

# 22 The electronvolt and momentum

## – Part 2

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

### Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

| English      | 中文   | Write it 3 times (English) |
|--------------|------|----------------------------|
| electronvolt | 电子伏特 | _____                      |
| momentum     | 动量   | _____                      |
| wavelength   | 波长   | _____                      |

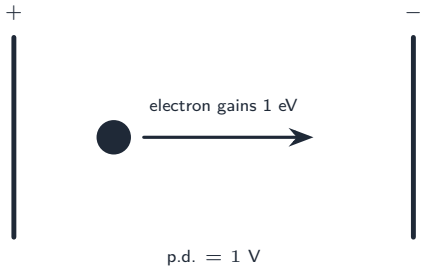
### Recall

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** 电子伏特 (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** 动量  $p = h/\lambda$ , where  $\lambda$  is the **wavelength** 波长.

*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  $1.60 \times 10^{-19}$ ; 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  $1.60 \times 10^{-19}$ ? [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]