# GCE 2004
*June Series*

ASSESSMENT and QUALIFICATIONS ALLIANCE

# Mark Scheme

## Mathematics and Statistics B
*MBD1*

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## Key to Mark Scheme

| | | |
|---|---|---|
| **M** | mark is for | method |
| **m** | mark is dependent on one or more M marks and is for | method |
| **A** | mark is dependent on M or m marks and is for | accuracy |
| **B** | mark is independent of M or m marks and is for | accuracy |
| **E** | mark is for | explanation |
| **√ or ft or F** | | follow through from previous incorrect result |
| **cao** | | correct answer only |
| **cso** | | correct solution only |
| **awfw** | | anything which falls within |
| **awrt** | | anything which rounds to |
| **acf** | | any correct form |
| **ag** | | answer given |
| **sc** | | special case |
| **oe** | | or equivalent |
| **sf** | | significant figure(s) |
| **dp** | | decimal place(s) |
| **A2,1** | | 2 or 1 (or 0) accuracy marks |
| **–*x* ee** | | deduct *x* marks for each error |
| **pi** | | possibly implied |
| **sca** | | substantially correct approach |

## Abbreviations used in Marking

| | |
|---|---|
| **MC – *x*** | deducted *x* marks for mis-copy |
| **MR – *x*** | deducted *x* marks for mis-read |
| **isw** | ignored subsequent working |
| **bod** | given benefit of doubt |
| **wr** | work replaced by candidate |
| **fb** | formulae book |

## Application of Mark Scheme

| | |
|---|---|
| No method shown: | |
| **Correct answer without working** | **mark as in scheme** |
| **Incorrect answer without working** | **zero marks unless specified otherwise** |
| | |
| More than one method / choice of solution: | |
| **2 or more complete attempts, neither/none crossed out** | **mark both/all fully and award the mean mark rounded down** |
| **1 complete and 1 partial attempt, neither crossed out** | **award credit for the complete solution only** |
| | |
| Crossed out work | **do not mark unless it has not been replaced** |
| | |
| Alternative solution **using a correct or partially correct method** | **award method and accuracy marks as appropriate** |

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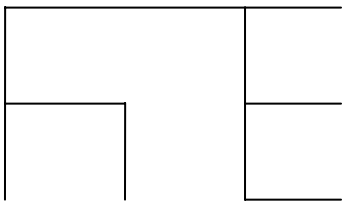
**Mathematics and Statistics B Discrete 1 MBD1 June 2004**

| Question Number and Part | Solution | Marks | Total | Comments |
|---|---|---|---|---|
| 1 (a) | **A B C flow**<br>0 0 0 0<br>0 0 1 0<br>0 1 0 0<br>0 1 1 1<br>1 0 0 0<br>1 0 1 0<br>1 1 0 1<br>1 1 1 1 | <br><br>B1<br>B1<br><br>B1<br><br>B1 | <br><br><br><br><br><br>4 | <br><br>Second entry<br>Third & fourth<br><br>Fifth & sixth<br><br>Seventh & eighth |
| (b) | The three missing labels must be A/B in the first row and B in the second | M1 A1<br>A1 | 3 | |
| | **Total** | | **7** | |
| 2 (a) | *CADEBFMLKJC* | M1 A1 | 2 | |
| (b) | Neither<br>More than two odd vertices | B1<br>B1 | 2 | |
| (c) (i) | *KL* | B1 | 1 | |
| (ii) | Starting at *A*, say, we can only get to *B* along *DE*, but then we cannot get back. | M1<br>A1 | 2 | (any sensible focus on the 'isthmus' *DE*) |
| | **Total** | | **7** | |
| 3 (a) | Essential labels:<br>*B*: 4 *E:* 5 I: 9 *F:* 10,9<br>*C:*10 *J: (14 poss),*13 *G:* 16,14<br>*D*: 15 *K*: 20,19 *H:* 20 *L*: 24<br>Traceback to *ABCGKL* of length 24 | M1<br>A1<br>A1<br>A1<br>M1 A1 | <br><br><br><br>6 | <br>One temporary label<br>Six permanent labels<br>Remaining permanent labels |
| (b)(i) | Kruskal gives<br>*AB CG EF EI FJ* (@ 4)<br>*AE CD GK KL* (@ 5)<br>*BC GH* (@6)<br>Total length = 52 km | M1<br>A1<br>A1<br>A1<br>B1 | <br><br><br><br>5 | <br><br><br><br>**sc** For correct tree only, with order of choice not given: 2 marks |
| (ii) |  | B1√ | 1 | ft |
| (c)(i) | 4 + 4 + 5 + 4 + 6 + 4 + 5 + 5 = 37 | B1 | 1 | |
| (ii) | Longest route on gritted paths = 37, so original distance ≤ 9.<br>Obvious contenders *J* & *K* give distances 7 and 32. | M1<br>A1 | <br>2 | (any sensible approach) |
| | **Total** | | **15** | |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**MBD1 (cont)**

| Question Number and Part | Solution | Marks | Total | Comments |
|---|---|---|---|---|
| 4 (a) | $\mathbf{j} \Rightarrow \mathbf{u}$ false (June)<br>$\mathbf{t} \Rightarrow \sim\mathbf{y}$ true (30-days end in L/E/R/R)<br>$(\mathbf{j} \wedge \mathbf{y}) \Rightarrow \mathbf{u}$ true (January/July) | B1<br>B1 B1<br>B1 B1 | 5 | |
| (b)(i) | **p q r I p∧q II I⇒II**<br>0 0 0 1 0 1 1<br>0 0 1 1 0 1 1<br>0 1 0 1 0 1 1<br>0 1 1 1 0 1 1<br>1 0 0 0* 0 1* 1<br>1 0 1 1 0 1 1<br>1 1 0 0 1 0 1<br>1 1 1 1 1 1 1 | M1<br>M1<br>A1<br>A1<br>A1 | 5 | 8 rows<br>appropriate columns<br>$\wedge$ correct<br>any $\Rightarrow$ correct<br>all correct |
| (ii) | For II true and I false we need case *<br>e.g. **p**: June begins with a J<br>**q**: June ends in a Y<br>**r**: June has 31 days | M1<br>A1 | 2 | |
| | **Total** | | **12** | |
| 5 (a) | Line 1: $3x + 2y = 42$<br>Line 2: $x + 2y = 30$<br>Line 3: $x + y = 16$ | B1<br>B1 | 2 | For one<br>For other two |
| (b) | $3x + 2y = 42$ , $x + y = 16 \Rightarrow$<br>$x = 10, y = 6$<br>Hence $C$ is (10,6) | M1<br>A1<br>A1 | 3 | For either coordinate |
| (c) | Trying all vertices leads to<br>$P = 2x + 3y$ maximised at (2,14)<br>So maximum of $P$ is 46 by making<br>2 Xtremes and 14 Yltras | M1<br>A1 A1<br>A1 | 4 | (or by lines/gradients) |
| (d)(i) | New contraint is $y \leq 0.2(x + y)$ and so<br>$4y \leq x$. | M1<br>A1 | 2 | |
| (ii) | This crosses the boundary of the feasible region at (12,3).<br>In new region maximum of $P$ is at (12,3) so they should make 12 Xtremes and 3 Yltras | M1<br>A1<br>M1<br>A1 | 4 | |
| | **Total** | | **15** | |

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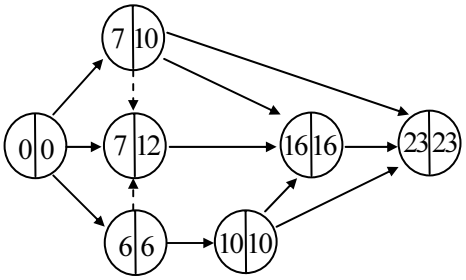
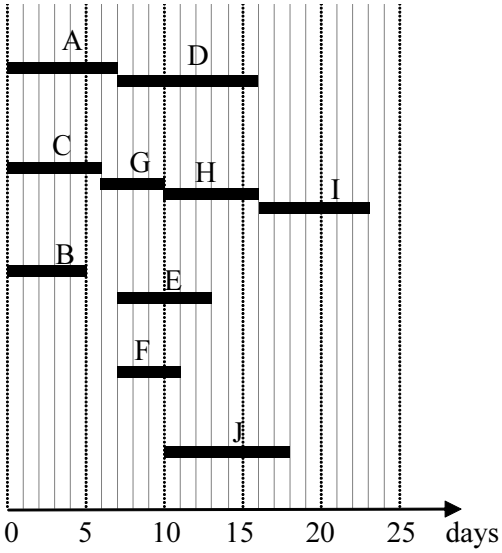
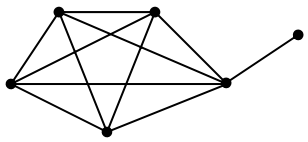
**MBD1 (cont)**

| Question Number and Part | Solution | Marks | Total | Comments |
|---|---|---|---|---|
| 6 (a) | A,B and C | B1 | 1 | |
| (b) |  | M1 A1<br>M1 A1<br>A1 | 5 | |
| (c) | Minimum completion 23 days<br>Critical activities C G H I | B1√<br>B1√ | 2 | ft<br>ft |
| 6(d) |  | M1 A1<br>A1<br>A1 | 4 | |
| (e) | e.g. move D (and J) to end | M1 A1 | 2 | |
| | **Total** | | **14** | |
| 7 (a)(i) | Sum = $7d - 6$ = even, so $d$ is even | M1 A1 | 2 | |
| (ii) | $3 \le d$ since there is a degree $d - 3$;<br>$d \le 5$ since the graph is simple | B1<br>B1 | 2 | |
| (b) |  | M1<br>A1 | 2 | |
| (c) | Not planar<br>Contains $K_5$ | B1<br>B1 | 2 | |
| (d) | All are isomorphic<br>All = $K_5$ + single edge | B1<br>B1 | 2 | |
| | **Total** | | **10** | |
| | **TOTAL** | | **80** | |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