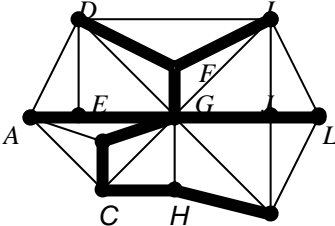
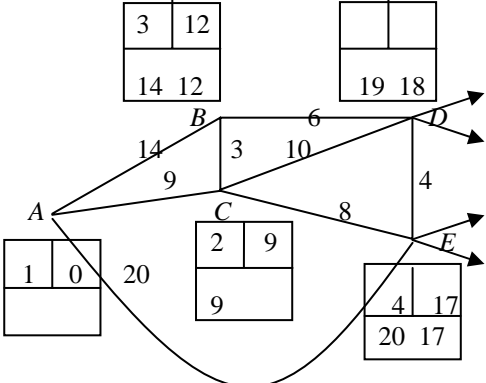
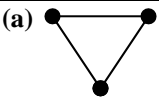
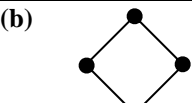
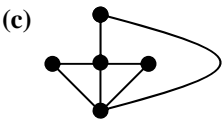
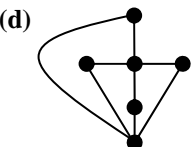


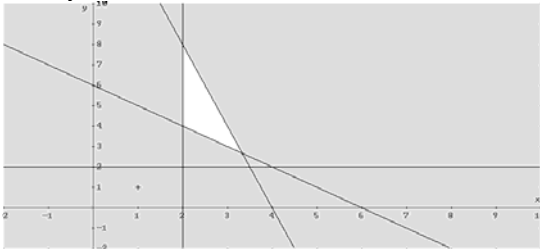
**Mark Scheme 4736  
January 2006**

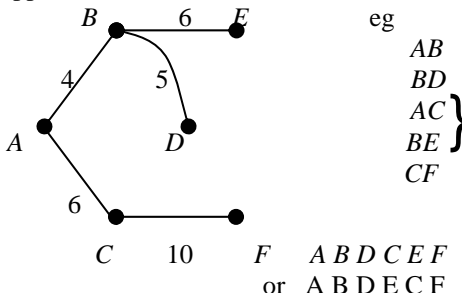
<p><b>1</b></p> <p>BC = 3          FG = 4          JL = 5          EG = 6          AE = 7          BG = 7  <del>AB = 8</del>          CH = 8          DF = 8          GJ = 8          HK = 8  <del>AC = 9</del>  <del>DE = 9</del>          FI = 9  <del>GH = 9</del>  <del>H = 9</del>  <del>JK = 9</del>          AD = 10          DG = 10  <del>GK = 10</del>  <del>H = 10</del>          KL = 10  <del>GI = 11</del>  <del>CG = 12</del>  <del>DI = 12</del></p>  <p style="text-align: right;">Total weight = 73</p>	<p>M1          A1          M1          A1          B1</p>	<p>For selecting all arcs up to <i>AB</i> and deleting <i>AB</i> in list          For deleting <i>AC, DE</i> in list and selecting arcs for tree correctly, indicated in any way          For a spanning tree drawn          For correct (minimum) spanning tree drawn          For total = 73</p>
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<p><b>2</b></p> 	<p>M1          M1          A1          B1          M1          A1</p>	<p>For temporary labels at <i>B</i> correct, no extras          For temporary labels at <i>E</i> correct, no extras          For permanent labels correct at <i>B, C</i> and <i>E</i> (dependent on both M marks)          For order of labelling correct at <i>C, B</i> and <i>E</i>          For temporary labels at <i>D</i> correct          For no permanent label at <i>D</i></p>
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<p><b>3</b></p> <p>(i) (a) </p> <p>(b) </p> <p>(c) </p> <p>(d) </p> <p>(ii) <math>2n</math> if <math>n</math> is even  <math>2n + 1</math> if <math>n</math> is odd</p>	<p>B1          B1          B1          B1          (4)          M1 (2)          A1</p>	<p>For a correct graph for (a)          For a correct graph for (b)          For a clearly correct graph for (c)          For a clearly correct graph for (d)          For treating the cases <math>n</math> odd and <math>n</math> even separately          For both rules correct</p>
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<b>4</b>	<b>(i)</b>	<table border="1"> <tr><th><math>P</math></th><th><math>x</math></th><th><math>y</math></th><th><math>z</math></th><th><math>s</math></th><th><math>t</math></th><th></th></tr> <tr><td>1</td><td>-5</td><td>4</td><td>3</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>2</td><td>-3</td><td>4</td><td>1</td><td>0</td><td>10</td></tr> <tr><td>0</td><td>6</td><td>5</td><td>4</td><td>0</td><td>1</td><td>60</td></tr> </table>	$P$	$x$	$y$	$z$	$s$	$t$		1	-5	4	3	0	0	0	0	2	-3	4	1	0	10	0	6	5	4	0	1	60	M1	For overall structure correct, including two slack variable columns
		$P$	$x$	$y$	$z$	$s$	$t$																									
		1	-5	4	3	0	0	0																								
		0	2	-3	4	1	0	10																								
	0	6	5	4	0	1	60																									
	A1	For a correct initial tableau, with no extra constraints added																														
	(2)																															
	<b>(ii)</b>	Pivot on 2 in $x$ column $r1 = r1 + 5npr$ $r2 = r2 \div 2$ $r3 = r3 - 6npr$	M1	For the correct pivot choice for their tableau																												
	<table border="1"> <tr><td>1</td><td>0</td><td>-3.5</td><td>13</td><td>2.5</td><td>0</td><td>25</td></tr> <tr><td>0</td><td>1</td><td>-1.5</td><td>2</td><td>0.5</td><td>0</td><td>5</td></tr> <tr><td>0</td><td>0</td><td>14</td><td>-8</td><td>-3</td><td>1</td><td>30</td></tr> </table>	1	0	-3.5	13	2.5	0	25	0	1	-1.5	2	0.5	0	5	0	0	14	-8	-3	1	30	A1	For dealing with the pivot row correctly (formula or numerical)								
	1	0	-3.5	13	2.5	0	25																									
0	1	-1.5	2	0.5	0	5																										
0	0	14	-8	-3	1	30																										
		M1	For dealing with the other rows correctly (formulae or numerical)																													
		A1	For a correct tableau (not ft)																													
$x = 5, y = 0, z = 0$ $P = 25$	B1 (6)	For reading off $x, y$ and $z$ from their tableau																														
	B1 <b>8</b>	For reading off $P$ from their tableau																														

<b>5</b>	<b>(i)</b>	$x =$ number of lengths swum using breaststroke $y =$ number of lengths swum using backstroke $z =$ number of lengths swum using butterfly	B1	For defining variables as 'number of lengths swum' using each stroke, or equivalent	
		<b>(ii)</b>	Maximise $2x + y + 5z$ $x + y + z \geq 8$ $2x + 0.5y + z \leq 10$ $x \geq 2, y \geq 2, z \geq 2$	B1 (2) B1 B1 B1 (3)	For a correct expression using their variables For a correct expression using their variables For a correct expression using their variables For correct expressions using their variables
		<b>(iii)</b>		M1 A1	For plotting the sloping lines correctly For completely correct shading
		$(2, 4), (2, 8), (3.3, 2.7)$	M1 A1	For two correct vertices from their graph For all three vertices correct to at least 1 dp	
		$2 \times 2 + 8 = 12$ $2 \times 3.33 + 2.67 = 9.33$	M1	For calculating $P$ at vertices or using a valid line of constant profit or writing down their max point	
	<b>(iv)</b>	So maximum is when $x = 2$ and $y = 8$ Swim 2 lengths using breaststroke, 8 lengths using backstroke and 2 lengths using butterfly	A1 (6) B1	For the correct values For interpreting their solution in the context of the original problem (at least for $x$ and $y$ )	
		Total = 22 style marks	B1 (2) <b>13</b>	For calculating the number of marks for their solution	

<p><b>6</b> (i) <i>A-B-D-E-G-F-C-A</i> 42 minutes <i>A-B-D-C-F-G-E-A</i> 46 minutes Upper bound = 42 minutes</p> <p>(ii) </p> <p>Total weight of tree = 31 minutes Two least weight arcs from G have weight 5+5 = 10 minutes Lower bound = 31 + 10 = 41 minutes</p> <p>(iii) Odd nodes: <i>B D E F</i></p> <p><math>BD = 5 \quad BE = 6 \quad BF = 16</math> <math>EF = \underline{10} \quad DF = \underline{14} \quad DE = \underline{7}</math> <math>\quad \quad \quad 15 \quad \quad 20 \quad \quad 23</math></p> <p>120 minutes Travel <i>BD, EG</i> and <i>FG</i> twice (accept <i>BD, EGF</i>) 3 times</p>	<p>M1 A1 B1 B1 B1ft(5)</p> <p>M1 A1</p> <p>B1</p> <p>A1 ft</p> <p>M1 A1 (6)</p> <p>B1</p> <p>M1 A1 B1 (5) B1 <b>16</b></p>	<p>For <i>A-B-D-E-G-F-C</i>, with or without closing tour For 42 For <i>A-B-D-C-F-G-E</i>, with or without closing tour For 46 For the smaller of their two times</p> <p>For a diagram or listing showing a tree connecting the vertices <i>A, B, C, D, E</i> and <i>F</i>, but not <i>G</i> For a diagram showing this tree (vertices need to be labelled, but arc weights are not needed)</p> <p>For a valid vertex or arc order</p> <p>For the total weight of their tree stated</p> <p>For stating or using <i>GE, GF</i> or 5+5 or 10 For 41 or 10 + their 31 calculated</p> <p>For identifying or using <i>B D E F</i></p> <p>For calculating 5+10 or 6+14 or 16+7 (may be implied from correct pair chosen) For 120 (unsupported 120 scores 0 marks) For correct arcs listed and no others For 3</p>
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<p><b>7</b> (i) Original list: 34 42 27 31 12 48 24 37 1<sup>st</sup> pass: 34 27 31 12 42 24 37 <u>48</u> 2<sup>nd</sup> pass: 27 31 12 34 24 37 <u>42</u> <u>48</u> 3<sup>rd</sup> pass: 27 12 31 24 34 <u>37</u> <u>42</u> <u>48</u> 4<sup>th</sup> pass: 12 27 24 31 <u>34</u> <u>37</u> <u>42</u> <u>48</u> 5<sup>th</sup> pass: 12 24 27 <u>31</u> <u>34</u> <u>37</u> <u>42</u> <u>48</u> 6<sup>th</sup> pass: 12 24 27 31 34 37 42 48</p> <p>Swaps = 5+5+2+2+1 = 15 Comparisons = 7+6+5+4+3+2 = 27</p> <p>(ii) Original list: 95 74 61 87 71 82 53 57 1<sup>st</sup> pass: 74 95 <u>61</u> <u>87</u> <u>71</u> <u>82</u> <u>53</u> <u>57</u> 2<sup>nd</sup> pass: 61 74 95 <u>87</u> <u>71</u> <u>82</u> <u>53</u> <u>57</u> 3<sup>rd</sup> pass: 61 74 87 95 <u>71</u> <u>82</u> <u>53</u> <u>57</u> 4<sup>th</sup> pass: 61 71 74 87 95 <u>82</u> <u>53</u> <u>57</u> 5<sup>th</sup> pass: 61 71 74 82 87 95 <u>53</u> <u>57</u> 6<sup>th</sup> pass: 53 61 71 74 82 87 95 <u>57</u> 7<sup>th</sup> pass: 53 57 61 71 74 82 87 95</p> <p>Swaps = 1+2+1+3+2+6+6 = 21 Comparisons = 1+2+2+4+3+6+7 = 25</p> <p>(iii) Each script is looked at once so the time taken is roughly proportional to the number of scripts</p> <p>(iv) Splitting 100 scripts takes 50 seconds so splitting 500 scripts takes about 250 seconds Sorting 50 scripts takes 250 seconds = <math>0.1 \times 50^2</math> Sorting 250 scripts takes about <math>0.1 \times 250^2</math> = 6250 seconds Total = 6500 seconds or 108 minutes 20 seconds</p>	<p>M1 M1 M1 A1 B1 B1 (6)</p> <p>M1 M1 M1 A1 B1 B1 (6)</p> <p>B1 B1 (2)</p> <p>M1 M1 } (4) A1 } A1 <b>18</b></p>	<p>nb decreasing or numbers misread <math>\Rightarrow</math> M only For result of first pass correct (underlined entries may be omitted) For second and third passes correct, must be using bubble sort For fourth and fifth passes correct, must be using bubble sort For sixth pass correct, from correct method For 15, from correct method For 27, from correct method</p> <p>nb decreasing or numbers misread <math>\Rightarrow</math> M only For result of first pass correct (underlined entries may be omitted) For second and third passes correct, must be using shuttle sort For fourth and fifth passes correct, must be using shuttle sort For seventh pass correct, from correct method For 21, from correct method For 25, from correct method</p> <p>For 'each script is looked at once', or equivalent For 'proportional', or equivalent</p> <p>250 (but not for 250 + 50) (500<math>\div</math>2)<sup>2</sup>, (250)<sup>2</sup>, (100<math>\div</math>2)<sup>2</sup> or equivalent For 6250, dependent on previous M only For 6500 or equivalent</p>
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