrated expression (need not be simplified) and set equal to ± 48 (oe). Needs to be in terms of a and b.	For reference (if simplified): $2a + b = -40$
			$a = -12,\ b = -16$	**A1**	**1.1**	**BC** (For reference if correct: $y = 5x^4 - 12x^3 - 16x$)	
			y-coordinate of P is -48	**A1**	**2.2a**	cao	www
				[7]			

Question			Answer	Marks	AO	Guidance	
7	(a)	(i)	8	B1 [1]	1.1		
7	(a)	(ii)	$\cos(30x+60)=1$	M1*	1.1a	Setting $\cos(30x+60)$ equal to 1	Possibly implied by next mark
			$30x+60=360$	M1dep*	1.1	Set $30x+60$ equal to 360	May see $x=-2+12$
			$x=10$	A1 [3]	1.1	The answer needs to come from sufficient working, if not **M0 A0**	**SC B1** $\cos(30x+60)=k$ for $0<k<1$ where $k=\frac{\text{their (a)(i)}-5}{3}$
7	(b)		$5+3\cos(30x+60)=7$ $\cos(30x+60)=\frac{2}{3}$	M1	1.1	Sets given equation equal to 7 and rearranges to obtain $\cos(30x+60)=k$ where $-1<k<1$	Condone sign errors in rearranging
			$(30x+60=)48.18$	A1	1.1	Finds the principal value of $30x$ + 60	48.1896851…
			$30x+60=360-48.18..$ or $360+48.18..$	M1	3.1a	At least one correct value of $30x$+ 60 using correct symmetry for cosine curve	
			$(x=)$8.39 to 3 sf Allow awrt 8.39	A1	1.1	One correct value of x (in the interval $0 < x < 12$)	8.393677163…
			$(x=)$11.6 to 3 sf Allow awrt 11.6	A1 [5]	2.2a	Second correct value	11.60632284…

Question			Answer	Marks	AO	Guidance	
8	(a)		$\left(5, \frac{8+p}{2}\right)$	B1 [1]	1.1	Allow unsimplified e.g. $\left(\frac{4+6}{2}, \frac{8+p}{2}\right)$ Allow $x = \frac{4+6}{2}, y = \frac{8+p}{2}$	ISW if correct unsimplified answer is incorrectly simplified
8	(b)		$(m_{AB} =) \frac{p-8}{2}$	B1 [1]	1.1	Allow unsimplified e.g. $\frac{8-p}{4-6}$	ISW if correct unsimplified answer is incorrectly simplified
8	(c)		$(m_{\perp} =) \frac{2}{8-p}$	B1FT	2.1	Correctly applies $m_1 m_2 = -1$ to their answer to part **(b)** to obtain the gradient of the line perp. to *AB*	
			$y - \left(\frac{8+p}{2}\right) = \frac{2}{8-p}(x-5)$	M1*	3.1a	Setting up an equation in p for the line through the midpoint of *AB* perp. to *AB* . Could use $y=mx+c$ and obtain c in terms of p.	Using their part **(a)** or $\left(\frac{7}{5}p, 0\right)$ and their perp. gradient to *AB*
			$0 - \left(\frac{8+p}{2}\right) = \frac{2}{8-p}\left(\frac{7}{5}p - 5\right)$	M1dep*	1.1	Substituting $\left(\frac{7}{5}p, 0\right)$ into their line. Could obtain another expression for c using the other point and equate the two expressions of c.	Or their part **(a)**
			$5p^2 - 28p - 220 = 0$ or $5p^3 - 68p^2 + 4p + 1760 = 0$	A1	1.1	Expand and simplify to a 3TQ in p or possibly a 4 term cubic in p.	
			(p = 10 and) so x = 14	A1 [5]	3.2a	**BC** cao	

Question			Answer	Marks	AO	Guidance	
8	(c)		Alternative method using gradients only: $(m_{\perp} =) \dfrac{2}{8-p}$	**B1FT**	**2.1**	Correctly applies $m_1 m_2 = -1$ to their answer to part **(b)** to obtain the gradient of the line perp. to *AB*	
			$(m_{\perp} =) \dfrac{\frac{8+p}{2} - 0}{5 - \frac{7}{5}p}$	**M1***	**3.1a**	Obtains an expression for the gradient between their part **(a)** and $\left(\frac{7}{5}p,\ 0\right)$.	
			$\dfrac{2}{8-p} = \dfrac{\frac{8+p}{2}}{5 - \frac{7}{5}p}$	**M1dep***	**1.1**	Equates the two expressions for the gradient to obtain an equation in p.	
			$5p^2 - 28p - 220 = 0$	**A1**	**1.1**	Expand and simplify to a 3TQ in p	
			(p = 10 and) so x = 14	**A1** **[5]**	**3.2a**	**BC** cao	

Question			Answer	Marks	AO	Guidance	
9	(a)		$\begin{pmatrix}3\\-7\end{pmatrix}+\begin{pmatrix}-5\\10\end{pmatrix}+\mathbf{F}_3=\mathbf{0}$	M1	3.3	Use $\mathbf{F}_1+\mathbf{F}_2+\mathbf{F}_3=\mathbf{0}$ Correct answer implies this mark	Allow sign errors. One correct component for $\mathbf{F}_3$ can imply this mark
			$\mathbf{F}_3=\begin{pmatrix}2\\-3\end{pmatrix}$ (N)	A1 [2]	1.1	cao – isw if magnitude of the force is found after correct vector seen	oe e.g. $-\begin{pmatrix}-2\\3\end{pmatrix}, 2\mathbf{i}-3\mathbf{j}$
9	(b)		$\begin{pmatrix}3\\-7\end{pmatrix}+\begin{pmatrix}-5\\10\end{pmatrix}+\begin{pmatrix}8\\1\end{pmatrix}=2.5\mathbf{a}$	M1	3.4	Use of $\mathbf{F}=m\mathbf{a}$ with m = 2.5 and at least one correct component for $\mathbf{F}=\begin{pmatrix}6\\4\end{pmatrix}$ (either stated or implied by working)	
			$\mathbf{a}=\begin{pmatrix}2.4\\1.6\end{pmatrix}$ (m s^{-2})	A1 [2]	1.1	cao – isw if magnitude of the acceleration is found after correct vector seen	

Question			Answer	Marks	AO	Guidance	
10	(a)			M1*	3.3	Attempt N2L for P and Q – three terms, mass required, condone sign errors	**M0** for $a = 0$ or $\pm g$
			$3g - T = 3a$ $T - 2g = 2a$	A1	1.1	Both equations correct	
			$3g - T = 3\left(\frac{T - 2g}{2}\right) \Rightarrow T = ...$	M1dep*	3.4	Eliminate a and attempt to solve for T	Or eliminate T to find a first and substitute back numerical a to evaluate T $(a = \frac{1}{5}g = 1.96)$
			$T = 23.52$ (N)	A1	1.1	Accept 23.5 or $\frac{12}{5}g$	
				[4]			
10	(b)		$v^2 = 4.2^2 + 2('1.96')(4)$	M1	3.4	$v^2 = u^2 + 2as$ with $u = 4.2$, $s = 4$ and their a (which must be positive but not g)	May have s = - 4 and their a is negative (but not -g)
			$v = 5.77$ to 3 sf	A1	1.1	5.772347876…	$\frac{7\sqrt{17}}{5}$
				[2]			

Question			Answer	Marks	AO	Guidance	
10	(c)		$'5.77\ldots' = 4.2 + ('1.96')t_1$	M1	3.3	Correctly uses $v = u + at$ with $u = 4.2$ and their v and a where $a \neq 0$ or g. (Or uses $s = ut + \frac{1}{2}at^2$ with $u = 4.2$, $s = 4$ and their calculated value for a Or uses $s = \frac{1}{2}(u + v)t$ with $s = 4$, u =4.2 and their v)	Where t_1 is the time for P to move 4 m Must be using a consistent sign convention to earn **M1**
			$t_1 = 0.801$ ... or 0.802 ...	A1	1.1		0.802218304… $\frac{-15+5\sqrt{17}}{7}$
			$0 = '5.77\ldots' + (-9.8)t_2$	M1	3.4	Correct use of $v = u + at$ with $v = 0$, $a = -g$ and their positive u from part (b) (If correct: $t_2 = \frac{\sqrt{17}}{7}$ =0.5890150894…)	Where t_2 is the time from P hitting the ground until Q comes to rest
			1.39 (s) to 3sf	A1	2.2a	Allow awrt 1.39	1.391233393… $\frac{-15+6\sqrt{17}}{7}$
				[4]			
10	(d)		If this string is not inextensible, then the acceleration of P and the acceleration of Q would not have equal magnitude	B1	3.5a	**B0** for inextensible $\Rightarrow$ accelerations same See appendix for exemplars	**B0** for any incorrect extras
				[1]			

Question			Answer	Marks	AO	Guidance	
11	(a)			M1*	3.1b	Attempt to integrate given expression for *v* (either one term correct **or** both powers increased by 1)	
			$(s_P =) 5t + 0.001t^3$	A1	1.1		
			$(s_Q =) 7.08(t - 5)$	B1	3.3	Correct expression for the displacement of Q	
			$5T + 0.001T^3 = 7.08(T - 5)$	M1dep*	1.1	Equate integrated expression from given *v* and $7.08(t \pm 5)$ only	Allow *t* for *T*
			$0.001T^3 - 2.08T + 35.4 = 0$ $\Rightarrow T^3 - 2080T + 35400 = 0$	A1	2.2a	**AG** - sufficient working must be shown (e.g. at least one line of working from setting correct (un-simplified) expressions equal to each other to obtaining the given answer)	
				[5]			

Question			Answer	Marks	AO	Guidance	
11	(b)		**DR**				
			$T^3 - 2080T + 35400 = 0$ $\Rightarrow (T-30)(T^2 + ... - 1180) = 0$	**M1***	**3.1b**	Factorising given cubic equation using given linear factor and obtaining a three-term quadratic factor of the form $(T^2 + kT - 1180)$ for some $k \neq 0$	Or obtains a three-term quadratic from using long division (errors in working may mean the remainder is not zero)
			$T^2 + 30T - 1180$	**A1**	**1.1**	Correct quadratic expression	
			$T = \frac{-30 \pm \sqrt{30^2 - 4(1)(-1180)}}{2} \Rightarrow T = 22.5$	**A1**	**3.2a**	Correct value of T (so not the negative value or 30)	Condone lack of explicitly rejecting negative root (–52.48...)
			$(a_P =) 0.006t$	**B1**	**3.4**	Correct expression for the acceleration of P at time t	
			0.135 (m s^{-2})	**B1**	**2.2a**	awrt 0.135	0.13489997…
				[5]			

APPENDIX : We were looking for the idea that the accelerations would be different or that they would not be constant.

Exemplar responses for Q10(b)

Response	Mark
Acceleration would not be constant	**B1**
Acceleration would vary	**B1**
Acceleration would be variable	**B1**
The acceleration of these two balls would be different	**B1**
The acceleration of these two balls would not be equal	**B1**
The acceleration of one ball is greater than the other	**B1**
The acceleration of these two balls would be greater/increase	**B0**
The acceleration of these two balls would be lower/decrease	**B0**
The acceleration of these two balls would be less	**B0**

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