22 Photons – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English	**Write it 3 times** (English)		
photons			
quantum			
Planck constant			

Recall

Light behaves like particles as well as waves. The particles of light are **photons** – small packets of energy.

New ideas

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

■ 1 The photon

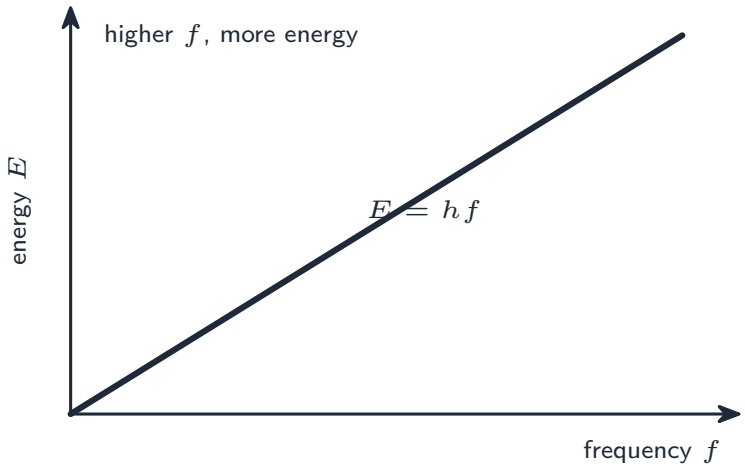
a photon (a packet of light)

A photon is a packet (a **quantum**) of light energy that travels at the speed of light.

Worked example. Light is not delivered smoothly but in whole packets. Even the

dimmest red laser sends out a stream of individual photons; you cannot have "half a photon".

■ 2 Photon energy



A photon of frequency f has energy $E = hf$, where $h = 6.63 \times 10^{-34}$ J s is the **Planck constant** . Higher-frequency light carries more energy per photon.

Worked example. A photon of green light has frequency $f = 5.0 \times 10^{14}$ Hz: $E = hf = (6.63 \times 10^{-34})(5.0 \times 10^{14}) = 3.3 \times 10^{-19}$ J.

Watch out: $E = hf$ tells you the energy of *one* photon, set by its frequency (colour). It does *not* tell you how bright the light is – brightness depends on how *many* photons arrive.

Practice

Try these in order.

22.1 What is a *photon*? [1]

22.2 Write the formula for the *energy of a photon.* [1]

22.3 What does h stand for? [1]

22.4 Which carries more energy per photon – red light or blue light? [1]

22.5 A photon has frequency 6.0×10^{14} Hz. Find its energy ($h = 6.63 \times 10^{-34}$). [2]

22.6 A red laser and a blue laser emit the same total power. Explain which one sends out more photons per second. [2]

22.7 Challenge. A very dim ultraviolet lamp can harm skin, but a bright red lamp cannot. Explain why, in terms of the energy of each photon. [2]