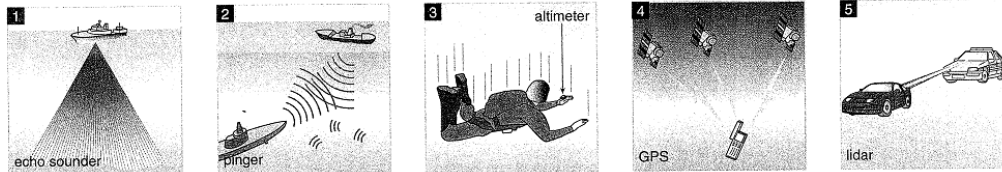


3 Positioning

- Start here** 1 Work in pairs. What do these systems calculate? Choose the most important one for each system.
distance, speed, location, height, depth



- Reading** 2 The footnotes on this web page are in the wrong order. Write the footnote numbers in the spaces.

What is GPS?
GPS stands for the Global Positioning System. It can tell you **your precise location**⁽¹⁾ anywhere on (or above) the Earth to within six metres.

5 A group of 24 or more satellites orbit the Earth at an altitude of 11,000 miles. Every 12 hours, a satellite makes an orbit, or one complete cycle in space around the Earth. The satellites transmit signals to receivers on the ground.

10 The user has a GPS receiver, which detects the signals from the satellites, and calculates **their distance**⁽²⁾ from the receiver. Receivers can be held in your hand or mounted in a vehicle, such as a car or ship. A hand-held receiver is about the

15 size of a mobile phone, but the newer models are even smaller. For instance, you can now buy one which is as small as an MP3 player.

How does the system work?
The satellites know **their precise position**⁽³⁾ in their own orbits. Each satellite sends a signal to the

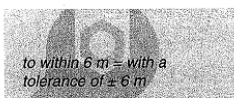
20 receiver at the speed of light. This signal tells the receiver its exact location. In addition, it tells the receiver **the transmission time**⁽⁴⁾ of the signal.

How does the receiver calculate how far it is from the satellite?
25 It subtracts the time when the signal was received (T_1) from the time when it was sent (T_2). Then it multiplies this number by the speed of light (c). This gives the distance (D) from the receiver to the

30 satellite. However, to find out your exact location (that is, your longitude, latitude, and altitude), your receiver needs signals from at least three satellites.

Why do you need at least three satellites to tell you where you are?
35 Each satellite transmits a different position and time signal to the receiver. The receiver is able to calculate its exact location (to within 6 m) by comparing the three different signals.

FOOTNOTES
() in other words, *when it was sent*
() that is, *how far away they are*
() or, *exactly where you are*
() i.e., *exactly where they (the satellites) are*



- 3 Choose the correct calculation according to the text.

- a) $D = (T_2 - T_1)/c$ c) $D = (T_2 - T_1) * c$
b) $T_1 - (T_2 * c) = D$ d) $T_2 - (T_1 * c) = D$

- 4 Choose the closest meaning for each word/phrase in the text. Choose from these meanings: **and, but, for example, in other words.**

- 1 *or* (line 7) 4 *In addition* (line 22)
2 *such as* (line 13) 5 *However* (line 30)
3 *For instance* (line 16) 6 *that is* (line 31)

Language

	Noun phrase
Please tell me	your location.
I need to know	the depth of the river.
	the altitude of the planes.
This instrument can show you	Indirect question
The computer calculates	where you are.
	how deep the river is.
	how high the planes are.

- 5** Replace the phrases in italics. Use the nouns in the box and add any necessary words.

altitude depth distance height length location speed temperature width

- 1 Please find out *where the ship is*, and *how fast she is going*.
- 2 Before you touch the liquid, you should check *how hot it is*.
- 3 I want to find out *how far away the plane is*, and *how high it is above sea level*.
- 4 Could you please tell me *how deep the river is* below the bridge.
- 5 I also need to know *how wide*, *how long* and *how high the bridge is*.

Example: I Please find out the location of the ship, and her speed.

- 6** Replace the phrases in italics. Use the word(s) in brackets.

- 1 All aeroplanes carry altimeters. These devices measure air pressure. From this reading, the altimeter can calculate *the height of the plane above sea level*. (how / high)
- 2 A submarine's pinger sends out a ping, or burst of sound, which is reflected back from ships in the sea. This allows the crew to find out *the location of the ships*. (where)
- 3 A lidar system can work out *the distance of a vehicle* from the device. It takes many readings as the vehicle approaches. From this it can calculate *the speed of the vehicle*. (how / far / fast)
- 4 An airport radar system sends out a sound signal which is reflected from an approaching plane. Since the system knows *the speed of the sound signal*, it can calculate *the distance of the plane* from the airport tower. (how / fast / far)

Example: I ... the altimeter can calculate how high the plane is above sea level.

- Task 7** Work in groups.

- Brainstorm an everyday applications which use GPS. Choose one that interests you.
- Prepare a short presentation, showing how GPS works in the application.
- Present your group's ideas to the rest of the class.

Some examples of the use of GPS include: *police, fire and emergency medical services; forest fire prevention; surveying and construction; tunnel digging; bridge building; mining; company cars; delivery vans; dealing with environmental disasters such as oil spills in the sea; air-sea rescue services; agriculture; animal herding; tracking endangered species; hiking and camping; sailing.*