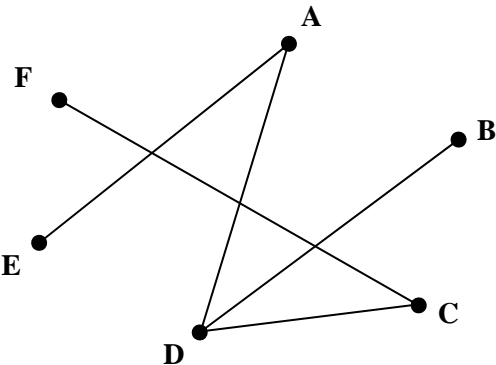


# Mark Scheme (Results) Summer 2009

GCE

GCE Mathematics (6689/01)

June 2009  
6689 Decision Mathematics D1  
Mark Scheme

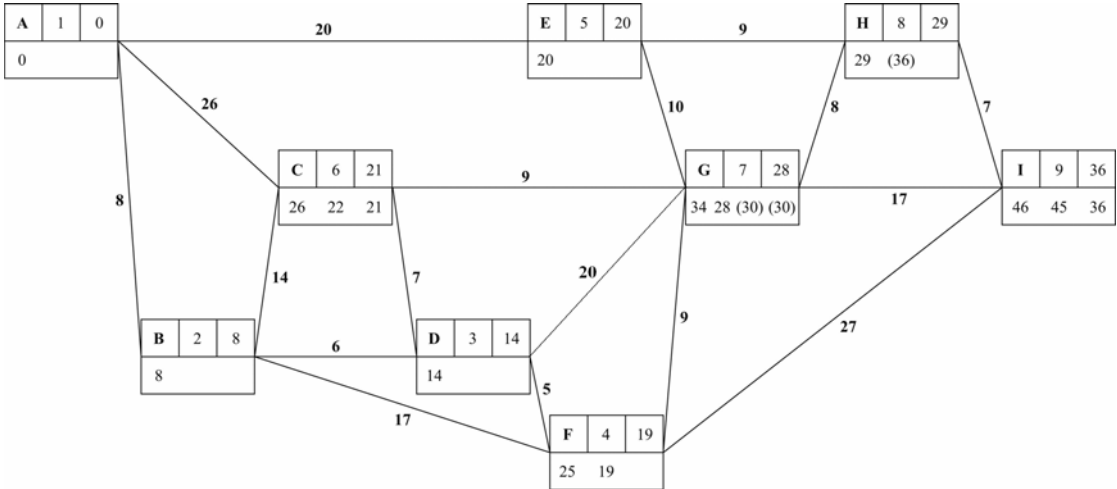
Question Number	Scheme	Marks																		
Q1	<p>(a) AD, AE, DB; DC, CF</p> <p>(b)</p>  <p>(c)</p> <p>Weight 595 (km)</p> <p><b>Notes:</b></p> <p>(a) 1M1: Using Prim – first 2 arcs probably but condone starting from another vertex. 1A1: first three arcs correct 2A1: all correct.</p> <p>(b) 1B1: CAO</p> <p>(c) 1B1: CAO condone lack of km.</p> <p><u>Apply the misread rule, if not listing arcs or not starting at A.</u> So for M1 (only) Accept numbers across the top (condoning absence of 6) Accept full vertex listing Accept full arc listing starting from vertex other than A</p> <table border="0" data-bbox="220 1724 1050 1982"> <tr> <td>[AD AE DB DC CF]</td> <td>{1 4 5 2 3 6}</td> <td>ADEBCF</td> </tr> <tr> <td>BD AD AE CD CF</td> <td>{3 1 5 2 4 6}</td> <td>BDAECF</td> </tr> <tr> <td>CD AD AE BD CF</td> <td>{3 5 1 2 4 6}</td> <td>CDAEBF</td> </tr> <tr> <td>DA AE DB CD CF</td> <td>{2 4 5 1 3 6}</td> <td>DAEBCF</td> </tr> <tr> <td>EA AD DB DC CF</td> <td>{2 4 5 3 1 6}</td> <td>EADBCF</td> </tr> <tr> <td>FC CD AD AE BD</td> <td>{4 6 2 3 5 1}</td> <td>FCDAEB</td> </tr> </table>	[AD AE DB DC CF]	{1 4 5 2 3 6}	ADEBCF	BD AD AE CD CF	{3 1 5 2 4 6}	BDAECF	CD AD AE BD CF	{3 5 1 2 4 6}	CDAEBF	DA AE DB CD CF	{2 4 5 1 3 6}	DAEBCF	EA AD DB DC CF	{2 4 5 3 1 6}	EADBCF	FC CD AD AE BD	{4 6 2 3 5 1}	FCDAEB	<p>M1 A1; A1 (3)</p> <p>B1 (1)</p> <p>B1 (1)</p> <p>[5]</p>
[AD AE DB DC CF]	{1 4 5 2 3 6}	ADEBCF																		
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FC CD AD AE BD	{4 6 2 3 5 1}	FCDAEB																		

Question Number	Scheme	Marks
Q2	<p>(a) <math>\frac{230}{60} = 3.8\dot{3}</math> so 4 needed</p> <p>(b) Bin 1: 32 17 9 Bin 2: 45 12 Bin 3: 23 28 Bin 4: 38 16 Bin 5: 10</p> <p>(c) e.g. Bin 1: 32 28 Bin 2: 38 12 10 Bin 3: 45 9 Bin 4: 23 17 16</p> <p><b>Notes:</b></p> <p>(a) 1M1: Their 230 divided by 60, some evidence of correct method 3.8 enough. 1A1: cso 4.</p> <p>(b) 1M1: Use of first fit. Probably 32, 45 and 17 correctly placed. 1A1: 32, 45, 17, 23, 38 and 28 placed correctly 2A1: 32, 45, 17, 23, 38, 28, 16, 9 placed correctly. 3A1: cao</p> <p>(c) 1M1: Use of full bin – at least one full bin found and 5 numbers placed. 1A1: 2 full bins found Eg [32+28 and 38+12+10] [23+28+9 and 16+12+32] [32+28 and 23+16+12+9] [38+12+10 and 23+28+9] 2A1: A 4 bin solution found.</p> <p><b>Special case for (b) misread using first fit decreasing.</b> Give M1A1 (max) Bin 1: 45 12 Bin 2: 38 17 Bin 3: 32 28 Bin 4: 23 16 10 9 M1 for placing 45, 38, 32, 28 and 23 correctly A1 for cao.</p>	<p>M1 A1 (2)</p> <p>M1 A1 A1 A1 (4)</p> <p>M1 A1 A1 (3)</p> <p>[9]</p>

Question Number	Scheme	Marks
Q3	<p>(a) <math>H - 2 = M - 5 = R - 4</math> change status to give</p> <p>(b) <math>C = 3</math> (E unmatched) <math>H = 2</math> <math>M = 5</math> <math>R = 4</math> <math>S = 1</math></p> <p>(c) e.g. C is the only person who can do 3 and the only person who can do 6</p> <p>e.g. <math>E - 5 = M - 2 = H - 1 = S - 3 = C - 6</math> change status to give</p> <p><math>C = 6</math> <math>E = 5</math> <math>H = 1</math> <math>M = 2</math> <math>R = 4</math> <math>S = 3</math></p> <p><b>Notes:</b></p> <p>(a) 1M1: Path from H to 4 1A1: correct path and change status 2A1: CAO must follow from correct path.</p> <p>(b) 1B1: CAO or e.g reference to E 5 M 2 H 1 S</p> <p>(c) 1M1: Path from E to 6 1A1: CAO do not penalise lack of change status a second time. 2A1: CAO must follow from a correct path</p>	<p>M1 A1</p> <p>A1 (3)</p> <p>B1 (1)</p> <p>M1 A1</p> <p>A1 (3)</p> <p>[7]</p>

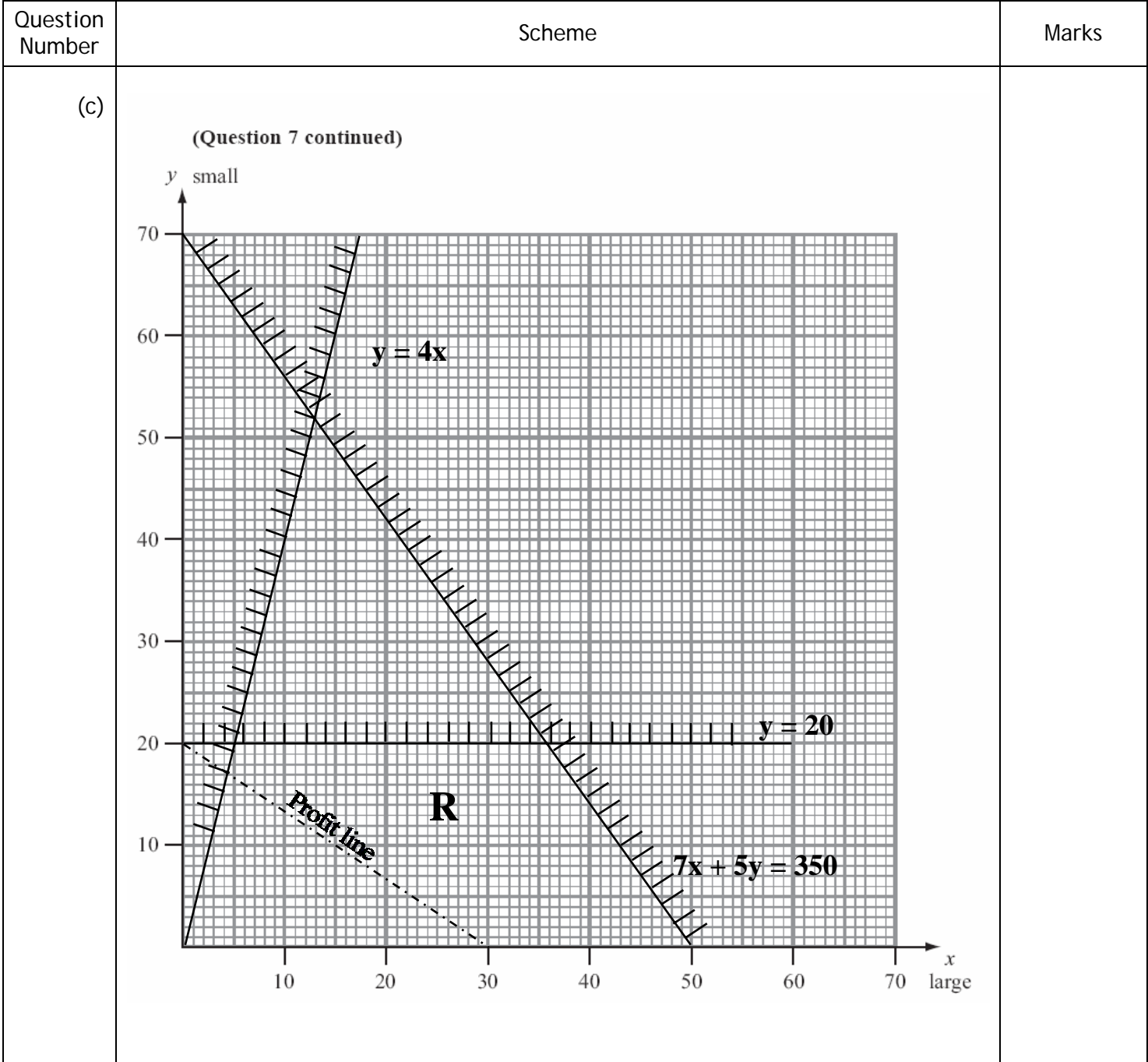
Question Number	Scheme	Marks																																																																		
Q4	<table border="1" data-bbox="400 320 1157 604"> <tr><td>M</td><td>J</td><td>E</td><td>K</td><td>H</td><td><b>B</b></td><td>L</td><td>P</td><td>N</td><td>D</td><td><b>B</b></td></tr> <tr><td><b>B</b></td><td>M</td><td>J</td><td>E</td><td>K</td><td><b>H</b></td><td>L</td><td>P</td><td>N</td><td>D</td><td><b>H</b></td></tr> <tr><td><b>B</b></td><td>E</td><td><b>D</b></td><td><b>H</b></td><td>M</td><td>J</td><td>K</td><td><b>L</b></td><td>P</td><td>N</td><td><b>D L</b></td></tr> <tr><td><b>B</b></td><td><b>D</b></td><td><b>E</b></td><td><b>H</b></td><td>J</td><td><b>K</b></td><td><b>L</b></td><td>M</td><td><b>P</b></td><td>N</td><td><b>(E) K P</b></td></tr> <tr><td><b>B</b></td><td><b>D</b></td><td><b>E</b></td><td><b>H</b></td><td><b>J</b></td><td><b>K</b></td><td><b>L</b></td><td>M</td><td><b>N</b></td><td><b>P</b></td><td><b>(J) N</b></td></tr> <tr><td><b>B</b></td><td><b>D</b></td><td><b>E</b></td><td><b>H</b></td><td><b>J</b></td><td><b>K</b></td><td><b>L</b></td><td>M</td><td><b>N</b></td><td><b>P</b></td><td><b>(M)</b></td></tr> </table> <p data-bbox="663 651 895 689" style="text-align: center;">Sort completed</p> <p data-bbox="225 741 671 824"><math>\left[ \frac{1+10}{2} \right] = 6</math> Katie reject left</p> <p data-bbox="225 880 730 963"><math>\left[ \frac{7+10}{2} \right] = 9</math> Natsuko reject right</p> <p data-bbox="225 1019 687 1102"><math>\left[ \frac{7+8}{2} \right] = 8</math> Miri reject right</p> <p data-bbox="284 1111 659 1149">7 = Louis name found</p> <p data-bbox="220 1240 325 1274"><b>Notes:</b></p> <p data-bbox="240 1283 1273 1319">(a) 1M1: quick sort, pivots, p, identified, two sublists one &lt;p one &gt;p.</p> <p data-bbox="288 1328 1070 1364"><b>If choosing one pivot only per iteration, M1 only.</b></p> <p data-bbox="300 1373 1150 1408">1A1: first pass correct, next pivot(s) chosen consistently.</p> <p data-bbox="277 1417 1190 1453">2A1ft: second pass correct, next pivot(s) chosen consistently</p> <p data-bbox="277 1462 1158 1498">3A1ft: third pass correct, next pivot(s) chosen consistently</p> <p data-bbox="304 1507 1262 1576">4A1: cso List re-written or end statement made or each element been chosen as a pivot.</p> <p data-bbox="225 1585 1107 1621">(b) 1M1: binary search, choosing pivot rejecting half list.</p> <p data-bbox="304 1630 818 1666"><b>If using unordered list then M0.</b></p> <p data-bbox="312 1675 654 1711"><b>If choosing J M1 only</b></p> <p data-bbox="304 1720 1257 1756">1A1: first two passes correct, condone 'sticky' pivots here, bod.</p> <p data-bbox="288 1765 903 1800">2A1ft: third pass correct, pivots rejected.</p> <p data-bbox="312 1809 895 1845">3A1: cso, including success statement.</p> <p data-bbox="220 1854 1315 1924"><b>Special case for (b)</b> – If just one letter out of order, award maximum of M1A1A0A0</p>	M	J	E	K	H	<b>B</b>	L	P	N	D	<b>B</b>	<b>B</b>	M	J	E	K	<b>H</b>	L	P	N	D	<b>H</b>	<b>B</b>	E	<b>D</b>	<b>H</b>	M	J	K	<b>L</b>	P	N	<b>D L</b>	<b>B</b>	<b>D</b>	<b>E</b>	<b>H</b>	J	<b>K</b>	<b>L</b>	M	<b>P</b>	N	<b>(E) K P</b>	<b>B</b>	<b>D</b>	<b>E</b>	<b>H</b>	<b>J</b>	<b>K</b>	<b>L</b>	M	<b>N</b>	<b>P</b>	<b>(J) N</b>	<b>B</b>	<b>D</b>	<b>E</b>	<b>H</b>	<b>J</b>	<b>K</b>	<b>L</b>	M	<b>N</b>	<b>P</b>	<b>(M)</b>	<p data-bbox="1362 327 1465 362">M1 1A1</p> <p data-bbox="1362 421 1437 456">2A1ft</p> <p data-bbox="1362 510 1437 546">3A1ft</p> <p data-bbox="1362 645 1522 680">4A1 (5)</p> <p data-bbox="1362 770 1401 806">M1</p> <p data-bbox="1362 904 1410 940">1A1</p> <p data-bbox="1362 1039 1437 1075">2A1ft</p> <p data-bbox="1362 1111 1522 1146">3A1 (4)</p> <p data-bbox="1485 1173 1522 1209"><b>[9]</b></p>
M	J	E	K	H	<b>B</b>	L	P	N	D	<b>B</b>																																																										
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<b>B</b>	<b>D</b>	<b>E</b>	<b>H</b>	<b>J</b>	<b>K</b>	<b>L</b>	M	<b>N</b>	<b>P</b>	<b>(J) N</b>																																																										
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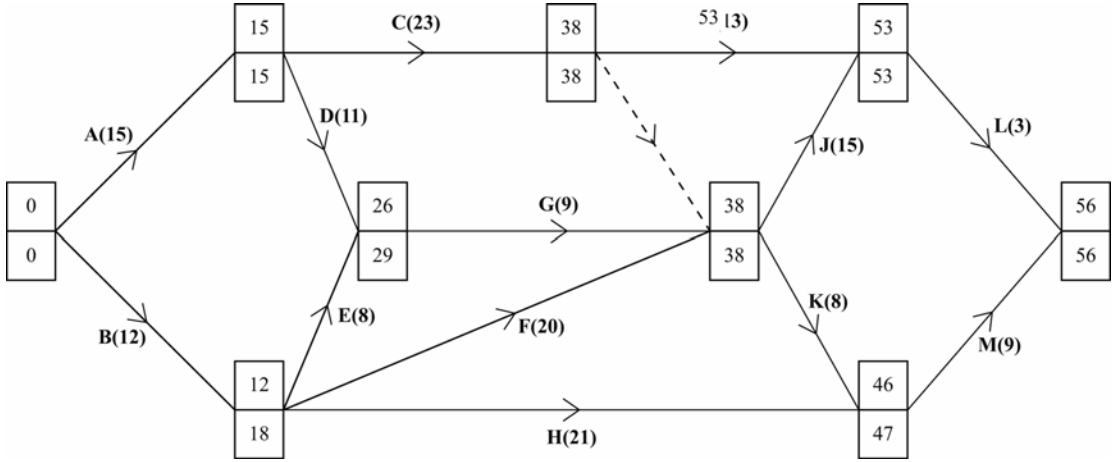
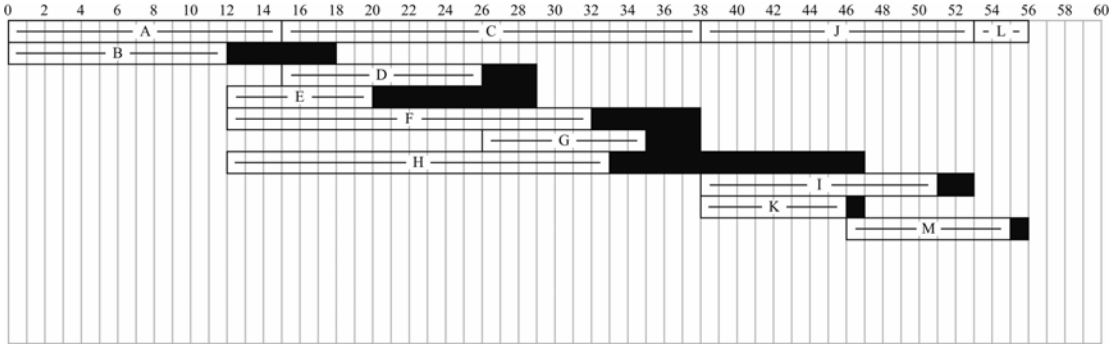
Question Number	Scheme	Marks
Q5 (a)	<p> <math>CD + EG = 45 + 38 = 83</math>  <math>CE + DG = 39 + 43 = 82 \leftarrow</math>  <math>CG + DE = 65 + 35 = 100</math>            Repeat CE and DG            Length <math>625 + 82 = 707</math> (m)         </p> <p>           DE (or 35) is the <b>smallest</b>            So finish at C.            New route <math>625 + 35 = 660</math> (m)         </p> <p> <b>Notes:</b>            (a) 1M1: Three pairings of their four odd nodes                1A1: one row correct                2A1: two rows correct                3A1: three rows correct                4A1ft: ft their least, but must be the correct shortest route arcs on network. (condone DG)                5A1ft: <math>625 +</math> their least = a number. Condone lack of m            (b) 1M1: Identifies their shortest from a choice of at least 2 rows.                1A1ft: ft from their least or indicates C.                2A1ft = 1Bft: correct for their least. (Indept of M mark)         </p>	<p>           M1 1A1            2A1            3A1            4A1ft            5A1ft (6)         </p> <p>           M1            A1ft            A1ft=1B1            (3)         </p> <p>[9]</p>

Question Number	Scheme	Marks
<p>Q6</p> <p>(a)</p>  <p>Route: A E H I</p> <p>(b)</p> <p>Shortest distance from A to G is 28 km</p> <p><b>Notes:</b></p> <p>(a) 1M1: Small replacing big in the working values at C or F or G or I            1A1: Everything correct in boxes at A, B, D and F            2A1ft: ft boxes at E and C handled correctly but penalise order of labelling only once            3A1ft: ft boxes at G and H handled correctly but penalise order of labelling only once            4A1ft: ft boxes at I handled correctly but penalise order of labelling only once            5A1: route cao A E H I</p> <p>(b) 1B1ft: ft their final label at G condone lack of km</p>		<p>M1</p> <p>1A1</p> <p>2A1ft</p> <p>3A1ft</p> <p>4A1ft</p> <p>5A1</p> <p>B1ft</p> <p>[7]</p>

Question Number	Scheme	Marks
Q7	<p>(a) <math>7x + 5y \leq 350</math></p> <p>(b) <math>y \leq 20</math> e.g. make at most 20 small baskets  <math>y \leq 4x</math> e.g. the number of small (<math>y</math>) baskets is at most 4 times the number of large baskets (<math>x</math>).            {E.g if <math>y = 40</math>, <math>x = 10, 11, 12</math> etc. or if <math>x = 10</math>, <math>y = 40, 39, 38</math>}</p> <p>(c) (see graph next page) Draw three lines correctly            Label R</p> <p>(d) (P=) <math>2x + 3y</math></p> <p>(e) Profit line or point testing.  <math>x = 35.7</math> <math>y = 20</math> precise point found.            Need integers so optimal point in R is (35, 20); Profit (£)130</p> <p><b>Notes:</b>            (a) 1M1: Coefficients correct (condone swapped <math>x</math> and <math>y</math> coefficients)            need 350 and any inequality            1A1: cso.            (b) 1B1: cao            2B1: cao, test their statement, need both = and &lt; aspects.            (c) 1B1: One line drawn correctly            2B1: Two lines drawn correctly            3B1: Three lines drawn correctly. Check (10, 40) (0, 0) and axes            4B1: R correct, but allow if one line is slightly out (1 small square).            (d) 1B1: cao accept an expression.            (e) 1M1: Attempt at profit line or attempt to test at least two vertices in their feasible region.            1A1: Correct profit line or correct testing of at least three vertices.  <b>Point testing:</b> (0,0) <math>P = 0</math>; (5,20) <math>P = 70</math>; (50,0) <math>P = 100</math>  <math>\left(35\frac{5}{7}, 20\right) = \left(\frac{250}{7}, 20\right) P = 131\frac{3}{7} = \frac{920}{7}</math>            also (35, 20) <math>P = 130</math>. Accept (36,20) <math>P = 132</math> for M but not A.  <b>Objective line:</b> Accept gradient of <math>1/m</math> for M mark or line close to correct gradient.            1B1: cao – accept <math>x</math> co-ordinates which round to 35.7            2B1: cao            3B1: cao</p>	<p>M1 A1 (2)</p> <p>B1 B1 (2)</p> <p>B3,2,1,0 B1 (4)</p> <p>B1 (1)</p> <p>M1 A1 B1 B1;B1 (5)</p> <p>[14]</p>





Question Number	Scheme	Marks
<p>Q8</p> <p>(a)</p>  <p>(b) A C J L</p> <p>(c) Total float for M = <math>56(ft) - 46 - 9 = 1</math> Total float for H = <math>47 - 12 - 21 = 14</math></p> <p>(d)</p>  <p>(e)</p> <p>1pm day 16: C 1pm day 31: C F G H</p>	<p>M1 A1</p> <p>M1 A1 (4)</p> <p>B1 (1)</p> <p>M1 A1ft</p> <p>B1 (3)</p> <p>M1 A1</p> <p>M1,A1 (4)</p> <p>B1ft</p> <p>B2ft,1ft,0 (3)</p> <p>[15]</p>	