Oxford Cambridge and RSA

Practice Paper – Set 4

A Level Mathematics B (MEI)

H640/01 Pure Mathematics and Mechanics

MARK SCHEME

Duration: 2 hours

MAXIMUM MARK 100

This document consists of 20 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 indicates that the instruction **In this question you must show detailed reasoning** appears in the question.

2. Subject-specific Marking Instructions for A Level Mathematics B (MEI)

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
A given result is to be established or a result has to be explained. 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 units. 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	AOs	Guidance	
1			Discriminant $k^2 - 4\times 2\times 8 > 0$	M1	1.1a	May be implied by $k^2 > 64$ oe without working; allow for $\geq$ used	Allow as part of the quadratic formula
			$k > 8$	A1	1.1b	oe	
			or $k < -8$	A1	1.1b	oe	
				[3]			

Question			Answer	Marks	AOs	Guidance	
2			Vertical equilibrium $N = 5g$	B1	1.1a	Must be seen – may be on a diagram	
			$F = P$	M1	1.1a	May be implied	
			On the point of sliding $P_{max} = F\ [= \mu N] = 0.3\times 5g$	M1	3.3	Allow for $0.3\times 5g$ even if B1 not awarded	
			$P_{max} = 14.7$	A1	3.4	cao	
				[4]			

Question			Answer	Marks	AOs	Guidance	
3	(a)		Taking moments about A: $0.3\times 100 + 0.75\times 60$	M1	1.1b	Allow for one moment only, but if two terms present, both must be moments	Do not allow for the total of a force and a moment
			$= 75$ Nm anticlockwise	A1	1.1b	cao; direction needed	
				[2]			
3	(b)		Minimum force when applied at B: $0.9F = 75$	M1	3.1b	Forming equilibrium equation with distance 0.9	
			$F = 83.3$	A1	1.1b	FT their moment in **(a)**	
				[2]			
3	(c)		The hinge provides an additional [horizontal] force at A	B1	3.2a	Must mention either A or the hinge	Do not allow either mark for an argument based on the weight
			But this will not have a moment about A	B1	3.2a	Must mention moment about A	
				[2]			

Question			Answer	Marks	AOs	Guidance	
4	(a)		Initial velocity is $\begin{pmatrix}-3\\0\end{pmatrix}$	B1	2.1	For correct vector seen	Allow full credit for an answer where the two components are considered separately only if the final answer is given as a vector
			$\mathbf{v}=\mathbf{u}+\mathbf{a}t=\begin{pmatrix}-3\\0\end{pmatrix}+\begin{pmatrix}-0.1\\0.2\end{pmatrix}25$	M1	2.1	FT their initial velocity as long as it is a vector	
			$=\begin{pmatrix}-5.5\\5\end{pmatrix}$	A1	2.5	AG; must be in vector form	
				[3]			
4	(b)		$\mathbf{r}=\mathbf{u}t+\frac{1}{2}\mathbf{a}t^2=\begin{pmatrix}-3\\0\end{pmatrix}t+\frac{1}{2}\begin{pmatrix}-0.1\\0.2\end{pmatrix}t^2$	M1	3.1a	FT their **u**	Allow full credit for both components considered separately
			$\begin{pmatrix}x\\y\end{pmatrix}=\begin{pmatrix}-3t-0.05t^2\\0.1t^2\end{pmatrix}$				
			Substitute $t^2=10y$ into equation for x	M1	3.1a	Attempt to eliminate t; FT their **r**	
			$x=-3\sqrt{10y}-0.5y$	A1	1.1b		
				[3]			

5			$\cos C=\dfrac{5^2+8^2-7^2}{2\times5\times8}=0.5$	M1	3.1a	Use of the cosine rule to find angle C	
			$C=\frac{1}{3}\pi$	A1	1.1b	Allow 60°	
			Area triangle = $\frac{1}{2}\times5\times8\times\sin\frac{1}{3}\pi$	B1	1.1a	May be implied	
			Area of sector = $\frac{1}{2}\times r^2\times\frac{1}{3}\pi=\frac{1}{2}\times\left(\frac{1}{2}\times5\times8\sin\frac{1}{3}\pi\right)$	M1	3.1a	Forming an equation for r^2	
			$r^2=\dfrac{6}{\pi}\times10\sin\frac{1}{3}\pi\Rightarrow r=4.07$ to 3sf	A1	1.1b	Allow 4.1 or better	
				[5]			

Question			Answer	Marks	AOs	Guidance	
6	(a)		$h = 0.5 \Rightarrow$ Integral $\approx \frac{1}{2} \times 0.5 \times 16.2075$	M1	1.1a	Substitution of h and the total from spreadsheet and using it in the trapezium rule formula	Allow recalculation of the spreadsheet total from scratch
			= 4.051 875	A1 [2]	1.1b	awrt 4.05	
6	(b)		The estimate is an overestimate; as the curve is concave upwards the tops of the trapezia are above the curve and so the trapezia include extra area	E1 [1]	2.2a	Overestimate stated with clear explanation (must include reference to trapezia being above the curve, or a suitable diagram showing this)	Do not allow for argument based on a value for the integral found by calculator

Question			Answer	Marks	AOs	Guidance	
7			Use of $s = ut + \frac{1}{2}at^2$ to compare two accelerations				
			For OA: $24 = 3 \times 4 + \frac{1}{2} a \times 4^2$	**M1**	**3.3**	Use formula with u = 3, s = 24, t = 4	
			a = 1.5	**A1**	**1.1b**		
			For OB: $104 = 3 \times 10 + \frac{1}{2} a \times 10^2$	**M1**	**3.3**	Use formula with u = 3, s = 104, t = 10 or (for AB) with u = 9, s = 80, t = 6	If AB considered do not allow u = 3; there must be an attempt to find the speed at A, e.g. via *suvat* for OA
			a = 1.48	**A1**	**1.1b**	(or a = 1.44 using data for AB)	
			Similar values, so constant acceleration is a good model	**A1**	**3.5a**	Clear comparison and conclusion. Allow alternative conclusion, i.e. that the model is not [exactly] consistent with the data	
			Alternative solution				Allow credit for any complete method
			Predicting a value and comparing with given figure				
			For OA: $24 = 3 \times 4 + \frac{1}{2} a \times 4^2$	**M1**		Find a for OA using u = 3, s = 24, t = 4	
			a = 1.5	**A1**			
			For OB: $s = 3 \times 10 + \frac{1}{2} \times 1.5 \times 10^2$	**M1**		Use of a = 1.5 for OB, oe	Do not allow u = 3 as initial speed for AB
			OB = 105 m	**A1**			
			Actual distance is 104 m, which is very close, so constant acceleration is a good model	**A1**		Clear comparison and conclusion Allow alternative conclusion, i.e. that the model is not [exactly] consistent with the data	
				[5]			

Question			Answer	Marks	AOs	Guidance	
8	(a)		Two valid comments, e.g.:				
			The car's direction of motion changes from negative to positive [at time t = 1]	**B1**	**2.2a**	For a comment involving the change of direction	
			The initial speed of the car is 1 m s^{-1} [in the negative direction]	**B1**	**2.2a**	For any essentially different sensible comment about the motion	
			After 1 s the car is momentarily stationary				
			The car accelerates [in the positive direction] reaching a speed of 19.8 m s^{-1} [after 4 seconds]	**[2]**			
8	(b)		**DR**				
			Consideration of two separate phases of the motion	**M1**	**3.1b**	May be implied	
			$s = \int (0.1t^3 + 0.9t^2 - 1)\,\mathrm{d}t = 0.025t^4 + 0.3t^3 - t \quad (+c)$	**M1**	**1.1a**	Attempt to integrate the terms is needed	
				A1	**1.1b**	Correct indefinite integration (may be seen as working for a definite integral)	+ c not required here
			For 1st second: $s = (0.025 \times 1^4 + 0.3 \times 1^3 - 1) - 0 = -0.675$	**M1**	**1.1a**	For substitution of limits, oe	Allow this mark for limits 0 and 4
			For the next three seconds: $s = (0.025 \times 4^4 + 0.3 \times 4^3 - 4) - (-0.675) = 22.275$				
			Total distance = $22.275 + 0.675 = 22.95$ m	**B1** **[5]**	**1.1b**	Allow for correct answer seen, www	
8	(c)		$a = \frac{\mathrm{d}v}{\mathrm{d}t} = 0.3t^2 + 1.8t$	**M1**	**1.1a**	Attempt to differentiate	
				A1 **[2]**	**1.1b**	cao	

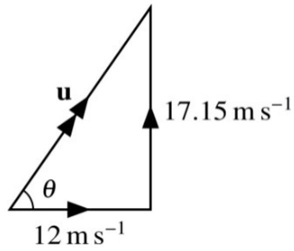
Question			Answer	Marks	AOs	Guidance	
9	(a)		Use of Newton's 2nd Law for the whole train				m = 0.5 used
			Weight component parallel to the plane is $0.5g\sin 20°$	B1	3.3	May be implied by use in an equation	
			$2.5 - 0.5g\sin 20° = 0.5a$	M1	1.1a	N2L with at least one correct force	
			$a = 1.65\text{ m s}^{-2}$ to 3sf	A1	2.1	AG; must be clearly shown	
			Alternative solution				
			Equations for engine and truck separately				m = 0.3 and/or 0.2 used
			N2L for engine: $2.5 - 0.3g\sin 20° - T = 0.3a$	B1		Correct weight component in at least one equation	
			N2L for truck: $T - 0.2g\sin 20° = 0.2a$	M1		Both equations attempted, plus attempt to eliminate T	
			$a = 1.65\text{ m s}^{-2}$ to 3sf	A1		AG; must be clearly shown	
				[3]			
9	(b)		**Either** $T - 0.2g\sin 20° = 0.2\times 1.65$ **Or** $2.5 - 0.3g\sin 20° - T = 0.3\times 1.65$	M1	3.3	Use of N2L for either engine or truck	Equation must have all the forces and no extras
			T = 1 N	A1	1.1b	Allow awrt 1.00	
				[2]			
9	(c)		$3^2 = 1^2 + 2\times 1.65\times s$	M1	1.1a	Use of *suvat* leading to a value for s	
			s = 2.42 m	A1	1.1b	Or 2.43 from use of a = 1.6482…	
				[2]			

Question			Answer	Marks	AOs	Guidance	
10	(a)		Completing the square: $(x-10)^2+(y+6)^2=36$	**M1**	**3.1a**	Attempt to rewrite the equation and find centre and radius	
			So the centre is (10, –6) and the radius 6	**A1**	**1.1b**	Correct centre and radius	
			The distance from the centre to the *x*-axis is equal to the radius, so the axis is a tangent	**A1**	**2.2a**	Complete argument with correct values	
			Alternative solution				
			Circle meets *x*-axis where $x^2-20x+100=0$	**M1**		Forming equation by letting *y* = 0	
			i.e. where $(x-10)^2=0$	**M1**		Solution attempt by factorising/formula	
			There is a repeated root so the *x*-axis is a tangent	**A1**		Complete argument with correct values	
				[3]			
10	(b)		Gradient of AB is $\frac{5-(-7)}{11-(-1)}=\frac{12}{12}=1$ so perp. grad is –1	**B1**	**2.1**	Correct gradient of bisector	
			Midpoint of AB is (5, –1)	**B1**	**2.1**	Must be explicitly identified	
			Equation is $y+1=-1(x-5)\Rightarrow y=4-x$	**B1**	**2.1**	AG; must be clearly shown	
				[3]			

Question			Answer	Marks	AOs	Guidance	
10	(c)		Centre (10, –6) lies on ⊥ bisector of AB, as –6 = 4 – 10	M1	3.1a	Showing that centre lies on the bisector	
			So the centre is equidistant from A and B, hence the circle through A also passes through B	A1	2.2a	Complete argument	
			Alternative solution				
			Distance from centre (10, –6):	M1		Attempt at finding both distances	
			to A $=\sqrt{(10+1)^2+(-6+7)^2}=\sqrt{122}$				
			to B $=\sqrt{(10-11)^2+(-6-5)^2}=\sqrt{122}$				
			Distances are equal, hence the circle through A also passes through B	A1		Complete argument from correct values	
				[2]			

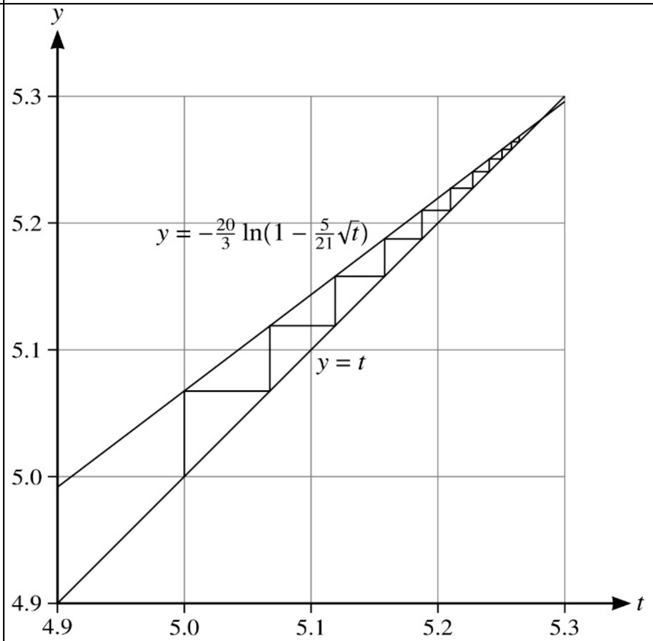
Question			Answer	Marks	AOs	Guidance	
11			$\int \frac{5}{y^2-y-6}\,dy = \int \frac{1}{x}\,dx$	M1	3.1a	Attempt to separate variables	
			$\frac{5}{y^2-y-6} = \frac{A}{y-3} + \frac{B}{y+2}$	M1	3.1a	Attempt to use partial fractions	With their factors
			$A=1,\ B=-1$	A1	1.1b	All correct	
			$\int \left(\frac{1}{y-3} - \frac{1}{y+2}\right) dy = \int \frac{1}{x}\,dx$	M1	1.1a	Integrating, obtaining natural logs	
			$\Rightarrow \ln(y-3) - \ln(y+2) = \ln x + c$	A1	1.1b	FT their partial fractions	
			When $x=1,\ y=8$ so $\ln 5 - \ln 10 = \ln 1 + c$	M1	1.1b	Use of initial conditions to find c	
			$c = \ln\frac{1}{2}$	A1	1.1b	oe	
			$\ln(y-3) - \ln(y+2) = \ln x + \ln\frac{1}{2}$				
			So $\ln\left(\frac{y-3}{y+2}\right) = \ln\left(\frac{x}{2}\right) \Rightarrow \frac{y-3}{y+2} = \frac{x}{2}$	M1	3.1a	Attempt to remove logs from their eqn	
			$2y-6 = xy+2x \Rightarrow y(2-x) = 6+2x$	M1	1.1a	Attempt to make y the subject	Of their equation
			$\Rightarrow y = \frac{6+2x}{2-x}$	A1	1.1b	oe, but must be $y = \mathrm{f}(x)$ form	
				[10]			

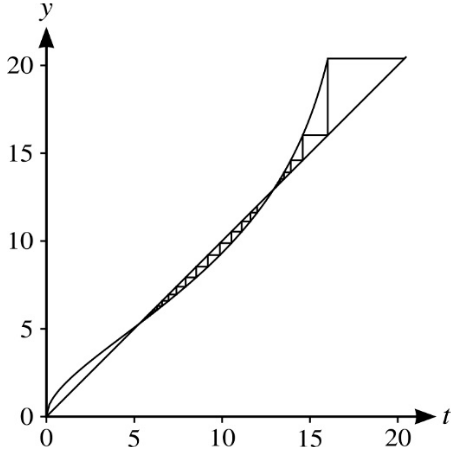
Question			Answer	Marks	AOs	Guidance	
12	(a)		Resistance to the motion is modelled as being negligible	B1 [1]	3.3	Or similar Or any correct assumption e.g. motion is in a vertical plane; football is modelled as a particle; acceleration is constant…	
12	(b)		Vertical motion: $0 = 3.5u - \frac{1}{2} \times 9.8 \times 3.5^2$ u = 17.15, so velocity component is 17.2 m s^{-1} (to 3sf)	M1 A1 [2]	3.1a 1.1b	Use of *suvat* equation(s) to find u. using either s = 0, g = –9.8 and t = 3.5 or v = 0, g = –9.8 and t = 1.75	
12	(c)		$s = 17.15 \times 1.75 - \frac{1}{2} \times 9.8 \times 1.75^2$ Maximum height is 15.0 m	M1 A1 [2]	1.1a 1.1b	Use of *suvat* equation(s) to find s, using any of u = (their) 17.15, v = 0, t = 1.75, g = –9.8 Allow for 15 or better	

Question			Answer	Marks	AOs	Guidance	
12	**(d)**	(*i*)	Horizontal velocity component is $\frac{42}{3.5}=12$	**B1**	**3.1a**		
			Initial speed $=\lvert \mathbf{u} \rvert=\sqrt{17.15^2+12^2}$	**M1**	**1.1a**	Use of Pythagoras	
			= 20.9 m s^{-1}	**A1**	**1.1b**	FT their components	
				[3]			
12	**(d)**	(*ii*)	Angle θ with horizontal is given by $\tan\theta=\frac{17.15}{12}$	**M1**	**1.1a**	Allow reciprocal for M mark only	
			Angle with horizontal is 55.0°	**A1**	**1.1b**	FT their components; allow 55° or better	
				[2]			

Question			Answer	Marks	AOs	Guidance	
13			$u = e^{kx},\ v = \sin 2x \Rightarrow \frac{du}{dx} = ke^{kx},\ \frac{dv}{dx} = 2\cos 2x$	M1	3.1a	Differentiation using product rule	May be implied
			$\frac{dy}{dx} = ke^{kx}\sin 2x + e^{kx}(2\cos 2x)$	A1	1.1b	Any form	
			At max point: $0 = e^{\frac{3}{8}k\pi}\left(k\sin 2\left(\frac{3}{8}\pi\right) + 2\cos 2\left(\frac{3}{8}\pi\right)\right)$	M1	3.1a	Equating their $\frac{dy}{dx}$ to 0 with $x = \frac{3}{8}\pi$	
			So $k = -\frac{2\cos\frac{3}{4}\pi}{\sin\frac{3}{4}\pi} = 2$	A1	1.1b	Correct value $k = 2$	
			Min point where $0 = 2e^{2x}\sin 2x + 2e^{2x}\cos 2x$	M1	1.1a	Using their k in $\frac{dy}{dx} = 0$ to find x at min	
			$2\sin 2x + 2\cos 2x = 0 \Rightarrow \tan 2x = -1 \Rightarrow 2x = -\frac{1}{4}\pi$	M1	1.1b	Use of appropriate trig identity	
			So minimum point occurs where $x = -\frac{1}{8}\pi$	A1	1.1b	FT their k	
			Minimum value $= f\left(-\frac{1}{8}\pi\right) = -\frac{e^{-\frac{1}{4}\pi}}{\sqrt{2}}$	A1	2.2a	FT; any equivalent exact form	
				[8]			

Question			Answer	Marks	AOs	Guidance	
14	(a)		$12\,000 = 22\,000 - a\sqrt{4} \Rightarrow a = 5\,000$	**B1** **[1]**	**3.3**	cao	
14	(b)		$\frac{\mathrm{d}V}{\mathrm{d}t} = -5\,000 \times \frac{1}{2} \times t^{-\frac{1}{2}}$ $t = 4 \Rightarrow \frac{\mathrm{d}V}{\mathrm{d}t} = -1250,$ so the caravan is losing value at a rate of £1250 per year when $t = 4$	**M1** **A1** **A1** **[3]**	**3.4** **1.1b** **3.4**	Attempt to differentiate Correct derivative, in any form Must interpret the negative value of the derivative and must state units	
14	(c)		For large values of t, [more than 19.36 years] the value of V is negative which is not possible	**E1** **[1]**	**3.5b**	Any argument based on negative values for [sufficiently] large t	
14	(d)		$c = 1000$ $22\,000 = b\mathrm{e}^0 + c$ so $b = 21000$	**B1** **B1** **[2]**	**3.3** **3.3**	cao cao	
14	(e)		Agree when $22\,000 - 5\,000\sqrt{t} = 21000\mathrm{e}^{-0.15t} + 1000$ i.e. when $\mathrm{e}^{-0.15t} = \frac{21\,000 - 5000\sqrt{t}}{21\,000} = 1 - \frac{5}{21}\sqrt{t}$ $-0.15t = \ln\left(1 - \frac{5}{21}\sqrt{t}\right)$ $t = -\frac{1}{0.15}\ln\left(1 - \frac{5}{21}\sqrt{t}\right) = -\frac{20}{3}\ln\left(1 - \frac{5}{21}\sqrt{t}\right)$	**M1** **M1** **A1** **[3]**	**2.1** **2.1** **2.1**	Equating their models and attempting to isolate the exponential term Taking logs of both sides AG; complete argument needed	$\mathrm{e}^{-0.15t} = \mathrm{K}$ need not be simplified at this stage
14	(f)		$t_1 = 5.067\,572\,851$ $t_2 = 5.118\,888\,519$	**B1** **B1** **[2]**	**1.1b** **1.1b**	BC Allow answers which agree when rounded to 3sf	

Question			Answer	Marks	AOs	Guidance	
14	(g)			B1 [1]	1.1b	Must show at least two steps beginning at $t = 5$	
14	(h)		The argument is false – the sequence is increasing and could [and in this case does] increase so that the root rounds to 5.3 or higher	B1 [1]	2.3	Accept an argument based on calculation of additional terms	Do not accept "false" without a reason

Question			Answer	Marks	AOs	Guidance	
14	(i)			B1	2.4	Sketch showing two staircases, one starting above the root and diverging and one starting below the root and converging on the root near 5	
			So the iteration will not find the root near 12	B1	2.2a	Correct conclusion for correct reason	
			Alternative solution 1 Sequence starting above the root, e.g. 13, 13.035, 13.089, 13.174, 13.310, 13.532, 13.909 and sequence starting below the root, e.g. 12, 11.611, 11.118, 10.530, 9.874, 9.193, 8.532, K	B1		Increasing sequence starting above and decreasing sequence starting below	
			So the iteration will not find the root near 12	B1		Correct conclusion for correct reason	
			Alternative solution 2 Near the root, the gradient of $y=-\frac{20}{3}\ln\left(1-\frac{5}{21}\sqrt{t}\right)$ is greater than 1	B1		For correct relevant statement about the gradient	Accept 'steeper than the line' for 'greater than 1'
			So the iteration will not find the root near 12	B1		Correct conclusion for correct reason	
				[2]			

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