Level 3 Certificate

Quantitative Reasoning (MEI)

H868/01: Introduction to Quantitative Reasoning

OCR Level 3 Certificate

Mark Scheme for November 2020

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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.

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
U1	Mark for correct units
G1	Mark for a correct feature on a graph
M1 dep*	Method 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

1. **Subject-specific Marking Instructions**

   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, award marks according to the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are involved) 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, eg 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, eg 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, exactly what is acceptable will be detailed in the mark scheme rationale. If this is not the case please consult your Team Leader.

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   Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise. Candidates are expected to give numerical answers to an appropriate degree of accuracy, with 3 significant figures often being the norm. Small variations in the degree of accuracy to which an answer is given (e.g. 2 or 4 significant figures where 3 is expected) should not normally be penalised, while answers which are grossly over- or under-specified should normally result in the loss of a mark. The situation regarding any particular cases where the accuracy of the answer may be a marking issue should be detailed in the mark scheme rationale. If in doubt, contact your Team Leader.

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.
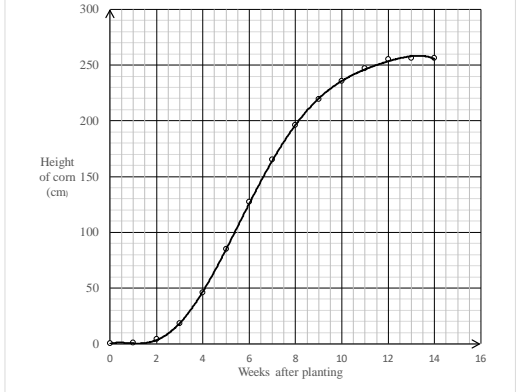
NB Follow these maths-specific instructions rather than those in the assessor handbook.

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.

Note that a miscopy of the candidate's own working is not a misread but an accuracy error.
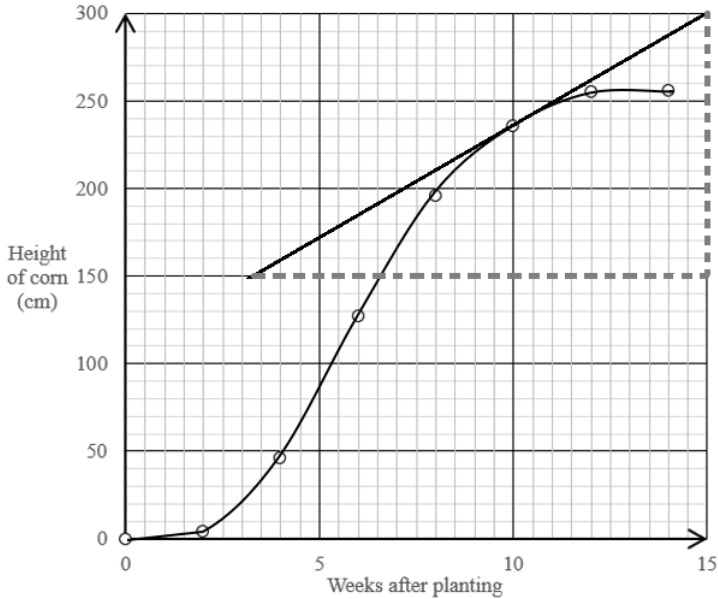
i   Anything in the mark scheme which is in square brackets […] is not required for the mark to be earned, but if present it must be correct.

Question		Answer	Marks	Guidance	AO	Level
1	**(i)**	Median = 6 (species)	**B1**		1	E(1)
		Inter-quartile range = 2 (species)	**B3**	1 for 1 quartile seen e.g. 5 or 7 (not 6) but not, for example in a finding the mean calculation **Or** 2 for 2 quartiles correctly identified and labelled as such. (Q1=5, Q3 = 7)		A(3)
			[4]			
	(ii)	Suitable value of n (species) used	**M1**	Selection of suitable value for n (e.g. median (6), greatest value (10), smallest value (3), mode (6) or mean (6.125))	2/3	C
		Giving age of 630 years.	**A1**	Correct answer(s) for *their n*		
		2020 – 1066 = 954 years (about a 1000 years)	**A1**	2020 – 1066 = 954 (or statement to the effect that 1066 is about 1000 years ago) Condone 2019 and 2021 only		
		This age does not support the idea.	**E1**	Comparison of above with *their* answer together with a consistent comment.		
		-------- Alternative approach "working back" from the present -------- 2020 – 1066 = 954 (years ago)	**B1**	--------------------or-----------------------		
		$100n + 30 = their$ 954	**M1**			
		$n = 9.24$	**A1**	Follow through on *their* correctly solved equation. Accept "9" if obviously rounded from correct process.		
		This number is not supported by the data	**E1**			
			[4]			

	(iii)	Using the simplifies rule gives an underestimate.	**B1**	"Slightly lower" oe (sole reference to "accuracy" gains no credit) Allow "simplified takes 30 years off" or equivalent.	3	C
		Worked example using both rules (for same n)	**B1**	(These are independent marks)		
			[2]			
2	**(i)**	Smooth curve passing through circles	**B1**	Accept the better line near the end (> 11 weeks and assume it to be a process of T&I)	1	E
			[1]			
	(ii)	(11 to 13) (weeks)	**B1**		3	E
			[1]			
	(iii)	(5.5 to 6.5) (weeks)	**B1**		3	E
			[1]			
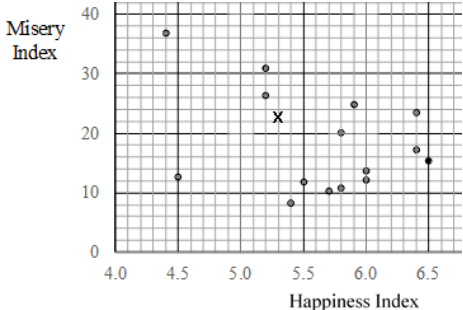
	(iv)	Starts of at zero/very low,	**E1**	"First two weeks very slow" oe	3	A
		Increases (then stays constant)	**E1**	Condone "straight line" oe		
		then slowly levels off oe	**E1**	Condone "reached full height" or equivalent.		
				Overall picture (i.e. 3 distinct regions)		
			[3]			

	(v)	Straight drawn of the appropriate gradient with triangle drawn.	**B1**	By-eye. The triangle may be implied by the working. Condone just correct tangent (symmetric about (10, 255)) Condone a symmetrical tangent at 10 weeks.	1/3	A
		with stated gradient of (10 to 20)	**B1**	With evidence of a tangent drawn and working (beware 300 ÷ 15 = 20)	1/3	A
		with correct units of cm / week oe (e.g. cm in a week)	**B1**	This is an independent units mark	1/3	A
			[3]			

3	(i)			Should candidate consistently and correctly give total paid back for all four deals award SC5 (effectively MR 3×) If not consistently treat as MR each time so -1 each occasion. | Deal	Total paid back		Total interest
1	(£) 2862.50	or	(£)362.50
2	(£)3600	or	(£)1100
3	(£)2870.16	or	(£)370.16
4	(£) 2817.06 …	or	(£)317.06 …			
		Deal 1 0.145 ×2500 or 1.145 ×25000 soi (£)362.50	**M1** **A1**	362.5 is not acceptable	1/2	E
		Deal 2 60×12×5 (=3600) 3600 – 2500 = (£)1100	**M1** **A1**		1/2	E
		Deal 3 (£)370.16	**B1**		1/2	E
		Deal 4 (1.01)^{12} soi (1.01)^{12} × 2500 – 2500 oe soi (£)317.06 ….	**M1** **M1** **B1**		1/2	C
			[8]			

	(ii)	Reason for Reason against **Deal 1** Reason for One of lowest interest payback at £362.50 Reason against Large lump sum after 1 year **or** **Deal 2** Reason for Small monthly repayments at £60 No final lump sum required oe Reason against Largest total interest at £1100 **or** **Deal 3** Reason for No final lump sum required oe Reason against Not cheapest (£)370.16 repayment **or** **Deal 4** Reason for Smallest total interest paid (£)317.06 Reason against One large lump sum to be paid back after 1 year	**E1** **E1**	● Condone if comparator of total paid back used rather than interest paid. ● Allow any other rational and relevant reasons given ● Sums of money should be quoted when not to do so would be ambiguous. ● Condone just "cheapest" iff based on *their* costings. ● Full and strict follow through on their figures from part (i) i.e. cheapest etc. on *their* costings. . ● Condone non-standard money notation for this item i.e. omitting "£" if clear and "£2.5p" etc	3	C
			[2]			
4	**(i)(A)**	7.5	**B1**	Condone addition of "%"	1	E
			[1]			
	(i)(B)	4.1(%) 6(.0) – 1.9 = 4.1(%)	**M1** **A1**	M1A0 for 1.9-6 = -4.1(%)	1	E
			[2]			

(ii)(A)	Correct point unambiguously indicated (< ±0.5 division) Point is at (5.3, 23) 	**B1**	Do not allow (5.3, 22) Condone lack of actual label of (5.3, 23)	1	E
		[1]			
(ii)(B)	Negative (correlation) [Small / slight / weak oe]	**B1**	Condone the additional "as *x* gets larger, *y* gets smaller" oe zero if conflicts with *their* stated correlation.	1	E
		[1]			
(iii)(A)	(33 to 35) (%)	**B1**		2	E
		[1]			
(iii)(B)	(15 to 17)% soi *Their* (15 – 17)% of 150 000 Giving sample size of 22 500 to 25 500	**B1** **M1** **A1**	Follow through	2	E
		[3]			

	(iv)	20 calls on hour oe	**B1**	soi	2	E
		Total of 500 hours call time oe	**B1**	May imply the first B1		
		500 ÷ 30 = 16.666 … people	**B1**			
		So 17 people	**B1**			
		-------- Alternative approach "working back" from calls per person ---------		-------------------- or -----------------------		
		A single person Can make 20 × 30 calla week	**B1**			
		= 600	**B1**	Award both Bs if 600 seen		
		10 000 ÷ 600 = 16.666 … people	**B1**			
		So 17 people	**B1**			
			[4]			
	(v)(A)	106.43 ÷ 19	**M1**	Care over 45.28 ÷ 8 which gives 5.66	2	C
		= 5.6 (015 …)	**A1**	gains zero		
			[2]			
	(v)(B)	=B9*C9	**B1**	Must be standard spreadsheet formula	3	E
				Including the "=" but		
				"condone "D9 =B9*C9" or "B9*C9=D9"		
			[1]			

5	(i)	$\pi \times 60 = 188.(49 \ldots)$ cm for 1 revolution	B1	(1 turn of trundle wheel =) $2\pi \times 30 = 188,(49 \ldots)$ soi	2/3	C/A
		Distance travelled $\frac{129}{360} \times$ *their* circumference	B1	Distance travelled by glacier in 27 hours = $\frac{129}{360} \times$ *their* $(188. (49 \ldots) = 67.5(44 \ldots)$ Full FT on *their* circumference		
		Speed of glacier $= 67.5(44 \ldots) \div 27$ (cm/hour)	M1	Speed of glacier = *their* above distance $\div 27$ Method mark for speed = distance $\div$ time $(= 2.5$ (cm/hour))		
		Speed cm/hour $\div$ 60 cm/min	B1	Follow though		
		$\div 60 = 0.00069(48 \ldots)$ or 0.0007 (cm/s) or 6.9×10^{-4} (cm/s)	B1	$= 0.00069(48 \ldots)$ (cm/s) Can imply previous B1 (*their* $2.5 \div 3600$)		
			[5]			
	(ii)		B2	B1 for 2 correct _____ SC1 _____ 	3	E
			[2]			

(iii) (*A*)		**B1**	Point (0, 2) indicated	3	C
		B1	Points (16, -18) and (20, -18) indicated		
		[2]			
(iii)(*B*)	7 (m)	**B1**		1	E
		[1]			
(iv)(*A*)	1.5×0.35×0.25 soi = 0.13(125) (km^3)	**M1** **A1**		1	E
		[2]			
(iv)(*B*)	21 days (follow through from (**iv**)(*A*))	**B1** **B1**	*Their* 0.131(25) ÷ 0.006 = (21.83 …) Full follow through on *their* answer rounded down.	1	E
		[2]			

	(iv)(C)	0.95^{12} $=0.54$ … and Yes	B1 B1	0.95^{12} soi Or equivalent. Condone lack of specific reference to 0.5 , 50% oe.	2	E
			[2]			
6	(i)(A)	PQ PR PS QR **QS RS**	B1	Condone (double counting) PQ PR PS QR **QS RS** **QP RP SP** **RQ SQ SR**	3	E
			[1]			
	(i)(B)	$\frac{1}{6}$	B1	Condone for full credit $\frac{2}{12}$ isw	3	E
			[1]			
	(i)(C)	The components fail independently of each other oe	E1	"Independent" must appear in the response.	2	A
	(ii)(A)	36 (or 35.5 to 36.5) (years)	B1		1	E
			[1]			
	(ii)(B)	0.988	B1	o.e. eg 98.8%	1	E
			[1]			

(iii)(A)	 _____ **OR** _____ Where candidates have adopted a frequency approach - n is a number chosen by them. 	**B2** **B1**	All correct either approach or Correct pair of branches on diagram from at least two nodes or by frequencies via multiplication Fraction equivalents are allowed throughout Percentages are allowed throughout the item but must have % attached. Fractions which will be produced working with fractions are:- $$\frac{19}{20}\times\frac{19}{20}=\frac{361}{400}$$ $$\frac{19}{20}\times\frac{1}{20}=\frac{19}{400}$$ $$\frac{1}{20}\times\frac{19}{20}=\frac{19}{400}$$ $$\frac{1}{20}\times\frac{1}{20}=\frac{1}{400}$$	2	A

				[2]		
	(iii)(B)	$(0.95 \times 0.95 =) 0.9025$	**B1**	o.e. eg 90.25% or $\frac{19}{20} \times \frac{19}{20} = \frac{361}{400}$	2	A
	(iii)(C)	$(0.95 \times 0.95) + (0.05 \times 0.95) + (0.95 \times 0.05)$ (or equivalent using fractions) $= 0.9975$ $= 99.75\%$ _____ alternative approach using frequency _____ Where n is a number chosen by the candidate Number of systems with two components failing $= 0.05n \times 0.05 = 0.0025n$ So the probability of two components (i.e. system) failing is of 0.0025 Probability of system working $= 1 - 0.0025 = 0.9975$ Which is 99.75%	**M1** **A1** **E1** **M1** **B1** **E1**	$(0.95 \times 0.95) + (0.05 \times 0.95) + (0.95 \times 0.05)$ 0.9975 (Which is greater than 99%) i.e. presentation of 99.75% is sufficient. to imply the A1, but no follow through with _their_ 99.75% Beware – problem solved fortuitously by $0.95 + 0.0475 = 0.9975$ – no credit. _____ or using frequency approach _____ P(fail) $= \dfrac{their\ 0.05n\ x\ 0.05}{their\ n}$ P(work) $= 1 - their$ P(fail) Showing this as a percentage (greater than 99%)	3	A
				[3]		

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored