2017 Senior External Examination

Mathematics A

Paper Two — Question and response book

Thursday 26 October 2017

1:15 pm to 4:25 pm

Time allowed

- Perusal time: **10 minutes**
- Working time: **3 hours**

Examination materials provided

- Paper Two — Question and response book
- Paper Two — Resource book

Equipment allowed

- QCAA-approved equipment
- ruler (metric, parallel or rolling)
- protractor
- drawing compass
- set squares
- templates (without formulas)
- non-programmable calculator
- graphing calculator

Not allowed: Calculators with computer algebra system (CAS) functionality.

Directions

Do not write in this book during perusal time.

Paper Two has **four** extended-response questions. Attempt **all** questions.

Assessment

Paper Two assesses the following assessment criteria:

- Knowledge and procedures (KP)
- Modelling and problem solving (MP)
- Communication and justification (CJ)

Assessment standards are at the end of this book.

After the examination session

The supervisor will collect this book when you leave.

Candidate use

Print your candidate number here

1	7	–					–	

Attach barcode here

Number of books used

Supervisor use only

Supervisor's initials

QCAA use only

Marker number

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For all Queensland schools

Paper Two has **four** extended-response questions. Attempt **all** questions.

Write your responses in the spaces provided. **Show full working in all responses. Partial credit can be awarded only if working is shown.**

Additional pages for responses are at the back of this book.

Question 1

a. If the inflation rate is 1.5% p.a. find the expected value in two years of a car that has a current price of $22950.

(KP)

b. Find the principal needed to accumulate a total of $10000 at 12% p.a. compounded quarterly for 5 years.

(KP)

c. The purchase price of a boat is $85 000.

A 10% deposit is paid and the balance is charged simple interest of 4.3% p.a. over 5 years.

i. Calculate the amount of the deposit.

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(KP)

ii. Calculate the amount of each monthly repayment during the 5 years.

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(KP)

d. A company's share price is $16.40.

Calculate the dividend paid if the percentage yield is 6.25%.

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(KP)

e. A couple want to buy a house. Their combined gross income is $4540 per fortnight. They can afford 25% of their gross monthly income for loan repayments. The couple are already paying off a car loan at $260 per month.

The bank offers a loan with monthly repayments of $8.36 per $1000 borrowed.

Calculate the largest loan that this couple can afford.

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(KP)

f. Michael has the choice of investing his money in two different investment funds:

i. 4.9% p.a. compounding quarterly

ii. 4.75% p.a. compounding daily

Determine which investment fund would provide Michael with the greatest return over two years.

State **one strength** and **one limitation** that may affect this situation. Justify your decisions with mathematical reasoning.

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(MP)

Question 2

a. A Christmas tree decoration is in the shape of a sphere. It has a diameter of 4.5 cm.

Twelve of these decorations are to fit into a rectangular box that is 10 cm wide and 5 cm high.

What is the minimum length that the box can be if it is to hold all 12 decorations, allowing an extra centimetre in the length of the box for packing?

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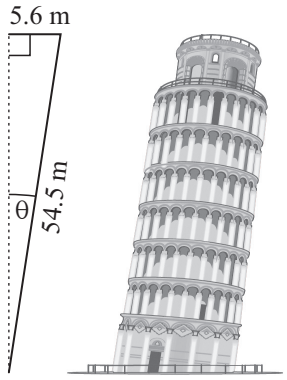
(KP)

b. A side of the Leaning Tower of Pisa is 54.5 metres long. The building is 5.6 metres 'off vertical' at the top.

Calculate the size of θ, the angle the Tower is 'off vertical'.



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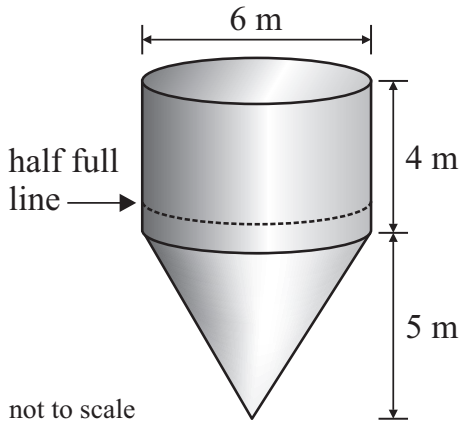
(KP)

c. A wheat silo is made from a cylinder and cone as shown. An engineer wishes to determine the position of a line on the outside of the silo to show when the silo is half full.



How far from the bottom of the silo should the line be marked?

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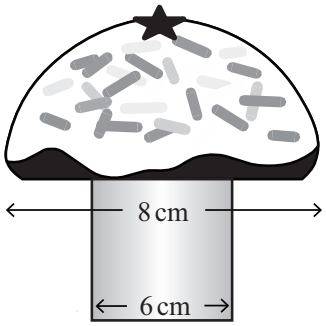
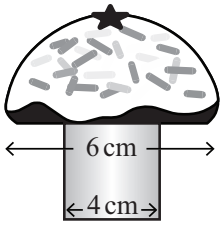
(KP)

d. A café sells two sizes of muffins. The bottom section of the larger size muffin is shaped as a cube with side length 6 cm. When cooked, a hemisphere is formed on the top with a diameter of 8 cm. The bottom section of the smaller size muffin is shaped as a cube with side length 4 cm. When cooked, a hemisphere is formed on the top with a diameter of 6 cm.





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The price is based on the volume of cake mixture used in the muffin. The large muffin costs \$5.40.

Determine the cost of the small muffin.

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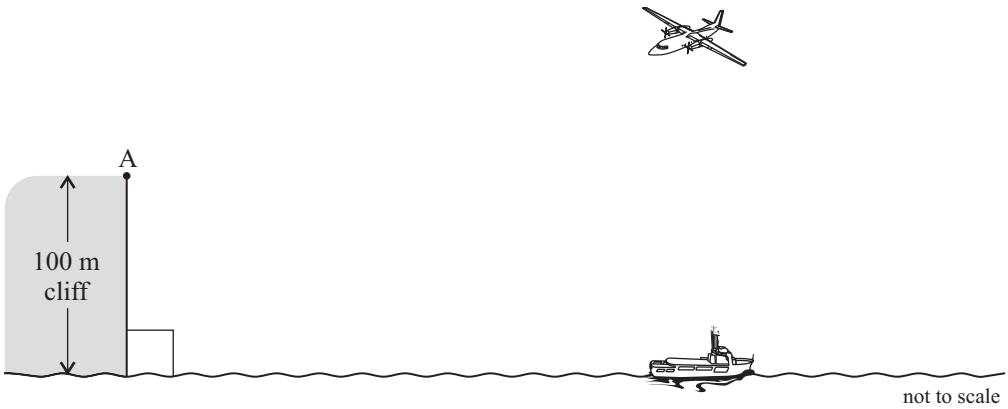
(KP)

e. A person standing at point A on a cliff 100 metres high notices a boat at an angle of depression of 12°.

An approaching plane is about to pass directly over the boat. At the exact time it passes over the boat, the altitude of the plane is 550 metres.

Calculate the angle of elevation from the top of the cliff to the plane at the moment it passes over the boat.



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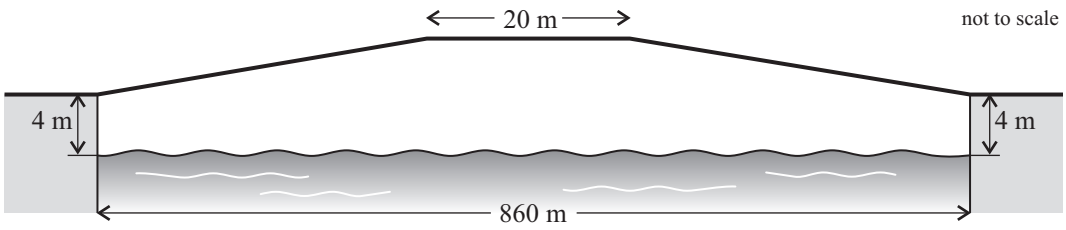
(KP)

f. The total length of a bridge is 862 metres. It slopes up from each end at an angle of 3°. It has a flat section 20 metres long in the middle. The ends of the bridge are 4 metres above the water as shown in the diagram below.

A yacht needs 25 metres clearance to safely navigate under this bridge.

Determine if the yacht will be able to sail under this bridge safely.

List **two limitations** that may affect this situation.



(MP)

g. Danielle lives in Perth (32° S, 116° E) and wishes to watch a live telecast of a cricket test match played in Christchurch (44° S, 173° E). The first session of the match commences at 10:30 am (Christchurch local time) and lasts for 2 hours.

What time will it be in Perth when the first session of the match **finishes**?

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(KP)

h. A plane flying at 600 km/h travelled directly north for 8 hours and 20 minutes before making an emergency landing. If the plane took off from Hobart (43° S, 147° E), what are the coordinates of where the plane makes the emergency landing?

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(KP)

Question 3

a. A house plan is drawn to a scale of 1:100.

i. What would be the dimensions of a bedroom measuring 3 cm square on the plan?

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(KP)

ii. The patio is 4500 mm wide. What would be its measurement on the plan?

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(KP)

iii. The interior ceiling is 2.4 metres high and all windows are 1 metre square.

The doors of the wardrobes are mirrored glass, cover one complete wall, and reach to the ceiling. The bedroom has one door and one window apart from the wardrobes.

A painter charges $25 per square metre. This includes all trim work and the door.

Determine the cost of painting the bedroom if the walls are 3 cm square.

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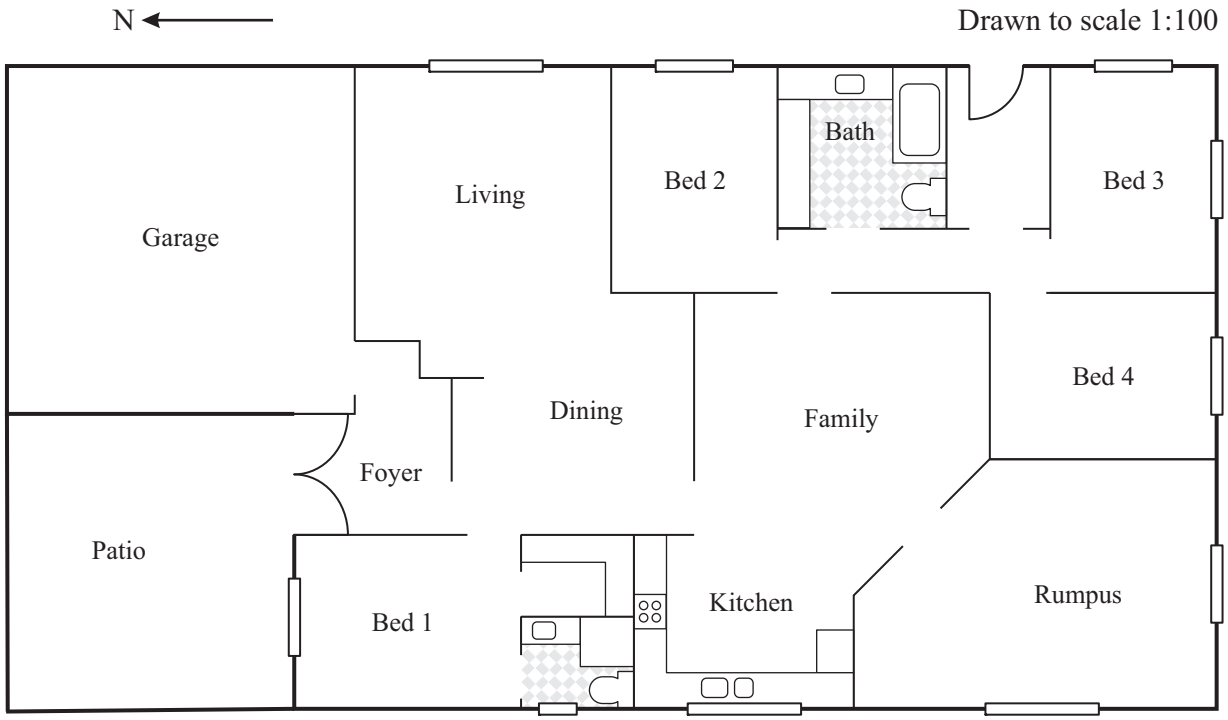
(KP)

b.



The above house is on a rectangular block of land. The front of the block faces north.

The front of the block is 20 metres wide and the property is 25 metres long.

The house is positioned 4 metres from the front boundary and 5 metres from the fence on the western side of the property.

i. Using the graph paper opposite, draw a site plan of the block with the house correctly positioned on it using a scale of 1:125.

(It is sufficient to represent the house using a rectangle only.)

(KP)

ii. Calculate if there is sufficient space to build a square 4 metre shed in the south-east corner of the property.

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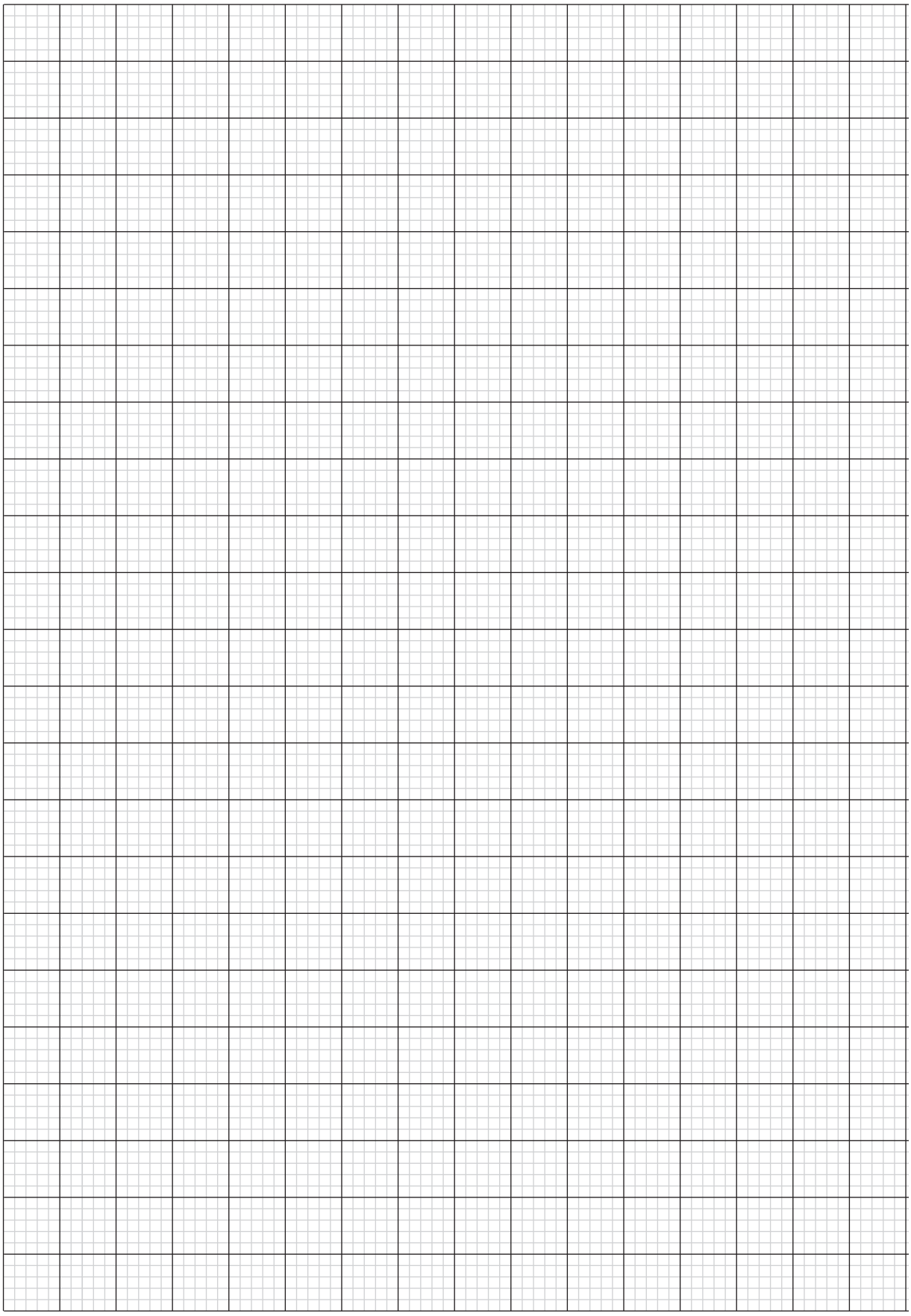
(MP)

Question 3 b. — response area (Spare graph paper is at the end of this paper.)



c. Two pieces of timber 480 mm and 640 mm in length are to be used to make a builder's square. How long should the other piece of timber be cut for the length of the hypotenuse?

Note: A builder's square is a large right angle triangle used to produce square corners on buildings.

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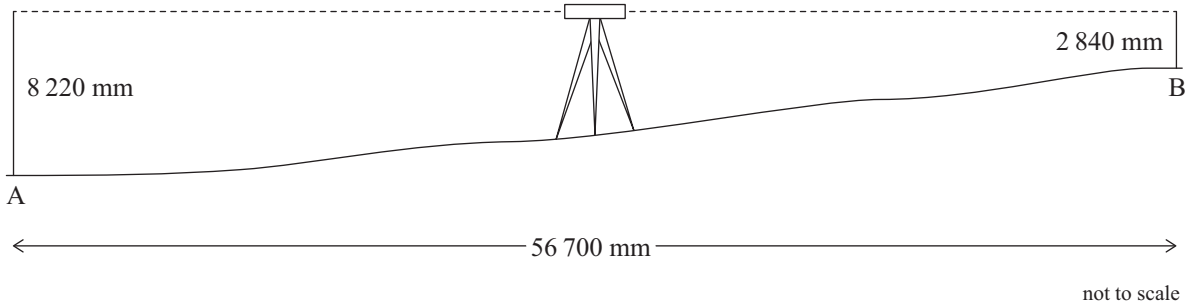
(KP)

d. Below is a cross-sectional view of a building site where levels were taken.



not to scale

Calculate the angle at which the ground rises.

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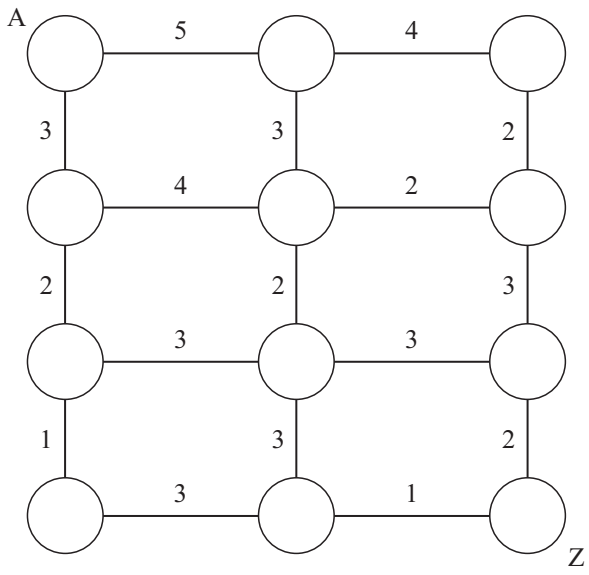
(KP)

Question 4

a. The network below shows the different routes and distances (in km) to get from A to Z.
Find the **shortest** distance from A to Z. Highlight this on the diagram and state this distance.



Distance:.....

(KP)

b. The costs (in $) of connecting various locations on a school campus with computer cable are given in the table below. A blank space indicates no direct connection.

	A	B	C	D	E
A	—	4000		5000	3000
B	—	—	1500	2200	4500
C	—	—	—	2200	1500
D	—	—	—	—	2500

i. Draw a network to represent this situation, showing the cost of connection along each arc.

(KP)

ii. Using a minimum spanning tree, find the least cost of connecting the cable.

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(KP)

c. Customers arrive with an inter-arrival time of 1 minute. There are two staff serving customers.

Time	Arrivals	Customer served (server 1)	Customer served (server 2)	Customer in queue	Queue length
10.00	C	A	B		
10.01	D	C	B		
10.02	E, F	C	D		
10.03	—	E	D		
10.04	G	E	F		
10.05	H	E	F		
10.06	—	G	H		
10.07	I	G	H		
10.08	J	I	H		
10.09	K, L	I	J		
10.10	M	K	J		
10.11	N	K	L		
10.12	O, P	M	N		
10.13	Q, R	O	N		
10.14	S	O	P		
10.15	T	Q	P		

Complete the 'Customer in queue' and 'Queue length' columns in the table above.

(KP)

d. A local petrol station has 4 petrol pumps available for customer use. This is a one-way station, where cars drive in for petrol, go to the vacant pump or form a queue. As soon as a pump becomes available another car drives up to the pump.

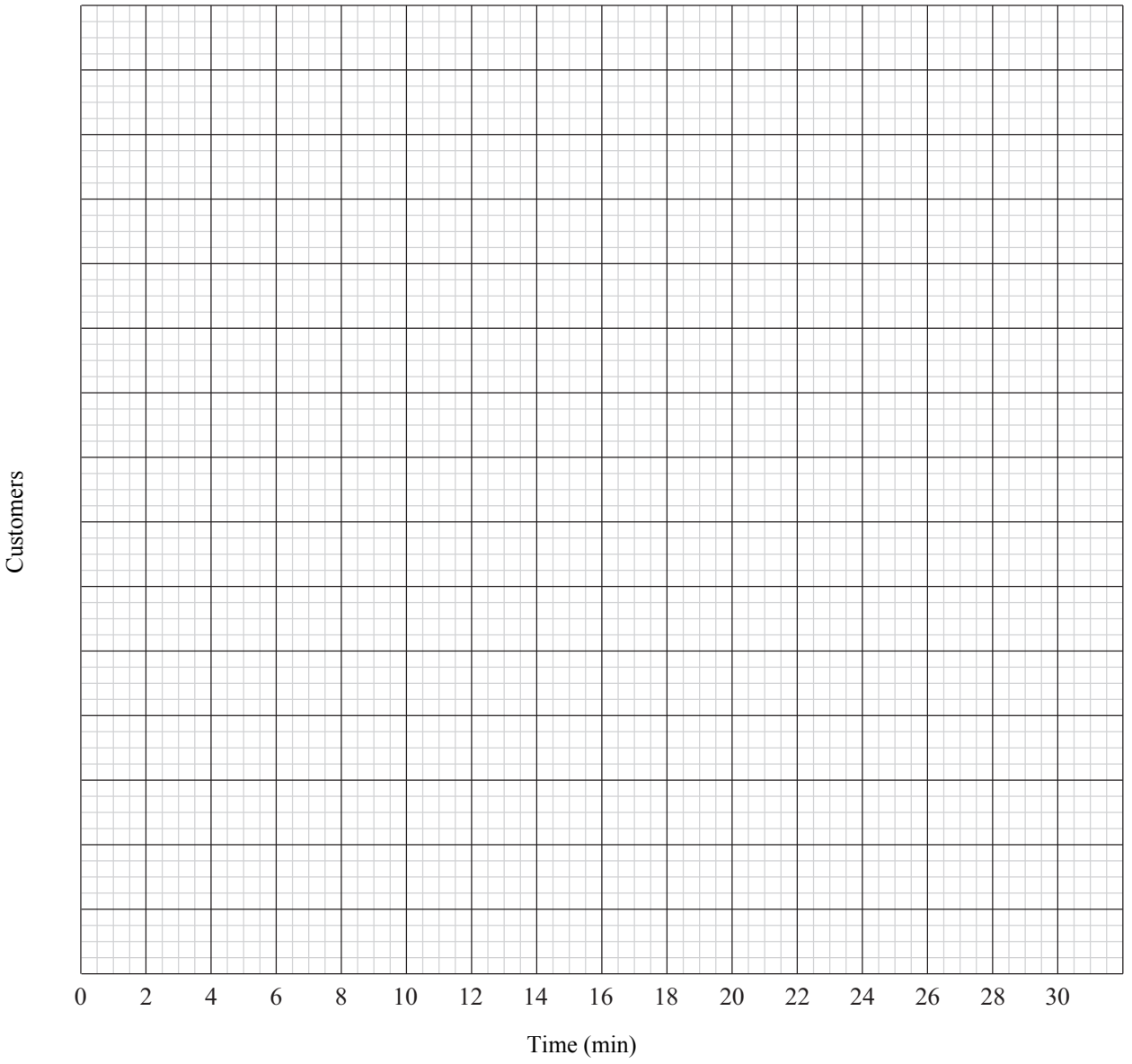
In addition to pumping fuel, it takes approximately 3 minutes for each car to make payment and depart.

The following table represents the time of arrival and the time taken to pump fuel for each customer.

All pumps are vacant when the first car arrives at 8.30 a.m.

Customer	A	B	C	D	E	F	G	H	I	J
Arrival time (am)	8.30	8.30	8.32	8.34	8.36	8.38	8.38	8.40	8.44	8.46
Time taken to pump fuel (mins)	4	3	4	2	4	2	3	4	4	3

i. Use the graph paper below to graph this scenario.



(KP)

ii. One of the petrol pumps stops working at 8.30 am.
Use the graph paper opposite to graph this new scenario.
State **one strength** and **one limitation** of this new scenario.

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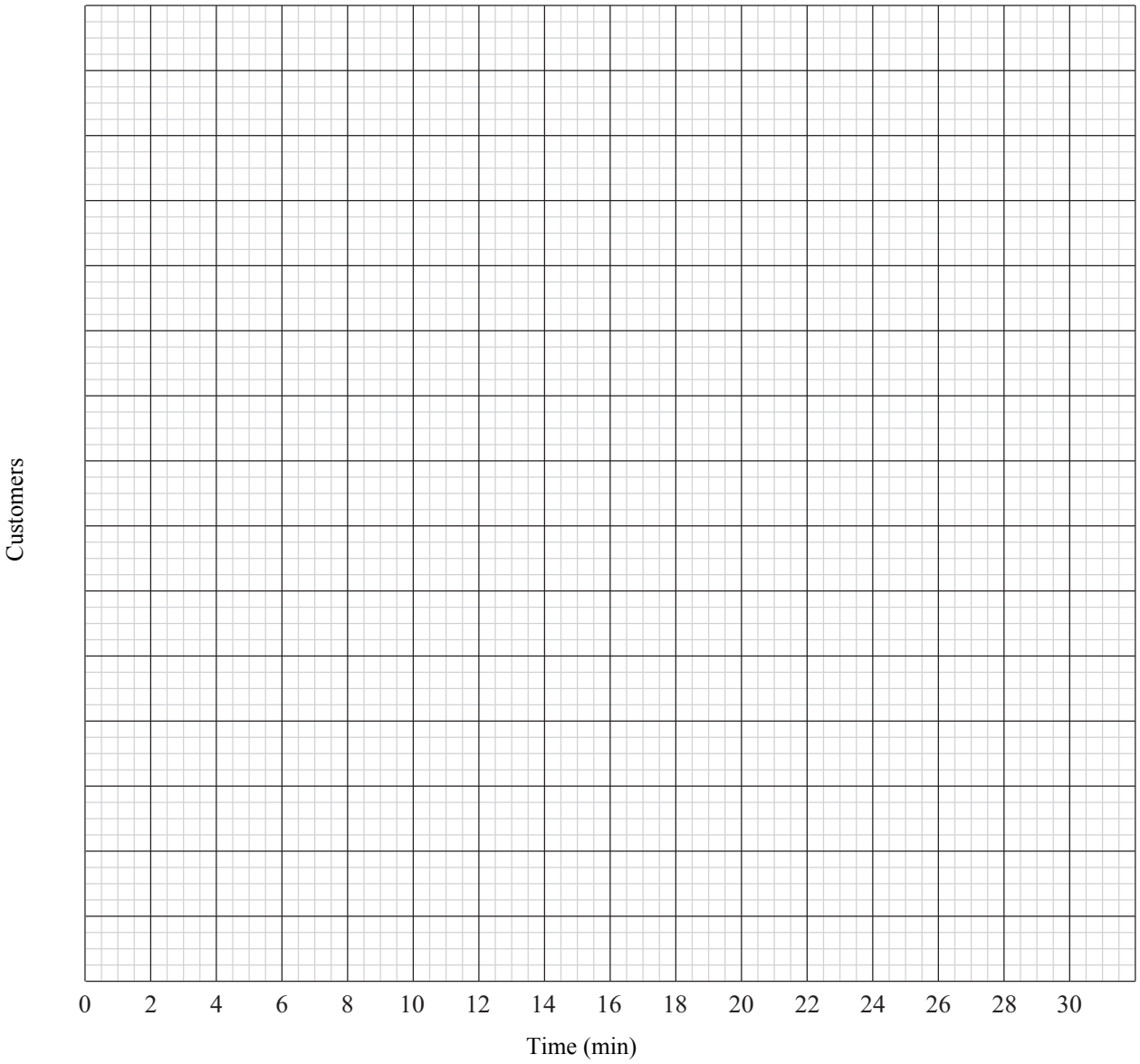
(MP)

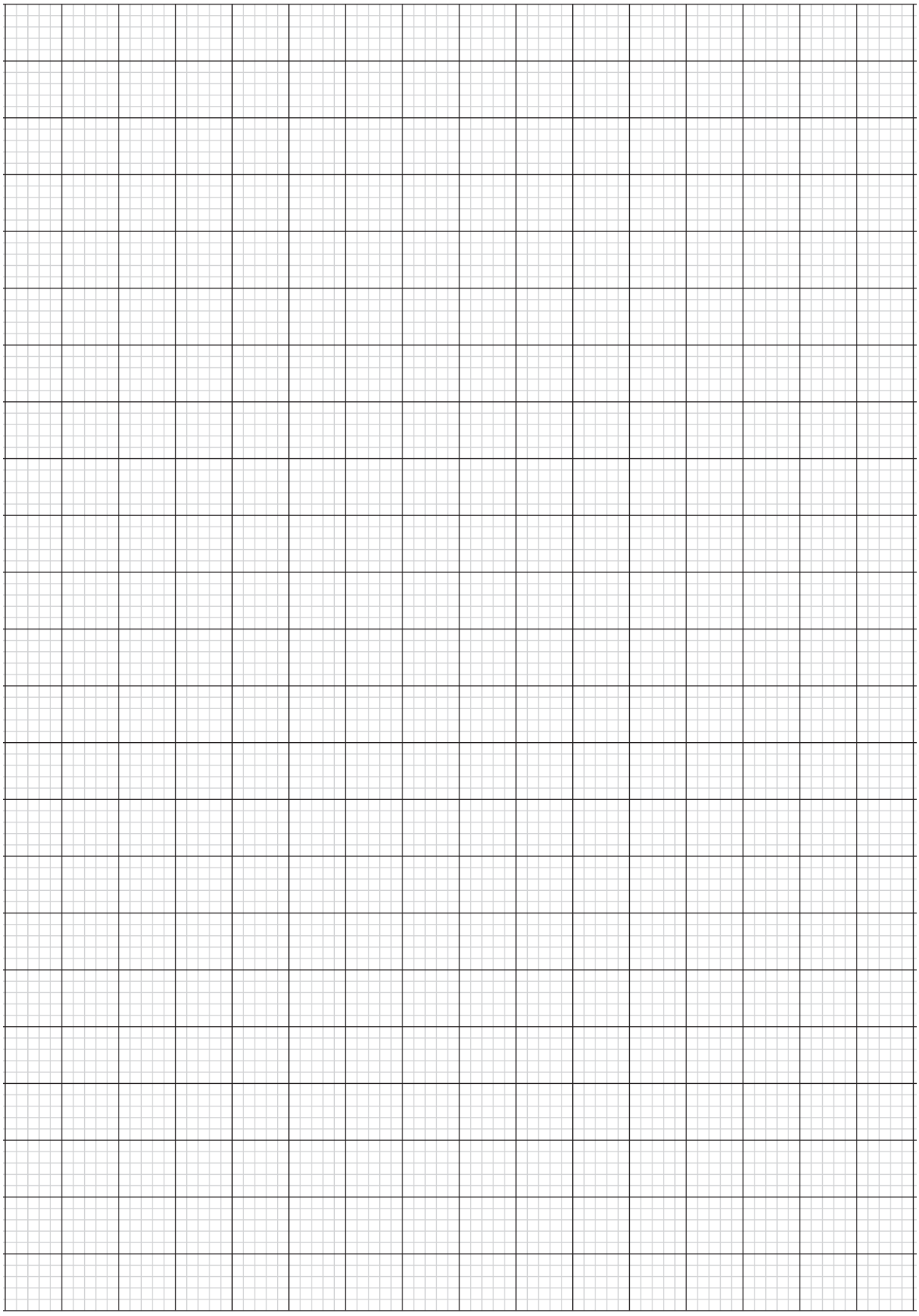
Question 4 d ii. — response area (Spare graph paper is at the end of this paper.)



(KP)

End of Paper Two

Spare graph paper (if required)



Additional page for responses (if required)

Question [ ]

Additional page for responses (if required)

Question [ ]

Assessment standards from the Mathematics A Senior External Syllabus 2006

Criterion	A	B	C	D	E
Knowledge and procedures (KP)	The **overall quality** of a candidate's achievement across the full range within the contexts of application, technology and complexity, and across topics, **consistently demonstrates**: • accurate recall, selection and use of definitions and rules • use of technology • recall and selection of procedures, and their accurate and proficient use.	The **overall quality** of a candidate's achievement across a range within the contexts of application, technology and complexity, and across topics, **generally demonstrates**: • accurate recall, selection and use of definitions and rules • use of technology • recall and selection of procedures, and their accurate use.	The **overall quality** of a candidate's achievement in the contexts of application, technology and complexity, **generally demonstrates**: • accurate recall and use of basic definitions and rules • use of some technology • accurate use of basic procedures.	The **overall quality** of a candidate's achievement in the contexts of application, technology and complexity, **sometimes demonstrates**: • accurate recall and use of some definitions and rules • use of some technology.	The **overall quality** of a candidate's achievement **rarely demonstrates** knowledge and use of procedures.
Modelling and problem solving (MP)	The **overall quality** of a candidate's achievement across the full range within each context, and across topics **generally demonstrates** mathematical thinking which includes: • interpreting, clarifying and analysing a range of situations, and identifying variables • selecting and using effective strategies • informed decision making … *and* sometimes **demonstrates** mathematical thinking which includes: • selecting and using procedures to solve a wide range of problems • initiative in exploring the problem • recognising strengths and limitations of models.	The **overall quality** of a candidate's achievement across a range within each context, and across topics, **generally demonstrates** mathematical thinking which includes: • interpreting, clarifying and analysing a range of situations, and identifying variables • selecting and using strategies … *and* sometimes **demonstrates** mathematical thinking which includes: • selecting and using procedures required to solve a range of problems • informed decision making.	The **overall quality** of a candidate's achievement **demonstrates** mathematical thinking which includes: • interpreting and clarifying a range of situations • selecting strategies and/or procedures.	The **overall quality** of a candidate's achievement **demonstrates** mathematical thinking which includes following basic procedures and/or using strategies.	The **overall quality** of a candidate's achievement rarely **demonstrates** mathematical thinking which includes following basic procedures and/or using strategies.

(continued)

Criterion	A	B	C	D	E
Communication and justification (CJ)	The **overall quality** of a candidate's achievement across the full range within each context **consistently demonstrates**: • accurate use of mathematical terms and symbols • accurate use of language • organisation of information into various forms suitable for a given use • use of mathematical reasoning to develop logical arguments in support of conclusions, results and/or decisions • justification of procedures.	The **overall quality** of a candidate's achievement across a range within each context **generally demonstrates**: • accurate use of mathematical terms and symbols • accurate use of language • organisation of information into various forms suitable for a given use • use of mathematical reasoning to develop simple logical arguments in support of conclusions, results and/or decisions.	The **overall quality** of a candidate's achievement in some contexts **generally demonstrates**: • accurate use of basic mathematical terms and symbols • accurate use of basic language • organisation of information into various forms • use of some mathematical reasoning to develop simple logical arguments.	The **overall quality** of a candidate's achievement **sometimes demonstrates** evidence of the use of the **basic** conventions of language and mathematics.	The **overall quality** of a candidate's achievement **rarely demonstrates** use of the **basic** conventions of language or mathematics.

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