OCR
Oxford Cambridge and RSA

Accredited

A Level Further Mathematics A
Y543 Mechanics
Sample Question Paper Version 2

Date – Morning/Afternoon
Time allowed: 1 hour 30 minutes

You must have:
- Printed Answer Booklet
- Formulae A Level Further Mathematics A

You may use:
- a scientific or graphical calculator

INSTRUCTIONS

- Use black ink. HB pencil may be used for graphs and diagrams only.
- Complete the boxes provided on the Printed Answer Booklet with your name, centre number and candidate number.
- Answer **all** the questions.
- **Write your answer to each question in the space provided in the Printed Answer Booklet.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question.
- The acceleration due to gravity is denoted by $g\,\mathrm{m\,s^{-2}}$. Unless otherwise instructed, when a numerical value is needed, use $g = 9.8$.

INFORMATION

- The total number of marks for this paper is **75**.
- The marks for each question are shown in brackets **[ ]**.
- **You are reminded of the need for clear presentation in your answers.**
- The Printed Answer Booklet consists of **12** pages. The Question Paper consists of **8** pages.

Answer **all** the questions.

1 A body, *P*, of mass 2 kg moves under the action of a single force **F** N. At time *t* s, the velocity of the body is $\mathbf{v}$ m s^{-1}, where

$$\mathbf{v} = \left(t^2 - 3\right)\mathbf{i} + \frac{5}{2t+1}\mathbf{j} \text{ for } t \geq 2.$$

(i) Obtain **F** in terms of *t*. **[3]**

(ii) Calculate the rate at which the force **F** is working at $t = 4$. **[3]**

(iii) By considering the change in kinetic energy of *P*, calculate the work done by the force **F** during the time interval $2 \leq t \leq 4$. **[3]**

2 As part of a training exercise an army recruit of mass 75 kg falls a vertical distance of 5 m before landing on a mat of thickness 1.2 m. The army recruit sinks a distance of *x* m into the mat before instantaneously coming to rest. The mat can be modelled as a spring of natural length 1.2 m and modulus of elasticity 10 800 N and the army recruit can be modelled as a particle falling vertically with an initial speed of 2 m s^{-1}.

(i) Show that *x* satisfies the equation $300x^2 - 49x - 255 = 0$. **[5]**

(ii) Calculate the value of *x*. **[2]**

(iii) Ignoring the possible effect of air resistance, make

- one comment on the assumptions made and,
- suggest a possible refinement to the model. **[2]**

3 A body, *Q*, of mass 2 kg moves in a straight line under the action of a single force which acts in the direction of motion of *Q*. Initially the speed of *Q* is 5 m s^{-1}. At time *t* s, the magnitude *F* N of the force is given by

$$F = t^2 + 3\mathrm{e}^t, \quad 0 \leq t \leq 4.$$

(i) Calculate the impulse of the force over the time interval. **[3]**

(ii) Hence find the speed of *Q* when $t = 4$. **[2]**

4 A light inextensible taut rope, of length 4 m, is attached at one end *A* to the centre of the horizontal ceiling of a gym. The other end of the rope *B* is being held by a child of mass 35 kg. Initially the child is held at rest with the rope making an angle of 60° to the downward vertical and it may be assumed that the child can be modelled as a particle attached to the end of the rope. The child is released at a height 5 m above the horizontal ground.

(i) Show that the speed, $v\,\text{m s}^{-1}$, of the child when the rope makes an angle θ with the downward vertical is given by $v^2 = 4g(2\cos\theta - 1)$. **[5]**

(ii) At the instant when $\theta = 0^\circ$, the child lets go of the rope and moves freely under the influence of gravity only. Determine the speed and direction of the child at the moment that the child reaches the ground. **[5]**

(iii) The child returns to the initial position and is released again from rest. Find the value of θ when the tension in the rope is three times greater than the tension in the rope at the instant the child is released. **[5]**

5 A particle P of mass m kg is projected vertically upwards through a liquid. Student *A* measures P 's initial speed as $(8.5 \pm 0.25)\ \text{m s}^{-1}$ and they also record the time for P to attain its greatest height above the initial point of projection as over 3 seconds.
In an attempt to model the motion of P student *B* determines that t seconds after projection the only forces acting on P are its weight and the resistance from the liquid. Student *B* models the resistance from the liquid to be of magnitude $mv^2 - 6mv$, where v is the speed of the particle.

(i) (a) Show that $\dfrac{\mathrm{d}t}{\mathrm{d}v} = -\dfrac{1}{(v-3)^2 + 0.8}$. **[3]**

(b) Determine whether student *B*'s model is consistent with the time recorded by *A* for P to attain its greatest height. **[5]**

After attaining its greatest height P now falls through the liquid. Student *C* claims that the time taken for P to achieve a speed of $1\ \text{m s}^{-1}$ when falling through the liquid is given by

$$-\int_0^1 \frac{1}{(v-3)^2 + 0.8}\mathrm{d}v.$$

(ii) Explain why student *C*'s claim is incorrect and write down the integral which would give the correct time for P to achieve a speed of $1\ \text{m s}^{-1}$ when falling through the liquid. **[3]**

6 Two uniform smooth spheres *A* and *B* of equal radius are moving on a smooth horizontal surface when they collide. *A* has mass 2.5 kg and *B* has mass 3 kg. Immediately before the collision *A* and *B* each has speed $u\,\text{m s}^{-1}$ and each moves in a direction at an angle θ to their line of centres, as indicated in Fig. 1. Immediately after the collision *A* has speed $v_1\,\text{m s}^{-1}$ and moves in a direction at an angle α to the line of centres, and *B* has speed $v_2\,\text{m s}^{-1}$ and moves in a direction at an angle β to the line of centres as indicated in Fig. 2. The coefficient of restitution between *A* and *B* is *e*.

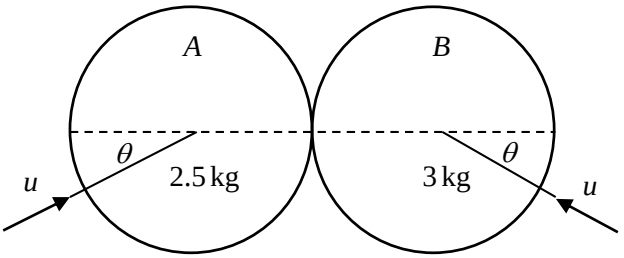

Fig. 1

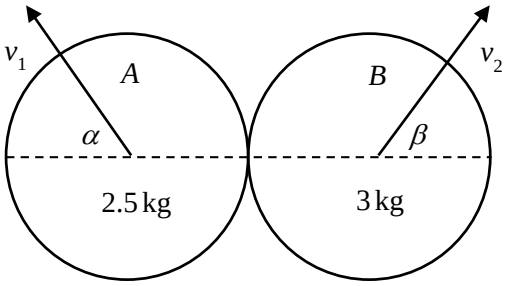

Fig. 2

(i) Show that $\tan\beta = \dfrac{11\tan\theta}{10e-1}$. **[8]**

(ii) Given that after impact sphere *A* moves at an angle of 50° to the line of centres and *B* moves perpendicular to the line of centres, find θ. **[4]**

7

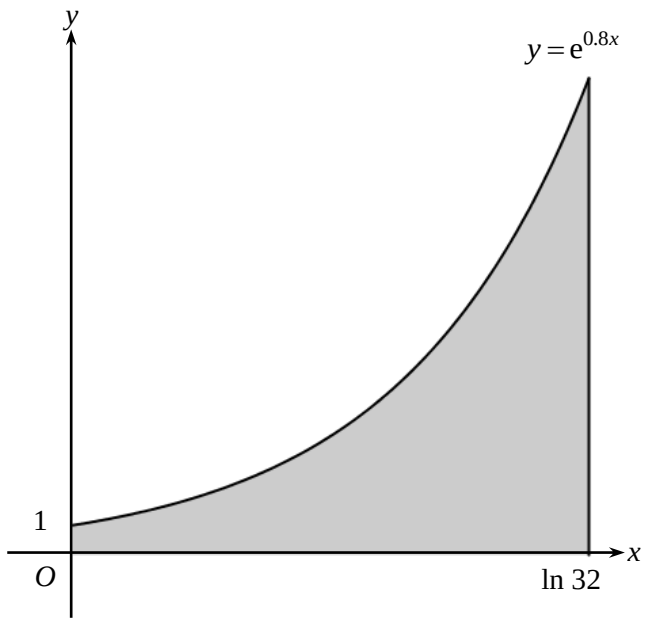

Fig. 3

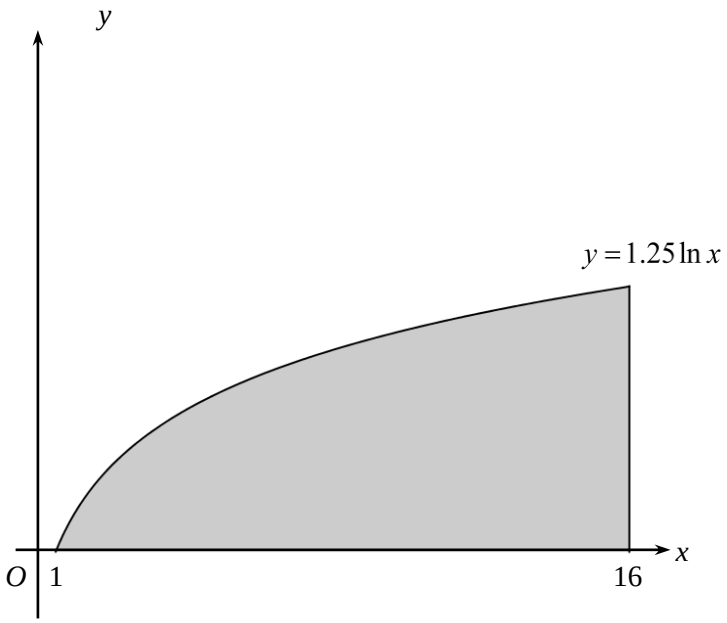

Fig. 4

The region bounded by the *x*-axis, the *y*-axis, the line $x = \ln 32$ and the curve $y = e^{0.8x}$ for $0 \leq x \leq \ln 32$, is occupied by a uniform lamina (see Fig. 3).

(i) Show that the *x*-coordinate of the centre of mass of the lamina is given by $\frac{16}{3}\ln 2 - \frac{5}{4}$. **[7]**

(ii) Calculate the *y*-coordinate of the centre of mass of the lamina. **[3]**

(iii) The region bounded by the *x*-axis, the line $x = 16$ and the curve $y = 1.25\ln x$ for $1 \leq x \leq 16$, is occupied by a second uniform lamina (see Fig. 4). By using your answer to part **(i)** find, to 3 significant figures, the *x*-coordinate of the centre of mass of this second lamina. **[4]**

END OF QUESTION PAPER

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OCR
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…day June 20XX – Morning/Afternoon

A Level Further Mathematics A

Y543 Mechanics

SAMPLE MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 75

This document consists of 12 pages

Text Instructions

1. Annotations and abbreviations

Annotation in scoris	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
Highlighting	
Other abbreviations in mark scheme	**Meaning**
E1	Mark for explaining a result or establishing a given result
dep*	Mark dependent on a previous mark, indicated by *
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.

2. Subject-specific Marking Instructions for A Level Further Mathematics A

a Annotations should be used whenever appropriate during your marking. The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks. It is vital that you annotate standardisation scripts fully to show how the marks have been awarded. For subsequent marking you must make it clear how you have arrived at the mark you have awarded.

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 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
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.

E
Mark for explaining a result or establishing a given result. This usually requires more working or explanation than the establishment of an unknown result.

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 Unless units are specifically requested, there is no penalty for wrong or missing units as long as the answer is numerically correct and expressed either in SI or in the units of the question. (e.g. lengths will be assumed to be in metres unless in a particular question all the lengths are in km, when this would be assumed to be the unspecified unit.) 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. This rule should be applied to each case. When a value is not given in the paper accept any answer that agrees with the correct value to 2 s.f. Follow through should be used so that only one mark is lost for each distinct accuracy error, except for errors due to premature approximation which should be penalised only once in the examination. There is no penalty for using a wrong value for *g*. E marks will be lost except when results agree to the accuracy required in the question.

g Rules for replaced work: if a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should do as the candidate requests; if there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the last (complete) attempt and ignore the others. NB Follow these maths-specific instructions rather than those in the assessor handbook.

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 papers. This is achieved by withholding one A mark in the question. Marks designated as cao may be awarded as long as there are no other errors. E marks are lost unless, by chance, the given results are established by equivalent working. 'Fresh starts' will not affect an earlier decision about a misread. 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, of course, that there is nothing in the wording of the question specifying that analytical methods are required). 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	(i)		$\mathbf{a} = \frac{d\mathbf{v}}{dt} = 2t\,\mathbf{i} - \frac{10}{(2t+1)^2}\,\mathbf{j}$	M1 A1	1.1 1.1	Differentiating one term of **v** correctly	
			$\mathbf{F} = m\mathbf{a} = 4t\mathbf{i} - \frac{20}{(2t+1)^2}\,\mathbf{j}$	A1FT [3]	3.3	FT their **a**	
1	(ii)		$\mathbf{F}.\mathbf{v} = 4t\left(t^2-3\right) - \frac{100}{\left(2t+1\right)^3}$	M1 A1	3.4 1.1	Attempt at scalar product	**OR** **M1** at $t = 4$ **A1** $\mathbf{F}\cdot\mathbf{v} = \left(16\mathbf{i} - \frac{20}{81}\mathbf{j}\right)\cdot\left(13\mathbf{i} + \frac{5}{9}\mathbf{j}\right)$
			Power is 208 W	A1 [3]	1.1	207.86282…	
1	(iii)		$T = \frac{1}{2}m\mathbf{v}.\mathbf{v} = \left(t^2-3\right)^2 + \frac{25}{\left(2t+1\right)^2}$	B1 M1	3.4 1.1	 $T(4) - T(2)$	**OR** **B1** for value of T at 2 or 4 **M1** $T(4) - T(2)$
			Work done is 167 J	A1 [3]	1.1	167.308642…	

Question			Answer	Marks	AO	Guidance	
2	(i)		$75g(6.2)+\frac{1}{2}(75)(2)^2=75g(1.2-x)+\frac{10800x^2}{2(1.2)}$	M1 A1 A1 A1	3.3 1.1 1.1 1.1	Attempt at conservation of energy GPE term(s) KE term EPE term	GPE is Gravitational Potential Energy KE is Kinetic Energy EPE is Elastic Potential Energy
			$300x^2-49x-255=0$	E1 [5]	2.1	www; AG must show intermediate step	
2	(ii)		$x=-0.8438977...<0$ so not valid	B1	2.3	The negative value of x must be seen and not given as a final answer	
			$x=1.01$	B1 [2]	3.4		1.007231…
2	(iii)		e.g. $g=9.8$ is not precise enough, use $g=9.81$ e.g. the army recruit is not a particle, model as a rigid body e.g. the mat is not a single spring, model as multiple springs	E1 E1 [2]	3.5b 3.5c	For one assumption and a sensible refinement	
3	(i)		$I=\int t^2+3e^t dt=\frac{1}{3}t^3+3e^t$	M1 A1	3.3 1.1	Integrating one term of F correctly	
			$I=\int_0^4 F dt=\frac{55}{3}+3e^4=182$, so impulse is 182 N s	A1 [3]	1.1	BC	182.1277…
3	(ii)		$2(v-5)=\frac{55}{3}+3e^4$	M1	3.4	Use of $I=mv-mu$	
			Speed is 96.1 m s^{-1}	A1 [2]	1.1		96.0638…

Question			Answer	Marks	AO	Guidance	
4	(i)			M1	3.3	Attempt at conservation of mechanical energy	
			$35g(5)-\frac{1}{2}(35)v^2=...$	A1	1.1	PE term on lhs	
				A1	1.1	KE term on rhs	
			$...35g(7-4\cos\theta)$	A1	1.1		
			$v^2=4g(2\cos\theta-1)$	E1	2.1	www; AG must show an intermediate step	
				[5]			
4	(ii)		When $\theta=0^\circ$, $v_H=2\sqrt{g}$	B1	3.3		6.260990…
			$v_V{}^2=2g(3)$	B1	3.3		
				M1	3.4	Use of either $v^2=v_V{}^2+v_H{}^2$ or $\tan\theta=\frac{v_V}{v_H}$	
			$v=9.90$ so speed is $9.90\,\text{m s}^{-1}$	A1	1.1		9.8994949…
			$\theta=50.8^\circ$ below the horizontal	A1	1.1		50.768479…
				[5]			
4	(iii)		Tension when $\theta=60^\circ$ is $17.5g$ N	B1	1.1	May appear anywhere in answer	
				*M1	3.1b	Attempt to use N2L radially with $a=\frac{v^2}{r}$	N2L is Newton's second law
			$T-35g\cos\theta=\frac{35}{4}\left(4g(2\cos\theta-1)\right)$	A1	1.1		
				dep* M1	1.1a	Substituting $3\times$ their(T) into their N2L attempt and solving for θ	
			$\theta=33.6^\circ$	A1	1.1	BC	33.55730…
				[5]			

Question			Answer	Marks	AO	Guidance	
5	(i)	(a)	$m\frac{\mathrm{d}v}{\mathrm{d}t} = -mg - \left(-6mv + mv^2\right)$	B1	3.3		
			$\frac{\mathrm{d}t}{\mathrm{d}v} = -\frac{1}{v^2 - 6v + 9.8}$	M1	1.1	Divide by m and rearrange	
			$= -\frac{1}{(v-3)^2 - 9 + 9.8} = -\frac{1}{(v-3)^2 + 0.8}$	E1	2.1	AG Completing the square in the denominator	
				[3]			
5	(i)	(b)	$t = -\int \frac{\mathrm{d}v}{(v-3)^2 + 0.8}$	M1	3.1a	Separation of variables	
			$t_1 = -\int_{8.25}^{0} \frac{\mathrm{d}v}{(v-3)^2 + 0.8}$, and $t_2 = -\int_{8.75}^{0} \frac{\mathrm{d}v}{(v-3)^2 + 0.8}$	B1	3.4	Using the limits correctly at least once	
			$t_1 = 2.9997903...$	A1	1.1	BC	Or use $\int \frac{1}{a^2 + x^2}\mathrm{d}x = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right)$
			$t_2 = 3.0159247...$	A1	1.1	BC	
			$2.9997... < t < 3.0159...$ so B's model for the vast majority of speeds in the interval $(8.5 \pm 0.25)\,\mathrm{m\,s^{-1}}$ does produce a value of t greater than 3 so it is extremely likely (but not certain) that B's model is consistent with the time recorded by A.	E1	2.2b	Indication that the non-exact nature of the initial speed leads to a result that is likely to be correct	
				[5]			

Question			Answer	Marks	AO	Guidance	
5	(ii)		e.g. student *C*'s claim is incorrect as they have assumed that the differential equation for the motion of the particle is the same in both directions	**B1**	**2.2a**	For explaining that the differential equation of motion is not the same in each direction	
			In fact the differential equation for when the particle is falling is given by $mg-(-6mv+mv^2)=m\frac{\mathrm{d}v}{\mathrm{d}t}$	**B1**	**2.3**	For either this corrected model or stating that the two forces in the vertical direction are now acting in opposite directions	
			$-\int_0^1 \frac{1}{(v-3)^2-18.8}\,\mathrm{d}v$	**B1**	**3.3**		
				[3]			

Question			Answer	Marks	AO	Guidance	
6	(i)			*M1	3.4	Attempt at use of conservation of linear momentum	
			$2.5u\cos\theta - 3u\cos\theta = -2.5v_1\cos\alpha + 3v_2\cos\beta$	A1	1.1		
				*M1	3.4	Attempt at use of restitution equation, must be correct way round	
			$-v_1\cos\alpha - v_2\cos\beta = -e(u\cos\theta + u\cos\theta)$	A1	1.1	Must be consistent with the directions used for conservation of linear momentum	
			$u\sin\theta = v_1\sin\alpha$ and $u\sin\theta = v_2\sin\beta$	*B2	1.1a	B1 for one correct	
					1.1a		
				dep* M1	3.1b	Solving simultaneous equations by eliminating v_1 and v_2 use of $\tan X = \frac{\sin X}{\cos X}$	
			$\tan\beta = \frac{11\tan\theta}{10e-1}$	E1	2.1	www; AG	
				[8]			
6	(ii)		$10e-1=0 \Rightarrow e=\frac{1}{10}$	*M1	2.2a	Setting the denominator of $\tan\beta$ equal to 0 and obtaining a value for e	
			$\tan\alpha = \frac{11\tan\theta}{1+12e}$	B1	3.1b		
			$\tan 50 = \frac{11\tan\theta}{1+12/10}$	dep* M1	3.1b	Substituting their e and $\alpha = 50^\circ$ and solving for θ	
			$\theta = 13.4^\circ$	A1	1.1	13.40634… BC	
				[4]			

Question			Answer	Marks	AO	Guidance	
7	(i)			M1	1.2	Attempt to integrate to find area	Limits not required for **M** mark
			$A=\int_0^{\ln 32} e^{0.8x}dx=\frac{75}{4}$	A1	1.1	BC	$\left[1.25e^{0.8x}\right]_0^{\ln 32}$
			$A\bar{x}=\int_0^{\ln 32} xe^{0.8x}dx$	M1	3.1a	Use integration by parts	
			$=\left[1.25xe^{0.8x}\right]_0^{\ln 32}-1.25\int_0^{\ln 32} e^{0.8x}dx$	A1	1.1	Correctly applied to end of first stage	
			$=\left[1.25xe^{0.8x}-1.5625e^{0.8x}\right]_0^{\ln 32}$	A1	1.1		
			$=(20\ln 32-25)-(0-1.5625)\Rightarrow\bar{x}=...$	M1	1.1	Using correct limits and $\bar{x}=\frac{A\bar{x}}{x}$	
			$\bar{x}=\frac{16}{3}\ln 2-\frac{5}{4}$	E1	2.1	www; AG	
				[7]			
7	(ii)			M1	2.1	For … $\frac{1}{2}\int y^2dx$ and attempt to integrate	
			$A\bar{y}=\frac{1}{2}\int_0^{\ln 32}\left(e^{0.8x}\right)^2dx=\frac{1275}{16}$	A1	1.1	BC	$\frac{1}{2}\left[\frac{e^{1.6x}}{1.6}\right]_0^{\ln 32}$
			$\bar{y}=\frac{17}{4}$ oe	A1	1.1		
				[3]			
7	(iii)			M1	3.1a	Table of values idea to get an equation/expression	
				M1	2.1	Attempt at $\text{cv}(\bar{x})=(8)(16)(\ln 32)-\text{cv}(A\bar{x})$	
			$\overline{X}\left(16\ln 32-\frac{75}{4}\right)=(8)(16)(\ln 32)-\left(\frac{17}{4}\times\frac{75}{4}\right)$	A1FT	1.1		
			$\overline{X}=9.92$	A1	1.1	9.915779…	
				[4]			

Assessment Objectives (AO) Grid

Question	AO1	AO2	AO3(PS)	AO3(M)	Total
1(i)	2	0	0	1	**3**
1(ii)	2	0	0	1	**3**
1(iii)	2	0	0	1	**3**
2(i)	3	1	0	1	**5**
2(ii)	0	1	0	1	**2**
2(iii)	0	0	0	2	**2**
3(i)	2	0	0	1	**3**
3(ii)	1	0	0	1	**2**
4(i)	3	1	0	1	**5**
4(ii)	2	0	0	3	**5**
4(iii)	4	0	1	0	**5**
5(i)(a)	1	1	0	1	**3**
5(i)(b)	2	1	1	1	**5**
5(ii)	0	1	0	2	**3**
6(i)	4	1	1	2	**8**
6(ii)	1	1	2	0	**4**
7(i)	5	1	1	0	**7**
7(ii)	2	1	0	0	**3**
7(iii)	2	1	1	0	**4**
Totals	**38**	**11**	**7**	**19**	**75**

PS = Problem Solving
M = Modelling

Summary of Updates

Date	Version	Change
October 2019	2	Amendments to the front cover rubric instructions to candidates

OCR
Oxford Cambridge and RSA

Accredited

A Level Further Mathematics A
Y543 Mechanics
Printed Answer Booklet Version 2

Date – Morning/Afternoon
Time allowed: 1 hour 30 minutes

You must have:
- Question Paper Y543 (inserted)
- Formulae A Level Further Mathematics A

You may use:
- a scientific or graphical calculator

First name									
Last name									
Centre number						**Candidate number**				

INSTRUCTIONS
- The Question Paper will be found inside the Printed Answer Booklet.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Complete the boxes provided on the Printed Answer Booklet with your name, centre number and candidate number.
- Answer **all** the questions.
- **Write your answer to each question in the space provided in the Printed Answer Booklet.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question.
- The acceleration due to gravity is denoted by $g\,\text{m}\,\text{s}^{-2}$. Unless otherwise instructed, when a numerical value is needed, use $g = 9.8$

INFORMATION
- **You are reminded of the need for clear presentation in your answers.**
- The Printed Answer Booklet consists of **12** pages. The Question Paper consists of **8** pages.

1(i)	
1(ii)	

1(iii)	

PLEASE DO NOT WRITE IN THIS SPACE

2(i)

2(ii)

2(iii)	
3(i)	
3(ii)	

4(i)

4(ii)

(answer space continued on next page)

4(ii)	**(continued)**
4(iii)	

5(i)(a)

5(i)(b)

5(ii)

6(i)

(answer space continued on next page)

6(i)	**(continued)**
6(ii)	

7(i)	
7(ii)	

7(iii)	