1. (a) (i) *award both marks for correct answer*

10 000 / 800 000 (× 100);
1.25 / 1.3 / 1(%);   2

  (ii) **R** *any reference to energy / light missing the plant*

reflected (off plant) / only certain wavelengths of light can be, absorbed / used; ora
absorbed by / hits, non-photosynthetic parts; e.g. bark
passes through leaf / misses chlorophyll / misses chloroplasts;
some is heat that is used in evaporation / respiration; max 2

  (iii) bacteria / named bacterium decomposer; (*Nitrobacter*, *Nitrosomonas*) 1

  (iv) *take the first 2 answers*:

death / dead remains;
excretion; **R** *waste products*
egestion;
other suitable method; e.g. insects moulting
         hatched eggs
         moulting (fur / feathers)
         R *leaves*   2

(b) *Primary consumers are eating and…*

producers have, cell walls / cellulose; ora
difficult to digest / much material, wasted / egested;
energy used by gut microorganisms; ora
much material cannot be eaten (by primary consumer); ora 3

                     [10]

2. (a) starts with previously uncolonised area / bare ground / bare rock / AW;
ref to pioneer species / named pioneer;
series of recognisable, seres / stages;
progresses to, climax / final equilibrium stage; max 2

(b) stabilise environment;
soil development / increase humus / organic material;
change soil pH;
hold more water;
release more minerals or nutrients / increase N content or fix N / hold
  ions;
form microhabitat / reduce exposure / provide shelter / reduce erosion; max 3

(c)   *any two from following*:

       grazing;
       burning;
       mowing / application of fertilizer / application of selective herbicide;
       exposure to wind;
       grass able to continue to grow (linked to a statement above);   2

(d)   increases;
       plants at later stages are large / plants in early stages are small;
       trees / shrubs. are woody, appear later in succession;   2

[9]

3.   population;
    habitat;
    community;
    ecosystem;

    (first) trophic; **R** *tropic*
    producers/(photo) autotrophs/autotrophic;
    (primary) consumers/heterotrophs/heterotrophic/herbivore;

    R *carnivore/other qualified consumer*   7

[7]

4.   (a)   (clinically) obese/obesity; **R** *morbidly obese*   1

(b)   *Diet B*
       essential fatty acids/linoleic acid/linolenic acid/fat soluble
       vitamins/A/D /E/K;

       Diet C
       sugars/named sugar/starch; **A** *vitamin C*   2

(c)   (i)   B;
          energy intake (of B) is lower ORA;   2

      (ii)   energy intake is less than energy used ORA;   1

(d)   (no fruit may mean) scurvy/described; **R** *vitamin C deficiency unless qualified*

raised, cholesterol/LDL, levels in blood; **R** *intake*
fatty substances deposited <u>in</u> artery walls/atherosclerosis;
<u>coronary</u> arteries;
narrows lumen;
reduces, blood/oxygen, delivered to <u>heart muscle</u>;
CHD/heart attack/angina;
thrombosis/clot;
raised blood pressure/hypertension;
stroke;

stress on liver;
stress on kidney;
due to excess protein/amino acids/urea;

AVP;
AVP; e.g.   deposition of subcutaneous fat/AW
            obesity
            stress on joints
            anorexia/bulimia/obsession on diet
            constipation
            bowel cancer
            hypoglycaemia
            giddiness
            lethargy/fatigue/tiredness *[but **R** 'lack of energy']*   3 max

[9]

5.   release of carbon dioxide;
from fungal respiration;
available for photosynthesis/carbon fixation;
extracellular digestion;
named enzyme(s);
release of, inorganic substance/minerals/named mineral; **R** *nutrients, nitrogen*
        A <u>*nitrogenous compound*</u>
uptake through, <u>roots/root hairs</u>;
named use of mineral in plants;
ref. to humus;
ref. to beneficial role of humus in soil; e.g. increase water retention, improve soil
        structure, stabilize soil   max 4

[4]

6. ref to, leaching/runoff, into waterways;
causing algal blooms;
blocking of light for aquatic plants;
ref to, decomposition/high numbers of decomposers;
leading to high BOD;

reference to 'blue-baby' syndrome;
links to haemoglobin;   max 4

[4]

7. 1 ref to setting grid/area to be sampled;
2 suitable systematic method chosen/ref to belt/line transect;
3 ref to repetition of line transects;
4 use of <u>quadrats</u>;
5 use of appropriate sized quadrat;
6 details of <u>regular</u> quadrat placing;

7 identify species/use of keys;
8 presence or absence in quadrat;
9 calculation of % of species frequency;
10 measure % cover/use of appropriate scale; e.g. (Braun-blanquet/ACFOR/
     DAFOR/DOMIN)
11 ref to analysis of data/use of kite diagram;
12 AVP; ref to relevant statistical analysis, e.g. Spearmans Rank Correlation   max 7

QWC - clear well-organised answer using specialist terms   1

[8]

8. (a) plants/protoctists;
animals/fungi/protoctists;

A *protoctists once only* **R** *taxa that are not kingdoms*   2

(b) *energy*
movement/locomotion/muscle contraction/cilia/flagella;
active transport; **A** *example*
anabolic reactions/AW; **A** e.g. *protein synthesis/DNA replication*
(movement of chromosomes in) mitosis/meiosis;
nerve impulse/electrochemical gradients;
maintain body temperature/generate heat;
AVP; (eg bioluminescence/electrical discharge)
AVP; (detail of any point)   *3 max*

carbon
in, biochemicals/macromolecules; **A** *in organic matter*
e.g. carbohydrate/protein/lipid/nucleotide/nucleic acid;
A *named examples*
growth;
repair;
AVP; e.g. detail of any point)　　　　　　　　　　　*3 max*　　max 4

(c)　(nitrifying bacteria) help/increase, plant growth;
　　　bacteria make nitrate (available);
　　　plants need nitrate;
　　　for, amino acids/protein/chlorophyll/DNA;
　　　for, new cells/mitosis/new leaves;　　　　　　　　　　max 2

(d)　(i)　chemoheterotrophic;　　　　　　　　　　　　　　1

　　　(ii)　photoautotrophic;　　　　　　　　　　　　　　1

(e)　(i)　carbon; **R** CO_2　　　　　　　　　　　　　　1

　　　(ii)　*Desulfovibrio*, uses sulphur (S)/makes hydrogen sulphide (H_2S);
　　　　　　green sulphur bacteria, use H_2S/make S;
　　　　　　colourless sulphur bacteria use H_2S;　　　max 2

(f)　colourless sulphur bacteria;　　　　　　　　　　　　1

(g)　*C. perfringens* similar to *C. difficile*/AW;
　　　(bacteria) anaerobic;
　　　(tissue damage/poor blood supply) decreases oxygen available;
　　　conditions suitable for *Clostridium* to multiply;
　　　AVP;　　　　　　　　　　　　　　　　　　　　max 2

[16]

9.　(a)　(i)　denitrification;　　　　　　　　　　　　　1

　　　　　(ii)　Rhizobium;　　　　　　　　　　　　　　　1

　　　　　(iii)　active transport / diffusion;　　　　　　　1

　　　　　(iv)　nitrification;　　　　　　　　　　　　　　1

(b) *max 3 for each method*

ploughing-in

1   legumes / named e.g., possess, (root) nodules /
     nitrogen fixing bacteria;

2   *Rhizobium,* performs nitrogen fixation / described;

3   nitrogenous compounds are present in, roots / nodules /
     legumes / plants;

4   made available to soil if, ploughed in / not removed;

5   roots / AW, decomposed / acted on by decomposers / rot / decay;

6   nitrogenous compounds released (by decomposers);

7   formation of nitrate; *3 max*

crop rotation

8   different, crops / plants, have different (nutrient / nitrate)
     requirements;

9   each year, different demands made on the soil / nutrients not
     being removed at the same rate;

10   in, 4th / fallow, year, no (little) nutrients removed / used
     for grazing animals;

11   nutrient levels allowed to build up;

12   use legume in rotation;

13   tuber / root, crop to improve soil structure; *3 max*

4 max

[8]

10. idea of soil development; **A** ref to depth or fertility of soil
     (increase), organic material / humus;
     (increase) in availability of water;
     minerals available; **A** nutrients
     (some pioneer species) carry out nitrogen fixation;
     photosynthesis (fixing carbon);
     create habitats / provide shelter;
     AVP; e.g. increase weathering, stabilise sand / soil   2 max

[2]

11. (i) final stage in succession / AW;
(community) in equilibrium with environment;   1 max

(ii) eat / trample, seedlings (of shrubs / trees) / AW; **R** eat grass
prevents, succession / establishment of next sere;   1 max
                                                                    [2]

12. (a) *award two marks if correct answer (18.4) is given*
incorrect answer (or no answer) but correct working = 1 mark

44 / 239 (× 100)
18.4%;;

ecf applied for minor addition errors +/- 2   2

(b) 1 lay, tape / string, <u>across</u> path; **R** along the path
2 include trampled and non trampled areas in same transect;
3 use of quadrat;
4 ref to how quadrat is placed; **R** random
5 count number of plants / percentage cover of plants;
6 plot a graph;
7 repeat the transect;
8 carry out statistical test (Mann-Whitney / Spearman's rank);
9 AVP; e.g. detail of sampling technique   5 max
                                                                    [7]

13. plot size;
soil type;
soil pH;
plant cover;
aspect / locality;
ref to temperature linked to aspect;
slope;
ref to rainfall or irrigation;
time period;
AVP; e.g. tillage, method of cultivation, degree of compaction
AVP; e.g. previous use of land   max 3
                                                                    [3]

14. 1 <u>eutrophication</u>;
    2 increased growth of, algae / seaweeds;
    3 block, light / space;
    4 ref to competition;
    5 (so) alters food chain / example;
    6 decomposition of, sewage / dead organisms;
    7 ref to aerobic bacteria / increased BOD / less oxygen in water;
    8 fish / sea slugs / sponges / corals, die; (linked to oxygen loss)
    9 AVP; e.g. increased mineral nutrients increases susceptibility of corals to
       disease,
       increased numbers of anaerobic species, ref to heavy metal toxicity   4 max

                                                                         [4]

15. (a) *do not credit if any incorrect answer included*

        (i) fox;   1

        (ii) grass / clover / legume;   1

    (b) (i) nitrogen fixation / Haber (process); **A** reduction   1

        (ii) lightning; **A** oxidation / combines with oxygen
                      A 'lightening'
                      R thunderstorm / lighting   1

        (iii) denitrifying; **A** correct e.g. (Pseudomonas)
                        R Nitrobacter / Nitrosomonas / Rhizobium   1

        (iv) fixes nitrogen / provides fixed nitrogen *or* $NH_4^{(+)}$; **R** ammonia
             ref to, clover / legume / named legume, making, amino acids /
             polypeptides / protein;
             (plant has) no need to rely on (fixed) nitrogen compounds in soil;
             R *ref to fertilisers*
             free-living species provide, ammonium (ions) / fixed nitrogen,
             for nitrifying bacteria / nitrification;   2 max

                                                                            [7]

16. (i) higher, number / proportion / percentage / ratio / fraction, of mounds
have thyme ;
(c.f. quadrats) *ora*

A figs, e.g. ⅔ vs ½, 2:1 vs 1:1, 36 vs 24   1

(ii) *look for a statement and a reason*

use smaller quadrat ; e.g. 50 cm × 50 cm
for fair test ; AW

use grid and random numbers ;
throwing keys biased ; AW

estimate, percentage cover / abundance ; **A** point (frame) quadrat
may be single plants in some samples and many in others ;

bigger study area / more data ; (keep equal numbers mounds and quadrats)
improves reliability / AW ;

record other plants ;
could influence thyme ;

measure / note, abiotic variables ; **A** example
explanation of how named variable affects thyme ;

AVP ;
AVP ;   4 max

                                                                                               [5]

17. (a) (i) (place) where, organism / animal / plant / population /
community, lives; **R** *things / named organism*   1

(ii) <u>role</u> of organism in**,** the ecosystem / AW;
A *habitat / environment / community / area / place*
R *population*   1

(iii) living / biotic**,** and, non-living / abiotic, components that interact;   1

(b) population = one <u>species</u>
<u>**and**</u> community = more than one / all, species / population;   1

                                                                                               [4]

18. (i) **1** some <u>food</u> not, eaten / accessible; **A** *an example*

2 some**,** food / energy, not digested / egested / lost as faeces;

3 (some assimilated) food / energy, lost in excretion;

4 ref to decomposers;

5 (some assimilated) food / energy, lost in respiration;

6 <u>energy</u> lost**,** as heat / in movement / in metabolism;

7 small proportion energy used for**,** growth / material**,**
and is available to next trophic level;   3 max

(ii) **1** plant material difficult to digest / animal material can be digested

easily;

2 ref to, cellulose / lignin / wood;

3 no cellulase;

4 (animal) gives similar spectrum of amino acids (as consumer);

5 less of the producer available to the 1° consumer than 1° consumer available to the 2° consumer;

6 AVP; e.g. ref to gut bacteria

ignore references to numbers of organisms eaten or size of organisms   2 max

[5]

19. (i) natural change in species composition (in an area) ;
ref to directional change ;
ref to named examples in the diagram (either species or category) ;
over a period of time ;
a number of recognisable stages / seres / seral stages ;
one sere changes the conditions for the next ;
e.g. depth of soil increases / soil stabilisation ;
leads to a climax community ;
creation of niches ;
ref to nitrogen fixation ;
AVP ; e.g. pioneer species   4 max

(ii) development of deeper soil ;
soil, becomes rich in humus / has more nutrients / is more fertile ;
dominant species change ;
plant species get larger / shrubs to trees / increase in biomass / larger root systems ;
    R soil structure improves unqualified ;
AVP ;   2 max

(iii) **biotic** = animal species / number of soil organisms / decomposers / detritivores / decrease in biodiversity ;
AVP ;

abiotic = pH of soil / nitrogen *or* mineral content of soil / soil texture / wind speed / humidity / shading / light intensity / soil water retention ;
AVP ; e.g. temperature   2 max

[8]

20. U;
V;
Z;
S;   4

[4]

21. (a) *advantages (max 2)*

can be used with any species (irrespective of size);

does not require to distinguish one individual from another;
quick to assess;   **R** simple

disadvantages

subjective / AW;
dominant species may be over-estimated;   max 3

(b) (i) line established, from shore to dune slack / from… to…;
quadrat used;
suitable size / actual size stated (minimum 0.25m^2);   **R** if no units
given
placed continuously / at specified intervals along line;
key to identify species;
abundance recorded in each quadrat;
bare ground recorded;   max 4

(ii) **1** ACFOR scale converted to numerical scale;
2 reading at each site recorded (on graph paper);
3 width of diagram related to ACFOR (maybe shown on diagram);
4 points from each site joined together;
5 repeated for each species found present;   max 3

(c) use of, thermometer / probe;
probe must be calibrated;
pushed into, sand / soil, to same depth each time;
repetitions at each sampling point;   max 2

(d) (i) a stage during the process of succession;   1

(ii) sea couch / marram grass, grow in bare sand;

dune builds up / stabilised by grasses;

OR

colonisers established on bare, rock / soil;
example; (if not sand dunes)

ref to pioneer species;
organic matter builds up / humus content increases;
forming soil / depth of soil increases;
other species take over from grasses;   **A** named example
from Fig. 1
roots stabilise soil structure;
diversity of species increases;
climax eventually reached;
AVP;
AVP;   e.g. reference to deflected succession,
                        growth of shrubs   max 4

[17]

22. **1** sun is the energy source (for the system);
2 producers / (green) plants, trap / use / absorb (sun's energy);
3 photosynthesis;
4 not all energy trapped and reason;

5	energy used for, plant metabolism / plant processes / e.g.; **A** respiration	
6	so this energy not, passed on / available, to consumer;	
7	(some energy) used for, growth / storage;	
8	so this energy is, passed on / available, to consumer;	
9	1° consumer / herbivore, eats, producer / plant;	
10	some producer, not edible / not accessible / e.g.;	
11	some, not digested / egested / lost as faeces;	
12	2° consumer / carnivore / omnivore, eats, 1° consumer / herbivore;	
13	some parts of animal not edible / e.g.;	
14	energy used by animal in moving (to feed);	
15	energy, used / lost, in, digestion / excretion / sweating / e.g.; **A** respiration	
16	transfer / loss, to, decomposers / bacteria / fungi / saprotrophs;	
17	energy lost as <u>heat</u> from respiration;	
18	net productivity = gross productivity – respiration;	
19	some ref to estimate of efficiency of transfer (a general statement);	
20	quote of (comparative) figures from diagram;	
21	manipulation of figures to illustrate a point; **NOT** 6612 and 14198	
22	AVP;	
23	AVP; e.g. loss out of ecosystem	
	another manipulation of figures	
	available energy limiting length of chain	max 9

QWC – legible text with accurate spelling, punctuation and grammar;   1

                                                    [10]

23.   (i)   anaerobic conditions encourage denitrifying bacteria;
                convert nitrate ions to (gaseous) nitrogen;
                reduces available nitrogen;

                sundew does not rely on, soil nitrate / soil nitrogen;
                ref to, hydrolysis / digestion / use of enzymes, on insect proteins;
                releasing amino acids;
                ref to deamination;   *max 3*   max 4

    (ii)   Reduces amount of air in soil;
                roots starved of oxygen;
                respiration becomes anaerobic;
                insufficient energy released;
                not able to absorb (enough), ions / named ion;
                via active transport;   max 3

                                                        [7]

24.   (a)   set out a grid in each area *or* site / description of how the grid is
                established;
                use random numbers;
                how generated; e.g. random number tables / use of calculator
                to give co-ordinates;
                at that point / co-ordinate, measure nearest plant;

repeat (14 times);   max 4

(b) (i)   total heights;
           divided by the number of plants (in the sample);
           provides an average height for the sample;   max 2

     (ii) measure of, variability / spread of heights (in sample); **R** range
           sum of differences from the mean;
           68% of values lie within mean ± 1 S.D.;
           95% of values lie within mean ± 2 S.D.;   max 2

(c) greater spread from mean in site **B** / *ora*; **R** range
     height of plants in site **B** is more variable / *ora*;   max 1

(d) (i)   that there is no <u>significant difference</u>;
           between the mean height in site **A** and the mean height in
           site **B**; **A** results any difference is entirely due to chance;   max 2

     (ii) there is a <u>significant difference</u> between the means at the two sites;
           the <u>difference</u> is due to something other than chance;
           reject the null hypothesis;
           with 28 degrees of freedom;
           at the 5% confidence level; **A** $p<0.05$ / <0.01 / <0.001
           the critical t value is, 2.05 / 2.76 / 3.67;
           calculated value, exceeds / is much higher than, this;
           assuming the sample shows a normal distribution;   max 4

                                                                        [15]

25. *accept reverse arguments if responses are referring to cereal plants*

     both have root nodules;
     with <u>*Rhizobium*</u> bacteria;
     which are nitrogen-fixing;
     convert nitrogen (gas), to nitrate ions / ammonium compounds; **A** NO_3^- / NH_4^+
           R ammonia / NH_3
     plants convert these to amino acids;
     which are used to make protein;
     high levels of proteins stored in seeds;   max 4

                                                                        [4]

26. *accept any three correct statements based on the data;;; for example*
     populations of, mites / springtails, much greater / more than twice the
     number, in the climax forest than before trees established *ora*
     number of species of springtail greatest in the climax community *ora*
     small difference in numbers / no significant difference, between areas with young
            trees and areas with mature trees
     there were always (many) more mites than springtails in the sample

     [3]

27. *mark (i) and (ii) to max 3 each – the question to max 4*

     (i)   *nitrifying bacteria*
           convert, ammonium / NH_4^+, to, nitrate III / nitrite / NO_2^-;
           A *ammonia / NH_3*

           nitrite, converted to, nitrate (V) / NO_3^-;

           A *one mark for single step 'ammonium to nitrate (V)'*

           requires, aerobic conditions / oxygen / aerated soil;
           (nitrate (V) ions) can be, taken up / used, by plants;

     (ii) *denitrifying bacteria*
           remove nitrate (V) (ions) / convert nitrate (V) (ions) to nitrogen (gas);
           in, anaerobic conditions / oxygen poor soil / non-aerated soil;
           recycles nitrogen / further use of nitrogen (by fixing);
           prevents nitrogen being trapped / AW;   4 max

     [4]

28. (i)   *look for prokaryote feature*

           no nucleus / no nuclear membrane / no nucleolus / DNA free
           (in cytoplasm); **R** DNA moving
           naked DNA / DNA not associated with proteins / no chromosomes;
           circular / loop, DNA;
           no, membrane-bound organelles / e.g.;
           smaller / 18nm / 70S, ribosomes;
           no ER;
           cell wall, not cellulose / polysaccharide and, amino acids / murein;
           AVP; e.g. mesosomes / plasmids   1 max

     (ii) glycosidic (link) <u>and</u> peptide (bonds) (in correct context);
           condensation;
           ref. OH groups;
           ref. NH_2 and OH group;
           water, removed / produced / by-product;
           enzyme;
           AVP; e.g. energy required   3 max

     (iii) iron / Fe; *ignore pluses / minuses*   1

    (iv) *treat enzyme as neutral*

        nitrogenase;
        leghaemoglobin;
        haemoglobin;   2 max

    (v) (nitrogen) fixation; **A** reduction   1

    (vi) type of inhibition (competitive / non-competitive / reversible / irreversible);
        basic mode of action (e.g. binds to active site);
        detail;
        consequence (e.g. prevents, substrate / nitrogen, from binding);   2 max

                                                    [10]

29.   primary consumer / herbivore; ignore e.g.s **R** vegetarian   1

                                                     [1]