Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

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

2.1

A: **capsule**

B: **flagellum**

C: **pili** (fimbriae)

2.2

$n = 120 \div 20 = 6$ doublings

$100 \times 2^6 =$ **6400**

2.3

any two of: exotoxins are proteins, endotoxin is LPS; exotoxins are released by living bacteria, endotoxin mainly when Gram-negative bacteria die; exotoxins are made by both Gram types, endotoxin by Gram-negatives only; exotoxins can be made into toxoid vaccines

2.4

C. difficile forms spores

spores are not killed by alcohol

wash hands with soap and water, and clean with a chlorine (sporicidal) product

3.1

(a) B: **log** (exponential) phase; C: **stationary** phase

(b) a rise of 3 logs is 1000 times, about 2^{10}, so 10 doublings in 200 min: **20 min**

(c) the cells adjust and make the enzymes they need for the new food

(d) food runs out and waste builds up

(e) the **log** phase, when cells are building new walls

3.2

(a) *Clostridium tetani*

(b) the toxin stops inhibitory nerve cells in the spinal cord from releasing their transmitters (glycine, GABA); motor neurons fire without control, so muscles contract

(c) it is an anaerobe: its spores grow where there is little oxygen

(d) the amount of toxin is too small to cause an immune response

3.3

(a) **LPS** (endotoxin; lipid A)

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(b) LPS binds TLR4 on macrophages; they release TNF, IL-1 and IL-6; these widen vessels and make them leak, so pressure falls

(c) dying bacteria release more LPS

(d) **pili** (fimbriae)

(e) bacteria form a **biofilm** on the catheter, which shields them from antibiotics and white cells; the catheter should be removed