Unit 29 · Applications of Microbiology

ANSWER KEY · FOR TEACHERS

Full marks 31

Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Key words

1. lactose
2. casein
3. chymosin
4. whey
5. wort
6. cider
7. koji
8. heterocysts

K · 4

Each carries 0.5 mark.

2 Label the diagram

1. curd (dahi)
2. yogurt
3. cheese
4. paneer

K · 2

Each carries 0.5 mark.

3 Multiple choice

i. **c.** brandy — K · 1

Brandy is distilled wine. Rum is distilled from fermented molasses; beer and cider are fermented, not distilled.

ii. **b.** germination makes amylase, which turns the grain's starch into sugar the yeast can ferment — U · 1

Yeast can't ferment **starch**. The sprouting grain makes **amylase**, which, in mashing, turns starch into **sugar**. Bitterness comes from hops; the alcohol comes later, from the yeast.

iii. **b.** *E. coli* lives in the gut in huge numbers, so finding it shows the water has fecal contamination, and pathogens may be there too — U · 1

E. coli is an **indicator**: most strains are harmless, but it is in all feces in huge numbers and easy to grow. Its presence means feces have reached the water, so the germs of diarrhea, typhoid and cholera could have too.

iv. **b.** a parasitoid — A · 1

Trichogramma wasps are **parasitoids**: each lays its eggs inside a pest moth's egg, and its larva kills it. Releasing them in large numbers is **augmentation**.

v. **c.** the fungus's threads reach far into the soil and bring the roots phosphorus and water — A · 1

The fungus's **hyphae** spread through far more soil than roots can and take up **phosphorus**, other minerals and water, which they pass to the root in exchange for sugar.

4 Short answers

a. MARKING SCHEME — K · 2

- ✓ Living microorganisms that promote a plant's growth by increasing the supply of nutrients.
- ✓ Any two nitrogen fixers (*Rhizobium*, *Azotobacter*, *Anabaena*, *Nostoc*, *Azolla–Anabaena*).

b. MARKING SCHEME — U · 2

- ✓ Curd: bacteria make lactic acid, which sets the milk.
- ✓ Paneer: added acid in hot milk clumps the casein at once, without microbes.

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c. MARKING SCHEME A · 2

✓ Acetobacter (acetic acid bacteria) turned the alcohol into acetic acid, using air.
✓ The correct equation.

d. MARKING SCHEME U · 3

✓ Fungus outside the root and between its cells, against inside the cortex cells.
✓ Mainly forest trees, against most crops and fruit trees.
✓ Mushroom-forming fungi, against Glomeromycota forming arbuscules.

5 Long answers

a. ANSWER U · 4

Drinking (potable) water is water safe to drink and to use in preparing food.

1. **Coagulation and flocculation**: a positively charged **coagulant** (alum or ferric chloride) cancels the negative charges of tiny particles of clay and microbes; stirred slowly, they stick together into **floc**.
2. **Sedimentation**: in a large tank the heavy floc **settles** to the bottom, taking many microbes with it.
3. **Filtration**: the clear water passes through **sand, gravel** and sometimes charcoal, removing the floc left, parasites such as *Giardia* and most bacteria.
4. **Disinfection**: **chlorine** or chloramine (or UV light, ozone) kills the germs left; **residual chlorine** keeps the water safe in the pipes to the taps.

MARKING SCHEME

✓ Definition, and coagulation and flocculation by alum into floc.
✓ Sedimentation: the floc settles.
✓ Filtration through sand and gravel removes particles, parasites and most bacteria.
✓ Disinfection by chlorine, with residual chlorine for the pipes.

b. ANSWER U · 4

Sewage is the wastewater of a town: from households (toilets, kitchens, baths), industries and, where drains are shared, surface runoff.

1. **Preliminary treatment**: **bar screens** catch rags, cans and plastic; a **grit chamber** settles sand and gravel; the flow is evened out, and fat and grease skimmed off.
2. **Primary treatment**: in **settling tanks** heavy solids settle as primary sludge, removing 50–70% of the suspended solids and 25–40% of the BOD; no microbes are used.
3. **Secondary treatment**: **microbes**, mostly aerobic bacteria, break down the dissolved organic matter, in the **activated sludge** process (air blown through an aeration tank, flocs settled, some sludge returned) or on a **trickling filter**.
4. **Tertiary treatment** polishes the water (sand filters, membranes, wetlands); it is **disinfected** (chlorine, UV, ozone) and nitrogen and phosphorus removed; the **sludge** is digested by anaerobic bacteria, giving **biogas** and fertilizer.

MARKING SCHEME

✓ Definition, and preliminary treatment (screens, grit, grease).
✓ Primary treatment: settling tanks remove solids as sludge.
✓ Secondary treatment by microbes: activated sludge or trickling filter.
✓ Tertiary treatment and disinfection, and sludge digested to biogas.

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6 Think

ANSWER HA · 3

The yogurt bacteria, *Streptococcus thermophilus* and *Lactobacillus bulgaricus*, like it **hot**: at about **42–45 °C** they grow fastest and set the milk in 4–6 hours; in cold milk they work very slowly.
Once the milk has set, it is **cooled to stop the bacteria**, so it doesn't go on getting more acid.
Boiling milk would **kill** the bacteria, so it would **never set**: it would stay sweet and runny, and other microbes might spoil it.

MARKING SCHEME

- ✓ At 42–45 °C the bacteria grow fastest (slowly in cold milk).
- ✓ Cooling after setting stops the bacteria making more acid.
- ✓ Boiling milk kills the bacteria, so it would never set.

7 Activity: What water do families drink?

(not marked)

WHAT STUDENTS SHOULD FIND

In towns many families drink **jar (purified) water** or **filter and boil** tap water; in villages many drink spring, stream or well water **untreated**, or boiled for small children only. Some use **chlorine** drops (Piyush) or **SODIS**. The water-borne diseases likely: **diarrhea** and gastroenteritis, **typhoid**, **dysentery**, **giardiasis**, **hepatitis A and E**, and in outbreaks **cholera**, commonest in the monsoon. Families who treat their water should have fewer of them.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	9	15	4	3	**31**

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