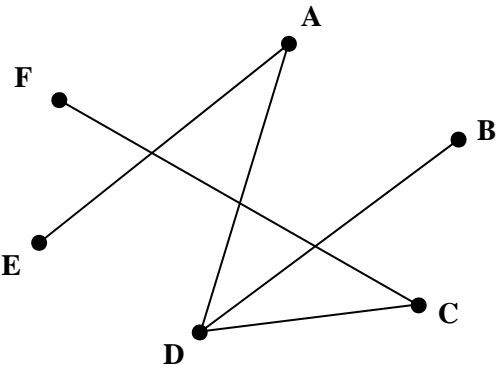


Mark Scheme (Results) Summer 2009

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>Notes:</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></p> <p>So for M1 (only)</p> <p>Accept numbers across the top (condoning absence of 6)</p> <p>Accept full vertex listing</p> <p>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 | | | | | | | | | | | | | | | | | | |
| 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 | | | | | | | | | | | | | | | | | | |

| Question Number | Scheme | Marks |
|-----------------|---|--|
| Q2 | <p>(a) $\frac{230}{60} = 3.8\dot{3}$ 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>Notes: (a) 1M1: Their 230 divided by 60, some evidence of correct method 3.8 enough. 1A1: cso 4. (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 (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>Special case for (b) misread using first fit decreasing. 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> |

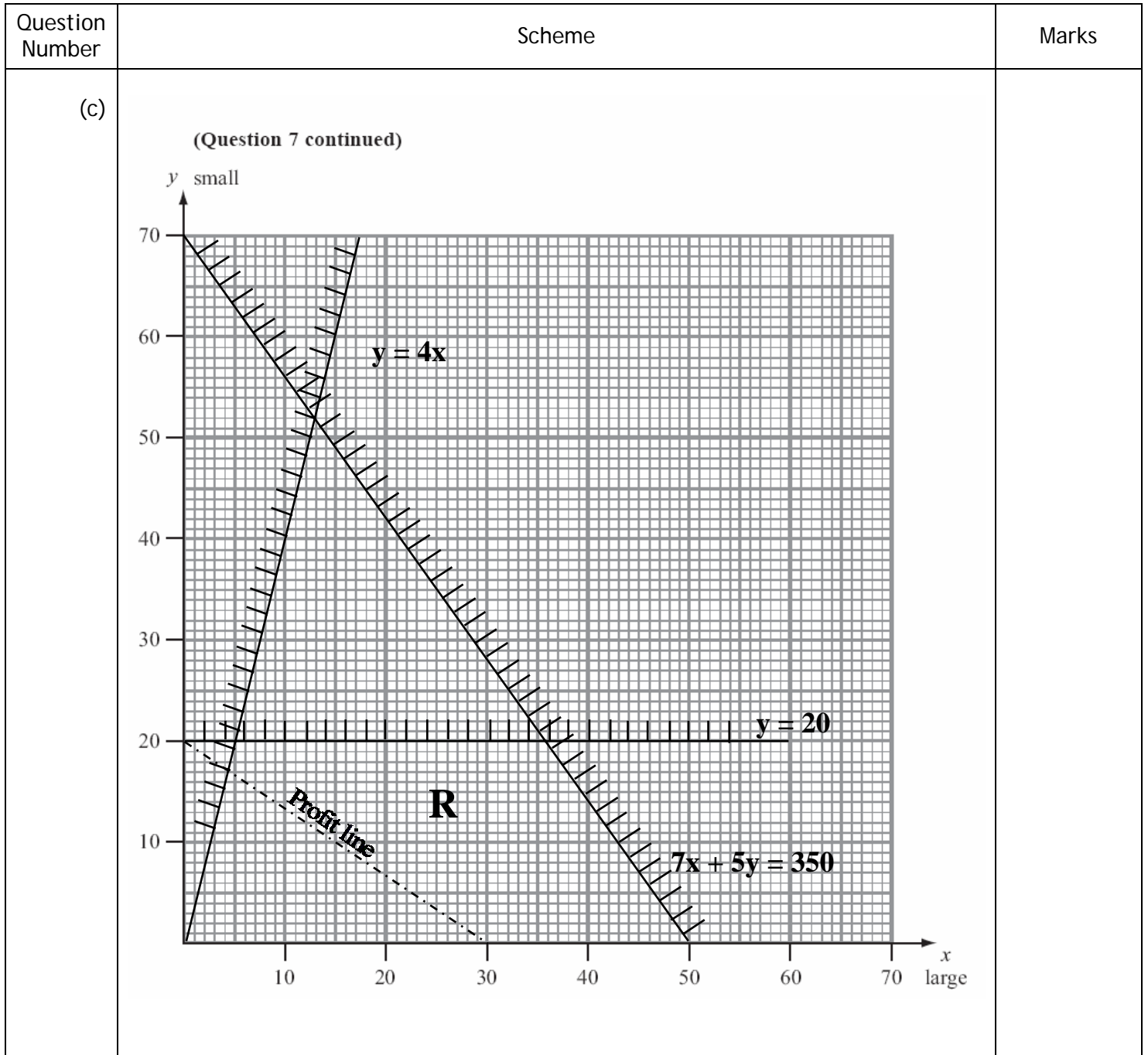
| Question Number | Scheme | Marks |
|-----------------|--|--|
| Q3 | <p>(a) $H - 2 = M - 5 = R - 4$ change status to give</p> <p>(b) $C = 3$ (E unmatched) $H = 2$ $M = 5$ $R = 4$ $S = 1$</p> <p>(c) e.g. C is the only person who can do 3 and the only person who can do 6</p> <p>e.g. $E - 5 = M - 2 = H - 1 = S - 3 = C - 6$ change status to give</p> <p>$C = 6$ $E = 5$ $H = 1$ $M = 2$ $R = 4$ $S = 3$</p> <p>Notes:</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> |

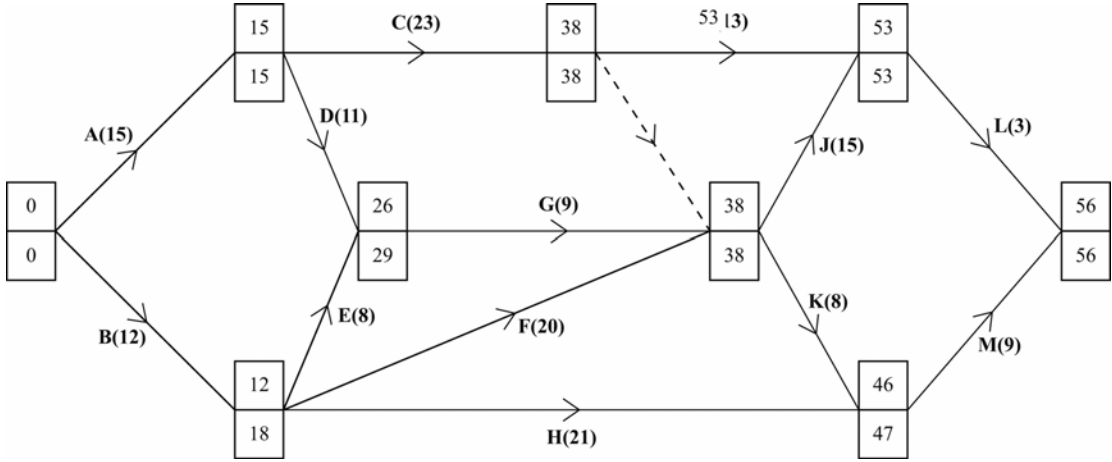
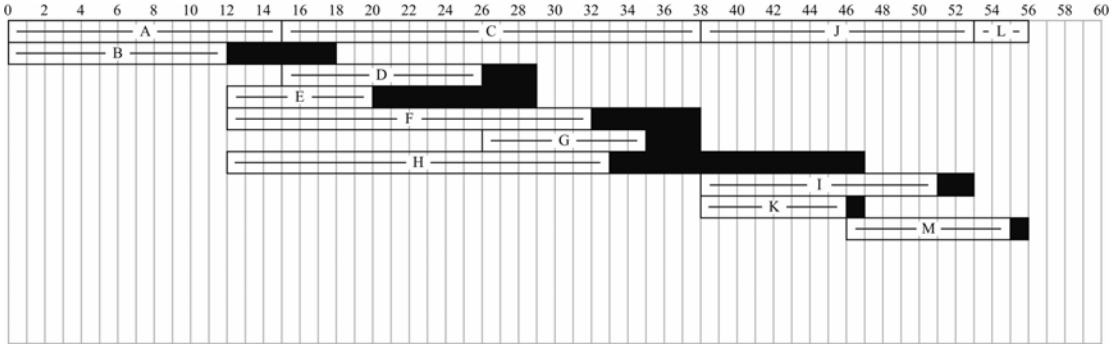
| Question Number | Scheme | Marks | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------|--|----------|----------|----------|----------|----------|----------|----------|----------|----------------|---|----------|----------|---|---|---|---|----------|---|---|---|---|----------|----------|---|----------|----------|---|---|---|----------|---|---|------------|----------|----------|----------|----------|---|----------|----------|---|----------|---|----------------|----------|----------|----------|----------|----------|----------|----------|---|----------|----------|--------------|----------|----------|----------|----------|----------|----------|----------|---|----------|----------|------------|---|
| 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</td><td>L</td><td>P</td><td>N</td><td>D</td><td>B</td></tr> <tr><td>B</td><td>M</td><td>J</td><td>E</td><td>K</td><td>H</td><td>L</td><td>P</td><td>N</td><td>D</td><td>H</td></tr> <tr><td>B</td><td>E</td><td>D</td><td>H</td><td>M</td><td>J</td><td>K</td><td>L</td><td>P</td><td>N</td><td>D L</td></tr> <tr><td>B</td><td>D</td><td>E</td><td>H</td><td>J</td><td>K</td><td>L</td><td>M</td><td>P</td><td>N</td><td>(E) K P</td></tr> <tr><td>B</td><td>D</td><td>E</td><td>H</td><td>J</td><td>K</td><td>L</td><td>M</td><td>N</td><td>P</td><td>(J) N</td></tr> <tr><td>B</td><td>D</td><td>E</td><td>H</td><td>J</td><td>K</td><td>L</td><td>M</td><td>N</td><td>P</td><td>(M)</td></tr> </table> <p data-bbox="663 651 895 689" style="text-align: center;">Sort completed</p> <p data-bbox="225 741 671 819">$\left[\frac{1+10}{2} \right] = 6$ Katie reject left</p> <p data-bbox="225 875 732 954">$\left[\frac{7+10}{2} \right] = 9$ Natsuko reject right</p> <p data-bbox="225 1010 687 1088">$\left[\frac{7+8}{2} \right] = 8$ Miri reject right</p> <p data-bbox="284 1111 659 1144">7 = Louis name found</p> <p data-bbox="220 1238 325 1272">Notes:</p> <p data-bbox="240 1283 1273 1317">(a) 1M1: quick sort, pivots, p, identified, two sublists one <p one >p.</p> <p data-bbox="288 1328 1070 1361">If choosing one pivot only per iteration, M1 only.</p> <p data-bbox="300 1373 1150 1406">1A1: first pass correct, next pivot(s) chosen consistently.</p> <p data-bbox="277 1417 1190 1451">2A1ft: second pass correct, next pivot(s) chosen consistently</p> <p data-bbox="277 1462 1158 1496">3A1ft: third pass correct, next pivot(s) chosen consistently</p> <p data-bbox="304 1507 1262 1574">4A1: cso List re-written or end statement made or each element been chosen as a pivot.</p> <p data-bbox="225 1585 1110 1619">(b) 1M1: binary search, choosing pivot rejecting half list.</p> <p data-bbox="304 1630 818 1664">If using unordered list then M0.</p> <p data-bbox="312 1675 655 1709">If choosing J M1 only</p> <p data-bbox="304 1720 1257 1753">1A1: first two passes correct, condone 'sticky' pivots here, bod.</p> <p data-bbox="288 1765 903 1798">2A1ft: third pass correct, pivots rejected.</p> <p data-bbox="312 1809 895 1843">3A1: cso, including success statement.</p> <p data-bbox="220 1854 1313 1921">Special case for (b) – If just one letter out of order, award maximum of M1A1A0A0</p> | M | J | E | K | H | B | L | P | N | D | B | B | M | J | E | K | H | L | P | N | D | H | B | E | D | H | M | J | K | L | P | N | D L | B | D | E | H | J | K | L | M | P | N | (E) K P | B | D | E | H | J | K | L | M | N | P | (J) N | B | D | E | H | J | K | L | M | N | P | (M) | <p data-bbox="1362 327 1466 349">M1 1A1</p> <p data-bbox="1362 416 1437 439">2A1ft</p> <p data-bbox="1362 506 1437 528">3A1ft</p> <p data-bbox="1362 640 1522 663">4A1 (5)</p> <p data-bbox="1362 775 1402 797">M1</p> <p data-bbox="1362 909 1410 931">1A1</p> <p data-bbox="1362 1043 1437 1066">2A1ft</p> <p data-bbox="1362 1111 1522 1133">3A1 (4)</p> <p data-bbox="1485 1178 1522 1200">[9]</p> |
| M | J | E | K | H | B | L | P | N | D | B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | M | J | E | K | H | L | P | N | D | H | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | E | D | H | M | J | K | L | P | N | D L | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | D | E | H | J | K | L | M | P | N | (E) K P | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | D | E | H | J | K | L | M | N | P | (J) N | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | D | E | H | J | K | L | M | N | P | (M) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Question Number | Scheme | Marks |
|-----------------|--|---|
| Q5 (a) | <p> $CD + EG = 45 + 38 = 83$ $CE + DG = 39 + 43 = 82 \leftarrow$ $CG + DE = 65 + 35 = 100$ Repeat CE and DG Length $625 + 82 = 707$ (m) </p> <p> DE (or 35) is the smallest So finish at C. New route $625 + 35 = 660$ (m) </p> <p> Notes: (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: $625 +$ 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>Notes:</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) $7x + 5y \leq 350$</p> <p>(b) $y \leq 20$ e.g. make at most 20 small baskets $y \leq 4x$ e.g. the number of small (y) baskets is at most 4 times the number of large baskets (x). {E.g if $y = 40$, $x = 10, 11, 12$ etc. or if $x = 10$, $y = 40, 39, 38$}</p> <p>(c) (see graph next page) Draw three lines correctly Label R</p> <p>(d) (P=) $2x + 3y$</p> <p>(e) Profit line or point testing. $x = 35.7$ $y = 20$ precise point found. Need integers so optimal point in R is (35, 20); Profit (£)130</p> <p>Notes: (a) 1M1: Coefficients correct (condone swapped x and y coefficients) need 350 and any inequality 1A1: cso. (b) 1B1: cao 2B1: cao, test their statement, need both = and < 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. Point testing: (0,0) $P = 0$; (5,20) $P = 70$; (50,0) $P = 100$ $\left(35\frac{5}{7}, 20\right) = \left(\frac{250}{7}, 20\right) P = 131\frac{3}{7} = \frac{920}{7}$ also (35, 20) $P = 130$. Accept (36,20) $P = 132$ for M but not A. Objective line: Accept gradient of $1/m$ for M mark or line close to correct gradient. 1B1: cao – accept x 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 = $56(ft) - 46 - 9 = 1$ Total float for H = $47 - 12 - 21 = 14$</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> | |