Unit 5 · Applied Biology

HARDER PRACTICE QUESTIONS

Full marks 46

Write your answers on separate paper. Show your working. Share of people who must be immune = $1 - 1 \div R_0$.

1 More than the share [4]

Take $R_0 = 15$ for measles. Two doses of MR protect about 97 in every 100 people.

i. What share of the people must be immune?
ii. If only vaccinated people are immune, what share must be vaccinated?
iii. In a school of 1,200 students, about how many is that?
iv. Why must a village with 90% of its children vaccinated worry?

2 Check the claim [5]

Niraj measures one person's antibodies against one germ (arbitrary units). She met the germ on day 0 and again on day 40.

Day	0	5	10	15	20	30	40	42	45	50	60
Antibodies	0	0	8	20	12	5	4	50	300	600	500

He says: "Antibodies left over from the first meeting are what protect her the second time."

i. Between which days do antibodies first appear after each meeting?
ii. How many times higher is the second peak than the first?
iii. Use the table to show why his claim can't be the whole story.
iv. What does protect her? Name the cells.
v. On which meeting was she most likely to feel ill? Why?

3 Two kinds, one story [4]

Tsering is given Td while pregnant, and her newborn is protected from tetanus. Years later, she is bitten by a cobra and given antivenom.

i. What kind of immunity does the Td give Tsering?
ii. What kind does it give her newborn, and how?
iii. What kind does the antivenom give?
iv. Will the antivenom protect her from a second bite a year later? Give a reason.

4 Spot the error [3]

A disease has $R_0 = 5$, and a school has 500 students. Rishav wrote:
"Share needed = $1 \div 5 = 0.2$. So only 20% of the students, 100 of them, must be immune."

5 Which step fails? [3]

A phagocyte has one fault. Predict what happens to a bacterium near it, and name the step that fails, in each case.

i. It can't sense the chemicals that bacteria give off.
ii. Its lysosomes can't join the bags inside it.
iii. It can't push out arms of cytoplasm.

6 What went wrong? [4]

For each person, name the defense that has failed, and what follows from it.

i. A man who has smoked for thirty years.
ii. A child with a large burn on her arm.
iii. A person with untreated AIDS.
iv. A woman who has just finished a long course of antibiotics.

7 Correct the misconceptions [4]

The paragraph has four mistakes. Write each mistake and correct it.

Yangchen wrote: “An antigen is a protein made by the body to fight germs. Red blood cells make antibodies. A vaccine works by giving ready-made antibodies. Antibiotics cause bacteria to become resistant by changing their DNA.”

8 Design a fair test [4]

Manju wants to find out whether the air by a busy road carries more dust than the air in her classroom, using slides smeared with petroleum jelly.

i. What will she change, and what will she measure?
ii. Name three things she must keep the same.
iii. Why should she count several squares on each slide, not one?
iv. Which part of the body does the slide stand for, and what doesn’t it do that the body does?

9 Predict, then explain [3]

Suppose you found a bacterium with no cell wall. Predict whether (a) penicillin and (b) tetracycline would work against it, and explain each. Then say why neither would help against measles.

10 The survivors take over [4]

A wound holds 1,000,000 bacteria, of which 10 can resist an antibiotic (a made-up number). The antibiotic kills all the others. The 10 divide every 30 minutes, and all their descendants survive.

i. What percentage of the bacteria were resistant before the antibiotic? After it?
ii. How many divisions until there are at least 1,000,000 again?
iii. How long does that take?
iv. Did the antibiotic make these bacteria resistant? Explain.

11 Estimate it [3]

A cilium beats about 15 times a second, and the mucus blanket moves about 0.5 cm to 1 cm a minute. About 10,000 liters of air pass through your nose and windpipe a day.

i. About how many times does one cilium beat in a day?
ii. How long does a speck take to ride 10 cm up the windpipe?
iii. About how many liters of air pass through in an hour?

12 Think [3]

A child who has had measles seldom catches it again, yet the same child may catch a cold every year, and a new flu vaccine is made each year. Explain all three.

13 Make your own [2]

Write a problem about herd immunity for a place you know, with a made-up R_0 and a number of people, and solve it.