**GCSE**

**3310U60-1**

**MATHEMATICS – NUMERACY**
**UNIT 2: CALCULATOR-ALLOWED**
**HIGHER TIER**

THURSDAY, 10 MAY 2018 – MORNING

1 hour 45 minutes

### ADDITIONAL MATERIALS

A calculator will be required for this paper.

A ruler, a protractor and a pair of compasses may be required.

### INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

If you run out of space, use the continuation page at the back of the booklet. Question numbers must be given for the work written on the continuation page.

Take $\pi$ as 3·14 or use the $\pi$ button on your calculator.

### INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

In question **1***(a)*, the assessment will take into account the quality of your linguistic and mathematical organisation, communication and accuracy in writing.

| | For Examiner's use only | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1.** | 7 | |
| **2.** | 6 | |
| **3.** | 9 | |
| **4.** | 8 | |
| **5.** | 5 | |
| **6.** | 7 | |
| **7.** | 9 | |
| **8.** | 5 | |
| **9.** | 6 | |
| **10.** | 10 | |
| **11.** | 8 | |
| **Total** | 80 | |

## Formula List - Higher Tier

**Area of trapezium** = $\frac{1}{2}(a + b)h$
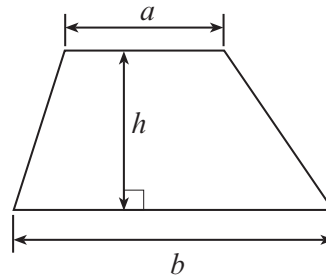
**Volume of prism** = area of cross-section × length
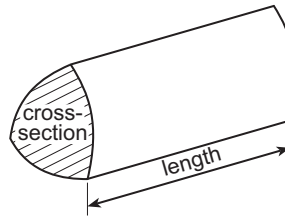
**Volume of sphere** = $\frac{4}{3}\pi r^3$

**Surface area of sphere** = $4\pi r^2$
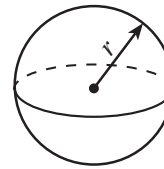
**Volume of cone** = $\frac{1}{3}\pi r^2 h$

**Curved surface area of cone** = $\pi r l$
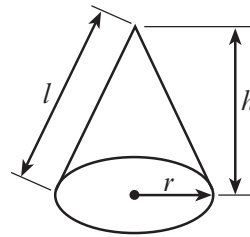
**In any triangle** $ABC$

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

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

**Area of triangle** = $\frac{1}{2} ab \sin C$
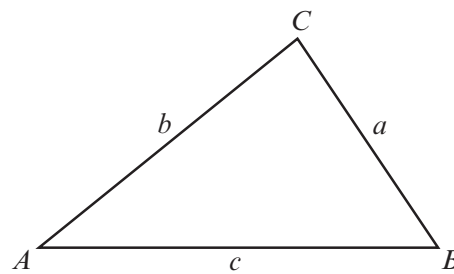
### The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$ are given by $\qquad x = \dfrac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

### Annual Equivalent Rate (AER)

AER, as a decimal, is calculated using the formula $\left(1 + \dfrac{i}{n}\right)^n - 1$ , where $i$ is the nominal interest rate per annum as a decimal and $n$ is the number of compounding periods per annum.

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**Turn over.**

**1.** In October 2011, a charge of 5p for a carrier bag was introduced in Wales.
Money raised from this charge is given to charity.

For the period 1st October 2011 to 31st January 2015, it was estimated that a total of between £16.8 million and £21.9 million was donated to charity. This is as a result of people buying 5p carrier bags.

(a) *In this part of the question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

Calculate an estimate of how much per month was given to charity between 1st October 2011 and 31st January 2015.

You must show all your working. [4 + 2 OCW]

*(b)* Over time, there has been a reduction in the use of 5p carrier bags. This is because more people are using their own bags.

What impact might this have had on the amount given to charity for the month of September 2014 when compared with September 2012? [1]

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**2.** *(a)* Megan and Rhodri both set out at the same time from home to go to the swimming pool.
Rhodri travels by car.
Megan cycles straight through the park.

Home

Megan's route

Rhodri's route
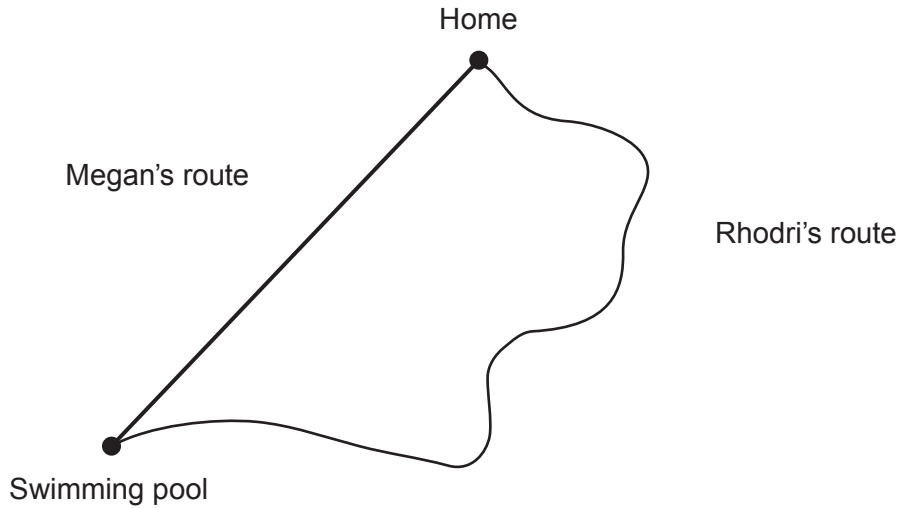
Swimming pool

*Diagram not drawn to scale*

Rhodri's journey by car is 5·5 miles.
His average speed for the journey is 22 mph.

Megan's average speed on her bike is 12 mph.
Megan arrives at the swimming pool 5 minutes before Rhodri.

Calculate the distance Megan cycles.
Give your answer in miles.
You must show all your working. [5]

Distance Megan cycles is ........................................ miles

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*(b)* Gary travelled a distance of 231 km in 3 hours and 30 minutes.
Calculate Gary's average speed in km/h.
Circle your answer.                                                                                    [1]

0·015            1·1            66            70            77

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**3.** Yared is going to make a door wedge.

(a) The cross-section of the wedge is shown below.
The horizontal length is 12 cm and the vertical height is 3 cm.
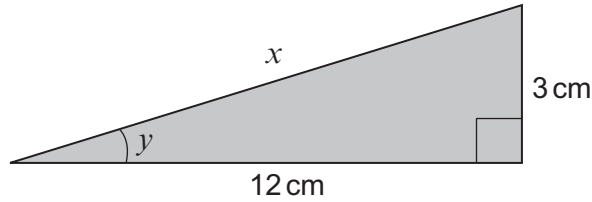


*Diagram not drawn to scale*

(i) Calculate the length $x$.

Give your answer correct to 3 significant figures. [4]

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$x$ = ........................................ cm

(ii) The wedge must fit under Yared's door.
The angle $y$ must be less than 15°.
Show that this wedge will fit under Yared's door.
You must show all your working. [3]

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*(b)* Yared decides to make a larger wedge that is mathematically **similar** to the one shown in part *(a)*.
This wedge is to have a vertical height of 4·5 cm.

4·5 cm
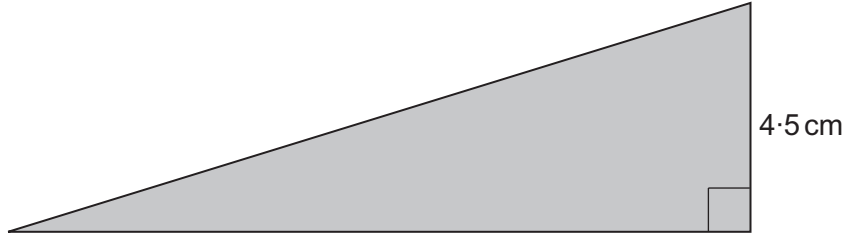
*Diagram not drawn to scale*

Calculate the horizontal length of this door wedge. [2]

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The wedge will be ........................................... cm long

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**4.** A grass racetrack is shown in the diagram below.
This is the region shaded in the diagram.
Each end of the grass racetrack is created from semicircles.
The inner semicircles have a radius of 15 m.
The outer semicircles have a radius of 20 m.
Each of the straight sections of the racetrack has a length of 65 metres.

15 metres

• X

Y •

20 metres

65 metres
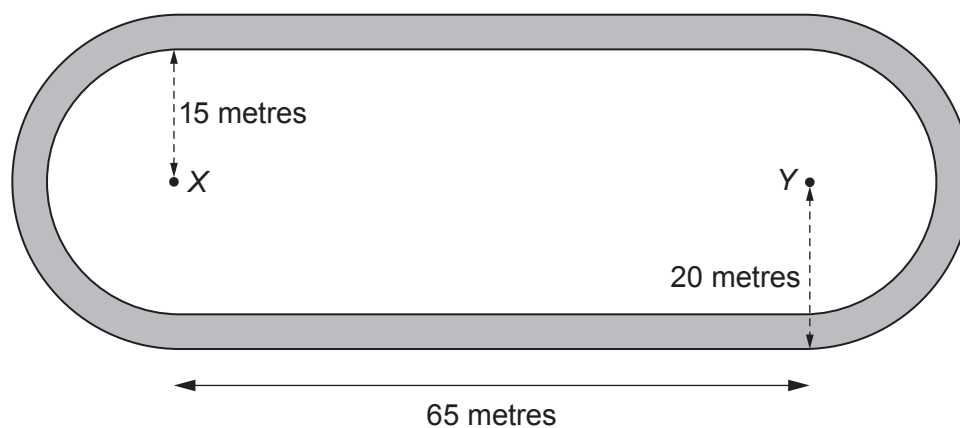
*Diagram not drawn to scale*

(a) What is the total area of grass in the two **straight** sections of the racetrack?
You must show all your working. [2]

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*(b)*  Calculate the area of the grass racetrack.
You must show all your working. [4]

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*(c)*  The grass is to be treated with a fertiliser.
It costs 20p to treat each $3\,m^2$ of grass.
How much will it cost to treat the grass racetrack?
Give your answer correct to the nearest pound.
You must show all your working. [2]

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Cost is £ ...............................................

**Turn over.**

**5.** Hot water is often stored in cylinders.
The water in the cylinder is heated for use in the shower.

A plumbing engineer wants to calculate how long a shower can be used continuously before the water runs cold. He uses the following formulae:

$$C = \frac{H(X-M)}{M-Y} \quad \text{and} \quad T = \frac{C+H}{F}$$

Where:

$C$ is the additional volume of water that feeds into the cylinder, in litres.

$H$ is the volume of hot water that the cylinder holds, in litres.

$M$ is the temperature of the water in the shower, in °C.

$X$ is the temperature of the hot water in the cylinder, in °C.

$Y$ is the temperature of the cold water that feeds into the cylinder, in °C.

$T$ is the time spent using the shower before the water runs cold, in minutes.

$F$ is the rate of flow of water in the shower, in litres per minute.

Daisy's cylinder holds 300 litres of hot water.
The temperature of the hot water in her cylinder is 60°C.
The temperature of the cold water that feeds into Daisy's cylinder is 8°C.

The water in Daisy's shower is set at a temperature of 32°C.
Her shower has a rate of flow of 26 litres per minute.

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Use the formulae to calculate
- the additional volume of water that feeds into Daisy's cylinder, in litres,
- the number of minutes Daisy's shower will run continuously before the water runs cold.

[5]

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**Turn over.**

**6.** Dr Khan and her daughter Faryl have different opinions about the mean temperature in their hallway.

Dr Khan and Faryl recorded the temperature in the hallway at 4 p.m. each day during the 30 days of April.

*(a)* In her note pad, Dr Khan summarised the temperatures in a grouped frequency table.

Unfortunately, Dr Khan has torn the page containing the table from her note pad and has lost some of the original data.

| Temperature, $t$ (°C) | Number of days |
|---|---|
| $20 \leqslant t < 21$ | 4 |
| $21 \leqslant t < 22$ | 8 |
| $22 \leqslant t < 23$ | 8 |
| $23 \leqslant t < 24$ | |

Calculate an estimate of the mean temperature at 4 p.m. for these 30 days in Dr Khan's hallway. [5]

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Estimate of the mean temperature at 4 p.m. for April in the hallway is ........................... °C

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*(b)* What assumption have you made in calculating an estimate of the mean temperature at 4 p.m. for April in Dr Khan's hallway? [1]

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*(c)* Faryl recorded the same temperatures as her mother at 4 p.m. each day during April. She found that the **actual** mean temperature in the hallway during April was **lower** than the correctly calculated estimate of the mean.

Explain how this can be true. [1]

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**Turn over.**

**7.** Gwen fills a 10-litre bucket with water from a tap.
She turns the tap until it is fully open. The bucket fills up with water, and when Gwen thinks it is close to being full, she slowly closes the tap.
The bucket is full after 20 seconds.

The graph below shows the volume of water in the bucket during the 20 seconds.
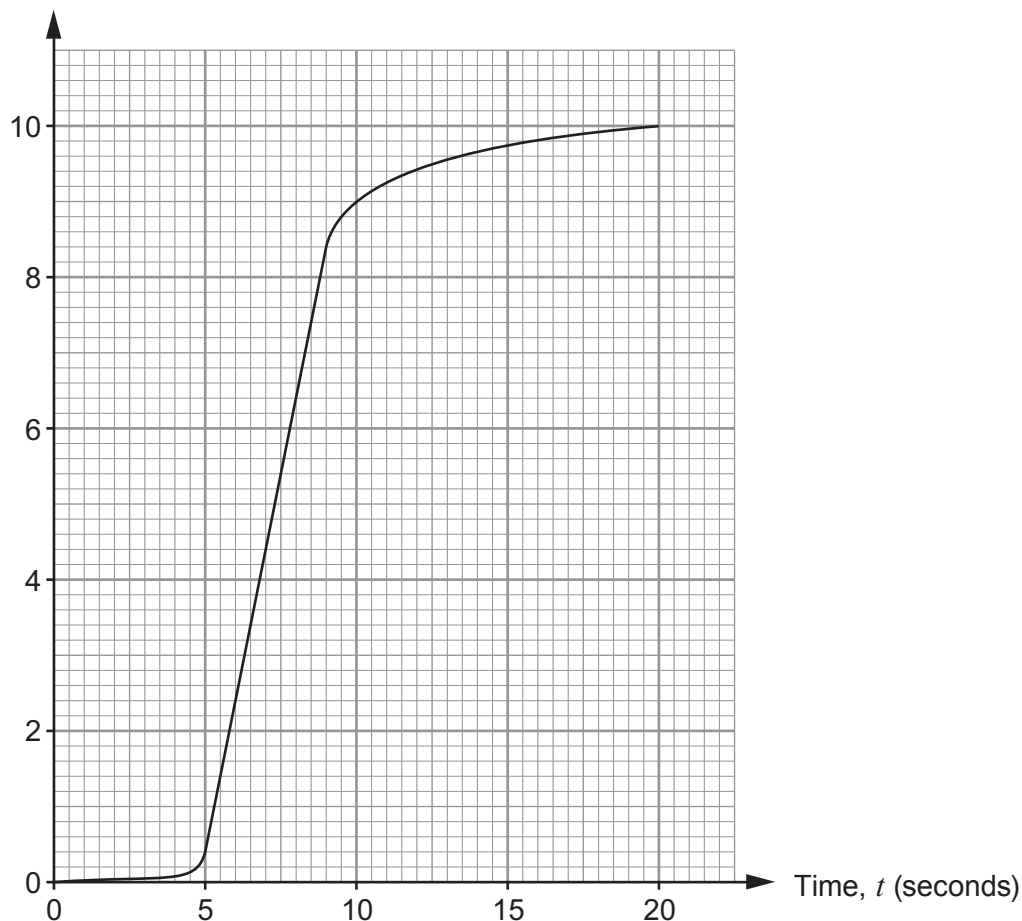


*(a)* After how many seconds did Gwen start to close the tap? [1]

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*(b)* Estimate at what rate water is entering the bucket at time $t$ = 10 seconds.
Give your answer in litres per second. [3]

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*(c)* When the tap is fully open, water flows out at 2 litres per second.

    (i)    Express 2 litres per second in **gallons per minute**.
          You must show all your working.     [3]

> Remember
>     1 gallon = 8 pints

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    (ii)    Can a fully open tap fill a 90-gallon tank in under $3\frac{1}{2}$ minutes?
          You must show all your working.     [2]

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**8.** The Headteacher of Ysgol Castell Gwyn wants to display pictures, drawn by pupils, along one side of a corridor.
The pictures are to be in one row with no gaps between them, as shown in the diagram below.

pictures

2010 cm

*Diagram not drawn to scale*

The pictures are all square, with sides of length 15 cm, correct to the **nearest 0·5 cm**.
The length of the corridor wall is 2010 cm, correct to the **nearest 10 cm**.

Calculate the smallest number of pictures and the greatest number of pictures that can be fitted in the row. [5]

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| Smallest number of pictures | Greatest number of pictures |
|---|---|
| ............................................... | ............................................... |

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**9.** *(a)* Circle either TRUE or FALSE for each statement given below. [2]

| STATEMENT | | |
|---|---|---|
| A nominal annual interest rate is **not** the same as an AER. | TRUE | FALSE |
| A savings account offers a nominal annual interest rate of 2%, with interest paid monthly. After a year, any investment will have increased in value by exactly 2%. | TRUE | FALSE |
| A savings account offers an AER of 2·4%, with interest paid monthly. The monthly interest rate the account offers will be exactly 0·2%. | TRUE | FALSE |
| £100 is invested in a savings account that pays monthly interest at a rate of 1%. There are no further transactions into or out of the account. The amount in the account after a year will be £112. | TRUE | FALSE |

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*(b)* Benjamin invests £1000 into an account that pays interest every 6 months.
He does not make any further payments into the account, and does not withdraw any money either.
After a year, there is £1036 in the account.

Calculate how much was in the account after 6 months.
Give your answer correct to the nearest penny.
You must show all your working. [4]

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**10.** *(a)* A company makes plastic shelf supports for use in kitchen cupboards.
A shelf support is made by attaching a cylinder to a right-angled triangular prism.



*Diagram not drawn to scale*

The cylinder has a diameter of 6 mm and a length of 9 mm.
The prism has dimensions *CD* = 8 mm, *DE* = 8 mm, *CE* = 11·3 mm and *BC* = 10 mm.

The company sells the shelf supports in packs of 500.
It needs to know the volume of plastic in 500 shelf supports.
Calculate the volume of 500 shelf supports. [4]

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Volume of 500 shelf supports = ...............................................................................
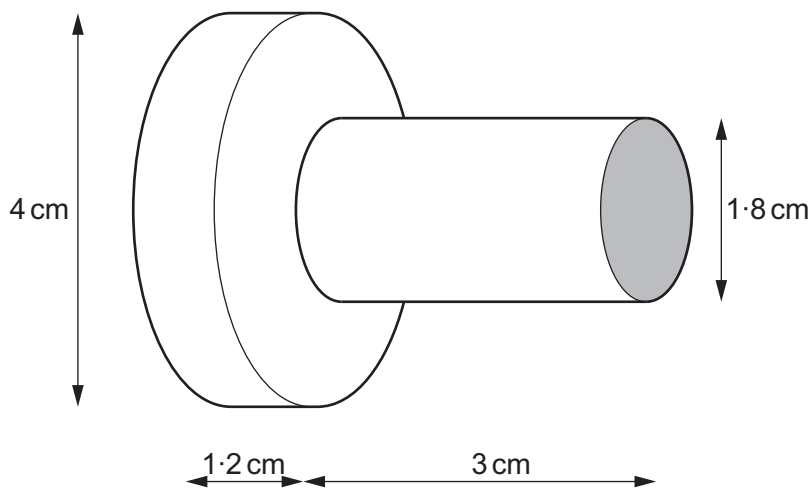
*(b)*



The company also makes metal door handles for kitchen cupboards.
One of the door handles it makes is shown below.
It is formed by joining two cylinders.
One of the cylinders has a diameter of 4 cm and a length of 1·2 cm.
The other cylinder has a diameter of 1·8 cm and a length of 3 cm.



4 cm

1·8 cm

1·2 cm          3 cm

*Diagram not drawn to scale*

At present, the company paints **all** the surfaces of the handle with a protective finish **after** the two cylinders have been joined together.

The shaded circular face is pressed against a cupboard door when fitted.
In future, the company is not going to paint this shaded circular face. This is to reduce costs.

Calculate the percentage reduction in the area that is painted.                    [6]

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**Turn over.**

**11.** A sensor can detect any movement up to a distance of 6·5 m.

Sensor

6·5 m
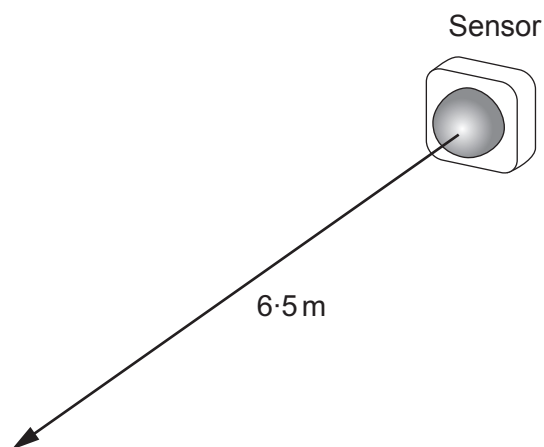
*Diagram not drawn to scale*

*(a)* A storeroom is in the shape of a cuboid, as shown below.
The sensor is placed at *A*, so that
- it is aimed directly at *B*, where *BD* = 2 m,
- the front of the sensor is 20 cm from *A* along the line *AB*.



3·2 m

*A*

*E*

*C*

*B*

*D*

2 m

5·5 m
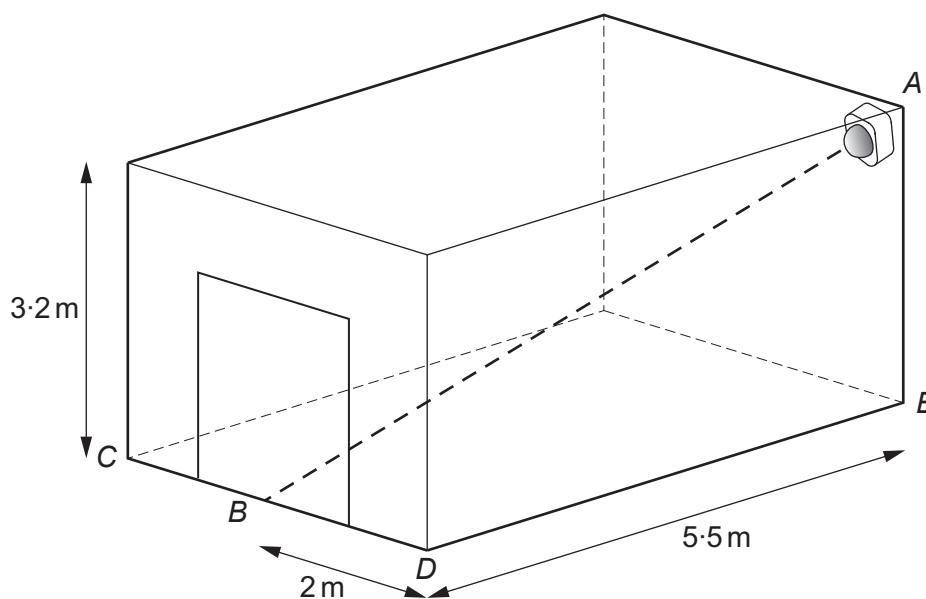
*Diagram not drawn to scale*

Will the sensor be able to detect movement at *B*?
You must show all your working. [5]

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*(b)* Show that $B\widehat{A}E$ = 61·3°, correct to 1 decimal place. [3]

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