**Skill Sheet: Angles and Trigonometry**

***What You Need to Know:***

You might be asked to calculate the angles or lengths of sides in a triangle. For example, this could be used to mark out a part, to calculate the angle of a taper on a turned part, or to determine the path for a machine tool.

The angles inside a triangle add up to 180o. For a right-angled triangle, the angle θ is related to the hypotenuse (H), opposite (O), and adjacent (A) by the equations for the tangent (tan), sine (sin) and cosine (cos):

O

H

A

θ

tan θ = O / A sin θ = O / H cos θ = A / H

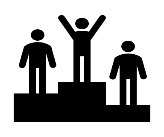
If at least two values are known, these equations can be rearranged to find the unknown values:

θ = tan-1 (O / A) A = O / (tan θ) or A = H x (cos θ)

θ = sin-1 (O / H) O = A x (tan θ) or O = H x (sin θ)

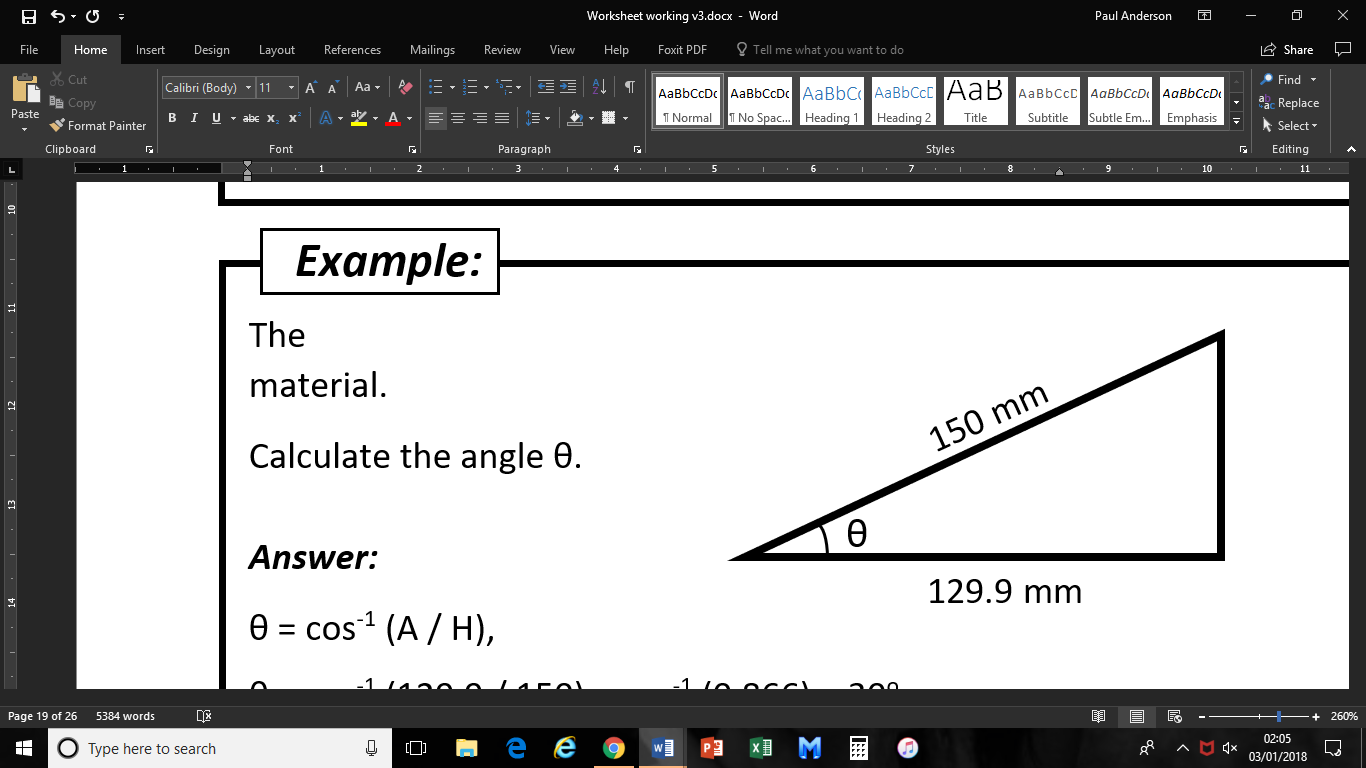
θ = cos-1 (A / H) H = A / (cos θ) or H = O / (sin θ)

***Example:***



***Examiners***

***Top Tip***

The right-angled triangle shown needs to be marked out on a sheet of material.

Calculate the angle θ.

*If you know the lengths of two sides and just need the length of the other side, it is simpler to use Pythagoras theorem H2 = O2 + A2*

***Answer:***

θ = cos-1 (A / H),

θ = cos-1 (129.9 / 150) = cos-1 (0.866) = 30o

***Now Try These:***

1. A sheet of material needs to be marked out for cutting,

NOT TO SCALE

100 mm

A

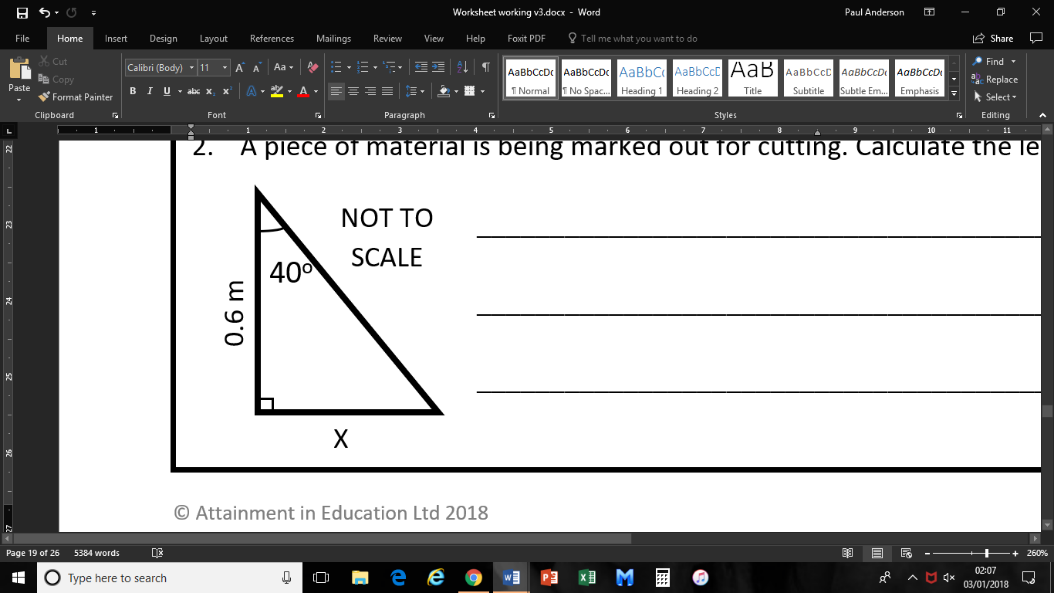
27o

Calculate the length of side A.

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1. A piece of material is being marked out for cutting. Calculate the length of side X to 4 decimal places.



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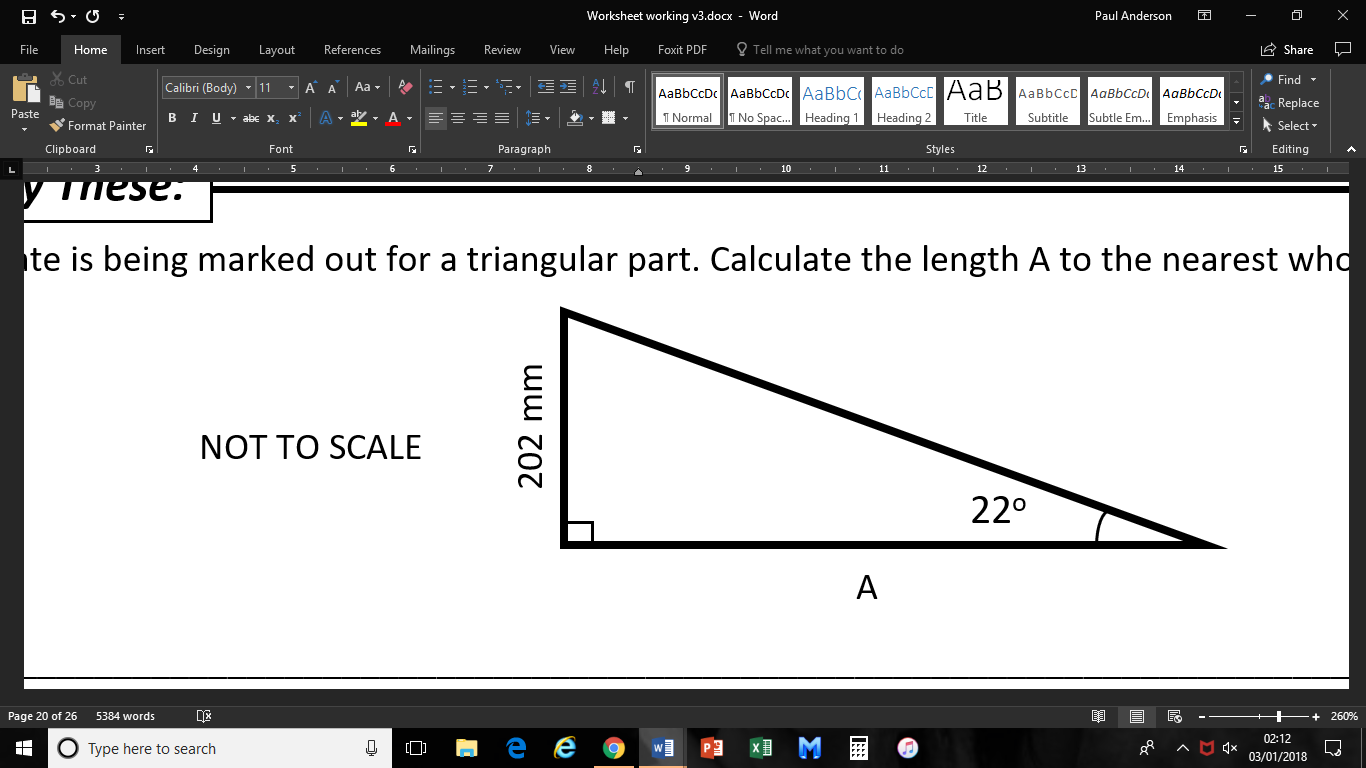
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**Practice Sheet: Angles and Trigonometry**

***Now Try These:***

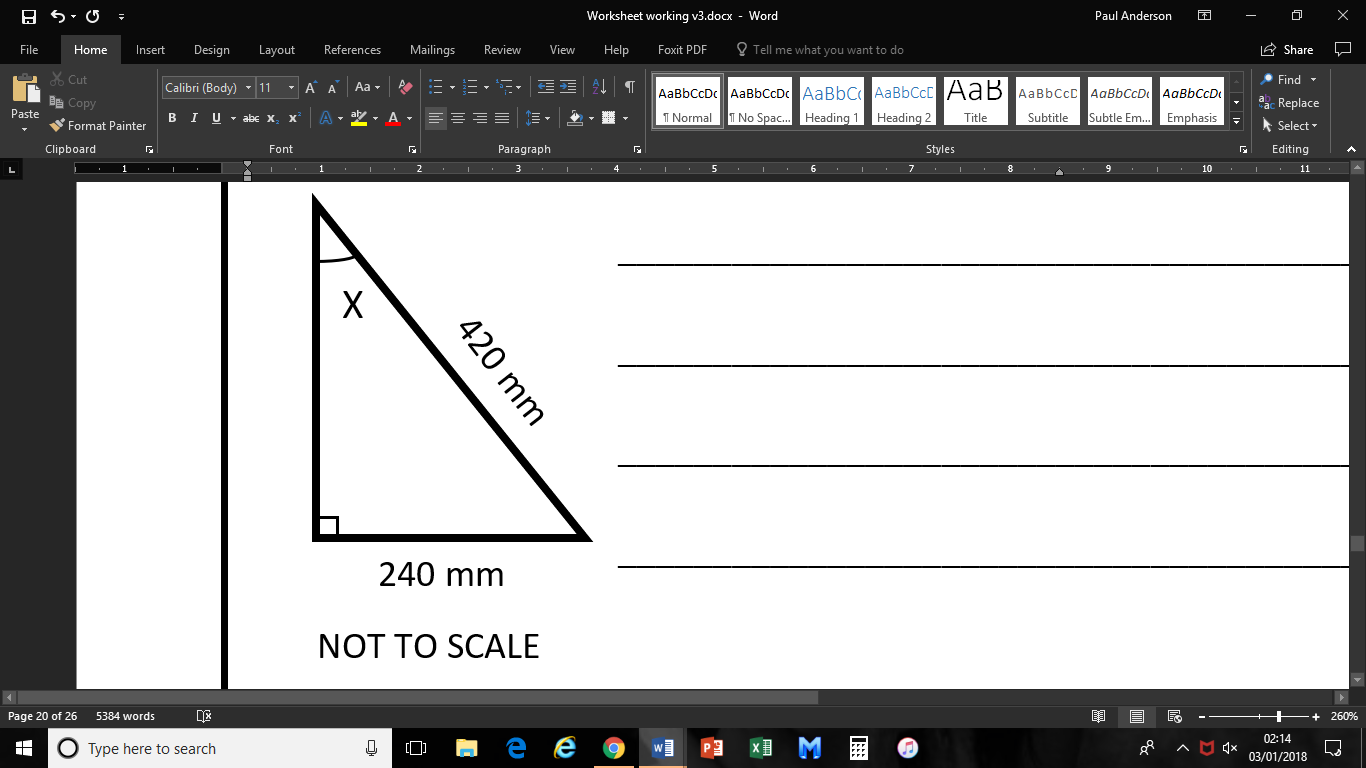
1. A template is being marked out for a triangular part. Calculate the length A to the nearest whole number.



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1. A piece of material is being marked out for cutting. Calculate the angle X to 1 decimal place.



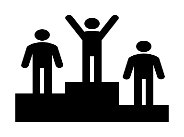
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1. Calculate the angles A and B, which are needed to program the path of a machine tool.



***Examiners***

***Top Tip***

NOT TO SCALE

B

A

2.4 m

1.8 m

*Remember that the angles inside a triangle add up to 180o*

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1. Calculate the taper, θ, on the part shown to two decimal places.



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**Answers:**

**Skill Sheet: Angles and trigonometry**

1. A = H x (cos θ) = 100 x cos 27o = 100 x 0.891 = 89.1 mm
2. X = O = A x (tan θ) = 0.6 x tan 40o = 0.6 x 0.839 = 0.5035 m

**Practice Sheet: Angles and trigonometry**

1. A = O / (tan θ) = 202 / (tan 22o) = 202 / 0.404 = 500 mm
2. θ = sin-1 (O / H) = sin-1 (240 / 420) = 34.8o
3. A = cos-1 (A / H) = cos-1 (1.8 / 2.4) = 41.4o; B = 180 – 90 – 41.4 = 48.6o
4. θ = tan-1 (O / A) = tan-1 (12 / 180) = 3.81o