Mark schemes

Q1.

(a) 3 cm^3 of (undiluted) disinfectant and 2 cm^3 of (distilled) water;

1

(b) 1. (Uncertainty =) 0.05 (cm^3);

2. (Percentage uncertainty =) 2.5;

Allow correct percentage uncertainty from student's incorrect answer to MP1.

2

(c) 1. Equally effective at 80% as at 100%;

2. Not effective at 20%

OR

Need higher than 20% concentration to be effective;

3. Light absorbance may not indicate number of living bacteria/cells

OR

Dead cells/bacteria absorb light

OR

Don't know if cells alive/dead at 80/100 %;

4. 100% not totally effective as still 10%/some absorbance;

5. Only (tested on) one species;

OR

Only tested on *B. subtilis*;

6. Only tested in laboratory/test tube

OR

May not be as effective on other surfaces;

Accept any description which indicates not tested on non-living surfaces.

Ignore statistical test, sample size and reference to repeats.

7. Only (tested) at 25°C;

4 max

[7]

Q2.

(a) 1. Breaking of ester bonds;

2. By addition of water;
Accept 'using', 'with' for addition

2

(b) 1. Emulsify lipids/fats;
Allow descriptions

2. Increases surface area (of lipid/fat) for (increased) lipase activity;

3. Form micelles;
Ignore 'neutralise'/ 'increase the pH'

2 max

(c) 1. Mutation results in (a new) allele;

2. Those with the (new) allele able to digest milk/triglycerides;

3. Individuals with CEL/allele more likely to (survive and) reproduce;
Accept 'pass on allele/characteristic' for reproduce

4. Directional selection;

5. Increase in frequency of (this) allele in population;
Accept description of increasing frequency, eg 'more common', 'higher proportion' but ignore increase in number of allele
*Allow ECF for use of gene rather than allele after not awarding mark in the first instance but **max 3** overall.*
Accept 'mutation' for allele

4 max

[8]

Q3.

(a) Membrane-bound organelle(s)

OR

Mitochondrion/mitochondria

OR

Vesicle(s)/lysosomes

OR

(Rough) endoplasmic reticulum

OR

Nucleus/(double) nuclear membrane/pore(s)/ nuclear envelope;

Ignore rER OR rough ER
Accept '80S ribosomes' OR 'large(r) ribosomes'
Reject smooth
Reject nucleolus
Reject cell membrane

1

(b) 1. Modify/package/transport proteins

OR

Make/transport glycoproteins;

Accept processes for modify
Accept 'adds carbohydrate to' for modify
Accept 'adds lipid to' for modify
Accept lipoprotein for glycoprotein
Accept chylomicron for glycoprotein/glycolipid

2. Modify/package/transport lipids

OR

Make/transport glycolipids;

Accept 'adds carbohydrate to' for modify
Accept chylomicron for glycoprotein/glycolipid
Accept phospholipid for lipid

3. Forms/releases vesicles/lysosomes;

Accept additional marking point,
Make/transport polysaccharides, but ignore cellulose

2 max

(c) Answer key:

India, Europe, East Asia, Central America, South America

1

(d) Correct answer of 8.3814 million/8 381 400/8.3814 x 10^6

OR

8.4 million/8400000/8.4 x 10^6;

Accept any correct numerical equivalent answer

1

(e) 1. Mutation produced allele;

Reject gene for allele only once

Reject 'mutation caused by infection/exposure to P. vivax'.

2. Those with allele/resistance less likely to/do not get malaria/*P vivax*

OR

Those with allele/resistance survive malaria/*P vivax*;

Accept converse; eg 'people lacking the allele die from malaria'

3. (So more likely to) reproduce and pass on the allele;

4. (Over generations) allele frequency increases;

*Accept description of increasing frequency of allele eg 'higher proportion', 'more common' but 'ignore increase in **number** of allele'*

4

[9]

Q4.

(a) Second box ticked;

Answer key: **B** – statements **1**, **2** and **4**

1

(b) A correct answer of $9(.144) \times 10^8$ **= 2 marks**;;

Answer not in standard form (914 400 000) **= 1 mark**

OR

Answer in incorrect standard form **= 1 mark**

OR

1.016×10^8 (everything else correct except failed to multiply by 9) **= 1 mark**

OR

2.286×10^8 (everything else correct but failed to take the plating of 0.25 cm^3 into account) **= 1 mark**

OR

9.432×10^8 (discounted 238 as anomalous, all other calculations correct) **= 1 mark**

2

(c) 30;

Accept correct number of generations from incorrect response to ***(b), the table will help with this***

Examples of how to use logs to solve

$2^x = 9.14 \times 10^8$

$\ln(2^x) = \ln(9.14 \times 10^8)$

$x \cdot \ln(2) = \ln(9.14 \times 10^8)$

$$x = \frac{\ln(9.14 \times 10^8)}{\ln(2)}$$

$x = 30$

OR

$2^x = 9.144 \times 10^8$

$\log_2 (9.144 \times 10^8) = 29.768$ *(so 30 generations)*

Number of generations	Standard form	Population size
1	2×10^0	2
2	4×10^0	4
3	8×10^0	8
4	1.6×10^1	16
5	3.2×10^1	32
6	6.4×10^1	64
7	1.28×10^2	128
8	2.56×10^2	256
9	5.12×10^2	512
10	1.024×10^3	1024
11	2.048×10^3	2048
12	4.096×10^3	4096
13	8.192×10^3	8192
14	1.638×10^4	16384
15	3.277×10^4	32768
16	6.553×10^4	65536
17	1.311×10^5	131072
18	2.621×10^5	262144
19	5.243×10^5	524288
20	1.049×10^6	1048576
21	2.097×10^6	2097152
22	4.194×10^6	4194304
23	8.388×10^6	8388608

Number of generations	Standard form	Population size
24	1.678×10^7	16777216
25	3.355×10^7	33554432
26	6.711×10^7	67108864
27	1.342×10^8	134217728
28	2.684×10^8	268435456
29	5.369×10^8	536870912
30	1.073×10^9	1073741824
31	2.147×10^9	2147483648
32	4.295×10^9	4294967296
33	8.590×10^9	8589934592
34	1.718×10^{10}	17179869184
35	3.436×10^{10}	34359738368
36	6.872×10^{10}	68719476736
37	1.374×10^{11}	
38	2.749×10^{11}	
39	5.498×10^{11}	
40	1.100×10^{12}	
41	2.199×10^{12}	
42	4.398×10^{12}	
43	8.796×10^{12}	
44	1.759×10^{13}	
45	3.518×10^{13}	

(d) 1. The concentration (of chloramphenicol) was too low/dilute (to kill all)

OR

There were too many *M. luteus*/bacteria for chloramphenicol/antibiotic to kill;

2. (Contamination with) other/resistant bacteria;

3. Mutation (occurred);

Accept as an additional mark point

Chloramphenicol/ antibiotic not (evenly) mixed in the liquid culture/bottle

2 max

[6]

Q5.

(a) 1. Unknown/new/different microorganism/pathogen/microbe/bacteria (introduced);

Ignore chemical contaminant

2. (these bacteria) use food source/space

OR

(these bacteria) produce toxins;

Accept description of competition for other resources

2

(b) Correct answer, for 2 marks = 480 000;;

Accept for 1 mark,

96 000 (correct number mm^{-3})

120 (correct number in 0.000 25 mm^3 undiluted)

OR any one of

$0.2 \times 5 \quad \frac{3}{15}$ (correct dilution factor)

OR

Evidence of dividing by 0.000 25

4.8×10^5 = 2 marks

2

(c) Correct answer for 3 marks, 3 bars given

1. Correct labelling of x axis;

eg culture **1**, culture **2** and culture **3**

OR

1,2,3 **and** (bacterial) culture;

2. Height of culture 2 bar about <u>one fifth</u> height of culture **1** bar;

3. Height of culture **3** bar higher than culture **2** bar **and** lower than culture 1 bar;

If 2 bars given **OR** if histogram given **OR** if graph given, accept for 2 marks,

1. Correct labelling of x axis;

2. Correct relative height of 2 bars/coordinates;

eg height of culture **2** about <u>one fifth</u> height of culture **1**

OR

height culture **3** above height of culture **2**

If no bar chart/histogram/graph given, accept for 1 mark,

1. Correct labelling of x axis;

For labelling of x axis
*Accept 'no substance' for culture **1***
*Accept 'substance **J**' for culture **2***
*Accept 'substance **K**' for culture **3***
Accept 'substance' for culture

3

[7]

Q6.

(a) Mating/courtship/sexual behaviour;

1

(b) 1. Repeat (the investigation) without stones

OR

Repeat (the investigation) with uniformly coloured stones;

2. Presence of stones has no effect on behaviour

OR

Colour of stones has no effect on behaviour;

Accept dull/grey/one/same for uniformly coloured

2

(c) 1. Directional;

2. Fish with more spots are more likely to be predated;

Accept converse
Accept killed/eaten for 'predated'
Accept more of them killed/eaten, for 'more likely'

3. Alleles for (more) spots not passed on;

Accept converse
Reject 'gene' once

4. (So) frequency of (more) spots alleles decreases;

Accept converse
Reject 'gene' once
Accept 'proportion' for frequency
Ignore 'number of alleles decreases'

4

[7]

Q7.

(a) 1. (Some bacteria have) alleles for resistance;

Reject reference to immunity only once

Accept gene for allele

Reject if antibiotics cause production of resistance gene/allele

2. (Exposure to) antibiotics is the selection pressure

OR

Non-resistant bacteria die

OR

Resistant bacteria survive/reproduce;

Reject reference to immunity only once

Accept strain for bacteria

3. More antibiotics used in hospital (compared with elsewhere)

OR

Patients have weakened immune systems

OR

(So) high frequency of resistance allele (in bacterial population);

Accept gene for allele

Ignore antibiotics prescribed when not needed OR antibiotic course is not finished

Ignore defence system, for immune system

Accept proportion/percentage for frequency

3

(b) Maltose;

Reject maltase

Accept phonetic spelling eg moltose/maltosse/maltoze/moltoes/maltoez

1

(c) 1. Wash hands with soap

OR

Disinfect surfaces;

Ignore sterilise hands OR surfaces
Accept sanitise for disinfect
Accept antiseptic /antimicrobial/alcohol (wipes)
Accept a named type of disinfectant

2. Use sterile pipette/syringe (to transfer bacteria);

Reject loop
Accept use unopened pipette/syringe for sterile

3. (Remove bottle lid and) flame neck of bottle;

4. Lift lid of (agar) plate at an angle;

Accept lift lid slightly OR keep lid over plate
Ignore work quickly with lid off

5. Work close to upward air movement;

Reject air movements sterilise air
Accept convection current for air movement

6. Use sterile spreader;

Accept loop for spreader
Examples of sterilising technique eg, flame OR dip in alcohol and flame OR dip in disinfectant and rinse (in sterile water)

7. Place pipette/spreader into disinfectant (immediately after use);

Accept a named type of disinfectant

3 max

(d) **For**

1. Resistant bacteria grow faster with trehalose;
   Accept C. difficile/strain for bacteria

2. (So) resistant bacteria (likely to) increase in frequency in the population/people;
   Accept C. difficile/strain for bacteria
   Accept 'percentage/proportion' for 'frequency'

3. Resistant bacteria (likely to) outcompete non-resistant bacteria;
   Accept C. difficile/strain for bacteria

Against

4. In laboratory not in people;
   Accept C. difficile/strain for bacteria

5. Other disaccharides (in the diet) might affect bacteria;
   Accept C. difficile/strain for bacteria
   Accept carbohydrate OR polysaccharide OR sugar, for disaccharide

6. Other bacterial species (in the body) might affect bacteria;

7. No stats test to see if difference/increase is significant;
   Accept 'is not due to chance' for 'is significant'
   Ignore standard deviation/SD (as not a stats test)
   Reject 'to see if results are significant'

8. No data for both resistant and non-resistant bacteria growing together;

9. No data for different concentrations of trehalose;

3 max

Max 2 if only 'For' or only 'Against' marks

[10]