

22 The electronvolt and momentum

– Part 2

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English	Write it 3 times (English)
electronvolt	_____
momentum	_____
wavelength	_____

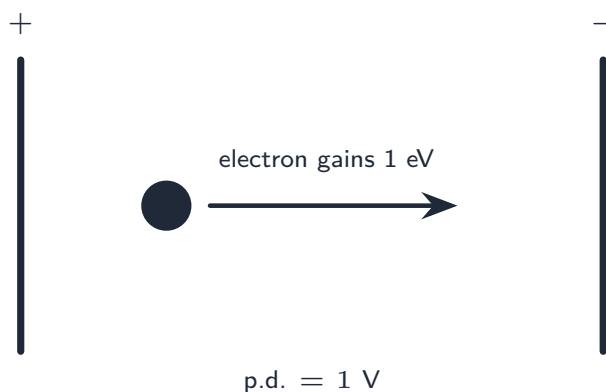
Recall

On the atomic scale, joules are awkwardly large. Physicists use a smaller energy unit, and photons also carry momentum.

New ideas

Read these first. Each idea has a short worked example. Then do the Practice.

■ 1 The electronvolt



The **electronvolt** (eV) is the energy an **electron** gains moving through a p.d. of 1 V: $1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$.

Worked example. An electron accelerated through 5.0 V gains 5.0 eV. In joules that is $5.0 \times 1.60 \times 10^{-19} = 8.0 \times 10^{-19} \text{ J}$.

■ 2 Photon momentum



A photon also carries **momentum** $p = h/\lambda$, where λ is the **wavelength**.

Worked example. A photon of wavelength $\lambda = 5.0 \times 10^{-7} \text{ m}$ has momentum $p = h/\lambda = (6.63 \times 10^{-34})/(5.0 \times 10^{-7}) = 1.3 \times 10^{-27} \text{ kg m s}^{-1}$.

Watch out: to convert eV to joules you *multiply* by 1.60×10^{-19} ; to go from joules to eV you *divide*. An electronvolt is an amount of *energy*, not a voltage.

Practice

Try these in order.

22.1 What is one *electronvolt*?

[1]

22.2 How many joules is 1 eV?

[1]

22.3 To convert eV to joules, do you multiply or divide by 1.60×10^{-19} ? [1]

22.4 An electron crosses a p.d. of 3.0 V. Find the energy it gains, in joules. [2]

22.5 Write the formula for the *momentum of a photon*. [1]

22.6 Does a shorter-wavelength photon have more or less momentum? Explain. [2]

22.7 Challenge. A photon has no mass, yet it carries momentum. Explain how this is possible, and give one real effect of photon momentum. [2]