Mark Scheme (Post-Standardisation)

Summer 2026

Pearson Edexcel International Advanced Level

In Mechanics M1

WME01/01A

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

EDEXCEL IAL MATHEMATICS
General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:
   - **M** marks: Method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
   - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
   - **B** marks are unconditional accuracy marks (independent of M marks)

   Marks should not be subdivided.

3. Abbreviations

   These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN:
   - bod – benefit of doubt
   - ft – follow through
     - the symbol $\surd$ will be used for correct ft
   - cao – correct answer only
   - cso – correct solution only. There must be no errors in this part of the question to obtain this mark
   - isw – ignore subsequent working
   - awrt – answers which round to
   - SC – special case
   - oe – or equivalent (and appropriate)
   - d… or dep – dependent
   - indep – independent
   - dp – decimal places
   - sf – significant figures
   - * – The answer is printed on the paper or ag- answer given
   - $\sqsubset$ or d… – The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected. If you are using the annotation facility on ePEN, indicate this action by 'MR' in the body of the script.

6. If a candidate makes more than one attempt at any question:
   a) If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
   b) If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

General Principles for Mechanics Marking

(***N.B.*** *specific mark schemes may sometimes override these general principles*)

- Rules for M marks:
  - correct number of terms
  - dimensionally correct
  - all terms that need resolving (i.e. *multiplied* by cos or sin) are resolved
  - only terms that need resolving are resolved
  - +/– errors are condoned
  - sin/cos confusion is condoned
- Omission or extra *g* in a resolution is an accuracy error not method error.
- Omission of mass from a resolution is a method error.
- Omission of a length from a moments equation is a method error.
- Omission of units or incorrect units is not (usually) counted as an accuracy error.
- DM indicates a dependent method mark, i.e. one that can only be awarded if a previous specified method mark(s) has been awarded.
- Any numerical answer which comes from use of $g = 9.8$ should be given as a decimal to 2 or 3 SF.
- Use of $g = 9.81$ should be penalised once per (complete) question.
  - N.B. Over-accuracy or under-accuracy of correct answers should only be penalised *once* per complete question. However, premature approximation should be penalised every time it occurs.
- Marks must be entered in the same order as they appear on the mark scheme.
- In all cases, if the candidate clearly labels their working under a particular part of a question i.e. (a) or (b) or (c)…then that working can only score marks for that part of the question.
- Accept column vectors in all cases.
- Misreads – if a misread does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, bearing in mind that after a misread, the subsequent A marks affected are treated as A ft

1. A particle A has mass m and a particle B has mass km, where k is a constant. The particles are moving towards each other in opposite directions along the same straight line when they collide directly.

Immediately before the collision, the speed of A is $3u$ and the speed of B is $2u$.

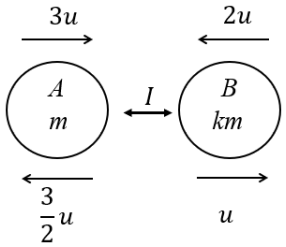
As a result of the collision, the speed of each particle is halved and the direction of motion of each particle is reversed.

(a) Find the value of k.

(3)

(b) Find, in terms of m and u, the magnitude of the impulse exerted on B by A in the collision.

(3)

QUESTION NUMBER	SCHEME	MARKS
1(a)		
	CLM	M1
	$3mu - 2kmu = -\frac{3}{2}mu + kmu$	A1
	$k = \frac{3}{2}$	A1
		(3)
1(b)	Impulse equation for A or B	M1
	For A: $\pm m\left(\frac{3u}{2} - -3u\right)$ **OR** For B: $\pm\ "\frac{3}{2}"m\left(u - -2u\right)$	A1ft
	$\frac{9mu}{2}$ oe	A1
		(3)
		(6)
	Notes for Question 1	
1(a)		
M1	CLM: all terms included, dimensionally correct, condone sign errors, allow consistent cancelled m's and consistent extra g's. The mass and speed must be paired correctly and both speeds must be halved.	
A1	Correct unsimplified equation in terms of k (m and u) only.	
A1	Correct answer.	
	S.C. For both speeds to have halved and changed direction, total initial momentum must be zero, so $m \times 3u - km \times 2u = 0$ and hence result.	
1(b)		
M1	Impulse-momentum equation for either particle in terms of m and u. No need to substitute k for the method mark only. Dimensionally correct, condone sign errors. Must correctly pair mass and *their* speeds used in part (a) for the method mark only. M0 if extra g.	
A1ft	Correct unsimplified expression in terms of m and u only. Follow through is **only** for their k value if using B.	
A1	Correct solution only i.e. the answer must be positive and, if $k = \frac{3}{2}$ is used, it must have come from correct working.	

2.

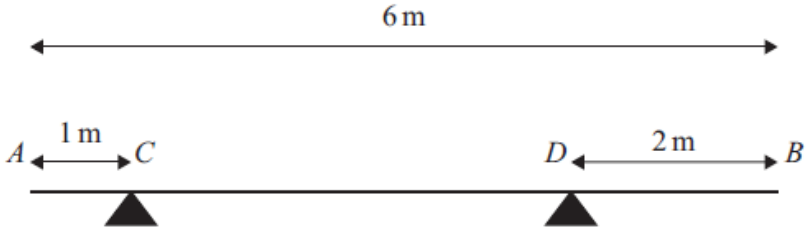


Figure 1

A uniform rod AB has mass 30 kg and length 6 m. The rod rests in equilibrium in a horizontal position on two supports, one at C, where $AC = 1$ m, and the other at D, where $DB = 2$ m, as shown in Figure 1.

A particle of mass 60 kg is placed on the rod at a point which is 2 m from A.

Another particle, whose mass is 75 kg, is placed on the rod at a point that is x metres from B.

The rod remains at rest in equilibrium in a horizontal position.

The magnitude of the force acting on the rod at C is two thirds of the magnitude of the force acting on the rod at D.

(a) Find the magnitude of the force acting on the rod at D.

(3)

(b) Find the exact value of x.

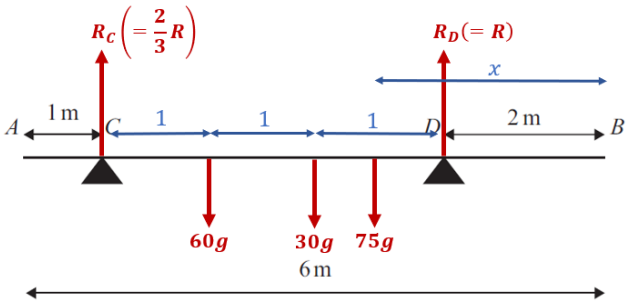
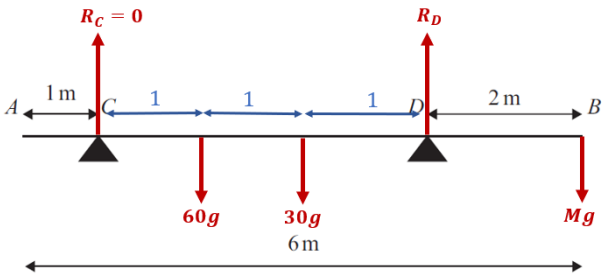
(3)

The particle of mass 75 kg is now removed.

A particle of unknown mass is placed on the rod at B and the rod is now on the point of tilting.

(c) Find the magnitude of the force that is now acting on the rod at D.

(3)

QUESTION NUMBER	SCHEME	MARKS
2(a)		
	Method to form an equation in R_C or R_D only E.g. Resolve vertically $R_c + R_D = 30g + 60g + 75g$	M1
	$\frac{2}{3}R_D + R_D = 30g + 60g + 75g$	A1
	$R_D = 970$ (N) Accept $99g$	A1
		(3)
2(b)	Method to form a moments equation in x only • M(B): $75gx + (30g \times 3) + (60g \times 4) = (R_C \times 5) + (R_D \times 2)$ Other possible equations: M(A): $75g(6-x) + (30g \times 3) + (60g \times 2) = (R_C \times 1) + (R_D \times 4)$ M(C): $(R_D \times 3) = (30g \times 2) + (60g \times 1) + 75g(5-x)$ M(D): $(R_C \times 3) = (30g \times 1) + (60g \times 2) + 75g(x-2)$ M(midpt): $(60g \times 1) + (R_D \times 1) = (R_C \times 2) + 75g(3-x)$	M1
	M(B): $75gx + 30g \times 3 + 60g \times 4 = "66g" \times 5 + "99g" \times 2$	A1ft
	$(x =) \frac{66}{25}$ Accept 2.64 following use of 970.2 or $99g$	A1
		(3)
2(c)		
	Method to form equation in R_D only	M1
	M(B): $(R_D \times 2) = (30g \times 3) + (60g \times 4)$	A1
	$R_D = 1600$ or 1620 (N) Accept $165g$	A1
		(3)
		(9)

	Notes for Question 2	
	Penalise use of $9.81 ms^{-2}$ or $10 ms^{-2}$ for g on first occurrence and only once per question.	
2(a)		
M1	Method resolving vertically, or otherwise, to form a relevant equation in R_C or R_D only. Allow both R_C and R_D for the method mark. Correct number of terms. Dimensionally correct. Condone consistent missing g for the method mark only.	
A1	Correct unsimplified equation with the correct ratio between R_C and R_D. E.g. Accept $2R + 3R = 30g + 60g + 75g$	
A1	970. Accept 99g (isw)	
2(b)		
M1	Moments equation with correct number of terms. Dimensionally correct (force $\times$ length). No need to replace R_C or R_D for the method mark. Consistent missing g may score M1A1ftA1.	
A1ft	Correct unsimplified equation in x only. Follow through their values of R_C or R_D.	
A1	Correct exact answer required, $\frac{66}{25}$. Accept equivalent exact fractions isw. Accept 2.64 following use of 970.2 or 99g	
2(c)		
M1	Complete method to obtain an equation in R_D only. Must have $R_C = 0$. If more than one equation is used, the mark is only awarded when an equation in R_D only is formed. Condone consistent missing g for the method mark only. M0 for using values of R_C or R_D from previous parts. Other possible equations: $\text{M}(A): 6Mg + 30g \times 3 + 60g \times 2 = 4R_D$ $\text{M}(C): 5Mg + 30g \times 2 + 60g \times 1 = 3R_D$ $\text{M}(D): 2Mg = 30g \times 1 + 60g \times 2 \Rightarrow M = 75$ $60g + 30g + Mg = R_D$	
A1	Correct equation in R_D only.	
A1	1600 or 1620. Accept 165g (isw)	

3. A train travels between two points, A and B, on a straight horizontal track.

The train usually travels at a constant speed of $50\,\text{m s}^{-1}$ for 15 minutes between the two points.

On one occasion, the train was delayed, because of signals. Figure 2 shows a sketch of the speed-time graph for the motion of the train on this occasion.

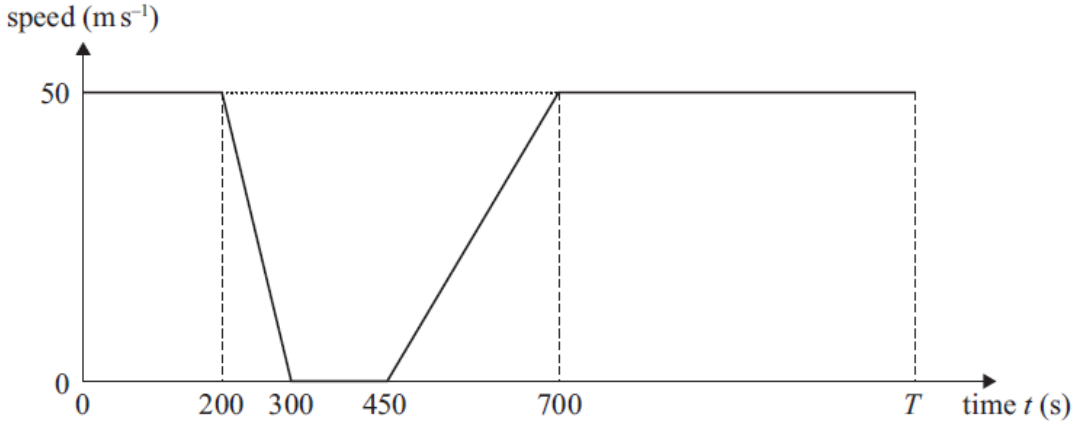


Figure 2

On this occasion, the train passes A at time $t = 0$ and passes B at time $t = T$ seconds.

(a) Find the deceleration of the train while it was slowing down.

(2)

(b) Sketch an acceleration-time graph for the motion of the train, from $t = 0$ to $t = T$ seconds, on this occasion.

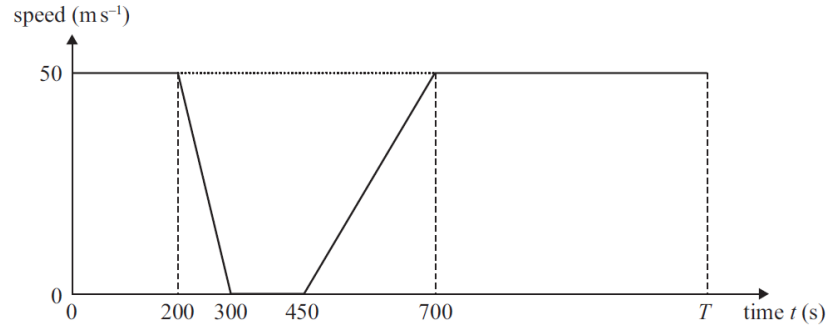
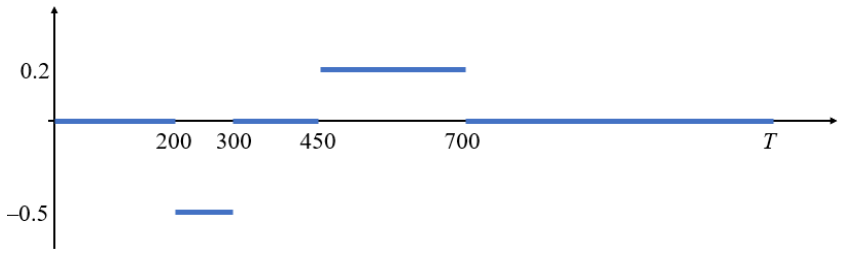
(2)

(c) Find the value of T.

(4)

(d) Find the total length of time, between $t = 0$ and $t = T$ seconds, for which the speed of the train was less than $30\,\text{m s}^{-1}$ on this occasion.

(4)

QUESTION NUMBER	SCHEME	MARKS
		
3(a)	Method to find deceleration, $\pm\dfrac{50}{300-200}$	M1
	(deceleration =) 0.5 (m s^{-2})	A1
		(2)
3(b)		B1 2 horiz lines for dec then acc B1ft ALL labels
		(2)
3(c)	Distance, $50\times15\times60$ (= 45000) (m) seen or implied	B1
	Method to find T or an equation in T	M1
	For example, • $45000=(200\times50)+\left(\dfrac{100\times50}{2}\right)+\left(\dfrac{250\times50}{2}\right)+(T-700)\times50$ • $45000=50\left(\dfrac{300+200}{2}\right)+50\left(\dfrac{(T-700)+(T-450)}{2}\right)$ • $45000=50T-\dfrac{1}{2}\times50\times(150+500)$	A1
	(T =) 1225	A1
		(4)
3(d)	Method to find the time moving at less than 30ms^{-1} whilst decelerating or accelerating.	M1
	Time whilst decelerating, for example • $\dfrac{30}{0.5}(=60)$ • $100-\left(\dfrac{30-50}{-0.5}\right)(=60)$ • $\dfrac{3}{5}\times100\,(=60)$	A1

	Time whilst accelerating, for example • $\frac{30}{0.2}(=150)$ • $\frac{3}{5}\times 250(=150)$	A1
	Total = 360 (s)	A1
		(4)
		(12)
	Notes for Question 3	
3(a)		
M1	Correct method to find acceleration or deceleration, ignore signs.	
A1	Correct answer, must be positive.	
3(b)		
B1	Two horizontal lines, one representing a negative acceleration and another representing a positive acceleration. B0 if there are any solid vertical line(s). B0 if any graph sections are slopes.	
B1ft	Correct figs on both axes including T (condone t unless it is clearly labelling the horizontal axis). Follow through their accelerations which must be numerical. B0 if any graph sections are slopes.	
3(c)		
B1	Correct, seen or implied.	
M1	Method using their "45000" to find T or $(T - 700)$. May form an equation in T only or may find the length of the relevant rectangle. May use areas or *suvat* but must include the correct number of terms, each with the correct structure. Condone a transcription error. Allow use of t for $(T-700)$.	
A1	Correct unsimplified equation in their T only	
A1	Correct	
3(d)		
M1	Method to find either time moving at less than 30ms^{-1} (whilst decelerating or accelerating). E.g. use of relevant *suvat*, gradient or 0.6 scale factor. Allow with their calculated acceleration or deceleration.	
A1	Correct unsimplified time while decelerating.	
A1	Correct unsimplified time while accelerating.	
A1	Correct, 360 (s), accept 6 minutes.	

4. [*In this question* **i** *and* **j** *are horizontal unit vectors.*]

A particle P of mass m kg lies on a smooth horizontal plane. The particle is acted upon by two forces, $\mathbf{F}_1$ N and $\mathbf{F}_2$ N, where $\mathbf{F}_1 = (3\mathbf{i} + \mathbf{j})$ and $\mathbf{F}_2 = (5\mathbf{i} - 16\mathbf{j})$.

Given that P moves with acceleration $68\,\text{m s}^{-2}$

(a) find the value of m.

(4)

Given that the force $(\mathbf{F}_1 + k\mathbf{F}_2)$ N, where k is a constant, acts in a direction which is perpendicular to the vector $(2\mathbf{i} + \mathbf{j})$

(b) find the exact value of k.

(4)

QUESTION NUMBER	SCHEME	MARKS
4(a)	Resultant force $(3\mathbf{i}+\mathbf{j})+(5\mathbf{i}-16\mathbf{j})=\ldots\mathbf{i}+\ldots\mathbf{j}$	M1
	N2L $\left\lvert(3+5)\mathbf{i}+(1-16)\mathbf{j}\right\rvert=68m$	M1
	Magnitude $\sqrt{8^2+(-15)^2}$	M1
	$m=0.25$ o.e.	A1
		(4)
4(b)	$(3\mathbf{i}+\mathbf{j})+k(5\mathbf{i}-16\mathbf{j})=\ldots\mathbf{i}+\ldots\mathbf{j}$	M1
	Correct method using the direction vector $\pm(-\mathbf{i}+2\mathbf{j})$ to form an equation in k only	M1
	$\dfrac{3+5k}{1-16k}=-\dfrac{1}{2}$	A1
	$k=\dfrac{7}{6}$	A1
		(4)
		(8)
	Notes for Question 4	
	Accept column vectors throughout	
4(a)		
M1	Find the resultant force by finding the sum of $\mathbf{F_1}$ and $\mathbf{F_2}$ only and collect **i**'s and **j**'s. If no addition is explicitly seen, one correct component sum can imply a correct method. M0 for the difference of $\mathbf{F_1}$ and $\mathbf{F_2}$	
M1	Use of N2L with their resultant force (must come from a vector sum). M0 if a weight term is included. Condone $(3+5)\mathbf{i}+(1-16)\mathbf{j}=68m$	
M1	Use of Pythagoras to find the magnitude of their resultant force (must come from a vector sum). Condone use of Pythagoras on mass written as a vector. If no addition is explicitly seen, one correct component sum can imply a correct method. M0 if a weight term is included. M0 for magnitude of separate vectors $\lvert\mathbf{F_1}\rvert$ or $\lvert\mathbf{F_2}\rvert$	
A1	Correct answer.	
4(b)		
M1	Find the resultant force in terms of k and collect **i**'s and **j**'s If no addition is explicitly seen, one correct component sum can imply a correct method i.e. one of $(3+5k)$ or $(1-16k)$	
M1	Use direction $\pm(-\mathbf{i}+2\mathbf{j})$ with their **i** and **j** components, to form an equation in k only. Accept equivalent forms.	

	May use $(3+5k)\mathbf{i}+(1-16k)\mathbf{j}=\lambda(-\mathbf{i}+2\mathbf{j})$ where $\lambda \neq 1$ and equate components to form an equation in k only. May use scalar product correctly to form an equation in k only $\begin{pmatrix}3+5k\\1-16k\end{pmatrix}\bullet\begin{pmatrix}2\\1\end{pmatrix}=0 \quad \Rightarrow \quad 2(3+5k)+1(1-16k)=0$ Condone **i** and **j** appearing in fraction.	
A1	Correct unsimplified equation in k only.	
A1	Correct exact answer. Allow $1.1\dot{6}$ (with recurring notation).	

5. A motor race between two cars, A and B, takes place on a straight horizontal track.

At time $t = 0$, A has speed $35\,\text{m s}^{-1}$ and is 1 km from the finishing line. It then moves with constant acceleration $0.4\,\text{m s}^{-2}$ until it reaches the finishing line at time $t = T$ seconds.

(a) Find the value of T.

(3)

At time $t = 0$, B has speed $44\,\text{m s}^{-1}$ and is 200 m behind A.

Car B then moves with constant acceleration $0.5\,\text{m s}^{-2}$ until it reaches the finishing line.

(b) Find the length of time, from the instant when the speed of B is $9.5\,\text{m s}^{-1}$ **greater than** the speed of A, to the instant when B catches up with A.

(7)

QUESTION NUMBER	SCHEME	MARKS
5(a)	Method to form a relevant equation in T only	M1
	$s = ut + \frac{1}{2}at^2$ $\quad 1000 = 35T + \frac{1}{2}\times 0.4T^2$	A1
	$(T =)\ 25$	A1
		(3)
5(b)	Method to find the time when $v_B = v_A + 9.5$ For example, Use of A $\quad v = u + at \quad v_A = 35 + 0.4t_1$ and use of B $\quad v = u + at \quad v_B = 44 + 0.5t_1$ and use of $v_B = v_A + 9.5$ to form an equation in t_1 only	M1
	Correct equation in t_1 eg • $44 + 0.5t_1 = 35 + 0.4t_1 + 9.5$ • $t_1 = \frac{35 + 9.5 - 44}{0.5 - 0.4}$	A1
	$(t_1 =)5$	A1
	Method to find the time when $s_B = s_A + 200$ For example, Use of A $\quad s = ut + \frac{1}{2}at^2 \quad s_A = 35t_2 + \frac{1}{2}0.4(t_2)^2$ and use of B $\quad s = ut + \frac{1}{2}at^2 \quad s_B = 44t_2 + \frac{1}{2}0.5(t_2)^2$ and use of $s_B = s_A + 200$ to form an equation in t_2 only	M1
	Correct equation in t_2 eg • $44t_2 + \frac{1}{2}\times 0.5t_2{}^2 = 35t_2 + \frac{1}{2}\times 0.4t_2{}^2 + 200$ • $0.05t_2{}^2 + 9t_2 - 200 = 0$	A1
	$(t_2 =)20$	A1
	$(t_2 - t_1 =)15$ (s)	A1
		(7)
		(10)
	Notes for Question 5	
5(a)		
M1	Use of relevant *suvat* equations to form an equation in T only. If more than one equation is used, the method mark is given when the equations are reduced to T only.	
A1	Correct unsimplified equation in T only	
A1	Correct answer, 25 only	
5(b)		
M1	Method to form an equation in time when $v_B = v_A + 9.5$, condone use of $v_B = v_A - 9.5$. Use of relevant *suvat* equations for	

	A and B to form a dimensionally correct equation in t_1 only. Allow use of any letter for time. If other equations are used, may find speeds $(v_A = 37, v_B = 46.5)$ before finding an equation in t_1 only.	
A1	Correct unsimplified equation in time only	
A1	Correct answer only	
M1	Method to form an equation in time when $s_B = s_A + 200$, condone use of $s_B = s_A - 200$ for the method only. Use of relevant *suvat* equations for A and B to form a dimensionally correct equation in t_2 only. Allow use of any letter for time.	
A1	Correct equation in time only	
A1	Correct answer only	
A1	Correct answer from correct values (e.g. 20 – 5 = 15)	

6.

Figure 3

A washing line $ABCD$ holds two heavy garments, one at B and one at C.

The section AB makes an angle of 20° with the horizontal, the section BC is horizontal and the section CD makes an angle of $\alpha°$ with the horizontal, as shown in Figure 3.

The points A, B, C and D all lie in the same vertical plane.

The washing line and the two garments are in equilibrium, with all three sections of the washing line taut.

- the garment at B is modelled as a particle of mass 2 kg
- the garment at C is modelled as a particle of mass 3 kg
- the washing line is modelled as being light

(a) Find the tension in AB.

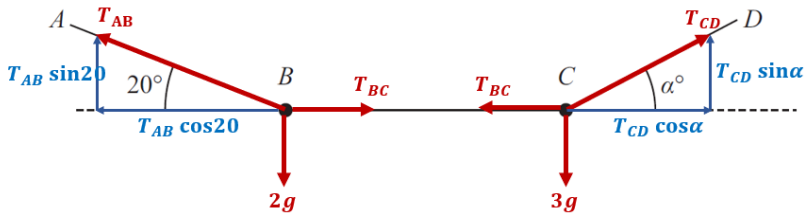
(2)

(b) Find the value of α

(6)

(c) If the washing line was **not** modelled as being light, state why it would **not** be possible to answer part (a).

(1)

QUESTION NUMBER	SCHEME	MARKS
6.		
6(a)	Form an equation in T_{AB} only E.g. Vert at B $\quad T_{AB}\sin 20° = 2g$	M1
	$T_{AB} = 57$ or 57.3 (N)	A1
		(2)
6(b)	First relevant equation in T_{CD} and α E.g. Vert at C	M1
	$3g = T_{CD}\sin\alpha°$	A1
	Second relevant equation in T_{CD} and α E.g. Horiz whole system	M1
	$T_{AB}\cos 20° = T_{CD}\cos\alpha°$	A1
	Equation in α only: $\quad \tan\alpha° = \frac{3}{2}\tan 20°$	dM1
	$\alpha = 29$ or better	A1
		(6)
6(c)	Correct statement with nothing incorrect and no extras • the tension would vary along the length of AB	B1
		(1)
		(9)
	Notes for Question 6	
6(a)		
M1	Form an equation in T_{AB} only. Resolve vertically at B. Correct no. of terms, dimensionally correct, any forces that should be resolved must be resolved, condone sin/cos confusion.	
A1	Correct tension in AB	
6(b)	**Note: Throughout part (b) the g's cancel.** **Do not withhold 1 mark for use of 9.81 ms^{-2} or 10 ms^{-2}**	
M1	First relevant equation in T_{CD} and α (and T_{AB}). Correct no. of terms, dimensionally correct, any forces that should be resolved must be resolved condone sin/cos confusion to give an equation in T_{AB} , T_{CD} and α only. M0 for **use of** equal tensions e.g. $T_{AB} = T_{CD}$ Allow re-use of T if it clearly represents a new tension.	
A1	Correct unsimplified equation in α, T_{CD} (and T_{AB}) only.	
M1	Second relevant equation in T_{CD} and α (and T_{AB}). To be relevant, it must be possible to combine with the first equation to find α . If an equation in T_{BC} is formed, T_{BC} must be eliminated. Correct no. of terms, dimensionally correct, any	

	forces that should be resolved must be resolved, condone sin/cos confusion to form an equation in T_{CD} and α only. Vert system: $T_{AB}\sin 20° + T_{CD}\sin\alpha = 2g + 3g$ Horiz at B: $T_{AB}\cos 20 = T_{BC}$ Horiz at C: $T_{CD}\cos\alpha = T_{BC}$ M0 for **use of** equal tensions e.g. $T_{AB} = T_{CD}$ Allow re-use of T if it clearly represents a new tension.	
A1	Correct unsimplified equation in T_{CD} and α only.	
d**M1**	Dependent on both previous method marks. Eliminate T_{AB} and T_{CD} to form an equation in α only	
A1	29 or better (Correct rounding for their choice of accuracy, calculator value gives 28.63256955)	
6(c)		
B1	Correct statement. B0 if incorrect statement seen or irrelevant extras included. Qn: *if the washing line is not modelled as being light, why would it **not** be possible to find the tension in AB* B1 (*singular, consider adding 'in AB' to their sentence*) E.g. The tension will vary at every point along *AB* The tension (in *AB*) will change The tension (in *AB*) would change along the string The tension (in *AB*) would be different at different points on the string. The tension (in *AB*) will not be constant The tension (in *AB*) will increase/decrease along the string The tension (in *AB*) is not the same B0 (*considering more than AB or implication that the tension in AB would have a different value or could be calculated*) E.g. The tensions on the two sides are not the same anymore The tensions will not be constant Tension is not the same at both ends The tension will increase so hard to answer Weight of the line needs to be considered in calculations B0 for any mention of acceleration.	

7. [*In this question* **i** *and* **j** *are horizontal unit vectors directed due east and due north respectively and position vectors are given relative to a fixed origin O.*]

A small boat is modelled as a particle moving with constant velocity.

At time t hours after 2 pm, the position vector of the boat is

$$[(4 - 3t)\mathbf{i} + (2 + t)\mathbf{j}]\,\text{km}$$

(a) Find the speed of the boat.

(3)

The point A has position vector $(2\mathbf{i} - \mathbf{j})\,\text{km}$

(b) Find the time of day when the bearing of the boat from A is 315°

(5)

QUESTION NUMBER	SCHEME	MARKS
7(a)	Velocity $(-3\mathbf{i}+\mathbf{j})$	B1
	Speed $\sqrt{(-3)^2+1^2}$	M1
	$=\sqrt{10}$, 3.2 or better (km h^{-1})	A1
		(3)
7(b)	Find difference between the position of the boat at time t and A $\left[(4-3t)\mathbf{i}+(2+t)\mathbf{j}\right]-(2\mathbf{i}-\mathbf{j})$ $\left\{=(2-3t)\mathbf{i}+(3+t)\mathbf{j}\right\}$	M1
	Method using direction to form equation in t only	dM1
	Correct equation in t eg • $\frac{3+t}{2-3t}=-1$ • $3+t=3t-2$	A1
	$t=2.5$	A1
	1630 or 4:30 pm	A1
		(5)
		(8)
	Notes for Question 7	
	Accept column vectors throughout	
7(a)		
B1	Seen or implied.	
M1	Use of Pythagoras with the square root of *their* velocity to find a numerical speed.	
A1	Correct answer, isw	
7(b)		
M1	Method to find the difference between $(2\mathbf{i}-\mathbf{j})$ and the position vector of the boat at time t. Condone subtraction either way round but M0 for addition. M0 if $(2-3t)\mathbf{i}+(-1+t)\mathbf{j}$ is seen without a valid method using subtraction.	
dM1	Dependent on previous M. Method using the bearing to form an equation in t only, allow with ± 1 for the method mark only. Must use their difference with **i**' and **j**'s collected.	
A1	Correct equation in t only	
A1	$t=2.5$, seen or implied	
A1	Correct time, condone 16:30pm. 4.5 is A0	

8.

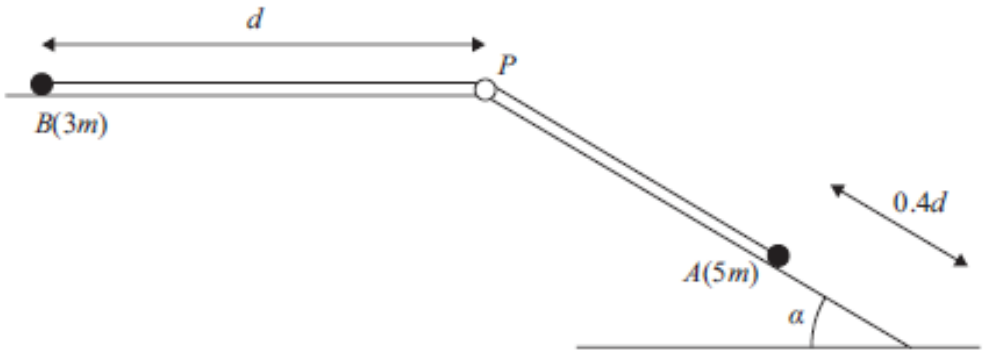


Figure 4

One end of a light inextensible string is attached to a particle A of mass $5m$. The other end of the string is attached to a particle B of mass $3m$. Particle A lies on a **smooth** plane that is inclined to horizontal ground at an angle α, where $\tan\alpha = \frac{3}{4}$. Particle B lies on a **rough** horizontal plane. The string passes over a small smooth pulley P that is fixed at the top of the inclined plane.

The two particles, the string and the pulley all lie in the same vertical plane.
The portion of the string between A and P lies along a line of greatest slope of the inclined plane. The portion of the string between B and P is horizontal.

The system is held at rest with $BP = d$ and particle A at a distance $0.4d$ from the bottom of the inclined plane, as shown in Figure 4.

The coefficient of friction between B and the horizontal plane is 0.2

The system is released from rest with the string taut and A begins to move down the inclined plane.

(a) Find, in terms of m and g, the magnitude of the frictional force acting on B.

(2)

By writing down an equation of motion for each particle,

(b) show that the acceleration of A down the inclined plane is $0.3g$

(5)

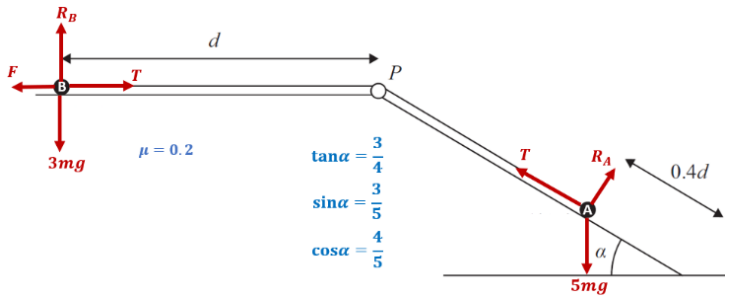
(c) State how you have used the fact that the string is inextensible in your working for part (b).

(1)

When A hits the ground at the bottom of the inclined plane it stops.

(d) Show that B comes to rest just as it reaches the pulley.

(5)

QUESTION NUMBER	SCHEME	MARKS
		
8(a)	$(R =)\ 3mg$	B1
	$(F =) 0.6mg$	B1
		(2)
8(b)	N2L for B	M1
	$T - F = 3ma$	A1
	N2L for A	M1
	$5mg\sin\alpha - T = 5ma$	A1
	$a = 0.3g$ *	A1*
		(5)
8(c)	Correct statement with nothing incorrect and no extras • The acceleration of both particles is the same.	B1
		(1)
8(d)	Method to find speed with $u = 0$, $a = 0.3g$ and $s = 0.4d$ • *suvat* $V^2 = 2\times 0.3g\times 0.4d$ • energy $5mg(0.4d\sin\alpha) = \frac{1}{2}(5m)V^2$ $(V^2 = 0.24gd)$	M1
	Method to find new acceleration of B	M1
	e.g N2L $(-)0.6mg = 3ma_1$ $(a_1 = \pm 0.2g)$	A1
	Complete method • to find the speed at the pulley using $s = 0.6d$ and their calculated V and a_1 $W^2 = V^2 + 2\times a_1\times 0.6d$ • to find the distance to rest and their calculated v and a_1 $0 = V^2 + 2\times a_1\times s$	M1
	$W = 0$ and hence (just) reaches the pulley * **OR:** $s = 0.6d$ and hence (just) reaches the pulley *	A1 *
		(5)
		(13)
	Notes for Question 8	
8(a)		
B1	Seen or implied by correct expression for friction	
B1	Correct expression for friction	
8(b)		

M1	Equation of motion for B (look at the ma term). Dimensionally correct, correct no. of terms, condone sign errors. No need to replace friction. Condone consistent missing m's for the method mark only.	
A1	Correct unsimplified equation of motion for B.	
M1	Equation of motion for A (look at the ma term). Dimensionally correct, correct no. of terms, condone sign errors and sin/cos confusion. Condone consistent missing m's for the method mark only.	
A1	Correct unsimplified equation of motion for A	
A1*	Given answer obtained from complete and correct working. Must see an equation of motion for each particle, $\sin\alpha = \frac{3}{5}$ and at least one line of working following the equations of motion. **S.C.** • If equations of motion for each particle are implied max score is M1A1M1A1A0* e.g. $5mg\sin\alpha - 5ma = F + 3ma$ • If whole system equation is used, max score is M1A1M0A0A0* e.g. $5mg\sin\alpha - F = 8ma$	
8(c)		
B1	Correct statement. B0 if incorrect statement seen or irrelevant extras included. Qn: *state how you have used the fact that the string is inextensible in your working for part (b).* B1 Acceleration is the same for A and B Acceleration is the same in each particle B0 Acceleration each side is the same Acceleration is the same throughout the string Same acceleration on both sides Tension and acceleration are the same Any mention of tension.	
8(d)		
M1	Method to form an equation for V or V^2 when A hits the ground. Dimensionally correct equation, correct number of terms, condone sign errors. May use *suvat* or conservation of energy.	
M1	Method to find the new acceleration of B. May form an equation of motion for B, correct no. of terms, condone sign errors. May write down $a_1 = \pm 0.2g$ with no evidence of incorrect working.	
A1	Correct unsimplified equation. May be implied by use of $a_1 = \pm 0.2g$	
M1	Complete method to obtain given answer. M0 if $a = 0.3g$ or $a = g$ is used.	
A1*	Given answer correctly obtained and conclusion stated.	