Level 3 Certificate in Using and Applying Mathematics

Provisional mark scheme

Sample assessment 1

Paper 1: Mathematical modelling
Paper 2: Part 1 – Mathematical comprehension
Part 2 – Communicating with mathematics

Paper 1: Mathematical modelling

Marks	Formulating	Model development	Evaluation and interpretation
0			
1	Formulates a simplification of the situation that does not adequately capture all of the most important aspects and/or which does not allow mathematical work to proceed.	Develops a mathematical model that • is dealt with using limited mathematics • contains errors in use of standard conventions and notation.	Gives only limited evidence of • checking the validity of their work • understanding of how their mathematical work relates to the situation they are investigating.
2			
3			
4	Formulates at least one simplification of the situation that • adequately deals with important factors • makes reasonable assumptions • allows mathematical analysis to proceed.	Develops a mathematical model that • is dealt with effectively using appropriate mathematics • contains only minor errors • contains only few slips in use of standard conventions and notation.	Provides evidence of having considered the validity of their model. Demonstrates some awareness of the implications of their mathematical work in terms of the situation it represents.
5			
6			
7	Formulates a model(s) that demonstrates • understanding of how to deal with factors in the situation so that they might be dealt with effectively using mathematics • evidence of understanding of how to modify/adapt/ improve this.	Develops a mathematical model that • is dealt with effectively using appropriate mathematics • is almost entirely without error, demonstrates efficiency and rigour • uses standard conventions and notation correctly throughout.	Provides evidence of having considered the validity of their model. Demonstrates clearly how outcomes of their mathematical work relate to the real situation and awareness of the implications for the situation/context.
8			
9			
10	*and* demonstrates how mathematical work provides insight into increasing sophistication in model formulation.	*and* demonstrates clear and rationally explained improvement.	*and* explains how the mathematical structure of their models are related to the real situation/context.
Mark			
Scaling factor	*2*	*1*	*1.5*
Scaled mark			
		TOTAL MARKS FOR PAPER 1	**/45**

Paper 2: Part 1 – Mathematical comprehension

AO1 Select, use and apply mathematical techniques effectively when solving problems and communicating with mathematics.
AO2 Represent authentic situations mathematically and analyse these using mathematics to provide insight and solve associated problems.
AO3 Critically make sense of mathematical reasoning, and solutions to problems and communicate mathematical working effectively and with clarity.

		Marks	Comments	Mark allocation to AOs		
1				AO1	AO2	AO3
a	The winning times for women are decreasing at a faster rate than for men	B2	Or equivalent			2
b	Values: -0.0146 for women and -0.0099 for men indication that these are the gradients of the lines of best fit and that these give the rate at which winning times are decreasing per year and that this is greater for women than for men	B1 B1 B1 B1				4
c	This shows how the speeds for both men and women are increasing and that this is greater for women than for men	B1 B1				2
d	That eventually women will run the 100 metres faster than men	B2				2
	TOTAL	**10**				
2				AO1	AO2	AO3
	For men: $T_m = -0.0146n + 40$ for women: $T_w = -0.0099n + 29.6$ $-0.0146n + 40 = -0.0099n + 29.6$ $0.0047n = 10.4$ $n = \frac{10.4}{0.0047} = 2212.766$	M1 M1 A1 M1		4		
	TOTAL	**4**				
3				AO1	AO2	AO3
a	100 metres: $\frac{100}{9.63} = 10.38\,\text{ms}^{-1}$ 200 metres: $\frac{200}{19.32} = 10.35\,\text{ms}^{-1}$	M1 A1 A1 A1	Method in either calculation Use of ms^{-1}	4		
b	He ran the 200 metres at a slightly faster speed than the 100 metres. This is because the period where he is running slowest (that is, accelerating at the start) is a greater proportion of the 100 metres than it is of the 200 metres.	B1 B2				3
	TOTAL	**7**				

4				AO1	AO2	AO3
	Equate $T_m = T_w$ rearrange to gather terms in *n* and isolate in the form $an = c$ divide both sides by *a* to give *n*	B1 B1 B1 B1				4
	TOTAL	**4**				
5				AO1	AO2	AO3
	Gradient of straight line for women: $\frac{148-144}{28} = 0.14286$ for men: $\frac{132-129}{28} = 0.10714$ Women running faster at a rate of 0.14286-0.10714 = 0.03572 minutes per year gap in 2012 is 15 minutes so to run in the same time will take $\frac{15}{0.03572} = 420$ years that is in 2432	M1 A1 A1 M1 M1 M1 A1ft	Alternatively using simultaneous equations		7	
	TOTAL	**7**				
6				AO1	AO2	AO3
	$327,680,000 This is double the amount owed at the end of the previous period. This is required to pay the investors the amount they invested at the start of the period plus the interest (which is the same amount)	B1 B1 B1 B1		2		2
	TOTAL	**4**				
7				AO1	AO2	AO3
a	Remains the same	B2				2
b	10 times greater	B2				2
	TOTAL	**4**				
8				AO1	AO2	AO3
a	F4: = E3 calculates the interest payable by equating with the amount invested at the start of the period. This is because the interest rate is 100%	B1 B1		2		
b	G4: = E3+F4 calculates the total paid out by adding the total amount invested at the start of the period (E3) and adding the interest that is due on this (F4)	B1 B1		2		
	TOTAL	**4**				

9				AO1	AO2	AO3
a	E4 = C4*100	B2		2		
b	F4 = E3*0.5	B2		2		
	TOTAL	**4**				
10				AO1	AO2	AO3
a	90 days: 110 180 days: 121 270 days: 133	M1 A1 B1ft B1ft		4		
b	90 days: $11,000 180 days: $12,100 270 days: $13,310	M1 A1 B1ft B1ft		4		
	TOTAL	**8**				
11				AO1	AO2	AO3
	Allow for people investing on different starting dates allow for investors to leave money invested for longer than 90 days	B2 B2				4
	TOTAL	**4**				
TOTAL MAX MARKS FOR PAPER 2: PART 1			**/60**	**26**	**7**	**27**
Scaling factor			**0.5**			
TOTAL SCALED MAX MARKS FOR PAPER 2: PART 1			**/30**	**13**	**3.5**	**13.5**

Key to marking allocation:

M - method marks
A - accuracy marks dependent on prior method marks being awarded
B - accuracy marks independent of prior method marks being awarded
ft - follow through using previous incorrect answer

Paper 2: Part 2 – Communicating with mathematics

Marks	Identifying and selecting data	Analysing and reasoning	Reasoning and presenting
0			
1	Identifies and selects data that in some cases is not entirely appropriate for analysis to allow the development of a well-reasoned case. The selection of data and methods of analysis to not always demonstrate awareness of the intended audience of the work and its purpose.	Mathematical analysis, is in the main, carried out accurately and using appropriate mathematics. There are some errors in working and standard conventions and notation are not always used correctly.	Mathematical reasoning, statements and diagrams lack clarity and in places are difficult to follow. Interpretation, arguments and conclusions are not always appropriate, may contain errors and do not sufficiently, take account of their intended • audience • purpose.
2			
3			
4	Identifies and selects appropriate data that can be analysed using mathematics to develop a well-reasoned case. The selection of data and methods of analysis demonstrate awareness of the intended audience of the work and its purpose.	Mathematical analysis is carried out effectively using appropriate mathematics. Mathematical work contains only minor errors and contains only few slips in use of standard conventions and notation.	Mathematical reasoning, statements and diagrams can, with few exceptions, be clearly followed. Interpretation and arguments developed are almost entirely correct, appropriate, take account of and apply in light of the intended: • audience • purpose.
5			
6			
7	Identifies and selects data judiciously so that it can be analysed using mathematics to develop a thoughtfully reasoned case. The selection of data and methods of analysis clearly demonstrate awareness of the intended audience of the work and its purpose.	Mathematical analysis is carried out effectively using appropriate mathematics almost entirely without errors and with efficiency and rigour. Standard conventions and notation are correctly used throughout.	Throughout mathematical reasoning, statements and diagrams can be clearly followed. Interpretation and arguments developed are correct, appropriate and in the main take account of and apply, in light of the intended: • audience • purpose.
8			
9			
10	*and allows exploration and communication of alternatives by selection of data.*	*and a range of different mathematical methods and measures are explored.*	*and alternatives are clearly presented and critiqued.*
Mark			
Scaling factor	*2*	*1*	*1.5*
Scaled mark			
		TOTAL MARKS FOR PAPER 2: PART 2	**/30**

Mark allocations to Assessment Objectives

Maximum marks available

Paper 1: Mathematical modelling

Strand	Formulating	Model development	Evaluation and interpretation
Assessment objective	AO2	AO1	AO3
Max. raw mark	10	10	10
Scaling factor	2.5	1	1
Max. raw scaled mark	25	10	10

Paper 2: Part 1 – Mathematical comprehension (see mark allocation analysis)

Assessment objective	AO2	AO1	AO3
Max. raw mark	7	26	27
Scaling factor	0.5	0.5	0.5
Max. raw scaled mark	3.5	13	13.5

Paper 2: Part 2 - Communicating with mathematics

Strand	**Identifying and selecting data**	**Analysing and reasoning**	**Reasoning and presenting**
Assessment objective	AO2	AO1	AO3
Max. raw mark	10	10	10
Scaling factor	1	0.5	1.5
Max. raw scaled mark	10	5	15

ASSESSMENT OVERALL

Assessment objective	AO2	AO1	AO3
Max. raw scaled mark	38.5	28	38.5
Required range	35-45	20-30	35-45