

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE

A381/02

APPLICATIONS OF MATHEMATICS

Applications of Mathematics 1
(Higher Tier)

THURSDAY 21 MAY 2015: Morning

DURATION: 1 hour 15 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 first 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.

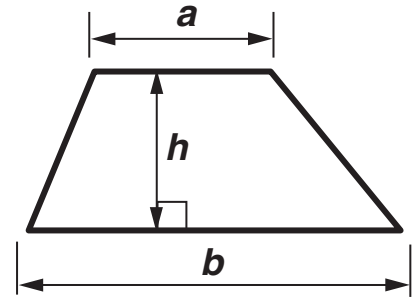
Your quality of written communication is assessed in questions marked with an asterisk (*).

The total number of marks for this paper is 60.

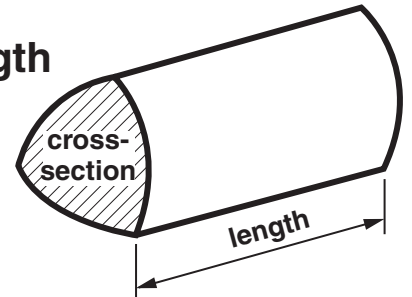
Any blank pages are indicated.

FORMULAE SHEET: HIGHER TIER

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



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

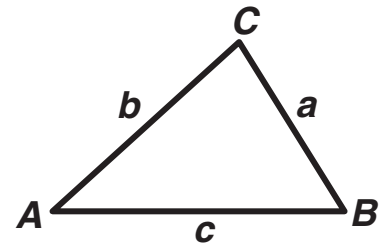


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

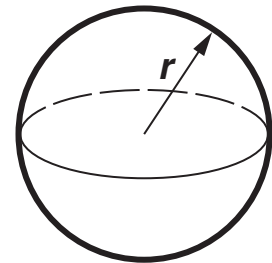
Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$

Area of triangle = $\frac{1}{2} ab \sin C$



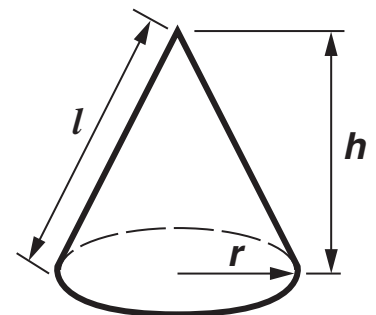
Volume of sphere = $\frac{4}{3} \pi r^3$

Surface area of sphere = $4\pi r^2$



Volume of cone = $\frac{1}{3} \pi r^2 h$

Curved surface area of cone = $\pi r l$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$,
where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Answer ALL the questions.

- 1 Logos can be very expensive to design. It can also be very expensive to change them. Here is a list of some famous logos and their cost, in dollars (\$) and pounds (£).**

Pepsi \$1 000 000

London Olympics \$625 000

Next £66 000

The 'Next' logo cost 10% of the cost of the 'Pepsi' logo.

**Work out the cost IN POUNDS of the 'London Olympics' logo.
Only use the information given above.**

£ _____ [4]

2 Billboards are a popular form of outdoor advertising.

A billboard by a road should be readable for 5 seconds before a car passes it.

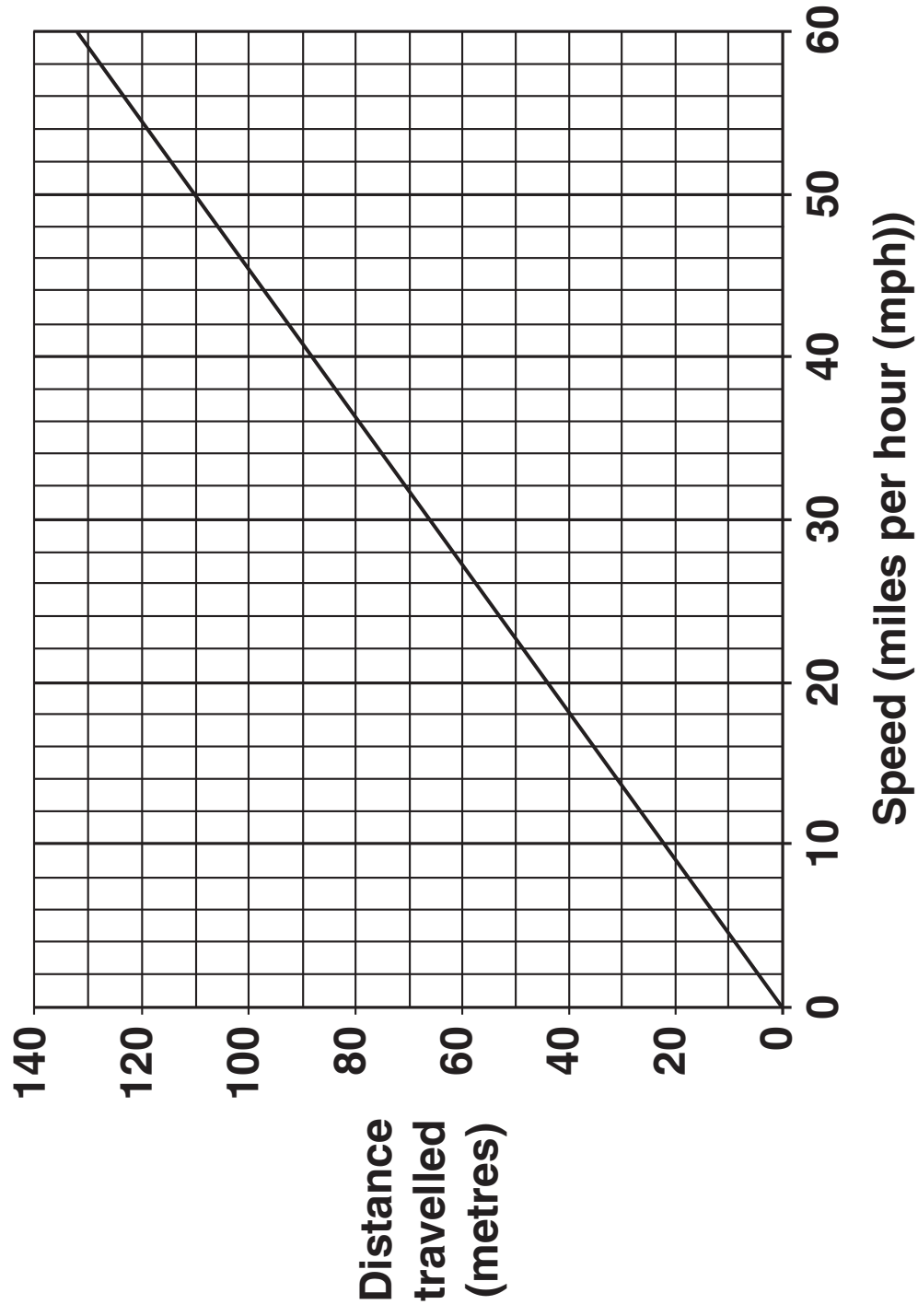
The letters must be big enough to be read at any point during this time.

The distance a car is from a billboard 5 seconds before passing it depends on the car's speed.

There is a simple connection between the smallest height of letters that can easily be read and the reader's distance from the billboard:

distance from billboard (in metres) = 3 × height of letter (in centimetres)

Distance travelled (metres) in 5 seconds for different speeds (mph)



- (a) A billboard is at the side of a road.
The traffic speed is 30 mph.**

What is the smallest height the letters on the billboard should be?

Support your answer with working.

(a) _____ cm [3]

(b)* Karl's Cameras estimates that each well-positioned billboard advertisement generates an additional 30 customers. On average the company makes £140 income from each customer. Each billboard advertisement costs £550 to place. Karl's Cameras has an advertising budget of £5000 to spend on billboard advertisements.

Using this budget, how many billboard advertisements can Karl's Cameras place? How much income will be generated from these billboards?

[4]

3 Coins are often identified and counted by using their weight.

Each type of coin has a different weight.

(a) Each 50p coin weighs 8 grams.

Each £2 coin weighs 12 grams.

Kiran has a mixture of 50p coins and £2 coins.

Her coins weigh 104 grams in total.

(i) Give a mathematical reason why she cannot have only £2 coins.

[1]

- (ii) One possibility is that Kiran has eight £2 coins and one 50p coin.

Give two other possible combinations of coins which Kiran could have.

Kiran could have _____ £2 coins
and _____ 50p coins
or she could have _____ £2 coins
and _____ 50p coins.
[2]

(b) Libby has a bag containing a mixture of 5p, 10p and 20p coins.

$\frac{1}{3}$ of the coins are 10p coins.

$\frac{2}{5}$ of the coins are 5p coins.

The total value of the 20p coins is £13.60.

How many coins are in the bag altogether?

_____ coins [6]

(c) £1 coins are made from a metal called nickel-brass.

Nickel-brass is a mixture of copper, nickel and zinc.

Each £1 coin weighs 9.5 grams.

(i) Nickel-brass is 70% copper.

Calculate the weight of copper in a £1 coin.

(c)(i) _____ grams [1]

(ii) Nickel-brass is 24.5% zinc.

What fraction of nickel-brass is zinc?

Give your answer in its simplest form.

(ii) _____ [2]

- (d) (i) The volume, $V\text{cm}^3$, of a cylindrical coin is given by

$$V = \pi r^2 t$$

where $r\text{ cm}$ is the radius of the coin and $t\text{ cm}$ is the thickness of the coin.

Each £1 coin is approximately a cylinder with radius 1.125 cm and thickness 0.315 cm .

Calculate the volume of a £1 coin.
Give your answer correct to 2 decimal places.

(d)(i) _____ cm^3 [2]

- (ii) Each £1 coin weighs 9.5 grams .

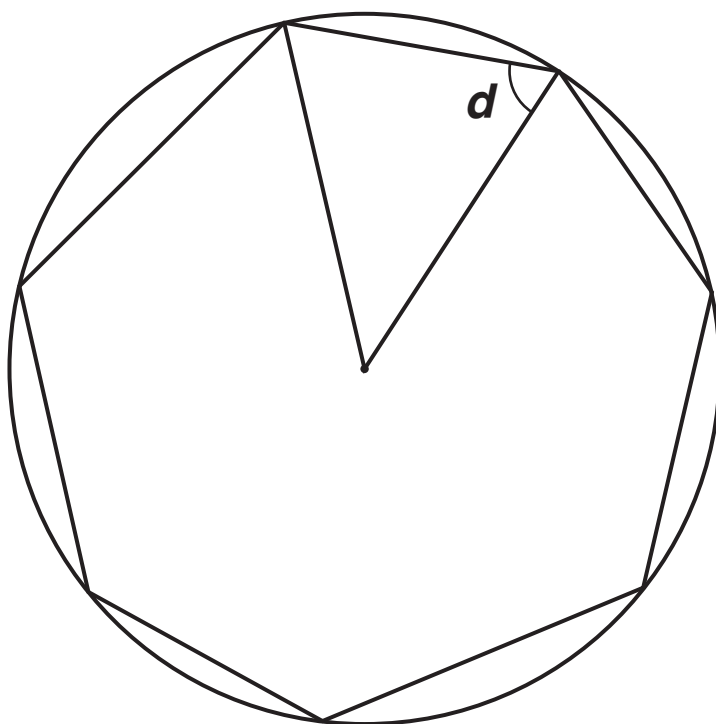
Calculate the density of a £1 coin.

(ii) _____ g/cm^3 [2]

(e) 50p coins are based on regular heptagons but have curved edges.

**(i) The sketch opposite shows a regular heptagon inscribed within a circle.
Each edge of this heptagon is straight.**

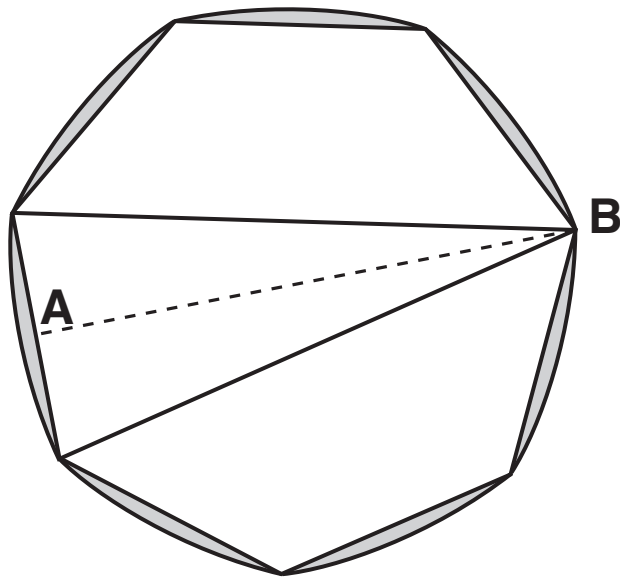
Calculate the angle marked d .



NOT TO
SCALE

(e)(i) _____ ° [3]

- (ii) This diagram shows the outline of a 50p coin. A regular heptagon is placed on its surface. The vertices of the heptagon and the coin coincide. The heptagon is divided into two trapezia and an isosceles triangle. The dotted line AB is the line of symmetry of the triangle.



**NOT TO
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The current 50p coin is smaller than the original 50p coin. They are mathematically similar.

On the ORIGINAL larger 50p coin, the area of the triangle is approximately 200 mm^2 , and the length AB is 30 mm.

On the CURRENT smaller 50p coin, the length AB is 27.5 mm.

The perimeter of the current 50p coin is roughly the same as the perimeter of the heptagon.

Use the information given to calculate, approximately, the perimeter of this heptagon.

(ii) _____ mm [4]

- 4 The Forth Railway Bridge was opened in 1890 and spans the Firth of Forth, connecting Edinburgh and Fife.**

Four companies contributed to the cost of building the bridge.

North British Railway contributed $\frac{7}{20}$ of the cost.

Midland Railway contributed 30% of the cost.

North Eastern Railway and Great Northern Railway split the remaining cost equally between them.

- (a) (i) Which company contributed most to the cost of the bridge?**

(a)(i) _____[2]

- (ii) Midland Railway contributed £900 000 to the cost of the bridge.**

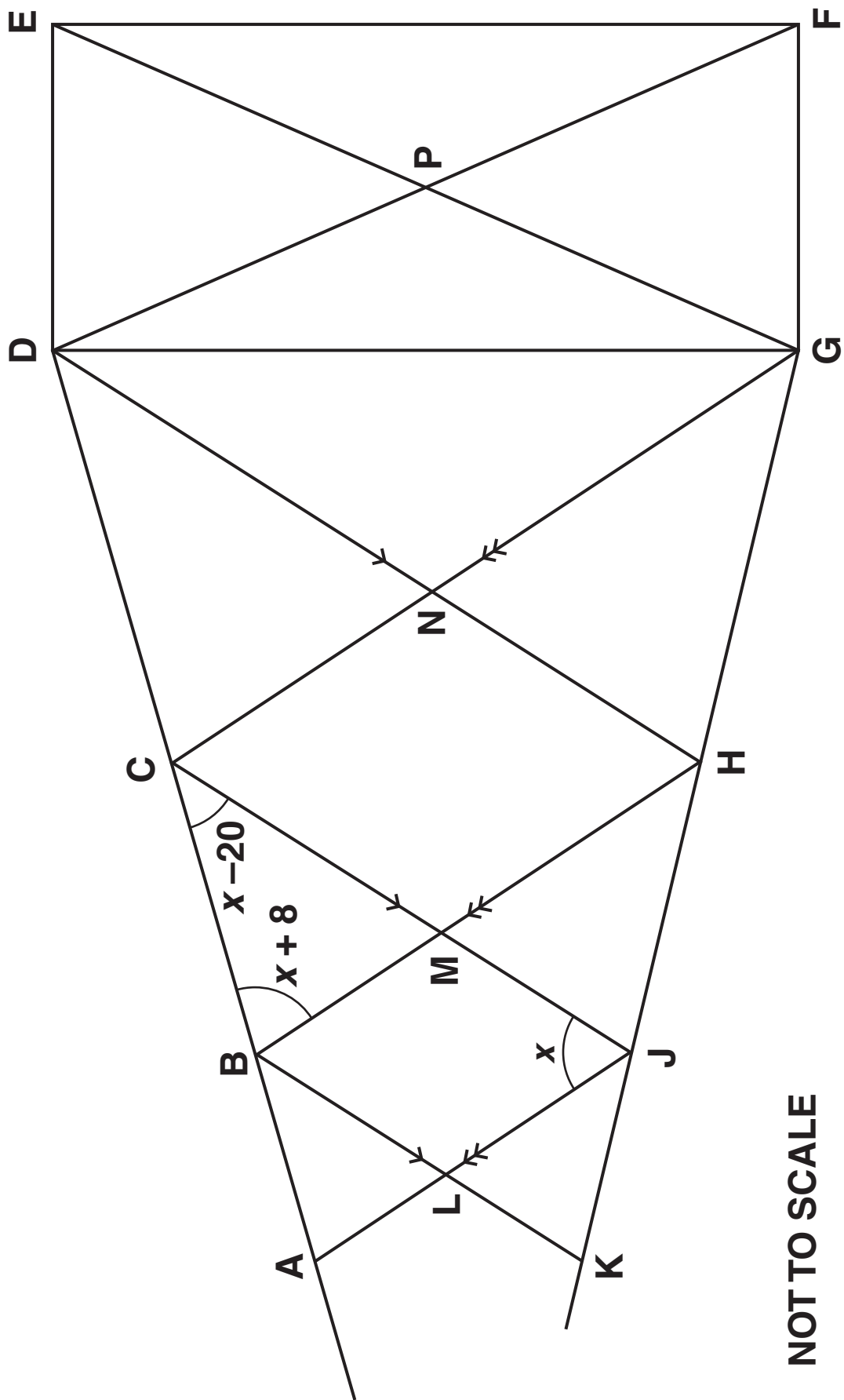
Calculate the total cost of the bridge.

(ii) £ _____ [2]

**(b)*The diagram opposite shows part of the steel structure of the Forth Railway Bridge.
The angles marked are measured in degrees.**

Calculate x , giving geometrical reasons for each stage of your working.

(b) _____[5]



NOT TO SCALE

- 5 Tanya is designing her garden.
 She wants to have a patio 4 m wide but is not sure what length she can afford to make it.
 The plan opposite shows the layout of Tanya's house and garden, and the planned patio.

The costs of possible coverings for the garden and patio are given below.

Gemma's Gardens

Prices per square metre

Turf _____ £12

Woodchip _____ £14

Pebbles _____ £39

Pedro's Patios

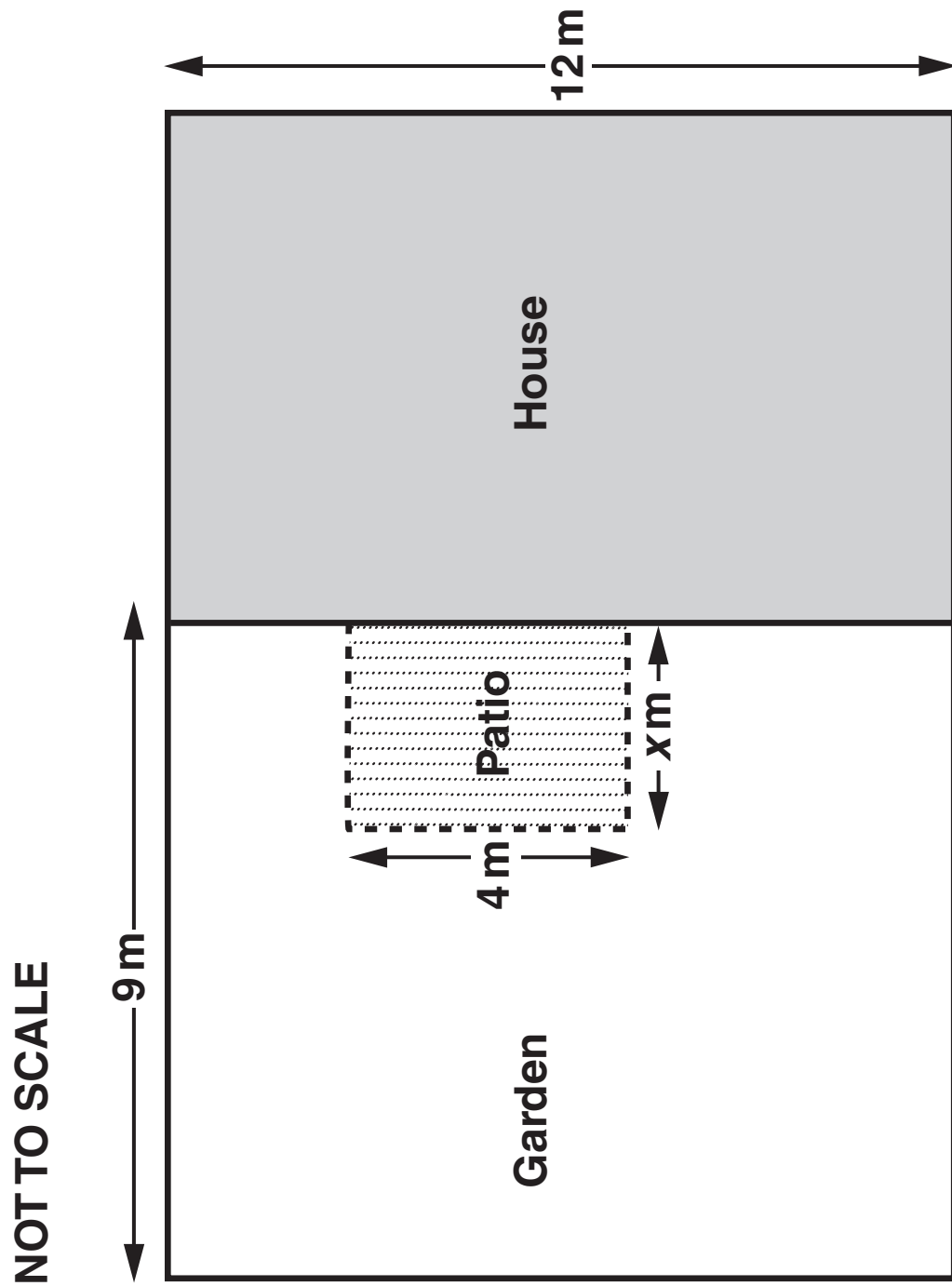
Sandstone _____ £44.88 per m²

Limestone _____ £52.13 per m²

Slate _____ £38.29 per m²

- (a) Tanya decides to cover the garden in woodchip.

Show that the cost of covering the garden in woodchip is £(1512 – 56x).



(b) Tanya chooses a material for her patio from Pedro's Patios.

The cost of covering the patio will be £179.52x.

Which material has she chosen?

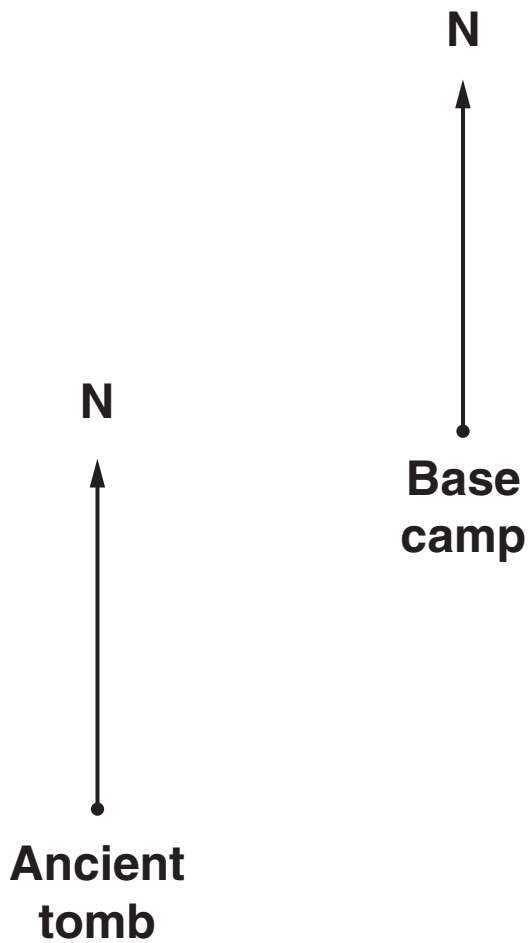
(b) _____[2]

(c) Tanya has £2300 to spend on covering both the garden and the patio.

Form an equation in x and solve it to find the largest length of patio she can afford.

(c) $x =$ _____ metres [3]

- 6 A team of archaeologists are using bearings to help them navigate across a desert.
The map below shows the position of an ancient tomb and the team's base camp.**



- (a) Measure the bearing of the base camp from the ancient tomb.**

(a) _____ ° [1]

- (b) The Lost Palace is on a bearing of 105° from the ancient tomb and southeast of the base camp.**

Show the position of the Lost Palace on the map. [3]

- (c) It takes 45 minutes for the archaeologists to travel from the ancient tomb to the Lost Palace.
On the return journey they travel at two-thirds of their speed on the outward journey.**

How long does the return journey take them?

(c) _____ minutes [2]

- 7** Radioactive Iodine-131 is made in batches.
The level of radiation emitted per day by a batch of Iodine-131 is given by this formula.

$$R = 200 \times \left(\frac{1}{2}\right)^{\frac{t}{8}}$$

where R is the level of radiation (mSv per day)
and t is the number of days after the batch is made.

- (a)** Calculate the level of radiation 34 days after the batch is made.

(a) _____ mSv per day [2]

(b) Write down the level of radiation when the batch is first made.

(b) _____ mSv per day [1]

END OF QUESTION PAPER

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