OCR
RECOGNISING ACHIEVEMENT

Monday 23 January 2012 – Morning

AS GCE MATHEMATICS (MEI)

4771 Decision Mathematics 1

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4771
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.
- The Question Paper will be found in the centre of the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book**. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- You are permitted to use a graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

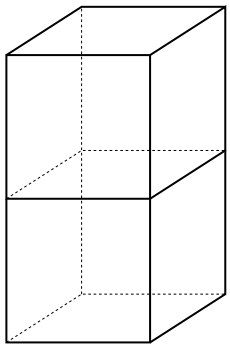
- This information is the same on the Printed Answer Book and the Question Paper.
- The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **8** pages. Any blank pages are indicated.

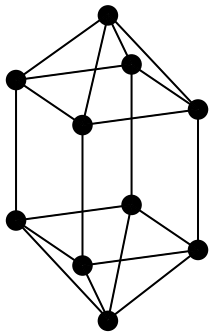
INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

Section A (24 marks)

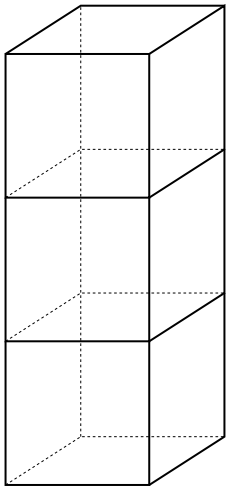
1 A graph is obtained from a solid by producing a vertex for each exterior face. Vertices in the graph are connected if their corresponding faces in the original solid share an edge. The diagram shows a solid followed by its graph. The solid is made up of two cubes stacked one on top of the other. This solid has 10 exterior faces, which correspond to the 10 vertices in the graph. (Note that in this question it is the exterior faces of the cubes that are being counted.)





(i) Draw the graph for a cube. **[4]**

(ii) Obtain the number of vertices and the number of edges for the graph of three cubes stacked on top of each other. **[4]**



2 The following is called the '1089' algorithm. In steps 1 to 4 numbers are to be written with exactly three digits; for example 42 is written as 042.

Step 1 Choose a 3-digit number, with no digit being repeated.

Step 2 Form a new number by reversing the order of the three digits.

Step 3 Subtract the smaller number from the larger and call the difference D. If the two numbers are the same then D = 000.

Step 4 Form a new number by reversing the order of the three digits of D, and call it R.

Step 5 Find the sum of D and R.

(i) Apply the algorithm, choosing 427 for your 3-digit number, and showing all of the steps. **[4]**

(ii) Apply the algorithm to a 3-digit number of your choice, showing all of the steps. **[2]**

(iii) Investigate what happens if digits may be repeated in the 3-digit number in step 1. **[2]**

3 Solve the following LP problem graphically.

Maximise $2x + 3y$

subject to $x + y \leqslant 11$

$3x + 5y \leqslant 39$

$x + 6y \leqslant 39$. **[8]**

Section B (48 marks)

4 The table defines a network in which the numbers represent lengths.

	A	B	C	D	E	F	G
A	–	5	2	3	–	–	–
B	5	–	–	–	1	1	–
C	2	–	–	–	4	1	–
D	3	–	–	–	4	2	–
E	–	1	4	4	–	–	1
F	–	1	1	2	–	–	5
G	–	–	–	–	1	5	–

(i) Draw the network. **[3]**

(ii) Use Dijkstra's algorithm to find the shortest paths from A to each of the other vertices. Give the paths and their lengths. **[6]**

(iii) Draw a new network containing all of the edges in your shortest paths, and find the total length of the edges in this network. **[2]**

(iv) Find a minimum connector for the original network, draw it, and give the total length of its edges. **[4]**

(v) Explain why the method defined by parts **(i)**, **(ii)** and **(iii)** does not always give a minimum connector. **[1]**

5 Five gifts are to be distributed among five people, A, B, C, D and E. The gifts are labelled from 1 to 5. Each gift is allocated randomly to one of the five people. A person can receive more than one gift.

(i) Use one-digit random numbers to simulate this process. One-digit random numbers are provided in your answer book.

Explain how your simulation works.

Produce a table, showing how many gifts each person receives. **[6]**

(ii) Carry out four more simulations showing, in each case, how many gifts each person receives. **[2]**

(iii) Use your simulation to estimate the probabilities of a person receiving 0, 1, 2, 3, 4 and 5 gifts. **[5]**

(iv) Describe what you would have to do differently if there were six people and six gifts. **[3]**

6 The table shows the tasks involved in making a salad, their durations and their precedences.

Task		Duration (seconds)	Immediate predecessors
B	get out bowl and implements	10	–
I	get out ingredients	10	–
L	chop lettuce	15	B, I
W	wash tomatoes and celery	25	B, I
T	chop tomatoes	15	W
C	chop celery	10	W
P	peel apple	20	B, I
A	chop apple	10	P
D	dress salad	10	L, T, C, A

(i) Draw an activity on arc network for these activities. **[5]**

(ii) Mark on your diagram the early and late times for each event. Give the minimum completion time and the critical activities. **[6]**

(iii) Given that each task can only be done by one person, how many people are needed to prepare the salad in the minimum time?

What is the minimum time required to prepare the salad if only one person is available? **[2]**

(iv) Show how two people can prepare the salad as quickly as possible. **[3]**