



ASSESSMENT and  
QUALIFICATIONS  
ALLIANCE

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# Mark scheme January 2004

## GCE

### Mathematics & Statistics B

### Unit MBD2

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## Key to mark scheme

<b>M</b>	mark is for	method
<b>m</b>	mark is dependent on one or more M marks and is for	method
<b>A</b>	mark is dependent on M or m mark and is for	accuracy
<b>B</b>	mark is independent of M or m marks and is for	method and accuracy
<b>E</b>	mark is for	explanation
<b>✓ or ft or F</b>		follow through from previous incorrect result
<b>CAO</b>		correct answer only
<b>AWFW</b>		anything which falls within
<b>AWRT</b>		anything which rounds to
<b>AG</b>		answer given
<b>SC</b>		special case
<b>OE</b>		or equivalent
<b>A2,1</b>		2 or 1 (or 0) accuracy marks
<b>- x EE</b>		Deduct $x$ marks for each error
<b>NMS</b>		No method shown
<b>PI</b>		Perhaps implied
<b>c</b>		Candidate

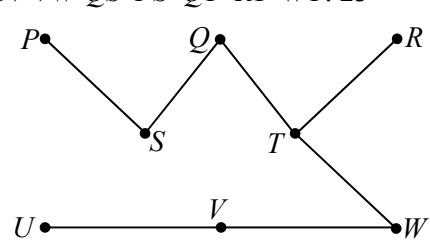
## Abbreviations used in marking

<b>MC - <math>x</math></b>	deducted $x$ marks for miscopy
<b>MR - <math>x</math></b>	deducted $x$ marks for misread
<b>ISW</b>	ignored subsequent working
<b>BOD</b>	gave benefit of doubt
<b>WR</b>	work replaced by candidate

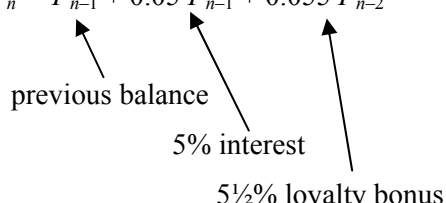
## Application of mark scheme

Correct answer without working	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise

Award method and accuracy marks as appropriate to an alternative solution using a correct method or partially correct method.

Question number and part	Solution	Marks	Total	Comments
1(a)	Formula $\Rightarrow$ $u_n = 3 \cdot (0.5)^{n-1} + 1 \cdot ((0.5)^{n-1} - 1) / (0.5 - 1)$ which tidies up to $2 + (0.5)^{n-1}$	M1 A1 A1 A1	4	(or other methods, e.g. $u_n = 3(0.5)^{n-1} + (0.5)^{n-2} + \dots + 1$ )
(b)	Tends to 2	B1 ✓	1	ft
<b>Total</b>			<b>5</b>	
2 (a)	DEED = - . . . - .	M1 A1	2	
(b)	- . . . - . can be read as BED	M1 A1	2	
(c)	e.g. need a third symbol for 'pause'	B1	1	
<b>Total</b>			<b>5</b>	
3(a)(i)	Six odd vertices $PRSTUW$ Pairing them off take at least 3 tracks	B1 B1	2	Just B1 for "odd vertices"
(ii)	Want to pair off $PRSTUW$ to include $PS$ or $PU$ : $PS RT UW \quad PU RS TW$ $PS RU TW \quad PU RT SW$ $PS RW TU \quad PU RW ST$ Repeating $PS RT UV/VW$ takes $4+4+4$ and is clearly unbeatable as each joined pair adds at least 4.	M1 A1 A1 A1 M1 A1	5	(or use any sensible short-cuts)
(b)	$UV VW QS PS QT RT WT: 23$ 	M1 A1 M1 A1	4	
(c)(i)	Trainspotter's cycle length $\geq$ $25 + 25 + \text{minimum connector length}$ $= 50 + 23 = 73$	M1 A1		
(ii)	73 not possible because (unique) minimum connector is not a path. Switching $QT$ to $QR$ makes it a path 1 mile longer, giving shortest round route: e.g. Home $PSQRTWWU$ Home	B1 M1 A1	5	
<b>Total</b>			<b>16</b>	

Question number and part	Solution	Marks	Total	Comments
4 (a)	(i) 30 (ii) 25	B1 B1	2	
(b)	$YZ = 5$ $XZ = 0$ $WX = 5$ $SW = 15$	M1 A1 A1	3	
(c)	$SYZT$ $SYWXT$	M1 A1 M1 A1	4	
(d)	Total flow in (c) = $15+5+5=25$ Max flow $\leq$ any cut, so no flow can exceed the 25 in (a)(ii)	M1 A1	2	
	<b>Total</b>		<b>11</b>	
5 (a)	00000 00101 11110 11011 00011	M1 A1 A1	3	
(b)(i)	Hamming distance $\delta = 2$	M1 A1		
(ii)	1 error will change codeword into non-codeword	B1	3	(or simply " $1 < \delta$ ")
(c)	00111 can be 00101 or 00011 (or 00110) with a single error – impossible to decide which	M1 A1	2	
(d)	e.g. $\begin{bmatrix} 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix}$	M1 A1	2	(or replace a row by (0 0 1 1 1))
(e)(i)	Hamming distance = 4	M1 $\checkmark$ A1 $\checkmark$		ft $2 \times$ earlier $\delta$
(ii)	Can correct 1 error per word	B1 $\checkmark$	3	ft
	<b>Total</b>		<b>13</b>	

Question number and part	Solution	Marks	Total	Comments
6 (a)	$P_0 = 460 \quad P_1 = 483$	B1 B1	2	
(b)	$P_n = P_{n-1} + 0.05 P_{n-1} + 0.055 P_{n-2}$  <p>previous balance</p> <p>5% interest</p> <p>5½% loyalty bonus</p>	B1 B1 B1	3	2 marks for starting at $P_n = 1.05 P_{n-1} + 0.055 P_{n-2}$
	Tidies up to $200P_n - 210P_{n-1} - 11P_{n-2} = 0$			
(c)	Auxiliary equation	M1		
	$200m^2 - 210m - 11 = 0$	A1		
	Roots 1.1 and $-0.05$	M1 A1		
	General solution			
	$P_n = A(1.1)^n + B(-0.05)^n$	A1	5	
(d)	$A + B = 460$			
	$1.1A - 0.05B = 483$	M1		
	$\Rightarrow 22A - B = 9660$	A1		
	$\Rightarrow A = 440, B = 20$	M1		
	$\Rightarrow P_n = 440(1.1)^n + 20(-0.05)^n$	A1	4	
	<b>Total</b>		<b>14</b>	

Question number and part	Solution	Marks	Total	Comments
7(a)	Maximise $P = 20x + 10y + 30z$ Subject to $x \geq 0, y \geq 0, z \geq 0, 2x + y + 2z \leq 110$ $x + y + z \leq 60, 2x + 3y + 3z \leq 140$	M1  A1 A1	3	
(b)	$P \quad x \quad y \quad z \quad s \quad t \quad u$ 1 -20 -10 -30 0 0 0 0 0 2 1 2 1 0 0 110 0 1 1 1 0 1 0 60 <u>0 2 3 3 0 0 1 140</u>	M1 A1	2	
(c)	1 0 0 -10 10 0 0 1100 0 <u>1</u> $\frac{1}{2}$ 1 $\frac{1}{2}$ 0 0 55 0 0 $\frac{1}{2}$ 0 $-\frac{1}{2}$ 1 0 5 <u>0 0 2 1 -1 0 1 30</u>	M1 A1 M1 A1 A1	5	Pivot $\rightarrow$ 1 Subtracting rows
(d)	1 0 20 0 0 0 10 1400 0 1 $-1\frac{1}{2}$ 0 $1\frac{1}{2}$ 0 -1 25 0 0 $\frac{1}{2}$ 0 $-\frac{1}{2}$ 1 0 5 <u>0 0 2 <u>1</u> -1 0 1 30</u>	M1 A1 A1	3	
(e)	Make 25 stools, 0 armchairs and 30 settees. Impractical because people want matching armchairs.	M1✓ A1✓ B1	3	ft
	<b>Total</b>		<b>16</b>	
	<b>TOTAL</b>		<b>80</b>	