

GCE AS Further Mathematics (8FM0) – Shadow Paper (Set 1) 8FM0-27 Decision Mathematics 1

October 2020 Shadow Paper mark scheme

Please note that this mark scheme is not the one used by examiners for making scripts. It is intended more as a guide, indicating where marks are given for correct answers. As such, it may not show follow-through marks (marks that are awarded despite errors being made) or special cases.

It should also be noted that for many questions, there may be alternative methods of finding correct solutions that are not shown here – they will be covered in the formal mark scheme from the original paper.

This document is intended for guidance only and may differ significantly from the examiners' final mark scheme for the original paper which was published in December 2020.

Guidance on the use of codes within this document

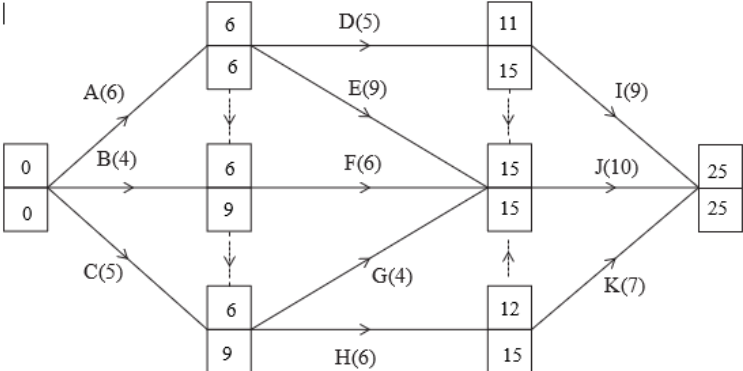
M1 – method mark. This mark is generally given for an appropriate method in the context of the question. This mark is given for showing your working and may be awarded even if working is incorrect.

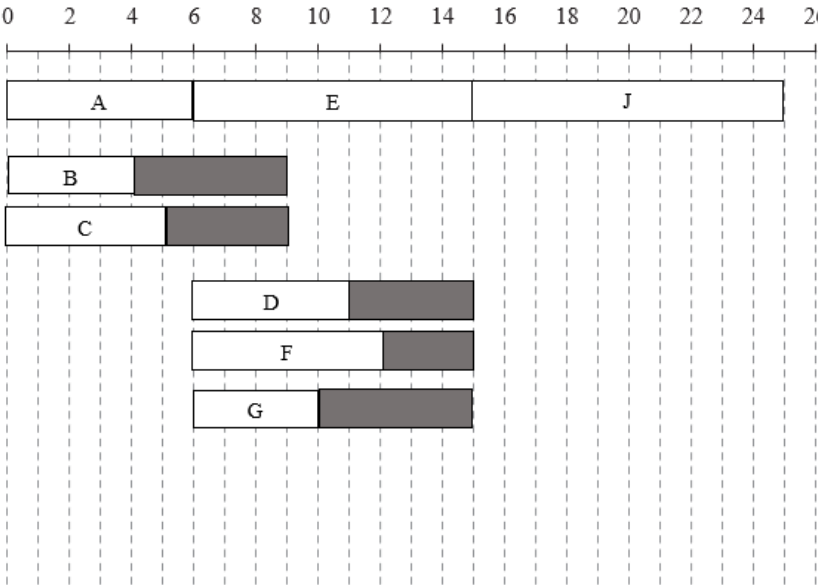
A1 – accuracy mark. This mark is generally given for a correct answer following correct working.

B1 – working mark. This mark is usually given when working and the answer cannot easily be separated.

Some questions require all working to be shown; in such questions, no marks will be given for an answer with no working (even if it is a correct answer).

| Question | Scheme | Marks |
|-------------|--|------------------------------|
| 1(a) | $32.1/9.2 = (3.4891\dots)$ Lower bound 4 | M1 A1 |
| | | (2) |
| 1(b) | Bin 1: <u>6.7</u> <u>2.5</u> Bin 2: <u>4.6</u> <u>1.2</u> <u>3.2</u> Bin 3: <u>2.1</u> <u>1.2</u> <u>4.5</u> Bin 4: <u>3.3</u> <u>2.8</u> | M1 <u>A1</u> A1 |
| | | (3) |
| 1(c) | Its not likely to lead to a good solution Or The first-fit algorithm will frequently not give an optimal solution Or similar | C1 |
| | | (1) |
| | | (6 marks) |

| Question | Scheme | Marks | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------|--|---|--------------------------------|---|---|---|---|---|---|---|---|---|----------|--------------------------------|---|---|---|------|---|---------|---|---------|---|----------|--------------------------------|---|---|---|---------------|---|---|---------------------|
| 2(a) | <table border="1"> <thead> <tr> <th>Activity</th> <th>Immediately preceding activity</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>-</td> </tr> <tr> <td>B</td> <td>-</td> </tr> <tr> <td>C</td> <td>-</td> </tr> <tr> <td>D</td> <td>A</td> </tr> </tbody> </table> | Activity | Immediately preceding activity | A | - | B | - | C | - | D | A | <table border="1"> <thead> <tr> <th>Activity</th> <th>Immediately preceding activity</th> </tr> </thead> <tbody> <tr> <td>E</td> <td>A</td> </tr> <tr> <td>F</td> <td>A, B</td> </tr> <tr> <td>G</td> <td>A, B, C</td> </tr> <tr> <td>H</td> <td>A, B, C</td> </tr> </tbody> </table> | Activity | Immediately preceding activity | E | A | F | A, B | G | A, B, C | H | A, B, C | <table border="1"> <thead> <tr> <th>Activity</th> <th>Immediately preceding activity</th> </tr> </thead> <tbody> <tr> <td>I</td> <td>D</td> </tr> <tr> <td>J</td> <td>D, E, F, G, H</td> </tr> <tr> <td>K</td> <td>H</td> </tr> </tbody> </table> | Activity | Immediately preceding activity | I | D | J | D, E, F, G, H | K | H | <p>B1</p> <p>B1</p> |
| | Activity | Immediately preceding activity | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | A | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | B | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D | A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Activity | Immediately preceding activity | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F | A, B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| G | A, B, C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| H | A, B, C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Activity | Immediately preceding activity | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| I | D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| J | D, E, F, G, H | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| K | H | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | (2) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2(b) |  | <p>M1</p> <p>A1</p> <p>A1</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | (3) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2(c)(i) | Minimum project completion time is 25 hours | B1ft | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2(c)(ii) | Critical activities are A, E and J | B1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | (2) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2(d) | G could be delayed by $15 - 4 - 6 = 5$ hours | B1ft | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | (1) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2(e) | $\frac{6+4+5+\dots+9+10+7}{25}$ | M1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | = 2.84 so a lower bound of 3 workers | A1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | (2) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| | | |
|-------------|---|--|
| | | |
| 2(f) |  <p>A Gantt chart with a horizontal axis from 0 to 26 in increments of 2. Vertical dashed lines are at every 2 units. Tasks are represented by horizontal bars:</p> <ul style="list-style-type: none"> A: 0 to 6 B: 2 to 8 C: 4 to 8 D: 8 to 14 E: 6 to 14 F: 10 to 14 G: 10 to 14 J: 16 to 24 <p>Shaded areas indicate overlapping periods: B and C overlap from 4 to 8; D, E, F, and G overlap from 10 to 14.</p> | <p>M1</p> <p>A1</p> <p>A1</p> |
| | | (3) |
| 2(g) | e.g. at time 10.5, E, D, F and H must all be happening and so you need more than 3 workers. | B1 |
| | | (1) |
| | | (14 marks) |

| Question | Scheme | Marks |
|-------------|--|-------------------|
| 3(a) | e.g. (each arc contributes 1 to the orders of two nodes, and so) the sum of the orders of all the nodes is equal to twice the number of arcs | B1 |
| | Which implies that the sum of the orders of all the nodes is even and therefore there must be an even (or zero) number of vertices of odd order hence there cannot be an odd number of vertices of odd order | B1dep |
| | | (2) |
| 3(b) | Either $3x - 3 < 9$ or $2x + 4 > 8$ | M1 |
| | $x < 4$ | A1 |
| | $x > 2$ | A1 |
| | | (3) |
| 3(c) | Applies the route inspection algorithm to this non-standard case | M1 |
| | GD +CB= $15+8=23$ or GC+BD = $18+10= 28$ | A1 |
| | GB route given $2 < x < 4$ then BAG= $3x + 7$ | A1 |
| | Maximum value of BAG=19 | A1 |
| | BG +CD = $3x + 10 < 22$ | M1dep |
| | $5x + 104 + 3x + 10 = 143$ $x = 3$ | A1 |
| | | (6) |
| | | (11 marks) |
| | | |
| | | |

| Question | Scheme | Marks | |
|------------------|---|------------|--|
| 4 | Line through (0, 4) and (10, 0) is $2x + 5y = 20$ Line through (0, 0) and (10, 5) is $2y = x$ $x = 3$ | M1 | |
| | $2x + 5y \leq 20$ | A1 | |
| | $x \geq 3$ or $y \geq 0$ | A1 | |
| | $2y \leq x$ | A1 | |
| | Solving correct two equations to find V | M1 | |
| | $V\left(\frac{40}{9}, \frac{20}{9}\right)$ | A1 | |
| | $P = k(x + 5y)$ and substituting $P = 140$ and their V | M1dep | |
| | Maximise $P = 9x + 45y$ | B1 A1 | |
| | | (9) | |
| (9 marks) | | | |