1. (a) large number – more representative and so more valid (mean can be calculated)

allow more reliable

1

random – avoid bias

1

(b) correct figures in table:

(3)
(8)
(16)
19
9
4
1

1

(c) all bars plotted correctly

± 1 mm

allow ecf from the table

1

(d) any **three** from:

- much overlap of values between the 2 shores

sheltered shore:

accept converse for exposed shore

- wider range **or** use of figures – e.g. approx 0.26 to 0.70 cf 0.21 to 0.55
- higher mode **or** use of figures – e.g. 0.41 to 0.45 cf 0.36 to 0.40

allow ecf for figures from (b)

- there are no limpets at 0.21 to 0.25

allow there are no limpets on exposed shore at 0.56 to 0.70

3

(e) sheltered – 0.47 **or** 0.466

1

exposed – 0.35 **or** 0.354

1

(f) radius = 2.48 cm

*an answer of 38.6 / 38.62 / 38.64 scores **3** marks*

1

(area = 3.14 × $(2.48)^2$ =) 19.3 cm^2

allow area calculated from incorrect radius

1

(force = 19.3 × 2 =) 38.6 (newtons)
or
(force = [3.14 × $(2.48)^2$] × 2)
= 38.62 (newtons)
or
(force = [π × $(2.48)^2$] × 2)
= 38.64 (newtons)

allow force calculated from 1 previous error

1

(g) any **two** from:

- foot may not be circular
- foot may be larger / smaller than outside of shell
- scientists' value is approximate
- variation between limpets / described

  *e.g. re muscle development **or** greater 'awareness' of some limpets*
- variation in rock surface texture

2

(h) any **three** from:

- more force of waves to dislodge limpets
- lower height lowers exposure to waves
- wider foot gives greater grip
- those with this / these feature(s) pass on alleles / genes to offspring leading to population of broad squat limpets

allow converse for sheltered shore throughout, if clearly stated

3

[17]

2. (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]

3. (a) (i) counts / 12

1

× 120 × 80 / × 9600
or
× area of field

1

(ii) (more) quadrats / repeats

1

placed randomly

ignore method of achieving randomness

1

(b) (i) any **three** from:

- temperature / warmth / heat
- water / rain
- minerals / ions / salts (in soil)

  allow nutrients / fertiliser / soil fertility

  ignore food
- pH (of soil)
- trampling
- herbivores

  ignore predators
- competition (with other species)
- pollution qualified e.g. SO_2 / herbicide
- wind (related to seed dispersal).

  ignore space / oxygen / CO_2 / soil unqualified

3

(ii) light needed for photosynthesis

1

for making food / sugar / etc.

1

effect on buttercup distribution eg more plants in sunny areas / fewer plants in shady areas

1

(c) (i) fertiliser / ions / salts cause growth of algae / plants

1

(algae / plants) block light

1

(low light) causes algae / plants to die

1

microorganisms / bacteria feed on / break down / cause decay of organic matter / of dead plants

*do **not** allow germs / viruses*

1

(aerobic) <u>respiration</u> (by microbes) uses O_2

*do **not** allow anaerobic*

1

(ii) sewage / toxic chemicals / correct named example eg metals / bleach / disinfectant / detergent etc

allow suitable named examples eg metals such as Pb / Zn / Cr / oil / SO_2 / acid rain / pesticides / litter

ignore chemicals unqualified

ignore waste unqualified

ignore human waste / domestic waste / industrial waste unqualified

1

(d) (i) 2 **1**

(ii) more food

allow other sensible suggestion eg more species colonise from tributary streams after forest

1

(iii) number of stonefly species decreases (from **A** to **B** / **B** to **C** / **A** to **C**) as more pollution enters river / less oxygen

allow fewer species in more polluted water

ignore none are found at site C

1

[19]