



ASSESSMENT and  
QUALIFICATIONS  
ALLIANCE

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# Mark scheme January 2004

## GCE

## Mathematics & Statistics B

## Unit MBD1

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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

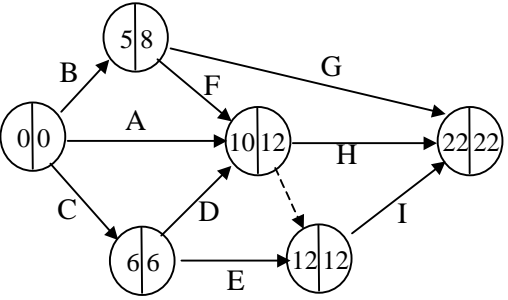
<b>MC - <math>x</math></b>	deducted $x$ marks for miscopy
<b>MR - <math>x</math></b>	deducted $x$ marks for misread
<b>ISW</b>	ignored subsequent working
<b>BOD</b>	gave benefit of doubt
<b>WR</b>	work replaced by candidate

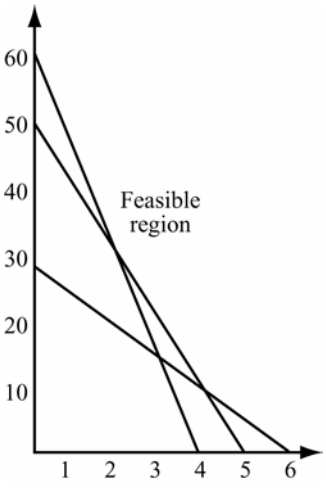
## Application of mark scheme

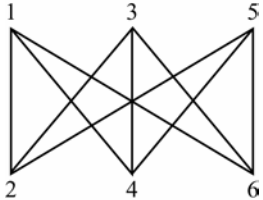
Correct answer without working	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise

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 marks	Comments																																																																																									
1	Two 1s into right-hand gate Two 1s into previous AND-gate, leading to $\mathbf{b} = 1, \mathbf{c} = 0$ For OR-gate to output 1 we need $\mathbf{a} = 1$	B1 M1 A1 M1 A1	5	(or by table)																																																																																									
<b>Total</b>			<b>5</b>																																																																																										
2(a)	Labels $R: 8 \quad U: 16,15 \quad Q: 14$ $S: 17 \quad T: 19$ $V: 27,26$ Route $PRTV$	M1 A1 A1 A1 B1 B1	6	3 labels + 2 labels temp labels ( $U, V$ ) for 26 at $V$																																																																																									
(b)	4 days $PRSTV$ only path $P$ to $V$ on arcs $< 10$	B1 B1	2																																																																																										
<b>Total</b>			<b>8</b>																																																																																										
3(a)	$AF \ 10$ $EF \ 10$ $DE \ 15 \quad AB \ 20$ $CF \ 25$	M1 A1 A1 A1 A1	5	(numbers not needed until part (c))																																																																																									
(b)		M1 A1	2																																																																																										
(c)	All points are linked by edges in the spanning tree with maximal paths $20+10+25, 20+10+10+15$ and $25+10+15$ all less than 60 minutes	M1 A1 A1	3																																																																																										
<b>Total</b>			<b>10</b>																																																																																										
4(a)	If a student is eligible for a grant then the student is married and under 18.	M1 A1	2	(missing brackets tolerated)																																																																																									
(b)	$(\sim p \vee \sim q) \Rightarrow \sim r$	M1 A1	2																																																																																										
(c)(i)	<table style="border-collapse: collapse; margin-left: 20px;"> <tr> <td><math>\mathbf{p}</math></td><td><math>\mathbf{q}</math></td><td><math>\mathbf{r}</math></td><td><math>\mathbf{p \wedge q}</math></td><td>(a)</td><td><math>\sim \mathbf{p}</math></td><td><math>\sim \mathbf{q}</math></td><td><math>\sim \mathbf{p \vee \sim q}</math></td><td><math>\sim \mathbf{r}</math></td><td>(b)</td> </tr> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td> </tr> <tr> <td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td> </tr> <tr> <td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td> </tr> <tr> <td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td> </tr> <tr> <td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td> </tr> <tr> <td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td> </tr> <tr> <td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td> </tr> <tr> <td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td> </tr> </table>	$\mathbf{p}$	$\mathbf{q}$		$\mathbf{r}$	$\mathbf{p \wedge q}$	(a)	$\sim \mathbf{p}$	$\sim \mathbf{q}$	$\sim \mathbf{p \vee \sim q}$	$\sim \mathbf{r}$	(b)	0	0	0	0	1	1	1	1	1	1	0	0	1	0	0	1	1	1	0	0	0	1	0	0	1	1	0	1	1	1	0	1	1	0	0	1	0	1	0	0	1	0	0	0	1	0	1	1	1	1	1	0	1	0	0	0	1	1	0	0	1	1	0	1	1	0	0	0	1	1	1	1	1	1	1	0	0	0	0	1	M1 A1 A1 A1 A1
$\mathbf{p}$	$\mathbf{q}$	$\mathbf{r}$	$\mathbf{p \wedge q}$	(a)	$\sim \mathbf{p}$	$\sim \mathbf{q}$	$\sim \mathbf{p \vee \sim q}$	$\sim \mathbf{r}$	(b)																																																																																				
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1	1	1	1	1	0	0	0	0	1																																																																																				
(ii)		B1	1																																																																																										
<b>Total</b>			<b>11</b>																																																																																										

Question number and part	Solution	Marks	Total marks	Comments
5	 <p>(a) I has 4 immediate predecessors. * is the only arc with 4 predecessors. Then E, A etc follow as shown above.</p> <p>(b) Forward pass Backward pass</p> <p>(c) minimum completion: 22 hours critical activities: CEI</p> <p>(d) H's independent float = <math>22 - 12 - 8</math> = 2 hours</p> <p>(e) If E's duration is 3 hours the new critical path is AI of length 20. So the minimum completion time is reduced by 2 hours.</p>	<p>B1 M1 A1 A1</p> <p>M1 A1 M1 A1 A1<sup>✓</sup></p> <p>B1 B1</p> <p>M1 A1</p> <p>M1 A1 A1</p>	<p>4</p> <p>5</p> <p>2</p> <p>2</p> <p>3</p>	<p>At least 3 correct (ft from (a))</p>
	<b>Total</b>		<b>16</b>	

Question number and part	Solution	Marks	Total marks	Comments
6 (a)	enough nails $\Leftrightarrow 1000x + 100y \geq 5000$ enough screws $\Leftrightarrow 1500x + 100y \geq 6000$ $\Leftrightarrow 15x + y \geq 60$ enough nails $\Leftrightarrow 500x + 100y \geq 3000$ $\Leftrightarrow 5x + y \geq 30$	B1 M1 A1 A1	4	
(b)		B1 B1 B1 M1 A1	5	1 for each line feasible region
(c)	$C = 6x + y$ is minimised at (4,10) (with a value of 34) Should buy 4 X-packs & 10 Y-packs	M1 A1 A1 B1	4	Vertex check or lines/gradients method sc B2 for cao
(d)	With '3 for the price of 2' again a vertex check gives minimum at (6,0) (of £24) so buy 6 X-packs only.	M1 A1 B1	3	(strictly " $\frac{2}{3}$ price" for linearity: but this does yield multiples of 3)
	<b>Total</b>		<b>16</b>	

Question number and part	Solution	Marks	Total marks	Comments
7(a)		M1 A1	2	
(b)(i)	e.g. 1234561	M1 A1	2	
(b)(ii)	For even $n$ ((and $>2$ ))	B2,1	2	B1 for “4 and 6” (the “ $>2$ ” not expected)
(c) (i)	$G_6 = K_{3,3}$	B1	1	
(c) (ii)	Planar for $n < 6$ . For $n \geq 6$ $G_n$ has $G_6$ as a subgraph For $n < 6$ clearly no $K_5$ or $K_{3,3}$ (or simply draw them in the plane)	B1 B1 B1	3	
(d)	$\frac{1}{2}n$	B1	1	
(e)	<u>Case <math>n</math> even:</u> By (i) we need $\frac{1}{2}n$ even; i.e. $n$ must be divisible by 4	M1 A1		
	<u>Case <math>n</math> odd:</u> Some vertices always have odd degree, so not Eulerian.	B1	3	
	<b>Total</b>		<b>14</b>	
	<b>TOTAL</b>		<b>80</b>	