

**GCE**

**Mathematics**

Unit **4736**: Decision Mathematics 1

Advanced Subsidiary GCE

**Mark Scheme for June 2018**

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.

© OCR 2018

These are the annotations, (including abbreviations), including those used in scoris, which are used when marking

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
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

Here are the subject specific instructions for this question paper

- 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.

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.

Use BP for blank Additional Answer Space and blank pages on Additional Objects. If used attach to appropriate question(s) - change from full response view to Structured response view to attach paperclip then change back to mark. Use SEEN for work that has been replaced and for the spare tableau in Q3(iii) and the spare graph in Q5(iii) if not used (to indicate that they were checked).

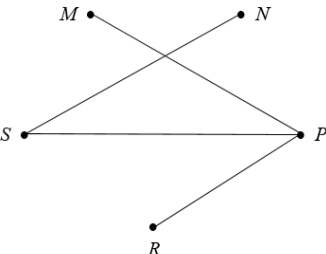
Question		Answer/Indicative content	Mark	Guidance									
1	(i)	Van 1: A B Van 2: C D Van 3: E F G Van 4: H	M1  A1 <b>[2]</b>	Vans 1 and 2: A (or 500) and B(or 400) in van 1 (in either order), C (or 600) and D (or 300) in van 2 (in either order), and no others in either van. Need not record the sizes Allow use of numbers instead of letters, but not the wrong letters. Numbers may be given as hundreds (e.g. 5 for 500).  Letters used and completely correct, including the order within the vans, need not record the sizes (but may)									
	(ii)	600, 500, 400, 400, 300, 300, 300, 200 C A B F D E G H  Van 1: C B Van 2: A F Van 3: D E G Van 4: H  or Van 1: C F Van 2: A B	M1  A1 <b>[2]</b>	Need not show decreasing order  Vans 1 and 2: C (or 600) and one of B, F (or 400) in van 1 (in either order) A (or 500) and the other of B, F (or 400) in van 2 (in either order), and no others in either van. If numbers are used they may be in hundreds (e.g. 6 for 600)  Correct, using letters, All 8 letters with no repeats, in 4 vans. B and F can be swapped, and D, E, G can be in any order									
	(iii)	e.g. <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>Van 1: C B</td> <td>C B/F</td> <td>600 400</td> </tr> <tr> <td>Van 2: A D H</td> <td>A D/E/G H</td> <td>500 300 200</td> </tr> <tr> <td>Van 3: F E G</td> <td>B/F D/E/G</td> <td>400 300 300</td> </tr> </table> or or	Van 1: C B	C B/F	600 400	Van 2: A D H	A D/E/G H	500 300 200	Van 3: F E G	B/F D/E/G	400 300 300	B1  <b>[1]</b>	Vans may be in any order, shops (letters) may be in any order within vans, letters may be interchanged with others of the same size. All 8 letters with no repeats Allow numbers used instead of letters (and e.g. 6 for 600)
Van 1: C B	C B/F	600 400											
Van 2: A D H	A D/E/G H	500 300 200											
Van 3: F E G	B/F D/E/G	400 300 300											
	(iv)	e.g. shops put together may not be near each other e.g. may not be able to reach right boxes when unloading	B1  <b>[1]</b>	Any sensible practical consideration relating to contents of vans (but <u>not</u> related to the weights or sizes of boxes, number of vans used or amount of space remaining in a van)									

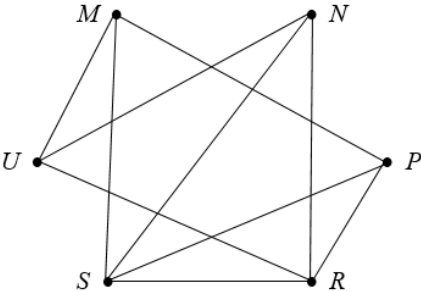
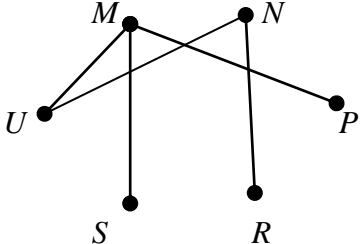
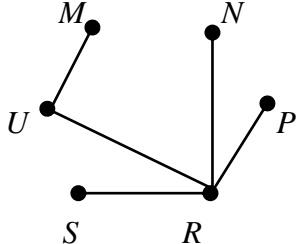
Question		Answer/Indicative content	Mark	Guidance																																			
2	(i)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th><math>M</math></th> <th><math>N</math></th> <th><math>P</math></th> </tr> </thead> <tbody> <tr> <td>8</td> <td>10</td> <td>3</td> </tr> <tr> <td></td> <td>20</td> <td></td> </tr> <tr> <td>4</td> <td></td> <td></td> </tr> <tr> <td></td> <td>40</td> <td></td> </tr> <tr> <td>2</td> <td></td> <td></td> </tr> <tr> <td></td> <td>80</td> <td></td> </tr> <tr> <td>1</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td>83</td> </tr> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>Output is 83</p>	$M$	$N$	$P$	8	10	3		20		4				40		2				80		1					83							<p>M1 Value of <math>N</math> doubles (seen at least once)</p> <p>M1 Even value of <math>M</math> is divided by 2 (seen at least once)</p> <p>M1 Final value for <math>P = 3 +</math> final value of <math>N</math> (in table)</p> <p>A1 (Output or <math>P =</math>) 83 (written, not implied from table unless indicated as STEP 7 or underlined or similar) cao and dependent on all M marks <u>AND</u> no errors in values in columns (ignoring repeats)</p> <p><b>[4]</b></p>			
$M$	$N$	$P$																																					
8	10	3																																					
	20																																						
4																																							
	40																																						
2																																							
	80																																						
1																																							
		83																																					
	(ii)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th><math>M</math></th> <th><math>N</math></th> <th><math>P</math></th> </tr> </thead> <tbody> <tr> <td>13</td> <td><math>n</math></td> <td><math>p</math></td> </tr> <tr> <td></td> <td></td> <td><math>p+n</math></td> </tr> <tr> <td></td> <td><math>2n</math></td> <td></td> </tr> <tr> <td>6</td> <td></td> <td></td> </tr> <tr> <td></td> <td><math>4n</math></td> <td></td> </tr> <tr> <td>3</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td><math>p+5n</math></td> </tr> <tr> <td></td> <td><math>8n</math></td> <td></td> </tr> <tr> <td>1</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td><math>p+13n</math></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>The output is the product of the inputs for <math>M</math> and <math>N</math> added to the input for <math>P</math>.</p>	$M$	$N$	$P$	13	$n$	$p$			$p+n$		$2n$		6				$4n$		3					$p+5n$		$8n$		1					$p+13n$				<p>M1 <math>P</math> changes from <math>p</math> to <math>p+n</math></p> <p>M1 Odd value of <math>M</math> (not 1) replaced by <math>(M - 1) \div 2</math> (seen at least once) e.g. <math>13 \rightarrow 6</math> or <math>3 \rightarrow 1</math></p> <p>M1 Final entry in <math>P</math> column = <math>p +</math> (their) <math>13n</math> (i.e. their previous, different, entry in <math>P</math> column plus their final value in <math>N</math> column) possibly written as e.g. <math>p+5n+8n</math></p> <p>A1 <math>P + MN</math> (or equivalent), (written, using capital letters) and dependent on all M marks AND correct values and expressions in columns, in any form (ignoring repeats)</p> <p><b>[4]</b></p>
$M$	$N$	$P$																																					
13	$n$	$p$																																					
		$p+n$																																					
	$2n$																																						
6																																							
	$4n$																																						
3																																							
		$p+5n$																																					
	$8n$																																						
1																																							
		$p+13n$																																					

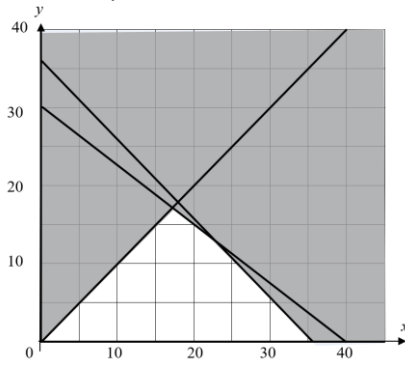
Question		Answer/Indicative content	Mark	Guidance
3	(i)	$P = 2x - 4y$	B1 [1]	(Final answer) $2x - 4y$ (may imply ' $P =$ '), not a multiple of $2x - 4y$ and not $P - 2x + 4y$ or $P - 2x + 4y = 0$
	(ii)	$4x - 12y \leq 12$ (or $x - 3y \leq 3$ )  $7x - 19y \leq 35$  $-3x + 15y \leq 0$ (or $5y \leq x$ )	M1  A1  A1  [3]	A correct LHS and RHS for any one of the constraints, or a scaled version, allow inequality sign wrong (but not $=$ ) and allow correct use of a slack variable (+ slack) with $=$ (but not a slack with inequality)  Any one constraint correct, or a scaled version, as an <u>inequality</u> (allow $<$ instead of $\leq$ ) o.e. (but NOT with slack)  All three correct, or scaled versions, as <u>inequalities</u> (allow $<$ instead of $\leq$ ) o.e. (but NOT with slack)  No extras, apart from non-negativity
	(iii)	Pivot on $x$ column $12 \div 4 = 3, 35 \div 7 = 5, 3 < 5$ so pivot on 4 in column $x$ (row 2 in column $x$ )  Pivot row (new row 2) = row 2 $\div$ 4 New row 1 = row 1 + 2 $\times$ pivot row New row 3 = row 3 - 7 $\times$ pivot row New row 4 = row 4 + 3 $\times$ pivot row	B1	Correct pivot choice identified (not implied from working since asked for in question). May be written or ringed in tableau, before or after augmenting  Mark (most complete) <u>tableau</u> not pivot operations  Rows may be reordered, try to follow candidate's intention [Allow an intermediate tableau with the new pivot row but the other rows as original followed by augmented tableau]



Question		Answer/Indicative content	Mark	Guidance																																			
(iii) cont		<table border="1"> <thead> <tr> <th><math>P</math></th> <th><math>x</math></th> <th><math>y</math></th> <th><math>s</math></th> <th><math>t</math></th> <th><math>u</math></th> <th>RHS</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0</td> <td>-2</td> <td>0.5</td> <td>0</td> <td>0</td> <td>6</td> </tr> <tr> <td>0</td> <td>1</td> <td>-3</td> <td>0.25</td> <td>0</td> <td>0</td> <td>3</td> </tr> <tr> <td>0</td> <td>0</td> <td>2</td> <td>-1.75</td> <td>1</td> <td>0</td> <td>14</td> </tr> <tr> <td>0</td> <td>0</td> <td>6</td> <td>0.75</td> <td>0</td> <td>1</td> <td>9</td> </tr> </tbody> </table>	$P$	$x$	$y$	$s$	$t$	$u$	RHS	1	0	-2	0.5	0	0	6	0	1	-3	0.25	0	0	3	0	0	2	-1.75	1	0	14	0	0	6	0.75	0	1	9	M1	Dividing through (their) pivot row correctly, in tableau, for a positive pivot value (pivot may be implied from augmented tableau if pivot choice was not identified, but not objective row or a basis column)
			$P$	$x$	$y$	$s$	$t$	$u$	RHS																														
1	0	-2	0.5	0	0	6																																	
0	1	-3	0.25	0	0	3																																	
0	0	2	-1.75	1	0	14																																	
0	0	6	0.75	0	1	9																																	
M1 dep	Augmented table has correct structure, i.e. 4 basis columns and 3 non-basis columns, all entries on RHS column are $\geq 0$ $P$ value in RHS column (6) is now $> 0$ [Basis columns must have a 1 (and 0's), not a scaled version]																																						
A1	A correct tableau (possibly with rows reordered and consequent changes to slack variable columns) [Ignore further iterations if carried out]																																						
[4]																																							
(iv)		$P = 9, x = 7.5, y = 1.5$ $s = 0, t = 11, u = 0$	B1 B1 [2]	Correct values for $P, x$ and $y$ (using fractions or decimals) Correct values for $s, t$ and $u$ No follow through because tableau was given in question																																			
(v)		$4(7.5) - 12(1.5) = 30 - 18 = 12$ $7(7.5) - 19(1.5) = 52.5 - 28.5 = 24$ $-3(7.5) + 15(1.5) = -22.5 + 22.5 = 0$  $24 + 11 = 35$ so slack in second constraint is 11 ( $t = 11$ ) No slack in first and third constraints ( $s = 0, u = 0$ )	M1 A1 B1 B1 [4]	Putting (their) $x$ and $y$ values through (their) three constraints (or with slack) (or implied from numerical values) Correct calculations for 12, 24, 0 or these values www, 24 may appear as expression + 11 = 35) Interpretation of positive slack (e.g. $24 + t = 35$ ), not $\leq$ or $\geq$ Interpretation of zero slack ( $s$ and $u$ identified with appropriate constraints), not $\leq$ or $\geq$																																			

Question		Answer/Indicative content	Mark	Guidance																																				
4	(i)	5	B1 [1]	cao ( $6 - 1 = 5$ , but not just $6 - 1$ )																																				
	(ii)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="text-align: center;"><i>M</i></td> <td style="text-align: center;"><i>N</i></td> <td style="text-align: center;"><i>P</i></td> <td style="text-align: center;"><i>R</i></td> <td style="text-align: center;"><i>S</i></td> </tr> <tr> <td style="text-align: right;"><i>M</i></td> <td></td> <td></td> <td style="text-align: center;">6</td> <td></td> <td style="text-align: center;">7</td> </tr> <tr> <td style="text-align: right;"><i>N</i></td> <td></td> <td></td> <td></td> <td style="text-align: center;">5</td> <td style="text-align: center;">4</td> </tr> <tr> <td style="text-align: right;"><i>P</i></td> <td style="text-align: center;">6</td> <td></td> <td></td> <td style="text-align: center;">3</td> <td style="text-align: center;">2</td> </tr> <tr> <td style="text-align: right;"><i>R</i></td> <td></td> <td style="text-align: center;">5</td> <td style="text-align: center;">3</td> <td></td> <td style="text-align: center;">4</td> </tr> <tr> <td style="text-align: right;"><i>S</i></td> <td style="text-align: center;">7</td> <td style="text-align: center;">4</td> <td style="text-align: center;">2</td> <td style="text-align: center;">4</td> <td></td> </tr> </table> <p style="margin-left: 20px;">Arcs used  <math>MP = 6</math>  <math>PS = 2</math>  <math>PR = 3</math>  <math>SN = 4</math></p> <p>Tree <span style="float: right;">Total weight</span>    <span style="float: right;">15</span></p>		<i>M</i>	<i>N</i>	<i>P</i>	<i>R</i>	<i>S</i>	<i>M</i>			6		7	<i>N</i>				5	4	<i>P</i>	6			3	2	<i>R</i>		5	3		4	<i>S</i>	7	4	2	4		<p>M1</p> <p>A1</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>[5]</p>	<p>Choosing four entries in table, (at least) two of which are from the same column (e.g. <i>P</i>)</p> <p>Choosing correct entries in table (not transposed)</p> <p>List of arcs in this order: <i>MP</i> (or <i>PM</i>) then <i>PS</i> (or <i>SP</i>) then <i>PR</i> (or <i>RP</i>) and finally <i>SN</i> (or <i>NS</i>), and no others</p> <p>Any tree on <u>these</u> five vertices (need not be correct tree but must use only four arcs), arcs may curve (e.g. curve <i>SN</i> so that arcs do not cross)  <u>Not</u> a tree that connects to <i>U</i> as well</p> <p>Weight 15 (cao)  not 15 million, £15 or £15 million  If both 15 (<u>on its own</u>) and <u>also</u> 15 million/£15/£15 million given (as two answers), ISW here but B0 in (iii), (iv) if done again there</p>
	<i>M</i>	<i>N</i>	<i>P</i>	<i>R</i>	<i>S</i>																																			
<i>M</i>			6		7																																			
<i>N</i>				5	4																																			
<i>P</i>	6			3	2																																			
<i>R</i>		5	3		4																																			
<i>S</i>	7	4	2	4																																				
	(iii)	6	B1 ft [1]	6, or value of 21 – (their) 15 (must be < 8); not 6 million																																				
	(iv)	8	B1 [1]	cao, not 9 or e.g. 8.1, not 8 million																																				

Question	Answer/Indicative content	Mark	Guidance
(v)	For $x \leq 8$ , the weight is $15 + x$  For $x \geq 8$ , the weight is 23	B1  B1  [2]	Weight = '(their) $15 + x$ ' (or described in words) but not just 'increases' (question asks 'describe in detail') Constant from $x = 8$ (o.e.) <u>or</u> after $x = 8$ other arcs ( $UN$ or $UR$ ) can be used <u>or</u> then weight (their) $15 + 8$ (o.e.)
(vi)	$  \begin{array}{c}  N - R \\  P - S \quad \diagup \quad \diagdown \\  \quad \quad \quad R - N \\  \quad \quad \quad U - M - P  \end{array}  $  $2 + 4 + 5 + 8 + x + 6 = 25 + x$	B1  B1  [2]	$PSNRUM(P)$ <u>or</u> $PSRNUM(P)$ (with or without final $P$ ) written using letters, not deduced from weights. May write arcs (e.g. $PS, SN, \dots$ ). Not in reverse. Only need one correct path. $25 + x$ (cao)
(vii)		B1  [1]	This graph (cao), arcs may be drawn curved If arcs are weighted, to form a network, ignore weightings  BOD lines with 'gaps' as being erased
(viii)	e.g.  e.g. 	B1  [1]	Other possible solutions, but must include $UM$  Any <u>tree</u> (with 5 arcs) that is a <u>subgraph</u> of the (correct) graph from part (vii) in which no location is more than two arcs from $U$  Not FT

Question	Answer/Indicative content	Mark	Guidance
5 (i)	<p><math>3x + 4y \leq 120</math> (given) because if all small jars then <math>x = 40</math> and <math>3 \times 40 = 120</math> and if all large then <math>y = 30</math> and <math>4 \times 30 = 120</math></p> <p>Other constraints:</p> <p><math>x \geq y</math> <math>x + y \leq 36</math> <math>x \geq 0, y \geq 0</math></p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>[4]</p>	<p>Showing how the ‘marmalade available’ for ‘all small’ and for ‘all large’ leads to the given constraint (as an inequality) Any equivalent explanation using <math>x \leq 40, y \leq 30</math> e.g. <math>\frac{1}{40}x + \frac{1}{30}y \leq 1</math> or a scaled version of this <u>leading to given</u> expression (may be from units produced or unit costs, but not <u>just</u> writing a scaled version of given result) If go straight to <math>0.3x + 0.4y \leq 12</math> then B0 unless explained If go straight to <math>30x + 40y \leq 1200</math> need to say <math>1200 = 30 \times 40</math></p> <p><math>x \geq y</math> in any form (accept <math>x &gt; y</math>) <math>x + y \leq 36</math> in any form (accept <math>x + y &lt; 36</math>) Both <math>x \geq 0</math> and <math>y \geq 0</math> (allow <math>x, y \geq 0</math>) Ignore extra ‘constraints’ (e.g. upper limits, <math>x \leq 40</math> or <math>y \leq 30</math>, as these are within given constraint <math>3x + 4y \leq 120</math>)</p>
(ii)	$P = 2x + 3y$ or $P = 2x + 3y - 12$	<p>B1</p> <p>[1]</p>	Any positive multiple of $2x + 3y$ or $2x + 3y \pm$ a constant
(iii)	<p>OVERLAY (yellow lines) should match candidate’s lines between the two horizontal pink lines</p> <p>Line <math>3x + 4y = 120</math> Line <math>y = x</math> Line <math>x + y = 36</math></p> 	<p>M1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>[4]</p>	<p>(Move overlay so that pink lines fit axes and <math>y = 15</math>, yellow lines are the boundaries, green line is a profit line)</p> <p>Line plotted through (or very close to) (40, 0) and (20, 15) Line through (or very close to) (0, 0) and (15, 15) Line through (or very close to) (36, 0) and (21, 15)</p> <p>Feasible region correctly identified (by labelling or shading/not shading) (need not shade <math>x, y &lt; 0</math>) (dependent on all three M marks) Correct constraints, not follow through</p> <p>May also see (at least one) profit line – ignore any ‘extra’ lines here</p>





Question		Answer/Indicative content	Mark	Guidance
(b)	(i)	Repeat $DG = 5$ , remaining odd nodes: $F, H, I, K$ $FH = 3$ $FI = 1$ $FK = 3$ $IK = \underline{3}$ $HK = \underline{3}$ $HI = \underline{2}$ 6                  4                  5  $47 + 5 + 4 = 56$ Minimum distance = 56 (in units of 100 m) Arcs representing repeated roads: $DG, FI, HK$	M1   A1   B1 B1 <b>[4]</b>	Correct least weight routes for at least <u>three</u> of $FH, FI, FK, IK, HK, HI$ <u>or</u> at least two correct totals ( $FH + IK = 6, FI + HK = 4, FK + HI = 5$ ), may also have $DG = 5$ included in totals  Choosing $FI + HK$ (or implied from total additional weight chosen or repeated arcs, having achieved M mark)  56, cao $DG, FI, HK$ (or in reverse) written as arcs, cao
	(ii)	Weight of arcs to $C = 9$ so total weight of network = $47 + 9 = 56$ $B, E$ are now odd instead of $D, F$ so need to pair $G, H, I, K$ Repeat $G - F - I = 2$ and $H - K = 3$  Minimum distance = $56 + 5 = 61$ (in units of 100 m)  $3 + 1 = 4$ Number of times through $F = 4$	M1   A1  B1	Pairing $G, H, I, K$ or implied from correct min distance ( $GI + HK$ or $GH + KI$ or $GK + HI$ )  61 (cao)  4 (cao)

**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](mailto:general.qualifications@ocr.org.uk)

[www.ocr.org.uk](http://www.ocr.org.uk)

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

**Oxford Cambridge and RSA Examinations**  
is a Company Limited by Guarantee  
Registered in England  
Registered Office; The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA  
Registered Company Number: 3484466  
OCR is an exempt Charity

**OCR (Oxford Cambridge and RSA Examinations)**  
Head office  
Telephone: 01223 552552  
Facsimile: 01223 552553

© OCR 2018

 **Cambridge  
Assessment**

