OCR
Oxford Cambridge and RSA

Thursday 21 October 2021 – 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

Y54401

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

Centre number [ ][ ][ ][ ][ ]   Candidate number [ ][ ][ ][ ]

First name(s) _____

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 $g\,\mathrm{m\,s^{-2}}$. 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 **[ ]**.
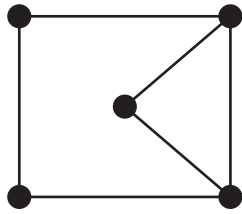• This document has **16** pages.

ADVICE
• Read each question carefully before you start your answer.

Turn over

1(a)	Bag 1:
	Bag 2:
	Bag 3:
	Bag 4:
	Bag 5:

1(b)	

1(c)	

2(a)(i)	
2(a)(ii)	
2(b)	
	1.
	2.

2(c)

	J	K	L	M	N
Indegree					
Outdegree					

2(d)(i)	
2(d)(ii)	

Turn over

3(a)

3(b)

3(c)

3(d)

4(a)	Graph is not isomorphic to K$_{2,3}$
	because
	Graph is not isomorphic to K$_{2,3}$
	because
4(b)	
4(c)	

4(d)

SPARE COPY

4(e)

4(f)

4(g)

4(h)

Turn over

5(a)

Beth

	X	Y	Z
P	x	3	2
Q	4	0	−2
R	−3	−1	−3

Alex

(i) Stable when

(ii) Unstable when

5(b)

X	Y	Z

5(c)

(answer space continued on next page)

5(c) | **(continued)**

For working, if required.

5(d)

Turn over
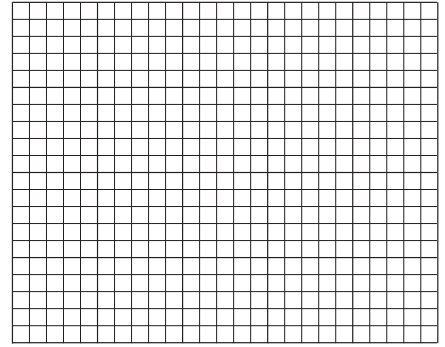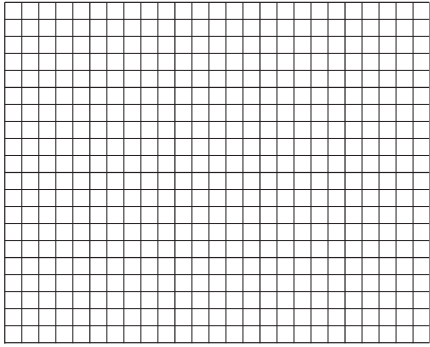
6(a)

P	x	y	s	t	u	RHS
1	2	−5	0	0	0	0
0	2	1	1	0	0	25.8
0	−1	3	0	1	0	13.8
0	4	−3	0	0	1	18.8

Maximise $P =$

Subject to

and $x \geqslant 0, y \geqslant 0$

6(b)

$$P = 23 \text{ at } x = 0, y = 4.6$$

$y \leqslant$ $y \geqslant$

$$P = \qquad \text{at } x = \quad , y =$$ $$P = \qquad \text{at } x = \quad , y =$$

$\leqslant$ $\geqslant$
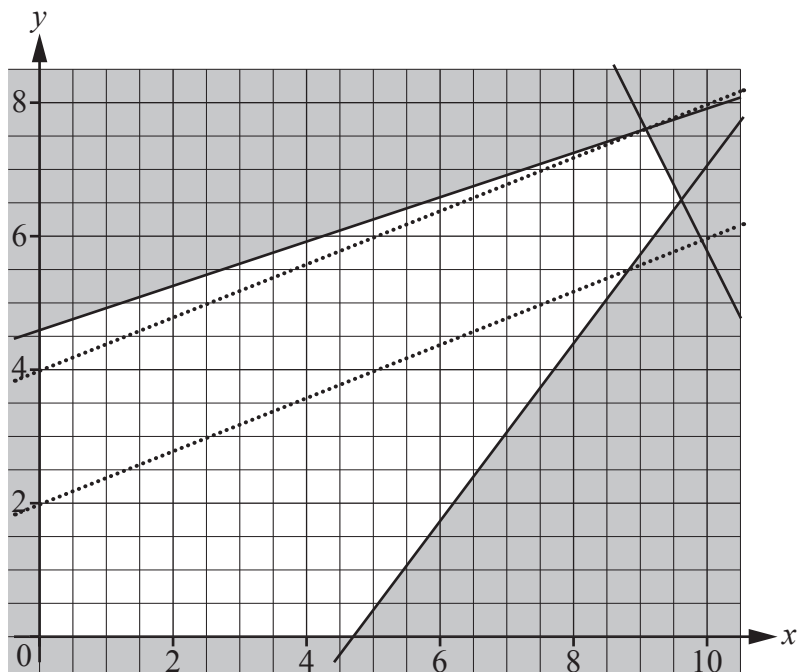
$\leqslant$ $\geqslant$

$$P = 21.6 \text{ at } x = 4.2, y = 6$$
Optimal solution < 22
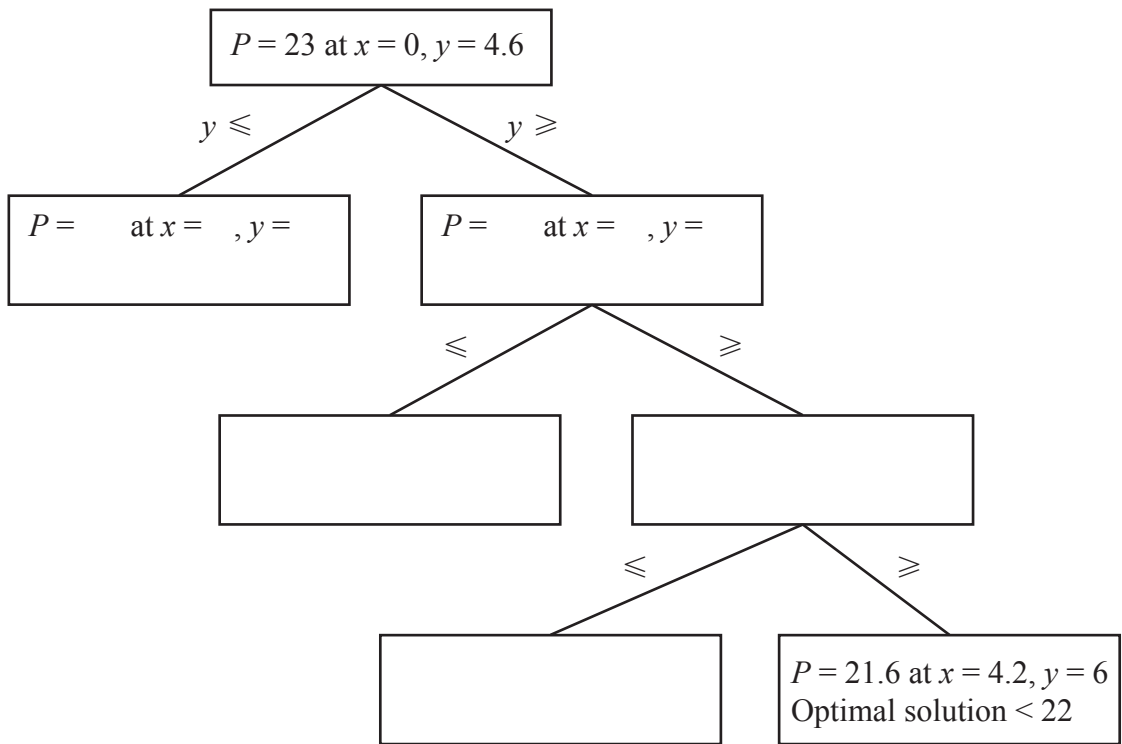
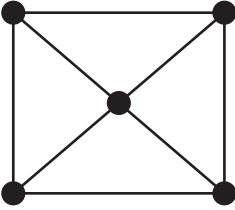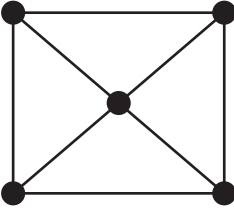For working, if required (there is another copy of this graph on the next page).

An optimal solution to the constrained problem is

$P =$ when $x =$ and $y =$

(answer space continued on next page)

Turn over

6(b) **(continued)** For working, if required.

6(c) For working, if required.

Turn over

7(a)(i)	BUBBLE SORT							
	Original list:	2.9	0.9	1.5	3.5	4.2	5.3	4.7	2.3
	After 1st pass:							
	After 2nd pass:							

7(a)(ii)	SHUTTLE SORT							
	Original list:	2.9	0.9	1.5	3.5	4.2	5.3	4.7	2.3
	After 1st pass:							
	After 2nd pass:							

7(b)	

| 7(c)(i) | Sorted list: | 0.9 | 1.5 | 2.3 | 2.9 | 3.5 | 4.2 | 4.7 | 5.3 |

7(c)(ii)

SPARE COPY

Total weight of minimum spanning tree:

7(c)(iii)

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).