

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE

A382/01

APPLICATIONS OF MATHEMATICS

Applications of Mathematics 2
(Foundation Tier)

FRIDAY 8 NOVEMBER 2013: Morning

DURATION: 1 hour 30 minutes
plus your additional time allowance

MODIFIED ENLARGED

Candidate forename		Candidate surname	
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Centre number						Candidate number				
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Candidates answer on the Question Paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:

Scientific or graphical calculator
Geometrical instruments
Tracing paper (optional)

<p>You are permitted to use a calculator for this paper</p>
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READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

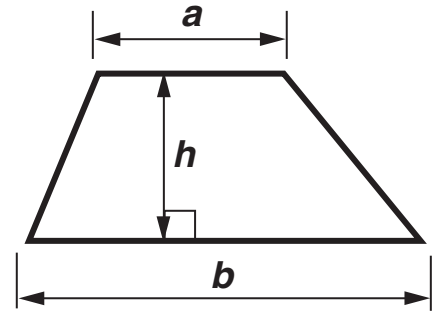
- Write your name, centre number and candidate number in the boxes on the front page. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer ALL the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Your answers should be supported with appropriate working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

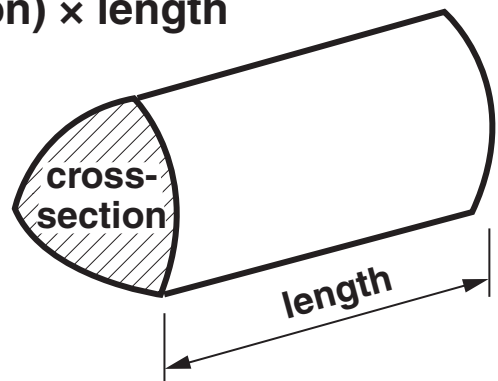
- The number of marks is given in brackets [] at the end of each question or part question.
- Your quality of written communication is assessed in questions marked with an asterisk (*).
- The total number of marks for this paper is 90.
- Any blank pages are indicated.

FORMULAE SHEET: FOUNDATION TIER

Area of trapezium = $\frac{1}{2}(a + b)h$



Volume of prism = (area of cross-section) \times length



Answer ALL the questions.

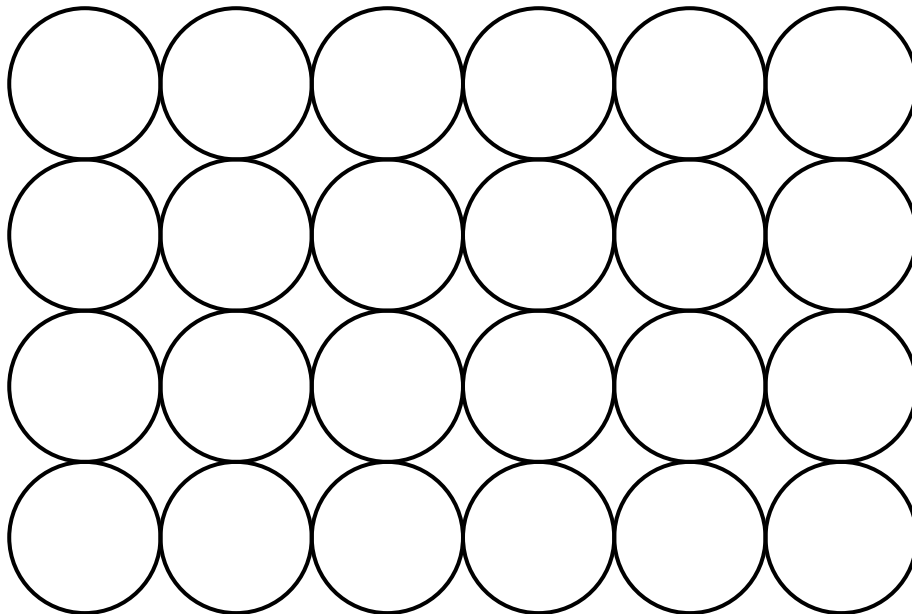
- 1 (a) The international measure of oil is the barrel.
A barrel of oil is 158.987 litres.**

- (i) To the nearest litre, how many litres are there
in a barrel of oil?**

(a)(i) _____ litres [1]

- (ii) Canada uses the most oil per household in the
world.**

**The following diagram shows the top view of
a stack of oil barrels. The stack shows the oil
used by the average Canadian household in a
year.**



**The barrels are stacked three layers high. Each
layer is the same as shown by the top view.
The barrels are full of oil.**

Use your answer to part (a)(i) to calculate the total volume, in litres, of the oil used by the average Canadian household.

(ii) _____ litres [3]

(b) Oil prices are usually given in dollars (\$) per barrel.

The line graph on the opposite page gives oil prices per barrel for the last 20 years.

Use the line graph opposite to answer the questions below.

(i) What was the price of oil in 1996?

(b)(i) \$ _____ per barrel [1]

(ii) For which years was the price of oil greater than \$80 per barrel?

(ii) _____ [1]

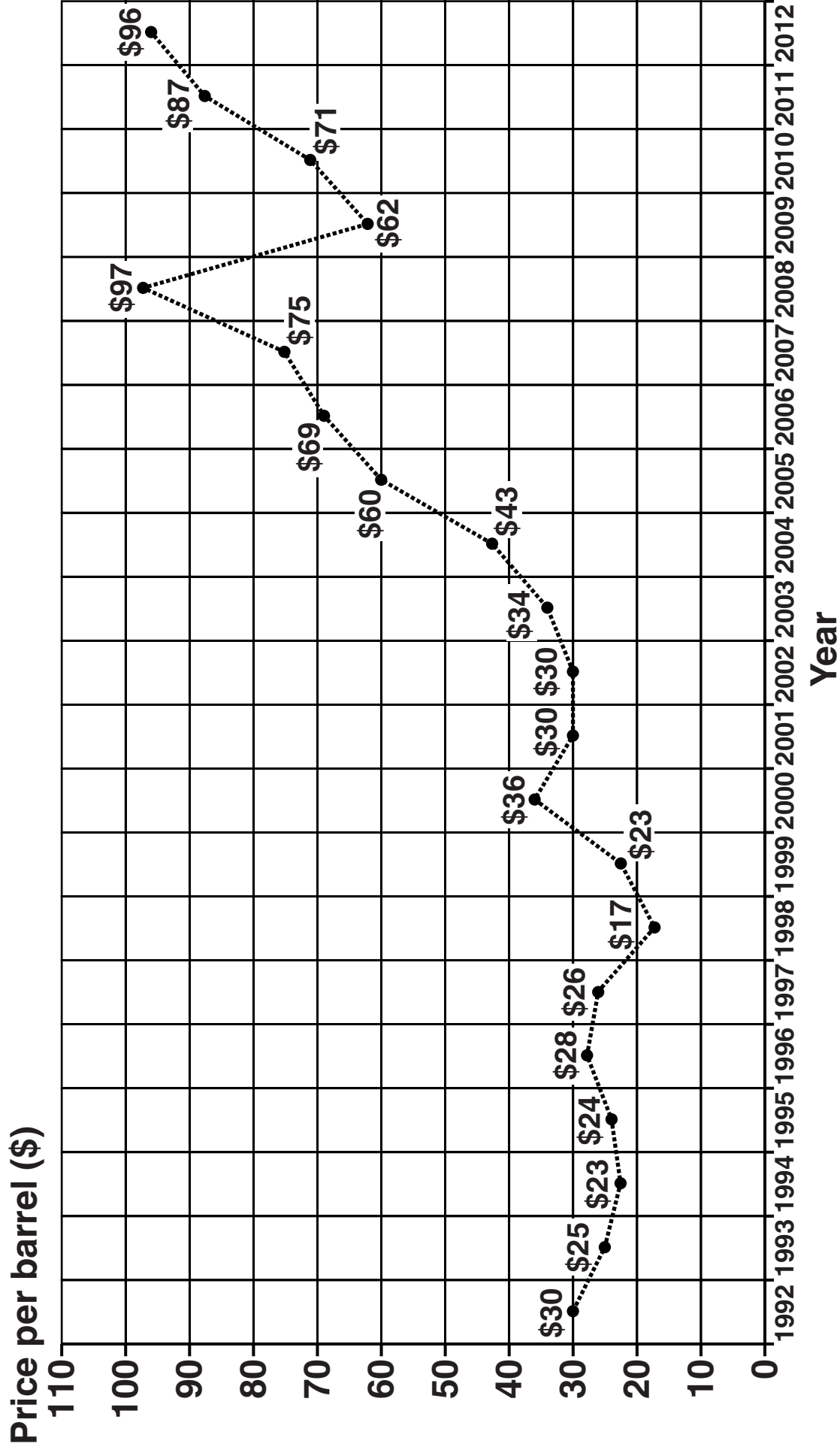
(iii) An economist wants to index the oil prices, so that the 1992 price of \$30 has an index of 100.

Year	Price per barrel	Index
1992	\$30	100
2005	\$60	

What index should she write for 2005?

(iii) _____ [1]

PRICE OF OIL PER BARREL



Sometimes ships need to flush out their oil tanks with sea water.

This mixture is then flushed into the sea.

International law sets an upper limit of 3 parts of oil to 200 000 parts of sea water for this mixture.

(c) (i) What is the maximum volume of oil that can be mixed with 400 000 litres of sea water?

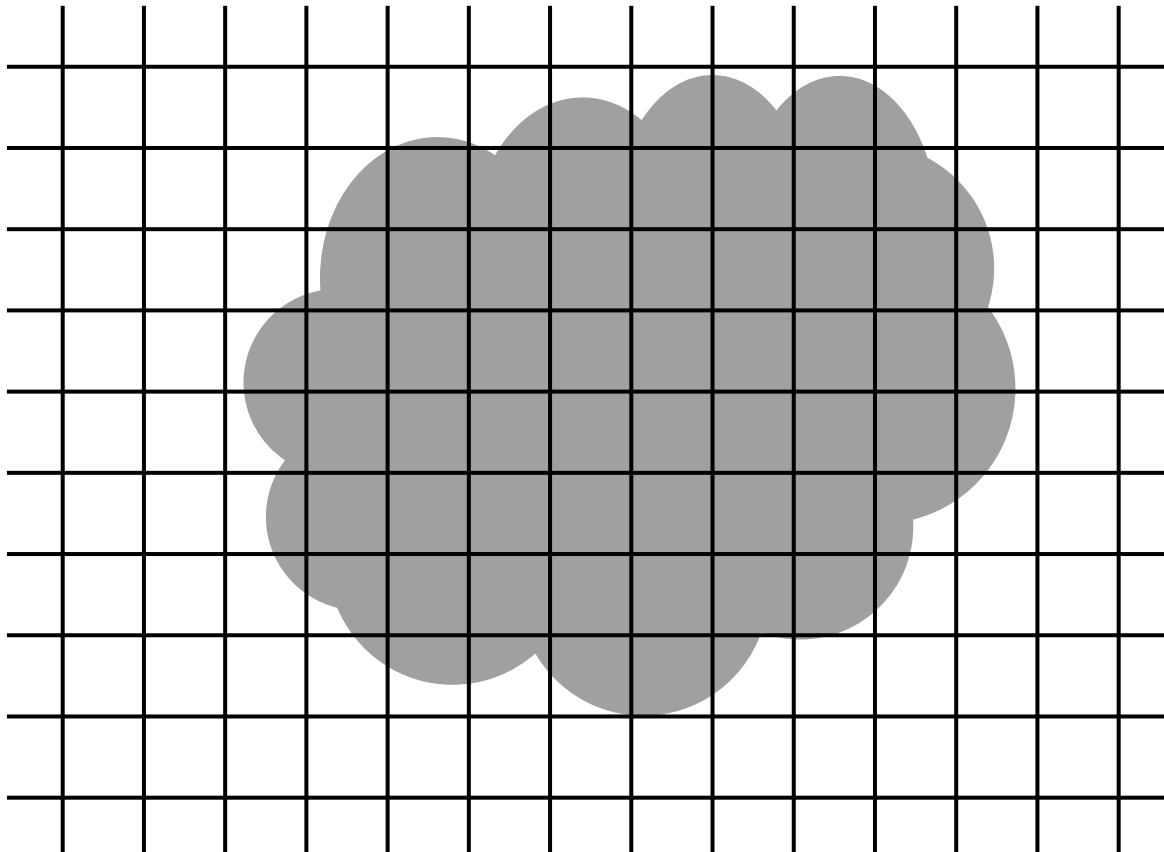
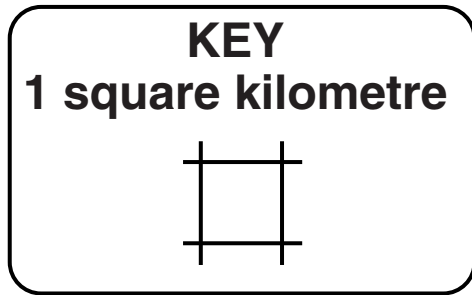
(c)(i) _____ litres [1]

**(ii) A ship flushes out 10 litres of oil with 100 tonnes of sea water.
A tonne of sea water is approximately 1000 litres.**

Show clearly whether the ship is breaking international law.

_____ **[2]**

(iii) Large oil slicks can be seen from the air.



This is the view from the air of an oil slick with a 1 kilometre grid added.

Estimate the area of the slick in square kilometres.

(iii) _____ km² [2]

The volume of oil in an oil slick can be estimated using this formula.

$$V = 1000 Ad$$

**V is the volume of oil in cubic metres,
 A is the area of the oil slick in square kilometres,
 d is the thickness of the oil slick in millimetres.**

A rough idea of how thick an oil slick is can be found from its colour using this table.

Thickness (mm)	Colour of oil slick
0.0001	Silvery
0.0003	Rainbow
0.001	Dull colours (red, turquoise)
0.01	Yellow/brown
0.1	Light brown
1.0	Black

(iv) The oil slick in part (c)(iii) is light brown in colour.

What is the volume, in cubic metres, of the oil in this oil slick?

(iv) _____ m³ [3]

- (d) Supertankers can hold two million barrels of oil!
They are very expensive to run.
This means they need to load and unload as fast
as possible.**

**Supertankers are filled by special high speed
pumps.**

**The volume of oil, V barrels, pumped into a
supertanker is given by this formula.**

$$V = 75\,000\, nt$$

**n is the number of pumps working,
 t is the time in hours they have been
pumping.**

- (i) Write two million in figures.**

(d)(i) _____ [1]

- (ii) A supertanker needs to be filled with two million barrels of oil in less than 12 hours.

What is the smallest number of pumps needed?

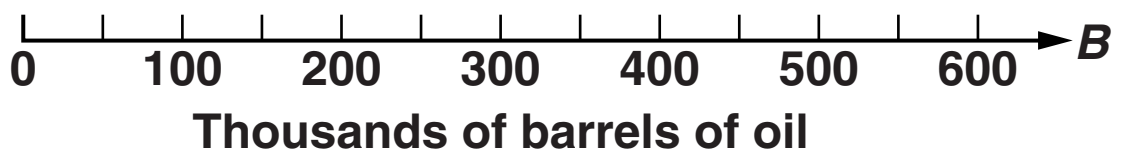
You MUST show how you got your answer.

(ii) _____ [3]

- (iii) At a large oil terminal the number of thousands of barrels of oil, B , which can be pumped in an hour is given by the following inequality.

$$300 \leq B < 500$$

On this number line show the values of B that fit the inequality.



[2]

- (iv) The statement “A supertanker may have 1, 2 or 3 pumps” can be written as an inequality.

Tick (✓) the inequalities below which express this statement.

n is the number of pumps a supertanker has.

$$1 < n < 3 \quad \square$$

$$1 \leq n \leq 3 \quad \square$$

$$1 \leq n < 3 \quad \square$$

$$1 < n \leq 3 \quad \square$$

$$1 \leq n < 4 \quad \square$$

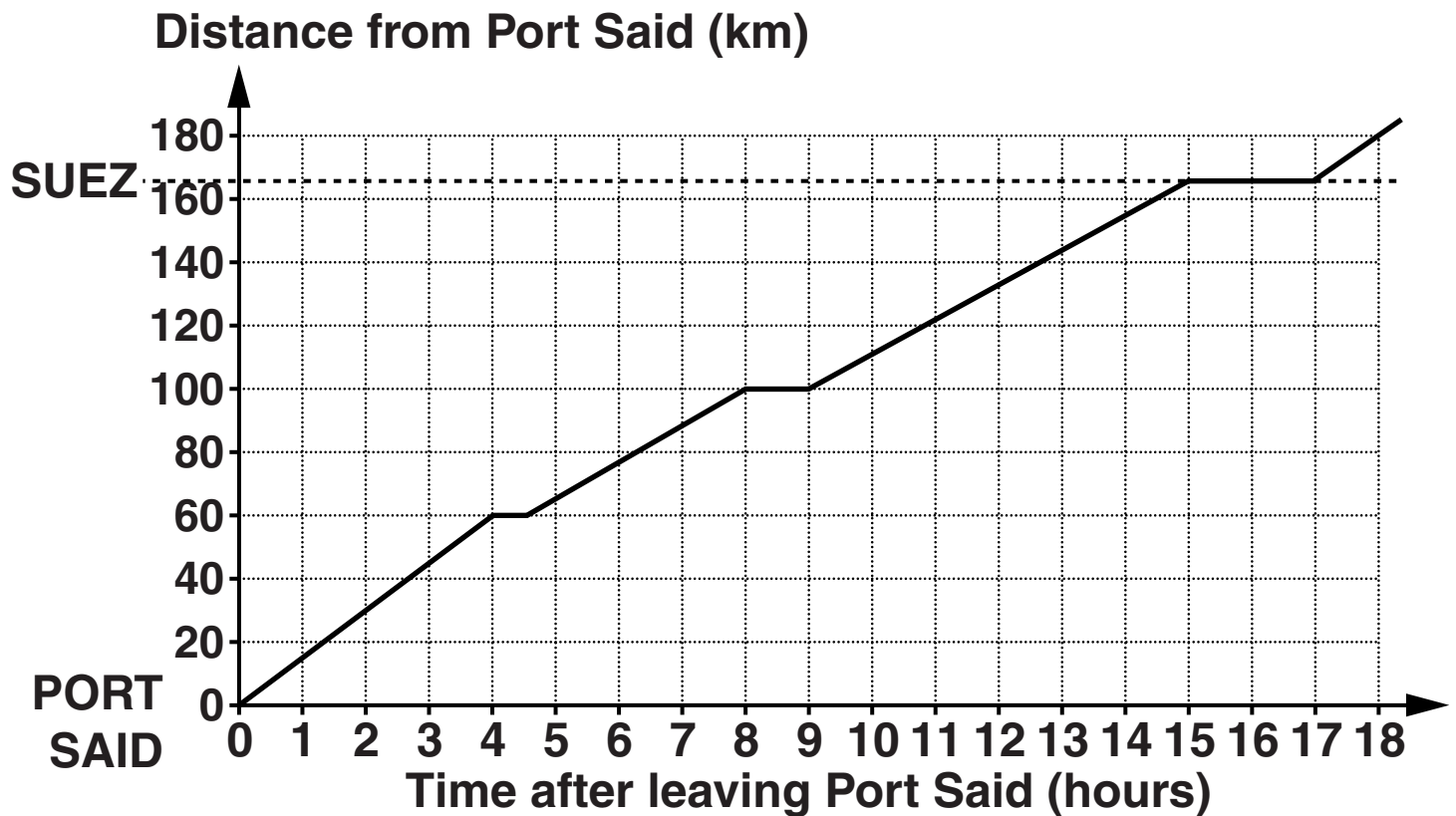
$$1 < n \leq 4 \quad \square$$

[2]

- (e) Many large oil tankers use the Suez Canal.
It runs from Port Said to Suez and is 165km long.

On the Suez Canal there are lay-bys where ships can stop to allow others to overtake them.

Here is a travel graph showing the passage of a ship through the Suez Canal.



- (i) How far from PORT SAID was the ship when it stopped for the first time?

(e)(i) _____ km [1]

- (ii) How far from SUEZ was the ship when it stopped for the second time?

(ii) _____ km [2]

(iii) How long after leaving Port Said did the ship reach Suez?

(iii) _____ hours [1]

(iv) How long did the ship wait in Suez before leaving again?

(iv) _____ hours [1]

**(f) Liopb is a small island near to one of the routes taken by supertankers.
Its main income is from tourists who come for the unspoilt beaches.**

Over the last 40 years there have been 2 oil spills nearby.

(i) Use these figures to estimate the probability that there will be an oil spill next year. Write your answer as a decimal.

(f)(i) _____ [2]

- (ii)* The island government calculates that an oil spill reaching the beaches would lose the island about \$12 million in tourist trade.**

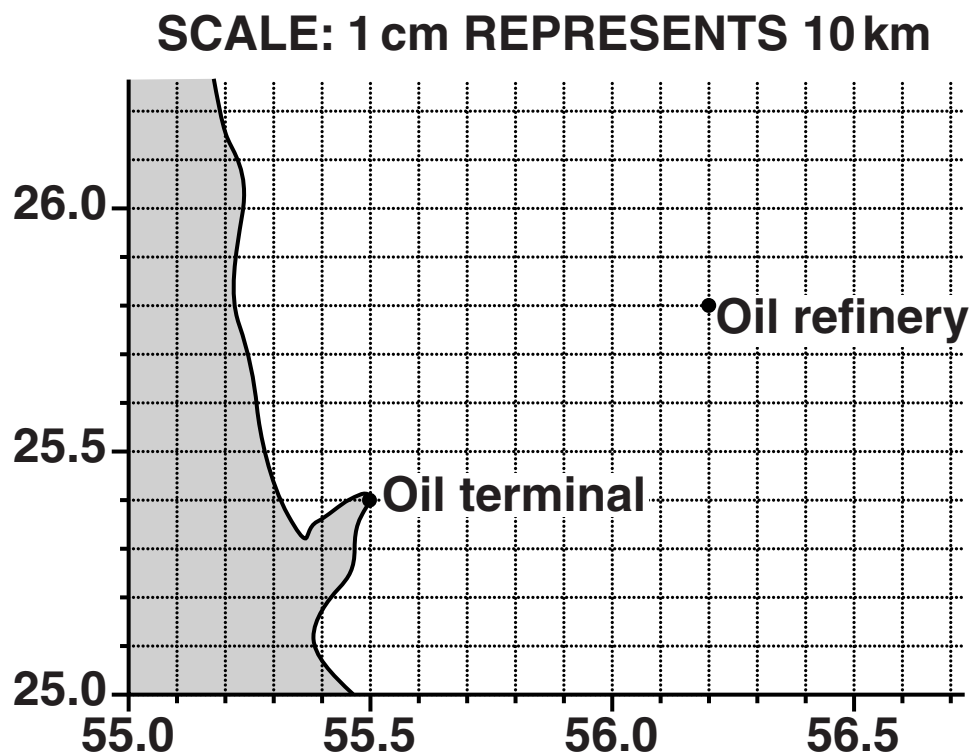
**A boom could be built around the island.
This would trap an oil spill and stop it reaching the beaches.**

The cost each year for the boom works out at about \$400 000 (\$0.4 million).

Use probability to work out if it is worthwhile for the island government to invest in the boom.

[3]

- (g) Although leaks do happen, oil pipelines can be a good way to transport oil. The map below shows the GPS coordinates of an oil terminal and an oil refinery. They are to be connected by a pipeline.



(i) What are the GPS coordinates of the OIL TERMINAL?

(g)(i) (_____ , _____) [1]

(ii)* Oil pipelines cost an average of \$3 million per kilometre to build.

Draw the cheapest route on the map.

How much would it cost to build the pipeline?

(ii) \$ _____ million [4]

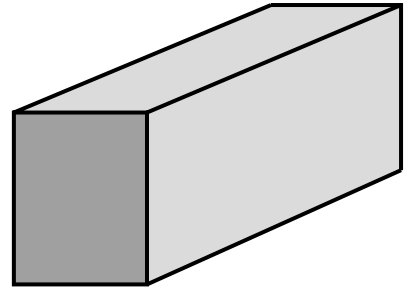
(iii) In Alaska, oil is pumped along a very long pipeline.

**On one day the temperature outside is -65°C .
The oil inside the pipe needs to be at 60°C
otherwise the oil is too sticky to pump.**

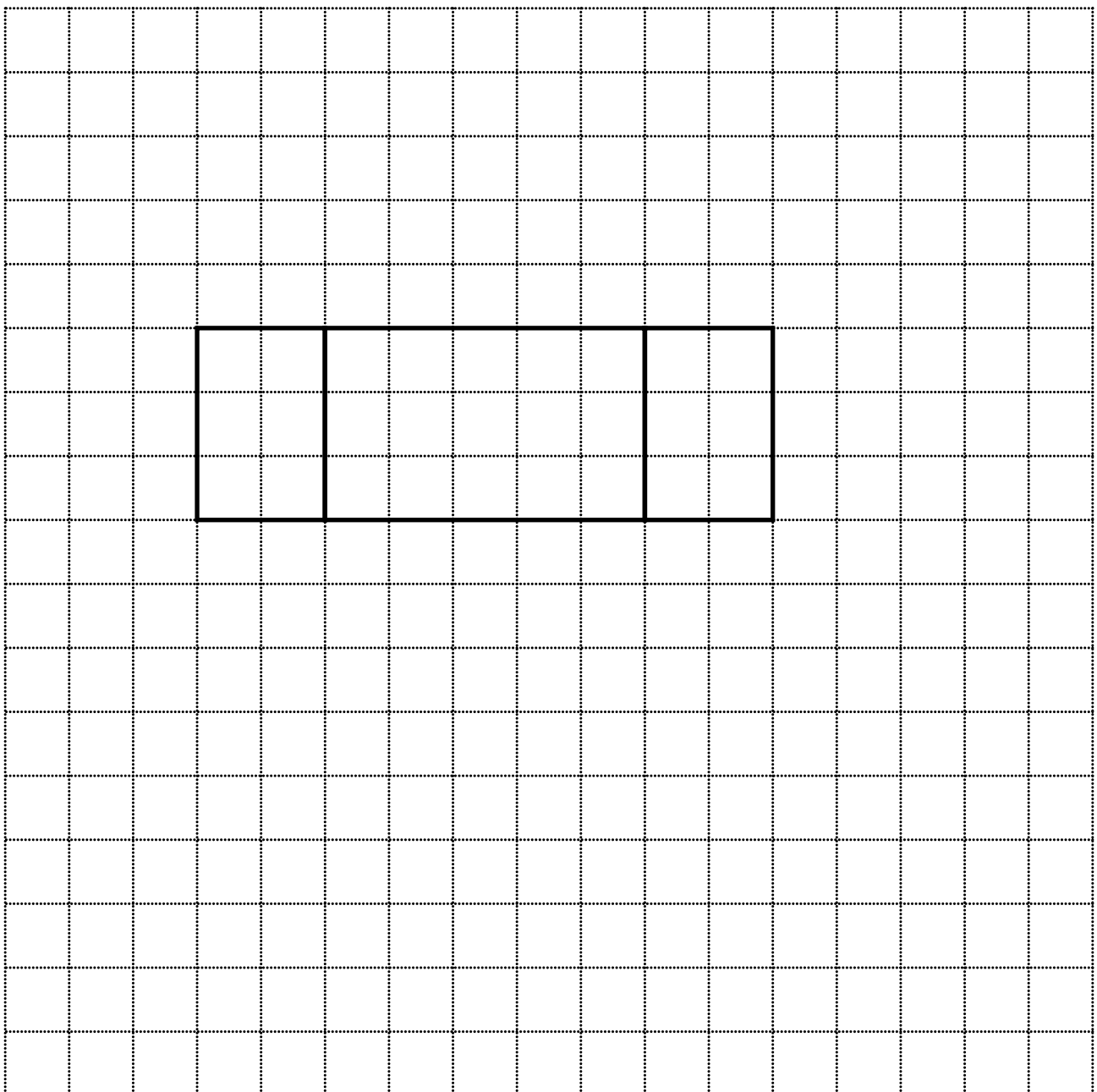
**How much warmer is this oil temperature than
the outside temperature?
Show your working.**

(iii) _____ $^{\circ}\text{C}$ [2]

- (h) Hollow cuboids can be used as floats to keep objects from sinking.
Arrangements of hollow cuboids are used to support oil rigs when they are moved.



- (i) A net of a cuboid has been started on the grid below. Complete this net of a cuboid.



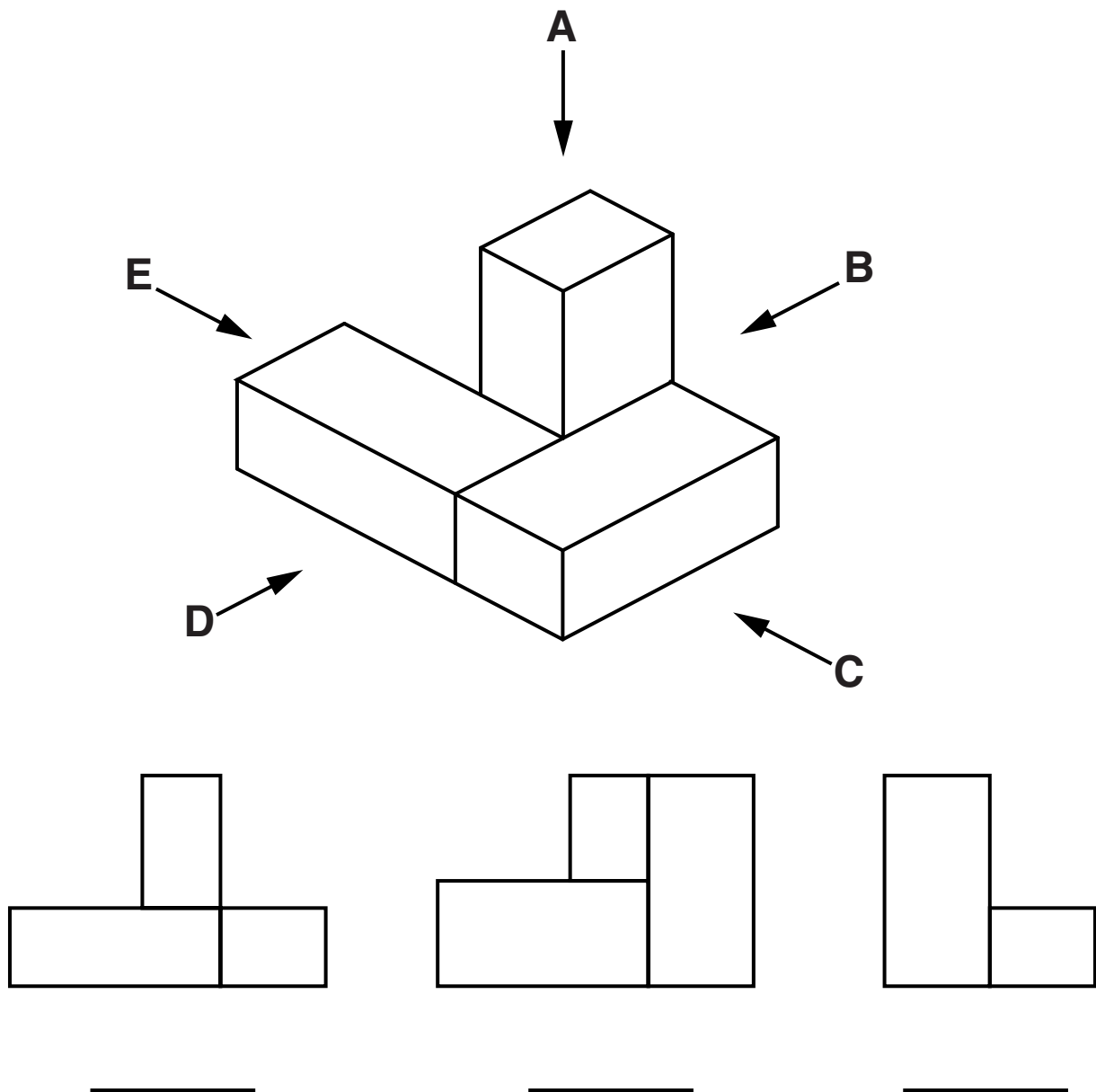
- (ii) Each cubic metre of a float can support a tonne in the water.
The hollow cuboids measure 3 m by 4 m by 8 m.**

What is the least number of these cuboids that could support a load of 1000 tonnes?

(h)(ii) _____ [4]

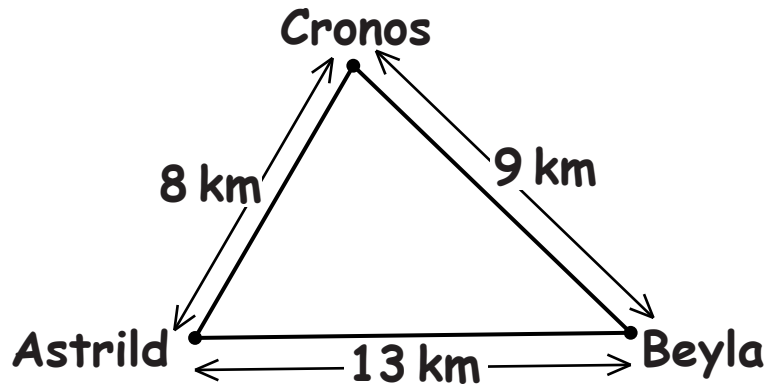
(iii) A float is made from three of these identical cuboids as shown in the diagram.

Match each view to a letter.



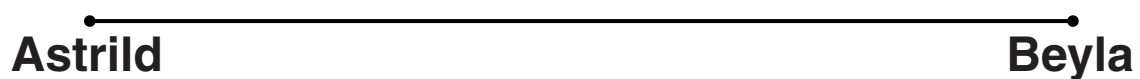
[2]

- (i) This rough sketch shows the positions of three oil rigs, Astrild, Beyla and Cronos.



**Astrild and Beyla are 13 km apart.
Beyla and Cronos are 9 km apart.
Cronos and Astrild are 8 km apart.**

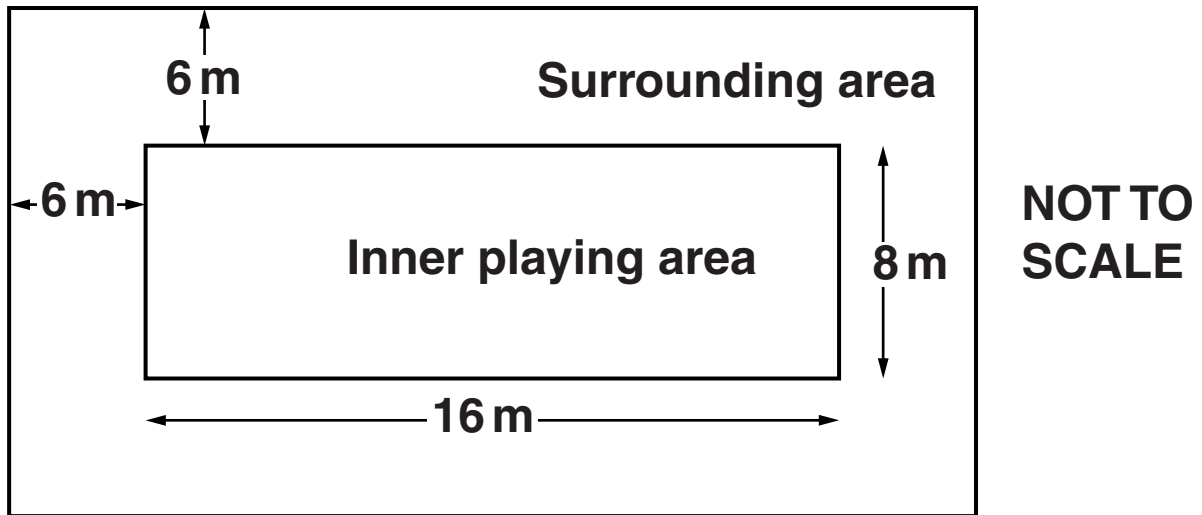
**Use a pair of compasses to complete the scale drawing of the positions of the three oil rigs.
Do not rub out any arcs you might draw.
Use a scale of 1 cm to represent 1 km.
The line linking Astrild and Beyla has already been drawn.**



[3]

- 2 A beach volleyball court has an inner playing area and a surrounding area.

The diagram below shows a beach volleyball court. The inner playing area is a rectangle 16 m by 8 m. The surrounding area is a border 6 m wide around the inner playing area.



The **WHOLE** beach volleyball court is filled with sand to a depth of 0.5 m.

- (a) How much sand is needed for the whole beach volleyball court?

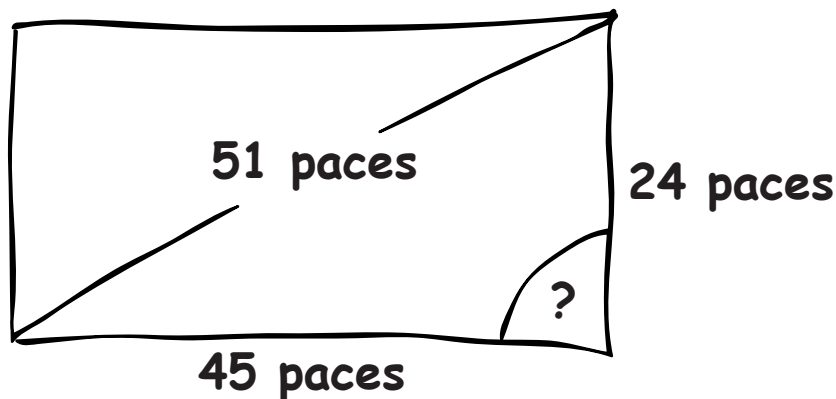
(a) _____ m^3 [3]

- (b) A local community group wants to build a beach volleyball court in a car park.
The group wants to check the site to make sure that it is a rectangle and the right size.

One of the members suggests finding the length and breadth of the site by pacing it out.

She says she could check that the angle marked is a right angle by pacing the diagonal of the site.

Here is a sketch of her results.



She says “According to these figures the angle must be a right angle! I know because I used Pythagoras which only works for right-angled triangles!”

Use Pythagoras’ theorem to show that the angle must be a right angle.

[2]

- (c) The group has to write a report on the total cost for the finance committee.
They find out these costs.

Sand from Gupta's Yard	£ 5500
160 tonnes of gravel @ £15 per tonne	
Posts and net	£ 120
Marking strip for court	£ 60
Wooden edging for court	£ 180
Hire of JCB digger and driver	£ 330
and of course the ball!	£ 30
All the other minor jobs we can do ourselves so they won't cost anything.	

Work out the total cost.
Give your final answer correct to the nearest £100.

(c) £ _____ [3]

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QUESTION 2(d) STARTS ON PAGE 30.

- (d) The group has some money but they will need a loan of £5000.

The local council gives 6-month loans to local community groups.

These loans have an APR of 5%.

Ross, a member of the finance committee, goes online to see what the repayments would be.

LOAN PAYMENT

Enter the amount of the loan: £

Enter the interest rate (APR): %

Payments on the loan will be made: ▼

Enter the number of payments:

Calculate

(Calculations may take a minute.)

LOAN REPAYMENT SCHEDULE

Pmt #	Balance	Interest	Payment	▲
1	5,000.00	20.83	845.53	
2	4,175.31	17.39	845.53	
3	3,347.17	13.95	845.53	
4	2,515.59	10.48	845.53	
5	1,680.55	7.00	845.53	
6	842.02	3.51	845.53	

He finds that a local bank will lend £5000 for a year with 12 monthly repayments of £420.

**Which deal, the council loan or the bank loan, will work out cheaper and by how much?
Show, with clear working, how you decide.**

[3]

3 A way of measuring a person's dental health is called DMFT.

This is the TOTAL number of decayed (D), missing (M) and filled teeth (F) they have.

A tooth that has decay and a filling is counted as just having decay.

(a) On the opposite page is Joni's grandad's dental chart.

It shows the state of his 32 teeth.

D stands for decayed, M stands for missing and F stands for filled.

(i) What is the DMFT of Joni's grandad?

(a)(i) _____ [1]

(ii) What percentage of the 32 teeth have nothing wrong with them?

(ii) _____ % [3]

(iii) What is the best DMFT a person can have?

(iii) _____ [1]

	Upper Right								Upper Left							
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
RIGHT	M	F													D	
Lower Right		F			M					F						D

Poor dental health can result in pain, time off work and illness.

DMFT is used by researchers and governments as an easy way of measuring dental health.

A HIGH DMFT shows poor dental health.

- (b) In 2006, a large research project investigated the average DMFT of workers in a factory making electrical goods compared with those working in a sweet factory.**

This table shows the average DMFT for workers in the two factories.

There were no workers under 25 in the sweet factory.

Age in years	Average DMFT	
	Electrical factory	Sweet factory
Under 25	4.8	—
25 to 34	8.6	9.3
35 to 44	10.8	11.6
Over 45	13.1	16.8

- (i) What was the average DMFT for people aged 25 to 34 working in the electrical factory?**

(b)(i) _____ [1]

- (ii) Write down one general conclusion from the table about the DMFT of the workers in the two factories.

[1]

The bar chart opposite shows how the average DMFT depends on tooth brushing.

- (iii) Describe fully which of the six groups has the best teeth.**

_____ [2]

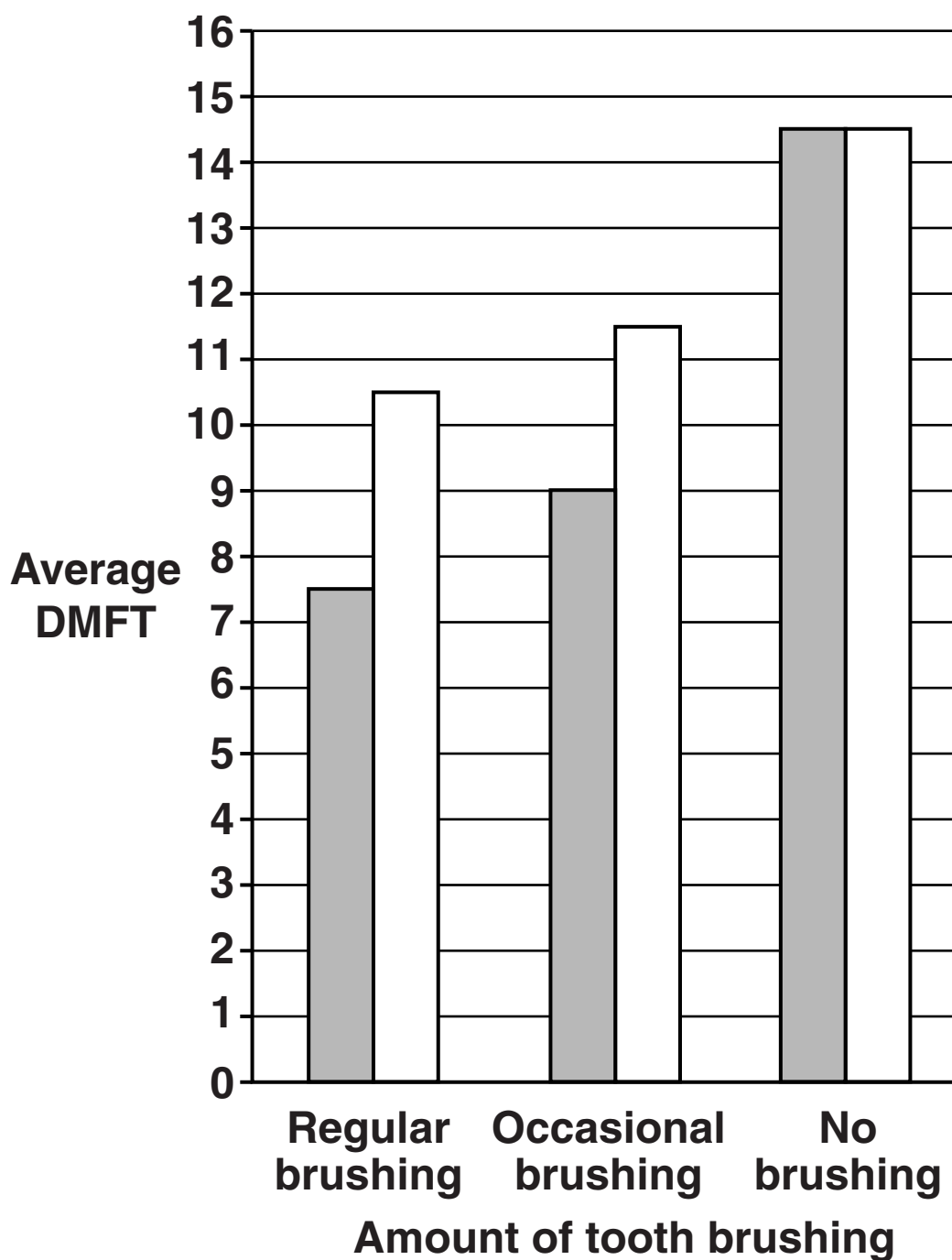
- (iv) Write down two general conclusions from the bar chart about the DMFT of the workers in the two different factories and their amount of tooth brushing.**

_____ [2]

HOW DMFT CHANGES WITH AMOUNT OF TOOTH BRUSHING

KEY

■ Electrical factory □ Sweet factory



- (c) The World Health Organisation (WHO) uses the DMFT for 12-year olds to measure dental health. Here are the latest figures for DMFT for 12-year olds in the ten largest South American countries.

Country	DMFT
Argentina	3.4
Bolivia	4.7
Brazil	2.8
Chile	1.9
Colombia	2.3
Ecuador	5.2
Paraguay	2.8
Peru	3.7
Uruguay	2.5
Venezuela	2.1

- (i) The WHO target DMFT for 12-year olds is 1.67.

How many of these South American countries met this target?

(c)(i) _____ [1]

- (ii) What is the median of these DMFT figures?

(ii) _____ [2]

(iii) What is the mean of these DMFT figures?

(iii) _____ [3]

(d) Opposite are the DMFT figures, for all ages, from 1980 to 2000 in Germany and Poland.

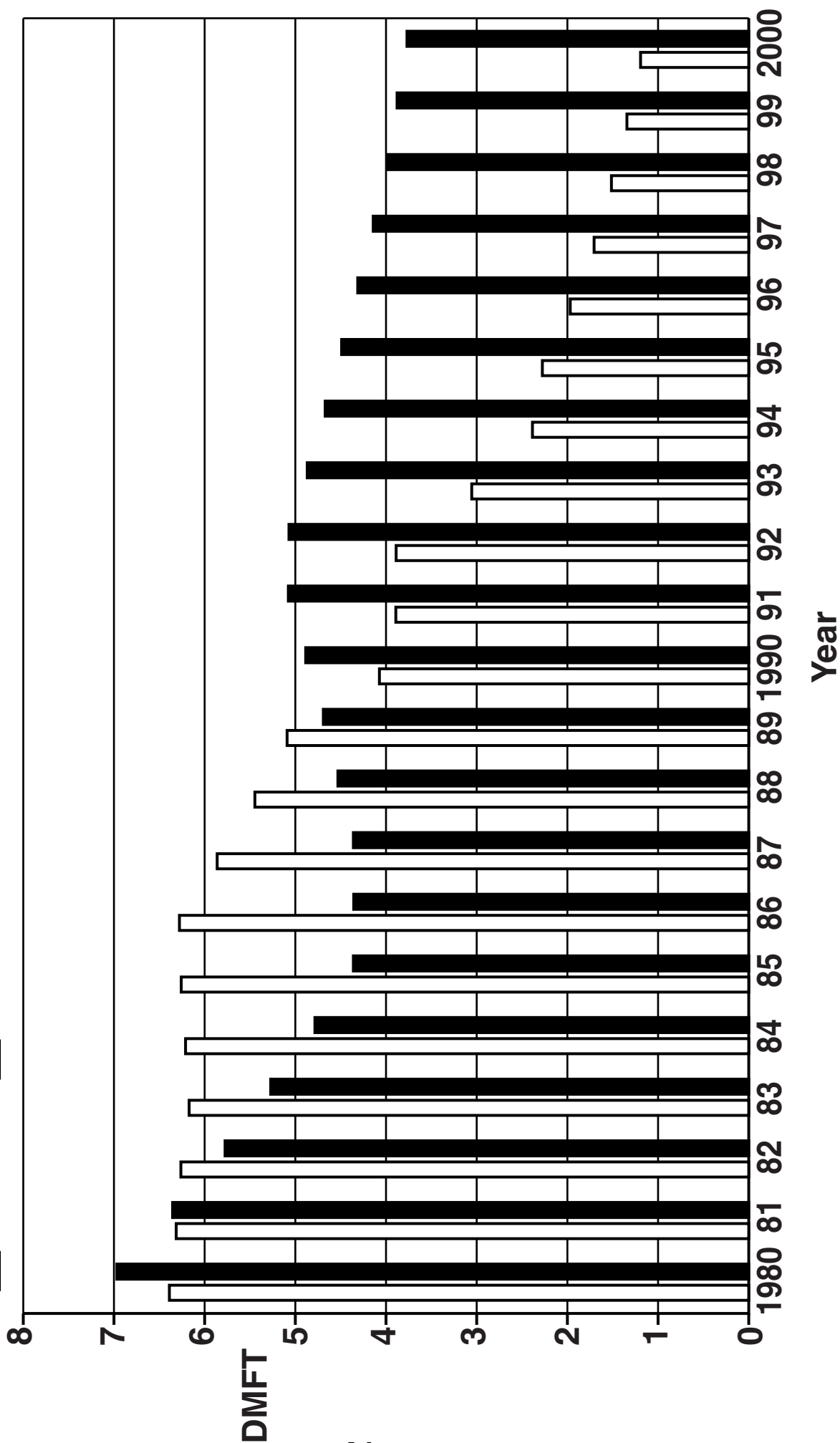
Write down three conclusions you can make from the chart.

[3]

DMFT FOR GERMANY AND POLAND (1980 TO 2000)

KEY

□ Germany ■ Poland



- (e) Something that might improve dental health is to increase the number of dentists.
To make a fair comparison the number of dentists per 1000 of the population is used. The DMFT for 12-year olds is used to measure dental health.**

The results for 25 rich countries are shown on the scatter graph opposite.

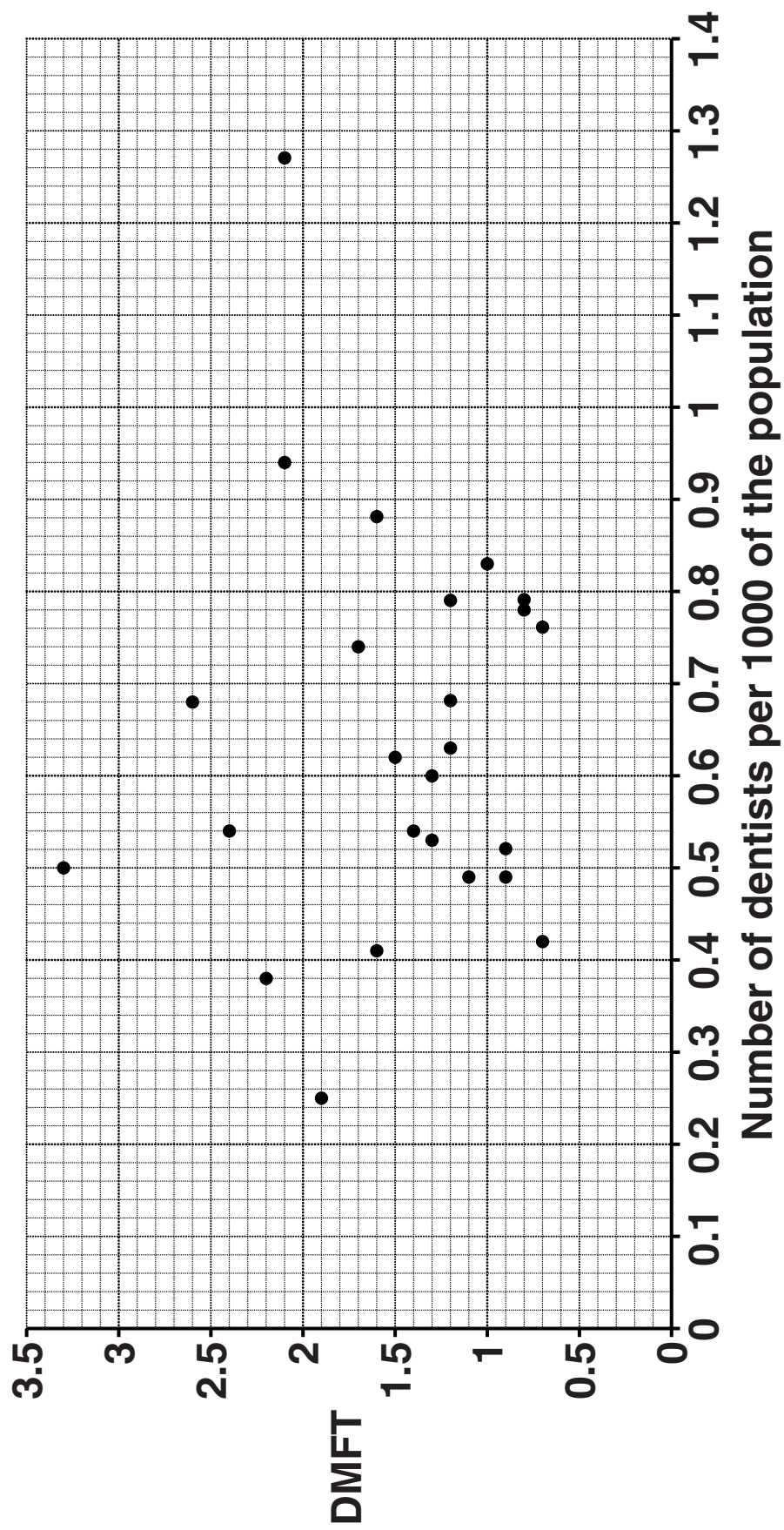
- (i) Hungary has 0.5 dentists per 1000 of the population and a DMFT of 3.3.
Draw a circle round Hungary on the scatter graph.**

[1]

- (ii) Does the scatter graph show any connection between dental health and the number of dentists?**

Give a clear reason for your decision.

[2]



- (f) Kerry, a dentist, wants to find out if a new mouthwash can protect teeth.
She chooses 100 patients.
50 are given the new mouthwash and the other 50 are asked to use their usual mouthwash.
After six months Kerry checks their teeth.
- (i) Give two reasons why she may not get reliable results.

1 _____

2 _____

_____ [2]

Kerry gives the 100 patients a questionnaire to complete.
This is one of the questions.

How often did you use mouthwash? (tick one response only)

- | | |
|--------------|--------------------------|
| Twice a day | <input type="checkbox"/> |
| Once a day | <input type="checkbox"/> |
| Once a week | <input type="checkbox"/> |
| Once a month | <input type="checkbox"/> |
| Less often | <input type="checkbox"/> |

- (ii) One of the patients, Henry, knows how often he used the mouthwash but is unable to answer the question using just the responses given.**

How often could Henry have used mouthwash?

_____ **[1]**

- (iii) Write down a set of responses that covers all possibilities.
Include three or more responses.**

[1]

END OF QUESTION PAPER

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