Mark schemes

Q1.

(a) place the quadrat using random coordinates

1

(b) $\frac{40 + 52 + 88 + 80 + 40}{5}$

or $\frac{300}{5}$

1

60

1

(c) the area of buttercup plants in quadrat 5 is much larger

1

(d) any **two** from:

- place (many) more quadrats
  allow repeat
  allow combine results with results of other students
- divide quadrats into more / smaller squares
- estimate actual percentage cover in quadrat (instead of counting squares)
- only count squares with at least 50% cover
  allow use a point quadrat
  ignore place quadrats randomly

2

(e) any **three** from:

- light
- water
  allow rain / moisture
- minerals / ions / salts
  allow named example such as nitrate / phosphate
  allow fertiliser
- pH
- temperature
- herbivores
  allow named example
- trampling / cultivation

- pathogens / disease
- use of weedkiller

allow wind

allow oxygen / air in the soil

ignore carbon dioxide

ignore weather

3

[9]

Q2.

(a) (put beaker in a) water bath

allow (put beaker in an) incubator

1

(b) volume of the milk

or

type of milk

allow amount of milk

allow named type of milk, eg cows' or semi-skimmed

1

(c) correct scale and axis labelled

scale must be at least 1 cm for 1 day

1

all points plotted correctly

allow a tolerance of ± ½ small square

*allow 4 or 5 correct plots for **1** mark*

2

suitable curved line of best fit

ignore line joined point to point with straight lines

1

(d) similar shaped line drawn to left of 20 °C line on **Figure 4**

1

same start pH

allow a tolerance of ± ½ small square

allow from student's line of best fit or student's plot for 0 days

1

[8]

Q3.

Level 2: Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.

4–6

Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.

1–3

No relevant content

0

Indicative content

in microorganisms
- digestion **or** large molecules to small molecules
- enzymes **or** named example
- respiration
- production of carbon dioxide
- release of mineral ions **or** named example such as nitrate / phosphate / magnesium

in plants
- carbon dioxide (from air) taken in by leaves
- by diffusion
- via stomata
- carbon dioxide used in photosynthesis
- making glucose / sugar / starch / cellulose **or** making other correctly named example

- (named) ions taken in by roots
- by active transport
- nitrate ions for making amino acids / proteins / DNA / chlorophyll
- phosphate for making DNA

For **Level 2** processes in microorganisms and in plants should be considered

[6]

Q4.

(a)

Factor	Biotic	Abiotic
Nitrates in the soil		✓
Rabbits eating the plants	✓	
Shading by a building		✓
Soil pH		✓
Temperature		✓
Trampling by people	✓	

all 6 correct = **3** marks
4 or 5 correct = **2** marks

2 or 3 correct = **1** mark
0 or 1 correct = **0** marks 3

3

(b) (grid and) coordinates

1

to achieve randomness

ignore throwing quadrat

*allow random coordinates for **2** marks*

*if no other mark awarded allow random walk **or** description of random walk for **1** mark*

1

(c) *(mean per m^2 =)*
24 **or** 6 × 4

1

(calculation of area of lawn =) (½ × 16 × 10) – (6 × 3)
or 80 – 18

1

(area of lawn =) 62 m^2

allow correct calculation using total area (of triangle) – area of rectangle

(total number of daisies =)
24 × 62

allow correct calculation using an incorrectly calculated area of the lawn and / or mean

1

1488

allow answer based on incorrect area

1

(answer to 3 sig figs =) 1490

allow student's calculated answer rounded to 3 sig figs

1

(d) too few quadrats **or** quadrat too small

allow sample size too small

1

sample may not be representative of the lawn

allow quadrats may not have been placed randomly

1

[13]

Q5.

(a) bacteria

allow singular

1

fungi

allow mould

ignore microbes / germs / decomposers
*do **not** accept viruses*

1

(b) fatty acid(s)

1

(c) any **one** from:

- universal indicator (paper / solution)
  allow UI (paper / solution)
  ignore pH paper unqualified
- pH meter
  allow pH probe
  ignore datalogger unqualified
  ignore Cresol red
  ignore phenolphthalein / litmus

1

(d) any **two** from:

- volume of milk
  allow amount of milk
- exposure to air / oxygen
- sterilise test tubes
  allow bungs on test tubes
- treatment of milk before investigation
  allow example such as pasteurised or not
- freshness / age of milk (at start)
- time of day pH was measured
  allow starting pH of milk

2

(e) almond (milk)

1

(f) as temperature increases up to 15 °C the time taken (to reach pH 5) decreases

allow converse

1

above 15 °C the time taken (to reach pH 5) stays the same

*if no other mark awarded allow **1** mark*
for as temperature increases the time taken (to reach 5 °C) decreases and then stays the same

1

(g) any **one** from:

- bacteria / microbes / microorganisms / fungi dividing faster (when warmer)

  allow converse if clearly describing 5 °C

  allow number of bacteria / microbes / microorganisms / fungi increasing (when warmer)
  allow more bacteria microbes / microorganisms / fungi

- reactions (in the bacteria) are happening faster (to decay milk)

- (because there is) more (kinetic) energy

  allow particles move faster
  allow more collisions between particles

- enzyme activity is higher (at 10 °C than at 5 °C)

  allow enzymes work faster
  ignore enzymes work better

1

(h) any **two** from:

- different concentration / type of fat / lipid

  allow different amounts of fat / lipid

- different concentration / type of proteins / carbohydrate / sugar

  allow different amounts of proteins / carbohydrate / sugar

- different (amount / type of) bacteria present

- may have been pasteurised by a different process

  allow may have been treated in different ways (before the investigation)

- different starting pH

  ignore different oxygen concentration

2

(i) determine the types of bacteria present in the milk

1

[13]

Q6.

(a) bacteria

1

fungi

1

(b) both increase rate

1

because oxygen is needed for (aerobic) respiration **or** oxygen is used to release energy

*do **not** accept anaerobic*

ignore energy produced

1

as increased temperature causes faster reactions

allow named example
eg respiration
allow increased rate of enzyme action

1

(c) water

allow H_2O / $H2O$ / moisture / rain

*do **not** accept H^2O / H2O*

1

(d) methane

1

(e) 60

allow sixty

1

(f) so plants / crops grow faster / better

1

(decays further and) releases / contains mineral ions / named example

allow releases / contains nutrients

ignore nitrogen / food / carbon dioxide
allow as a fertiliser
allow retains water in soil
allow improves drainage
allow insulates / keeps warm
allow suppresses weed growth
allow improves soil structure

1

[10]

Q7.

(a) diffusion

1

(b) A

1

(c) B

1

(d) (earthworm) can absorb more oxygen (in a given time)
or
increases / more gas exchange

allow get / obtain / take in more oxygen
ignore easier absorption of oxygen
ignore references to food

1

(e) lipase

1

(f) more oxygen (in soil with earthworms)

allow earthworms bring oxygen to soil

1

(for) more (aerobic) respiration

*do **not** accept anaerobic respiration*

1

(of) bacteria / fungi / microorganisms / microbes / decomposers

1

reference to more is only needed once for the first two marking points

(g) fertilisation

ignore sexual reproduction

1

(h) asexual (reproduction)

allow cloning

1

[10]

Q8.

(a) description of a method to achieve random placement

examples could include random number generator or random coordinates
*allow throw over the shoulder **or** with eyes shut*
ignore throw unqualified

1

(b) any **one** from:

- random (location)

  allow by chance

- avoid bias
- obtain valid / representative results

  allow more accurate / precise mean

ignore fair test / accurate / precise
unqualified

1

(c) as a control / comparison

allow see the difference

1

or

B varies from A in only one factor

*do **not** accept a control variable*

(to) show results (in A) are due to weed killer

allow to see the effect of the weed killer
allow so the results are valid

1

(d) 11

allow eleven

1

(e) $\frac{10-2}{10} \times 100$

1

80

1

*an answer of 80 scores **2** marks*

(f) use more quadrats

allow use larger quadrats
allow repeat

1

original may not be representative **or** reference to weeds being distributed unevenly

allow mean is more reliable / accurate / precise
ignore more valid

1

or

leave for more than two weeks (1)

original may not be representative (1)

allow mean is more reliable / accurate / precise
allow weed killer may take longer than two weeks to work (fully)
ignore more valid

[9]

Q9.

(a) there is an uneven distribution of dandelions
or
(more) representative / valid
or
avoid bias
or
more accurate / precise mean

ignore accurate / precise unqualified
ignore repeatability / reproducibility / reliability / fair test

1

(b) (correct mean per m^2 =) 6 or 6.0

1

(correct field area =) 55 000 (m^2)

1

mean × area − e.g. 6(.0) × 55 000

allow incorrect calculated values for mean and / or field area

1

330 000

allow correct calculation from previous calculation

1

3.3×10^5

allow calculated value in standard form

1

*an answer of 3.3×10^5 scores **5** marks*
*an answer of 330 000 scores **4** marks*

(c) **Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

5–6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

- placing of quadrat
- large number of quadrats used
- how randomness achieved − e.g. table of random numbers **or** random number button on calculator **or** along transect

- quadrats placed at coordinates **or** regular intervals along transect
- in each of two areas of different light intensities **or** transect running through areas of different light intensity
- for each quadrat count number of dandelions
- for each quadrat measure light intensity
- compare data from different light intensity

to access **level 3** the key ideas of using a large number of quadrats randomly, or along a transect, and counting the number of dandelions in areas of differing light intensity need to be given to produce a valid outcome

(d) any **two** from:

- temperature
  allow heat
- water
  allow moisture / rain
- (soil) pH
  allow acidity
- minerals / ions
  *allow e.g. magnesium ions **or** nitrate*
  allow salts / nutrients
- winds
- herbivores
  allow trampling
  ignore carbon dioxide
  ignore space
  ignore competition unqualified
  *do **not** accept oxygen*

2

[14]

Q10.

(a) to kill microorganisms on / in the flask
or
so only microorganisms in the milk caused the results
allow bacteria / fungi / microbes
*do **not** accept viruses*
ignore germs

1

(b) heating

1

to over 100 °C
allow place in oven / pressure cooker
*do **not** accept disinfectant*

allow other suitable method – e.g. use of UV

1

(c) to prevent microorganisms entering from the air

allow bacteria / fungi / microbes for microorganisms
*do **not** accept viruses*
ignore germs

1

(d)

0	olive-green	**7**
1	olive-green	**7**
2	olive-green	**7**
3	orange-green	**6**

*all correct for **1** mark*

1

(e) (pH meter) – more accurate / more precise

allow more exact
allow can measure to 0.1 pH unit
***or** to smaller intervals of pH*

1

(leaving…6 days) – obtain greater pH change
or
because there was (very) little change in 3 days

allow more acid will be made

1

(f) scale > $\frac{1}{2}$ of x-axis
and
x-axis labelled (time in) days

1

points plotted correctly

*all 7 correct = **2** marks*
*5 or 6 correct = **1** mark*

2

line of best fit = smooth curve through points

*do **not** accept ruled point-to-point*

1

(g) (1st day) too few bacteria

1

(after day 1 more bacteria so more) acid made

1

(days 5-6) sugar / food used up

or
low pH denatures enzymes
or
low pH kills bacteria

allow enzymes do not work
*do **not** accept enzymes killed*

1

(h) (similarity) – same start pH /
pH7 and end pH / pH4.5
or
same pH change / change = 2.5

1

(difference) – faster

1

[16]

Q11.

(a) any **two** from:
- sprinkled through air
- air spaces between stones
- thin layer over stones (for efficient diffusion)
- slow flow (for efficient diffusion)

2

(b) green algae

1

(c) (large / small) protist

1

(d) **Level 2 (3-4 marks):**
Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.

Level 1 (1-2 marks):
Facts, events or processes are identified and simply stated but their relevance is not clear.

No relevant content (0 marks)

Indicative content

digestion:
- (external) enzymes released
- role of enzymes – e.g. amylase / protease / lipase
- substrates & products – e.g. starch ⟶ sugar / protein ⟶ amino acids / fat ⟶ fatty acids

absorption:
- by diffusion / active transport

deamination:
- amino acids ⟶ ammonia / ammonium ions

release of other ions:
- e.g. phosphate / nitrate / magnesium

respiration:
- produces carbon dioxide (+ water)
  or
  equation is given
- release of energy allows other processes to take place e.g. active transport

[8]

Q12.

(a) snail
or
shrew

additional incorrect answer negates correct answer

1

(b) shrew

additional incorrect answer negates correct answer

1

(c) fewer shrews to eat them

1

(d) population

1

(e) **C**

1

(f) (11 000 × 0.1 =)
1 100 (kJ)

1

(g) the snails do not eat the roots of the lettuces

1

(h) any **one** from:
- light (intensity)
- temperature
- moisture (levels)
- soil pH
- mineral / ion content (of soil)
- wind intensity / speed

  ignore wind direction
- carbon dioxide (levels)
- oxygen (levels)

1

[8]

Q13.

(a) measure the length / area of the field

1

(b) use (a) random number(s) (generator)
or
use coordinates method explained

1

(c) compare their results with another student's results

1

place more quadrats

1

(d) 0.25 × 5 = 1.25

1

500 / 1.25 = 400

1

(40 × 400 =) 16 000
*allow 16 000 with no working shown for **3** marks*

1

(e) 11

1

(f) (quadrat) 5
*both quadrat number and correct reason must be given for **1** mark*

1

very few or only 2 growing (here)

[9]

Q14.

(a) methane is produced
ignore bad smell

1

which is a greenhouse gas / causes global warming

1

(b) (9.80 / 0.20 = 49 therefore) 49:1

1

(c) horse (manure)
*allow ecf from **11.2***

closest to 25:1 (ratio)

1

(d) **Level 3 (5–6 marks):**
A detailed and coherent explanation is given, which logically links how carbon is released from dead leaves and how carbon is taken up by a plant then used in growth.

Level 2 (3–4 marks):
A description of how carbon is released from dead leaves and how carbon is taken up
by a plant, with attempts at relevant explanation, but linking is not clear.

Level 1 (1–2 marks):
Simple statements are made, but no attempt to link to explanations.

0 marks:
No relevant content.

Indicative content

statements:
- (carbon compounds in) dead leaves are broken down by microorganisms / decomposers / bacteria / fungi
- photosynthesis uses carbon dioxide

explanations:
- (microorganisms) respire
- (and) release the carbon from the leaves as carbon dioxide
- plants take in the carbon dioxide released to use in photosynthesis to produce
  glucose

use of carbon in growth:
- glucose produced in photosynthesis is used to make amino acids / proteins / cellulose
- (which are) required for the growth of new leaves

6

(e) any **three** from:
(storage conditions)
- (at) higher temperature / hotter
- (had) more oxygen
- (had) more water / moisture
- (contained) more microorganisms (that cause decay)

  allow reference to bacteria / fungi / mould

3

[13]

Q15.

(a) any **one** from:
- continuous readings
- do not need to be there

  allow automatic readings
- (more likely to be) accurate

  allow greater resolution

  *do **not** allow valid*
- reduces human error

  allow easier to read

1

(b) (i) microorganisms

allow microbes / bacteria / fungi / decomposers for microorganisms, throughout

1

(microorganisms) respire

1

respiration / decay / microorganisms releases carbon dioxide

ignore carbon released

1

(ii) all grass decomposed / decayed / rotted

*allow idea that all microorganisms dead (due to accumulation of waste **or** lack of oxygen)*

allow lack of / no oxygen (for respiration of microorganisms)

1

[5]

Q16.

(a) 88 000

correct answer = 2 marks

allow 1 mark for 1.1 (in 1 m^2)

or

allow 1 mark for answer = [candidate's value in 1m^2] × 80 000

2

(b) Place the quadrat in 100 random positions.

1

(c) any **three** from:

must include at least one advantage and one disadvantage for full marks

Advantages:

- less cost / free
- less likely to kill other (harmless species of) plants
- weedkiller may be toxic **or** may cause water pollution
- weedkiller may accumulate up food chains

allow uneven distribution of ragwort so much wastage of weedkiller

Disadvantages:

- volunteers may mistake other species for ragwort
- volunteers may miss plants

allow weeds will grow back

- some ragwort left to poison horses
- time consuming
- difficulties getting enough volunteers

if no other disadvantages; allow ref. to issues with volunteers – eg don't turn up / not careful / don't

finish the job

3

[6]