



Oxford Cambridge and RSA

# Wednesday 22 June 2022 – Afternoon

## A Level Further Mathematics A

### Y544/01 Discrete Mathematics

#### Printed Answer Booklet

**Time allowed: 1 hour 30 minutes**



**You must have:**

- Question Paper Y544/01 (inside this document)
- the Formulae Booklet for A Level Further Mathematics A
- a scientific or graphical calculator



Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

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Candidate number

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Last name \_\_\_\_\_

### INSTRUCTIONS

- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided in the **Printed Answer Booklet**. If you need extra space use the lined pages at the end of the Printed Answer Booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.
- Give non-exact numerical answers correct to **3** significant figures unless a different degree of accuracy is specified in the question.
- The acceleration due to gravity is denoted by  $g\text{ m s}^{-2}$ . When a numerical value is needed use  $g = 9.8$  unless a different value is specified in the question.

### INFORMATION

- The total mark for this paper is **75**.
- The marks for each question are shown in brackets [ ].
- This document has **16** pages.

### ADVICE

- Read each question carefully before you start your answer.

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**PLEASE DO NOT WRITE ON THIS PAGE**



|                            |                                   |         |
|----------------------------|-----------------------------------|---------|
| <b>2(a)</b><br><b>2(b)</b> |                                   |         |
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|                            | Minimum project completion time = | minutes |
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| <b>2(c)</b>                |                                   |         |
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| <b>3(a)</b> |  |
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| <b>3(b)</b> |  |
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| <b>3(c)</b> |  |
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| <b>3(d)</b> |  |
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| <b>4(a)</b> |  |
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| <b>4(b)</b> |  |
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| <b>4(c)</b> |  |
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| <b>4(d)</b> |  |
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|-------------|--|----------|--------|--------|--------|----------|--|--|--|---|---|---|----------|---|--------|--------|--------|--|---|--------|--------|--------|--|---|--------|--------|--------|
| <b>5(a)</b> | <table style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td colspan="3" style="text-align: center;">Player 2</td> </tr> <tr> <td></td> <td style="text-align: center;">X</td> <td style="text-align: center;">Y</td> <td style="text-align: center;">Z</td> </tr> <tr> <td style="text-align: right; padding-right: 10px;">Player 1</td> <td style="text-align: center;">A</td> <td style="text-align: center;">(6, 0)</td> <td style="text-align: center;">(1, 7)</td> <td style="text-align: center;">(5, 6)</td> </tr> <tr> <td></td> <td style="text-align: center;">B</td> <td style="text-align: center;">(9, 4)</td> <td style="text-align: center;">(2, 6)</td> <td style="text-align: center;">(8, 1)</td> </tr> <tr> <td></td> <td style="text-align: center;">C</td> <td style="text-align: center;">(6, 8)</td> <td style="text-align: center;">(1, 3)</td> <td style="text-align: center;">(7, 2)</td> </tr> </table> |          |        |        |        | Player 2 |  |  |  | X | Y | Z | Player 1 | A | (6, 0) | (1, 7) | (5, 6) |  | B | (9, 4) | (2, 6) | (8, 1) |  | C | (6, 8) | (1, 3) | (7, 2) |
|             |  | Player 2 |        |        |        |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
|             |  | X        | Y      | Z      |        |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
|             | Player 1   | A        | (6, 0) | (1, 7) | (5, 6) |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
|             |  | B        | (9, 4) | (2, 6) | (8, 1) |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
|             |  | C        | (6, 8) | (1, 3) | (7, 2) |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
|             | Play-safe strategy for player 1 is   |          |        |        |        |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
|             |  |          |        |        |        |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
|             |  |          |        |        |        |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
|             | Play-safe strategy for player 2 is   |          |        |        |        |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
|             |  |          |        |        |        |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
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| <b>5(b)</b> |  |          |        |        |        |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
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|             |  |          |        |        |        |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
| <b>5(c)</b> | <table style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td colspan="3" style="text-align: center;">Player 2</td> </tr> <tr> <td></td> <td style="text-align: center;">X</td> <td style="text-align: center;">Y</td> <td style="text-align: center;">Z</td> </tr> <tr> <td style="text-align: right; padding-right: 10px;">Player 1</td> <td style="text-align: center;">A</td> <td style="text-align: center;">(6, 0)</td> <td style="text-align: center;">(1, 7)</td> <td style="text-align: center;">(5, 6)</td> </tr> <tr> <td></td> <td style="text-align: center;">B</td> <td style="text-align: center;">(9, 4)</td> <td style="text-align: center;">(2, 6)</td> <td style="text-align: center;">(8, 1)</td> </tr> <tr> <td></td> <td style="text-align: center;">C</td> <td style="text-align: center;">(6, 8)</td> <td style="text-align: center;">(1, 3)</td> <td style="text-align: center;">(7, 2)</td> </tr> </table> |          |        |        |        | Player 2 |  |  |  | X | Y | Z | Player 1 | A | (6, 0) | (1, 7) | (5, 6) |  | B | (9, 4) | (2, 6) | (8, 1) |  | C | (6, 8) | (1, 3) | (7, 2) |
|             |  | Player 2 |        |        |        |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
|             |  | X        | Y      | Z      |        |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
|             | Player 1   | A        | (6, 0) | (1, 7) | (5, 6) |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
|             |  | B        | (9, 4) | (2, 6) | (8, 1) |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
|             |  | C        | (6, 8) | (1, 3) | (7, 2) |          |  |  |  |   |   |   |          |   |        |        |        |  |   |        |        |        |  |   |        |        |        |
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| <b>5(d)(i)</b>  |   |
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|                 |   |
|                 |   |
|                 | $p =$   |
|                 |   |
| <b>5(d)(ii)</b> |   |
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|                 |   |
|                 | Player                      expects to win the greater number of points when player 1 chooses B |
|                 |   |

|                 |                             |          |          |          |          |          |          |     |
|-----------------|-----------------------------|----------|----------|----------|----------|----------|----------|-----|
| <b>6(a)(i)</b>  |                             |          |          |          |          |          |          |     |
|                 |                             |          |          |          |          |          |          |     |
|                 |                             |          |          |          |          |          |          |     |
|                 | <i>P</i>                    | <i>x</i> | <i>y</i> | <i>z</i> | <i>s</i> | <i>t</i> | <i>u</i> | RHS |
|                 |                             |          |          |          |          |          |          |     |
|                 |                             |          |          |          |          |          |          |     |
|                 |                             |          |          |          |          |          |          |     |
| <b>6(a)(ii)</b> |                             |          |          |          |          |          |          |     |
|                 |                             |          |          |          |          |          |          |     |
|                 |                             |          |          |          |          |          |          |     |
|                 |                             |          |          |          |          |          |          |     |
|                 | <i>P</i>                    | <i>x</i> | <i>y</i> | <i>z</i> | <i>s</i> | <i>t</i> | <i>u</i> | RHS |
|                 |                             |          |          |          |          |          |          |     |
|                 |                             |          |          |          |          |          |          |     |
|                 |                             |          |          |          |          |          |          |     |
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|                 |                             |          |          |          |          |          |          |     |
|                 |                             |          |          |          |          |          |          |     |
|                 | Spare tableau (if required) |          |          |          |          |          |          |     |
|                 | <i>P</i>                    | <i>x</i> | <i>y</i> | <i>z</i> | <i>s</i> | <i>t</i> | <i>u</i> | RHS |
|                 |                             |          |          |          |          |          |          |     |
|                 |                             |          |          |          |          |          |          |     |
|                 |                             |          |          |          |          |          |          |     |
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| <b>6(b)(i)</b>   |       |
|                  |       |
|                  |       |
| <b>6(b)(ii)</b>  | $x =$ |
|                  | $y =$ |
|                  | $z =$ |
|                  |       |
| <b>6(b)(iii)</b> |       |
|                  |       |
|                  |       |
|                  |       |
| <b>6(c)</b>      |       |
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| <b>6(d)</b>      |       |
|                  |       |
|                  |       |

7(a)

7(b)

A •

C •

F •

B •

D •

G •

E •

| B | C | D | E | F | G |
|---|---|---|---|---|---|
|   |   |   |   |   |   |

7(c)

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| <b>7(d)</b>      |   |
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|                  |   |
|                  | seconds                                   |
|                  |   |
| <b>7(e)(i)</b>   |   |
|                  |   |
|                  |   |
|                  |   |
|                  |   |
|                  | Lower bound = metres                      |
|                  |   |
| <b>7(e)(ii)</b>  |   |
|                  |   |
|                  |   |
|                  |   |
|                  | Upper bound = metres                      |
|                  |   |
| <b>7(e)(iii)</b> |   |
|                  |   |
|                  |   |
|                  |   |
|                  |   |
|                  | Length of shortest possible tour = metres |
|                  |   |





