AQA Physics
GCSE Student calculation sheet

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🔲 The wave equation

Specification references:

- P6.1.1 Transverse and longitudinal waves
- P6.1.2 Properties of waves
- MS 1a, 1b, 2a, 2h, 3a, 3b, 3c, 3d

Aims

In this worksheet you will learn how to calculate wave speed, frequency, and wavelength. You will rearrange the equations to find unknowns and calculate the time period. You will also carry out calculations involving indices and rounding to the correct number of significant figures.

Learning outcomes

After completing this worksheet, you should be able to:

- calculate speed, frequency, time period, and wavelength of a wave
- carry out calculations involving indices.

Worked example

Calculate the frequency of a microwave that has a speed of 300×10^6 m/s and a wavelength of 300×10^{-3} m. Then calculate the period of the microwave.

Firstly, you need to recall the wave equation:

wave speed v (m/s) = frequency f (Hz) $\times$ wavelength λ (m)

Divide both sides of the wave equation by λ to make f the subject:

$$f = \frac{v}{\lambda}$$

Next, write down the quantities that you already know:

$v = 300 \times 10^6$ m/s

$\lambda = 300 \times 10^{-3}$ m or 0.3 m

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Substitute these values into $f = \dfrac{v}{l}$:

$$f = \frac{300 \times 10^6}{300 \times 10^{-3}} \, \text{Hz}$$

$$= 1 \times 10^9 \, \text{Hz}$$

So the frequency is 1×10^9 Hz.

In order to calculate the period, use the equation:

$$\text{Time period } T \, (\text{s}) = \frac{1}{\text{frequency } f \, (\text{Hz})}$$

Substitute the value you calculated for frequency:

$$T = \frac{1}{1 \times 10^9}$$

$$= 1 \times 10^{-9} \, \text{s}$$

So the period is 1×10^{-9} s.

Questions

1   **a**   A siren emits a note which has a frequency of 430 Hz and a wavelength of 0.8 m. What is the speed of this sound?

....

....   (*2 marks*)

b   What is the wavelength of a sound wave with frequency 100 Hz? Assume the speed of sound is the same as the value you calculated in part **a**.

....

....   (*2 marks*)

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2 a A boy pushed the end of a slinky back and forth at a frequency of 3 hertz. If the distance from one compression to the next is 0.4 m, calculate the speed of the wave on the slinky.

.... (*1 mark*)

b A girl stands on a boat and feels the boat rise and fall 7 times in 1 minute. What is the period of the water wave? Give your answer to 3 significant figures.

.... (*1 mark*)

c A man counts 6 waves on a pond in 10 seconds. The distance between them is 40 cm. What is their speed?

....

....

.... (*3 marks*)

3 a The label on the back of a microwave oven displays:

frequency $= 2450\,MHz$

If $v = 3 \times 10^8$ m/s, what is the wavelength of the microwaves? Give your answer to 3 significant figures.

....

.... (*2 marks*)

b Jasmine plays a note of wavelength 22 cm on her clarinet. The speed of sound in air is 340 m/s. What is the frequency of this note? Give your answer to 3 significant figures.

....

.... (*2 marks*)

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4   **a**   The period of a note is 0.3 seconds and the speed of sound in air is 340 m/s. What is the wavelength of the note? Give your answer to 3 significant figures.

....

....

....   (*3 marks*)

    b   A bird on a post out at sea is exposed to a series of water waves, each travelling at 3.3 m/s, that periodically splash its feet when the crest of the wave hits the post. Each crest is 4.5 m apart. For how long do the bird's feet dry for between each drenching?

....

....   (*2 marks*)

5   A radio station RadioDJJazzy broadcasts on a frequency of 102 MHz. Radio waves have a speed of 3×10^8 m/s.

    a   What is the wavelength of RadioDJJazzy?

....

....   (*2 marks*)

    b   What is the period of this wave?

....   (*1 mark*)