# 1.3 Infection and Response: Test Pack

AQA 8461 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

**Answer ALL questions. Show all your working.**

**1** Pathogens are organisms that cause disease.

**(a)** Name a type of pathogen and give one disease it causes. **(1)**

**(b)** Name a different type of pathogen and give one disease it causes. **(1)**

**(Total for Question 1 is 2 marks)**

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**2** Vaccination helps protect people from infectious diseases.

**(a)** State what is given to a person during vaccination. **(1)**

**(b)** Name one benefit of vaccination. **(1)**

**(Total for Question 2 is 2 marks)**

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**3** An experiment tests how long antiseptic kills bacteria on a surface. The table shows number of colonies remaining after treatment time in minutes: 0 min 120 colonies; 1 min 30 colonies; 2 min 8 colonies.

**(a)** Describe the trend in the number of colonies over time. **(2)**

**(b)** Suggest one conclusion about the antiseptic's effectiveness. **(1)**

**(Total for Question 3 is 3 marks)**


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**4** A student investigates how temperature affects flu virus survival on a surface. They keep humidity and time constant and only change temperature. This is an investigation into variables.

**(a)** Identify the independent variable. **(1)**

**(b)** Identify the dependent variable. **(1)**

**(c)** Identify one control variable. **(1)**

**(d)** State why it is important to control humidity in this investigation. **(1)**

**(Total for Question 4 is 4 marks)**

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**5** Malaria is caused by a protist pathogen and is spread by a vector.

**(a)** Name the vector that spreads the protist pathogen that causes malaria. **(1)**

**(b)** Describe how the mosquito spreads the protist pathogen between people. **(2)**

**(c)** Suggest two methods, other than drug treatment, that could reduce the spread of malaria in an area. **(2)**

**(Total for Question 5 is 5 marks)**


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**6** Required practical: A student investigated the effectiveness of two antibiotics, A and B, against a bacterial culture using agar plates and paper discs soaked in each antibiotic. The student measured the diameter of the clear zone (zone of inhibition) around each disc after 48 hours of incubation. The table shows the results for three repeats of Antibiotic B: Repeat 1 = 21 mm, Repeat 2 = 23 mm, Repeat 3 = 22 mm. The mean diameter of the zone of inhibition for Antibiotic A was found to be 16 mm.

**(a)** State three aseptic techniques the student should use when setting up this investigation, and give the purpose of each. **(3)**

**(b)** Explain why the agar plates were incubated at 25°C rather than at 37°C. **(2)**

**(c)** Calculate the mean diameter of the zone of inhibition for Antibiotic B. **(2)**

**(d)** Calculate the area of the zone of inhibition for Antibiotic B, using your answer to part (c). Give your answer to 3 significant figures. (area of a circle = $\pi \times r^2$) **(3)**

**(e)** The mean diameter of the zone of inhibition for Antibiotic A was 16 mm. Calculate the area of this zone, to 3 significant figures, and use both calculated areas to determine which antibiotic was more effective. Explain your reasoning. **(3)**


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**(f)** Suggest one improvement to the method that would increase the reliability of this conclusion. **(2)**

**(g)** Explain the purpose of including a control disc, soaked in sterile water only, in this investigation. **(2)**

**(Total for Question 6 is 17 marks)**


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**7** A microbiologist grew a culture of bacteria in a flask. A fixed dose of antibiotic was added to the flask at time = 4 hours. The table shows the total number of bacteria and the number of antibiotic-resistant bacteria in the culture over time. Time (hours): 0, 2, 4, 6, 8, 10. Total bacteria (million per cm3): 4, 8, 16, 10, 6, 5. Resistant bacteria (million per cm3): 0.1, 0.2, 0.4, 3, 5, 4.8.

| Time (hours) | Total bacteria (million per cm3) | Resistant bacteria (million per cm3) |
|---|---|---|
| 0 | 4 | 0.1 |
| 2 | 8 | 0.2 |
| 4 | 16 | 0.4 |
| 6 | 10 | 3 |
| 8 | 6 | 5 |
| 10 | 5 | 4.8 |

**(a)** Calculate the mean rate of decrease in the total bacteria population between 4 and 6 hours, in million bacteria per cm3 per hour. **(2)**

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**(b)** Calculate the percentage of the total bacterial population that was antibiotic-resistant at t = 10 hours. **(2)**

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**(c)** Explain the trend shown in the number of resistant bacteria after the antibiotic was added at t = 4 hours. **(2)**

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**(Total for Question 7 is 6 marks)**


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**8** A student tests three antiseptic solutions A, B and C against a bacterial lawn. The diameters of zones of inhibition (mm) from three repeats are:

| | | | |
|---|---|---|---|
| **A** | **12** | **14** | **13** |
| B | 8 | 9 | 10 |
| C | 15 | 14 | 16 |

**(a)** Calculate the mean diameter for A, B and C. Show one calculation. **(2)**

**(b)** State which antiseptic is most effective and justify using your means. **(1)**

**(c)** Suggest one improvement to the method to make the comparison fairer. **(1)**

**(Total for Question 8 is 4 marks)**


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# Mark scheme · 1.3 Infection and Response: Test Pack

## Question 1

(a) one correct type and example, e.g. bacterium - salmonella; virus - influenza; fungus - athlete's foot; protist - malaria, oe **B1**

**(a) Answer: Any one correct pair, e.g. bacterium - salmonella.**

(b) a second correct type and example different from (a), oe **B1**

**(b) Answer: Any different correct pair, e.g. virus - influenza.**

## Question 2

(a) a small amount of weakened or dead pathogen or parts of a pathogen (antigen) that stimulates immune response, oe **B1**

**(a) Answer: A small amount of a weakened or dead pathogen or parts of a pathogen (antigen).**

(b) prevents the person from getting the disease or reduces severity, or gives herd immunity to protect others, oe **B1**

**(b) Answer: It prevents the person from getting the disease or reduces the severity; it also helps protect others by herd immunity.**

## Question 3

(a) states that number of colonies decreases as time increases **M1**

(a) gives an appropriate example of decrease, e.g. from 120 to 30 to 8 colonies, cao **A1**

**(a) Answer: The number of colonies decreases as treatment time increases, for example 120 at 0 min, 30 at 1 min and 8 at 2 min.**

(b) antiseptic reduces bacterial colonies quickly and is effective at killing or inhibiting bacteria on this surface, oe **B1**

**(b) Answer: The antiseptic is effective and reduces bacterial colonies quickly on the tested surface.**

## Question 4

(a) temperature (it is changed by the student) **B1**

**(a) Answer: Temperature.**

(b) measure of virus survival, e.g. number of viable viruses or colonies after set time **B1**

**(b) Answer: Virus survival measured as the number of viable viruses or colonies after the set time.**

(c) one correct control such as humidity, exposure time, or surface type, oe **B1**

**(c) Answer: Humidity (or exposure time or surface type).**

(d) humidity can affect virus survival so if not controlled it could change results and make temperature effects unclear, oe **B1**

**(d) Answer: Humidity affects virus survival, so controlling it ensures changes are due to temperature only.**

## Question 5

(a) mosquito (allow Anopheles mosquito) **B1**

**(a) Answer: Mosquito**

(b) the mosquito feeds on (bites) an infected person, taking in the protist along with the blood **B1**

(b) the mosquito then bites/feeds on an uninfected person, transferring the protist into their blood **B1**

**(b) Answer: A mosquito bites an infected person and picks up the protist, then bites another person and transfers the protist to them.**

(c) using mosquito nets (ideally treated with insecticide) while sleeping **B1**

(c) using insect repellent, spraying insecticide, or removing/treating standing water where mosquitoes breed (any one) **B1**

**(c) Answer: Using insecticide-treated mosquito nets and removing standing water/using insect repellent to reduce mosquito bites.**


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## Question 6

(a) sterilise the inoculating loop by passing it through a flame - kills unwanted microorganisms before use **B1**

(a) tape the lid of the petri dish without sealing it completely - reduces contamination from airborne microorganisms while allowing some air in for aerobic respiration **B1**

(a) work near a lit Bunsen burner (or use a sterile bench) - creates an updraught of air, reducing the chance of airborne microorganisms settling on the culture **B1**

**(a) Answer: Flame the inoculating loop; tape (not seal) the petri dish lid; work near a lit Bunsen burner - each reduces contamination by unwanted microorganisms.**

(b) 37°C is close to human body temperature **B1**

(b) incubating at this temperature would encourage the growth of pathogens that could be harmful to humans in a school laboratory **B1**

**(b) Answer: 25°C avoids growing microorganisms that thrive at body temperature (37°C), which could be harmful pathogens to humans.**

(c) (21 + 23 + 22) / 3 **M1**

(c) 22 (mm) cao **A1**

**(c) Answer: 22 mm**

(d) radius = 22 / 2 = 11 (mm) **M1**

(d) area = $\pi \times 11^2$ **M1**

(d) 380 $mm^2$ (3 sf) ft from (c) **A1**

**(d) Answer: 380 $mm^2$ (3 s.f.)**

(e) radius = 16 / 2 = 8 (mm); area = $\pi \times 8^2$ **M1**

(e) 201 $mm^2$ (3 sf) **A1**

(e) Antibiotic B is more effective, because it produced a larger zone of inhibition (area), showing it killed/inhibited bacteria over a larger area **B1**

**(e) Answer: Area for A = 201 $mm^2$ (3 s.f.); Antibiotic B is more effective, as its zone of inhibition covers a larger area (380 $mm^2$ vs 201 $mm^2$).**

(f) increase the number of repeats for Antibiotic A (only a mean is given, with no repeats shown) **B1**

(f) this reduces the effect of anomalous results/random error, allowing a more reliable mean to be calculated **B1**

**(f) Answer: Carry out more repeats for Antibiotic A, so a more reliable mean can be calculated and anomalies have less effect.**

(g) shows that any zone of inhibition is caused by the antibiotic and not by another factor (e.g. the paper disc or the water itself) **B1**

(g) allows a valid/fair comparison to be made between the antibiotics tested **B1**

**(g) Answer: It confirms that any clear zone seen is due to the antibiotic (not the disc or water), allowing a fair comparison between antibiotics.**

## Question 7

(a) (16 - 10) / 2 **M1**

(a) 3 million per cm3 per hour cao **A1**

**(a) Answer: 3 million bacteria per cm3 per hour**

(b) (4.8 / 5) x 100 **M1**

(b) 96% cao **A1**

**(b) Answer: 96%**

(c) non-resistant bacteria are killed by the antibiotic, so the total population falls after t = 4 hours **B1**

(c) resistant bacteria survive and can reproduce, so they make up an increasing proportion of the (smaller) surviving population **B1**

**(c) Answer: The antibiotic kills non-resistant bacteria, so resistant bacteria form an increasing share of the shrinking population as they survive and reproduce.**

## Question 8

(a) shows correct method for a mean for one antiseptic, e.g. A mean = (12+14+13)/3 = 13 **M1**

(a) gives all three correct means: A = 13 mm, B = 9 mm, C = 15 mm cao **A1**

**(a) Answer: Means: A = 13 mm, B = 9 mm, C = 15 mm**

(b) C is most effective because it has the largest mean zone of inhibition (15 mm) compared with A and B, oe **B1**

**(b) Answer: C is most effective because it has the largest mean zone of inhibition, 15 mm.**

(c) one valid improvement, e.g. use the same volume and concentration of each antiseptic, ensure plates are incubated at the same temperature and time, or use more repeats, oe **B1**

**(c) Answer: Use the same volume and concentration of each antiseptic and incubate all plates at the same temperature for the same time.**


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