Solutions

Each answer shows the steps, then the **result**.

2.1

(a) sound goes **into** the computer → **input**

(b) the result comes **out** on paper → **output**

(c) it shows the image and detects the touch → **both**

(d) the result comes **out** as sound → **output**

2.2

(a) the fuser melts toner → **laser printer**

(b) melted plastic from a nozzle → **3D printer**

(c) a diaphragm moved by sound → **microphone**

(d) a lens for each eye → **virtual reality headset**

(e) two layers pushed together → **resistive touchscreen**

2.3

- the drum is charged first, and the laser then draws on it: D, B
- toner sticks, then moves to the paper: E, A
- the fuser comes last: **D, B, E, A, C**

2.4

- a microphone's signal changes continuously → **analogue**; the converter into binary is an **ADC** (analogue-to-digital converter)
- for the speaker the conversion goes the other way → a **DAC** (digital-to-analogue converter) produces a changing **current** (or voltage)

2.5 any **two** of:

- resistive detects **pressure** pushing two layers together; capacitive detects a **change in the electric field** when a finger touches the glass
- resistive works with a glove or any pen; capacitive needs a bare finger (or a special pen)
- capacitive allows multi-touch; resistive does not
- resistive is cheaper; capacitive gives a clearer image

2.6

- a **temporary** storage area
- that holds data while it passes between two devices (or processes) that work at **different speeds**

3.1

(a) any **five** of:

- the rotating drum is given an electrical charge
- a laser beam scans across the drum and removes the charge at some points, drawing the page as a pattern of charge
- the drum is coated with charged toner, which sticks only to the drawn areas
- the (charged) paper rolls against the drum, and the toner is transferred to the paper
- the paper passes through the fuser, where heated rollers melt the toner onto it
- the charge is removed from the drum before the next page

(b) the computers send data much faster than the printer can print it

- each document is stored in the buffer, in the order in which it arrives, and the printer takes the data from the buffer when it is ready
- so each computer can carry on with other work without waiting, and no document is lost

3.2 any **four** of:

- the design is made with CAD software
- the design is cut into many thin horizontal layers
- the nozzle moves over the base and lays down melted material in the shape of one layer
- the layer cools and hardens, and the nozzle (or the base) moves by one layer's height
- the handle is built layer by layer, from the bottom up (additive manufacturing)

3.3

(a) sound waves make the diaphragm vibrate

- the diaphragm moves a coil near a permanent magnet, which produces a changing electrical current
- this analogue signal is changed into binary by an ADC

(b) any **four** of:

- a DAC changes the binary data into a changing (analogue) current, and an amplifier makes it stronger
- the current flows through a coil, which becomes an electromagnet
- as the current changes, the coil is pulled towards and pushed away from the permanent magnet
- the coil moves the cone, so the cone vibrates
- the vibrating cone produces sound waves

3.4

(a) **resistive**

- it detects pressure, so it works when the passenger is wearing gloves; a capacitive screen needs a bare finger

(b) the screen has two conductive layers with a small gap between them

- pressure pushes the top layer onto the bottom layer, which completes a circuit at that point
- the microprocessor calculates the coordinates of the touch from the voltage at the point of contact

3.5

(a) a slightly different image is shown to each eye, on two screens or one split screen

- lenses focus the images, and the brain joins the two images into one 3D view

(b) sensors such as a gyroscope and an accelerometer detect the movement of the head

- the sensor data is sent to the processor, which works out the new direction of view
- the images are redrawn at once, so the view of the city moves with the head

(c) the speed of the network changes, but the video must play at a steady rate

- the buffer holds video that has been downloaded ahead of time, so the video keeps playing when the network slows down