

1. (a) Soil erosion / mud slides / flooding / leaching  
of minerals – trees no longer protect soil from rain / from  
wind / roots no longer hold soil;  
Increased CO<sub>2</sub> (in air) OR “greenhouse effect” – trees remove  
CO<sub>2</sub> / trees photosynthesise / burning releases CO<sub>2</sub>;  
Less diversity / loss of (forest) species / fewer individuals – loss  
of food / loss of habitat / niches / ecosystem;  
Changed rainfall patterns / drought – less transpiration from trees; 2 max
- (b) 1. Suitable habitat / food nearby for displaced animals;  
2. Later recolonisation possible from adjacent areas;  
3. Reference to sufficient time for recovery (e.g. not felled again  
for 280 years); 3 max

[5]

2. (a) greenflies take in (small mass of) insecticide from roses/leaves;  
ladybirds eat large numbers of/more/many greenflies;  
bioaccumulation idea / insecticide cannot be excreted/remains in  
body/stored in fat/not broken down; 3
- (b) (i) chemical: numbers fluctuate throughout year;  
biological: numbers fairly constant throughout year /  
accurate description; 2
- (ii) number of plants drops because of spraying/reapplication, then  
rises because insecticide washed away/new plants grow; 1
- (c) (i) chemical: some plants/parts of plants are not sprayed / spray washes  
off before it has effect;  
plant may be resistant to spray; (*Reject ‘immune’*) 2
- (ii) biological: because biological control never eats all plants;  
as weeds diminish so do control agents and/or *vice versa* / is balance  
between food and consumer; 2

[10]

3. (a) interspecific; 1
- (b) one mark for two resources e.g. light; named nutrient, water; 1

- (c) (i) one mark for working showing spruce and heather as control;  
0.16/0.17 metres per year; 2
- (ii) produces substance/ nutrient which stimulates  
growth of spruce / inhibits growth of spruce /  
provides nitrogen-fixing bacteria; 1

[5]

4. (a) similar characteristics / physically similar / DNA similar;  
breed among themselves;  
to produce fertile offspring;  
do not share same ecological niche with any other species; max 2

- (b) (i) isolation;  
no gene flow between populations;  
variation;  
different environmental factors;  
natural selection / selection for specific alleles / characteristics;  
change in allele / phenotype frequency;  
changes over a long period of time; max 4

- (b) (ii) more habitats / niches;  
more / greater range of food for herbivores;  
more / greater range of food for carnivores / predators;  
more detritus; max 2

- (c) colonisation / description e.g. seeds blown in / pioneer species;~  
succession;  
alteration of habitat / more humus / deeper soil;  
development of herbaceous / field layer;  
followed by shrub layer; max 4

[12]

5. (a) Shells;  
Spray/flooding by seawater;  
Weathering of underlying rock;  
Nitrogen fixation;  
Excretory products; max 2

- (b) One mark for correct numbers = 4, 1, 1/2;
- (i) The last stage in succession, therefore furthest from sea has greatest diversity/number of species of plants; greatest amount of organic matter;
  - (ii) Little humus/organic matter to hold/retain moisture/ More sand promoting drainage;
  - (iii) Pioneer species/colonisers are often wind-dispersed/need large numbers of small seeds in order for some to land on bare sand;

4

[6]

6. (a) dry ice;  
combustion;  
manure / compost;

max 2

- (b) not cost effective;  
since some other factor limiting rate of photosynthesis;

2

- (c) cost of provision covered by extra cash from sale;  
as crops fetch higher price in winter;

2

[6]

7. (a) using a predator / parasite / pathogen to control (the numbers of) a pest organism;  
name of control organism and pest;  
explanation of control method;

3

- (b) advantages (max 3)  
(if well-screened) a biological control agent only attacks the pest;  
forms self-perpetuating population (only one application required);  
cheaper (qualified) e.g. saves cost of repeatedly using chemicals;  
safer because does not leave chemical residue;  
organisms do not become resistant to biological control;
- disadvantages (max 3)  
doesn't completely eradicate pest;  
cost of researching / setting up a biological control system;  
biological control agent may become a nuisance itself/must be well screened;  
slower to get rid of pest than chemicals;  
more subject to environmental factors;

any 4

- (c) use of restriction / endonuclease enzyme;  
cuts DNA at specific base sequence / recognition site;  
reference to vector / method of inserting DNA;  
same endonuclease to cut vector/host DNA;  
use of ligase enzyme (to join DNA strands);  
(allow equivalent mark points for use of reverse transcript) max. 4
- one mark for advantage of genetic engineering  
e.g. much quicker / more efficient / several genes can be inserted at once;

[12]

8. (a) correct % reduction for A; (*16.6 → 7.6 OR 9%*)  
correct % reduction for B; (*15.04 → 10.07 OR 5%*)  
greater percentage reduction in A 3
- (b) (i) destruction of affected trees;  
use of insecticides;  
release sterile males / females  
selective breeding of beetle resistant palms max 2
- (ii) if one method fails, other still partially effective;  
reduced amounts of pesticides needed;  
increased yield / less chance of resistant species developing /  
less effect on food webs; max 2
- (c) possible effects on non-target species;  
possibility of population explosion due to lack of natural predators;  
not all pests killed;  
difficulty in maintaining population of control organism max 2

[9]

9. (a) (i) protein / amino acid production 1
- (b) (i) increased yields;  
replace ions taken in by crop; 2
- (ii) increased application of fertiliser does not increase yields;  
therefore uneconomic 2
- (c) (i) increased leaching as result of increased application 1
- (ii) Either  
increased rainfall (leading to increased volume of water flowing  
into reservoirs);  
increased volume leads to increased dilution of nitrate  
Or  
less rain;  
therefore more uptake by crop / less leaching 2

- (d) increased growth of plants / algae;  
 (leading to) eutrophication;  
 increase in microorganisms feeding on dead plants / algae;  
 leading to deoxygenation;  
 increased nitrate in drinking water;  
 causing human illness

4

[12]

10. (a) (i) lower light intensity limits rate of photosynthesis;  
 lower light duration limits total photosynthesis;  
 lower temperature limits rate of photosynthesis;  
 fewer products/use of stored products decreases growth rate;  
*for 2 factors not explained, allow 1 mark.*

max. 3

- (ii) carbon dioxide, burning oil/ coal/ gas/compressed gas;  
 heat, use of heaters/undersoil heaters;  
 light, lights on for extra hours;  
 fertilisers, add regularly;

max. 2

- (b) 20-25°C;  
 greatest difference between the rate of photosynthesis and  
 the rate of respiration;

2

[7]

11. (a) name of pest and predator/parasite;  
 method of killing pest;

2

- (b) pest and its parasites are likely to occur in same place/more likely  
 to find suitable parasite;  
 if climate similar parasite more likely to survive;  
 laboratory conditions to study possible effect on native species;  
 as may compete with other species for habitat/food;  
 may parasitise other species/be preyed on by other species;  
 large numbers increases chance of successful introduction;  
 decline in pest indicates control is taking place/control is successful;  
 numbers of pest must be reduced so that amount of damage is economically  
 acceptable;  
 stable coexistence means no need for further introduction  
 of parasite/no additional measures are required;  
 pest needs to be kept at low levels to prevent damage to crop;  
 if pest dies out parasite may become a pest itself/if parasite dies out it  
 will have to be reintroduced;

8

- (c) non-target species not killed/host specific;  
 no toxic residues/no accumulation up the food chain;  
 no resistance;  
 no resurgence;  
 continuous control;  
 only one application necessary/self perpetuating; 2

[12]

12. (a) Light / solar energy used for photosynthesis;  
 Synthesis of materials used in growth / storage;  
 Chemical energy stored / energy in biomass; 3

- (b) (i) Fewer nutrients available;  
 Limited light penetration;  
 No organic matter from terrestrial sources;  
 Other limiting factor explained; max 2

- (ii) Reason for difference, e.g. plants smaller / less vegetation / crops harvested / grazing;  
 Explanation linked to difference, e.g. less area for photosynthesis / not structured into layers / nutrients removed in harvesting; 2

- (c) Desert, because lowest productivity;  
 few plant species so few animal species able to feed on them;  
or, desert because abiotic conditions extreme / named factor;  
 few species adapted to extreme conditions / less stable food web; 2

[9]

13. (a) (i) glass allows light and heat through;  
 retains heat inside glasshouse;  
 limits wind/air movements; max 2

- (ii) controls light entering glass house / shades plants from excess light;  
 controls heat entering glass house/prevents scorching; max 1

- (iii) allows entry of carbon dioxide level;  
 prevents excess humidity;  
 limits spread of disease; max 1

- (b) stomata close if water stressed;  
 (closed stomata) limits carbon dioxide absorption;  
 may wilt reducing surface area exposed to light; max 2

[6]

14. (a) (i) A = nitrogen is limiting so crop increases with nitrogen added;  
 B = nitrogen is no longer limiting crop growth restricted by other factors/ shading / carbon dioxide;  
 C = nitrogen apparently inhibiting growth/high nitrate causes plants to lose water; 3
- |      |                  |                    |            |   |
|------|------------------|--------------------|------------|---|
| (ii) | fertiliser costs | yield sales        | net profit |   |
|      | 125 x 120 = £150 | 4.8 x 200 = £960   | £810       |   |
|      | 150 x 120 = £180 | 5.0 x 200 = £1,000 | £820       | 2 |

- (b) Advantage:  
 ions in readily available form;  
 effects relatively rapid;  
 easy to apply;  
 quantities applied can be controlled/measured; max 1
- Disadvantage:  
 quickly leached;  
 more likely to cause pollution;  
 relatively expensive; max 1

[7]

15. (a) method 2 apparently more effective as fewer aphids by day 49;  
 fewer aphids per leaf gives less damage and more/larger cucumbers;  
 Or  
 differences in aphids are not significant;  
 method 1 less economic as space occupied by maize could be used for more cucumbers;  
 Or  
 differences in aphids are not significant;  
 method 1 more economic as aphid control system is self sustaining; max 2

- (b) advantages:  
 specific to one pest/ chemicals may kill pollinators/useful insects  
 application linked to life cycle of pest;  
 number of applications depends on survival of control organism/  
 self sustaining;  
 no residues harmful to health left on crop;  
 does not result in resistant varieties of pest; max 3  
 disadvantages:  
 can only be used for glasshouse crops;  
 may create an imbalance in natural ecosystem;  
 may be labour intensive/costly to maintain;  
 have to retain some of the pest to maintain the control organism; max 3  
 (section max 4)

[6]

16. (a) Energy required for producing things required in crop production; 1  
*Credit examples such as tractors / fertilisers etc*
- (b) (i) Greater mechanisation/more intensive in US; 2  
 Involves greater energy input/example;
- (ii) Bred/selected for efficient energy conversion; 1
- (c) Different species have different root lengths;  
 Mineral ions/water can be obtained from different depths;  
 Shade plants grow as well as those needing full sunlight;  
 Pests tend to be specific;  
 Pests will not destroy total crop in mixed system;  
 Less fallow time; max 2

[6]

17. (a) *Maximum of 4 marks, two for suggestions and two for explanations:*  
 e.g. the fungus will not destroy other (native) species/is specific;  
 so not damaging/killing endangered species/damage Everglades/environment;  
 fungus will replicate itself;  
 so no need for expense of repeated applications. 4



- (b) *Maximum of 'two marks for two suggestions:*  
 e.g. claim that fungus only attacks cannabis plant might  
 be wrong/fungus might mutate back;  
 so fungus attacks crops;  
 fungus attacks (endangered) wild species. 2 [6]
18. (a) increase growth of both weeds and cereal crop;  
 inorganic nutrients/minerals not a limiting factor /  
more inorganic nutrients available; 2
- (b) removal of competition by weeds; 1
- (c) effective use of machinery;  
 timing of harvest for max yield; 2
- (d) use plants with smallest amount of unwanted material;  
 detail of cross pollination / select and repeat cross; 2 [7]
19. (a) (i) low toxicity to mammals / humans; 1
- (ii) excess would run off into water courses;  
 lethal to aquatic organisms;  
 at low concentrations; 3
- (b) (i) only affects an insect that eats plant;  
 insecticide not diluted / concentration inside plant is high /  
 reduce the amount needed;  
 not leached into environment / non polluting; 2
- (ii) gene incorporated into genome of plant;  
 produces toxin which affects insects that eats plant; 2 [8]
20. (a) wrong wavelength;  
 reflected;  
 miss chloroplast / chlorophyll;  
 (carbon dioxide concentration) another factor may be limiting; 2
- (b) oxygen produced / carbon dioxide used;  
 per unit time; 2

- (c) description of how temperature is changed / range of temperatures used;  
 how other factors kept the same / named factors controlled;  
 measure mass of given product in given time; 3

[7]

21. (a) loss of hedgerows;  
 since small fields impracticable for large machines;  
 soil more exposed to wind;  
 resultant increase in soil erosion (*once*);  
 reduction in diversity;  
 since smaller variety of niches/habitats;  
 since smaller variety of producers/plants  
 deeper rooted plants removed;  
 resultant increased soil erosion (*once*);  
 increased risk of large-scale crop failure/increased disease/increased  
 number of pest;  
 since large numbers of same crop species grown close to each other;  
 increased use of fertilisers result in eutrophication/damage to soil structure;  
 reduction of gene pool  
 (*references to pesticides neutral*) 4 max

- (b) (i) bioaccumulation in gull (via food chain);  
 explanation in terms of organisms at higher trophic level eating  
large numbers of organisms at lower trophic level; 2

- (ii) different shaped molecules;  
 do not fit active sites of enzymes produced by decomposers 2

- (iii) resistant forms more likely to survive/non resistant forms die;  
 to breed/reproduce;  
 their genes/alleles more likely to be passed to next generation  
 (*natural selection unqualified neutral*) 3

[11]

22. (a) (Light intensity)  
 When light intensity is increased, rate of photosynthesis increases; 1

- (b) (Carbon dioxide)  
 An increase of CO<sub>2</sub> from 0.03 to 0.12% nearly doubles the rate of  
 photosynthesis/ temperature change from 20 to 30° C only small increase in  
 photosynthesis;  
 More CO<sub>2</sub> to convert/combine with RuBp (to GP);  
 More GP available to use with the products of the light  
 dependent reaction; 2 max

(c) Light and CO<sub>2</sub> will be limiting factors;  
 increase temp will increase rate of respiration as well as photosynthesis/  
 net gain / cost to increase temperature not matched by increase in  
 photosynthesis/yield/not cost effective; 2

(d) Any two from  
 Misses chloroplast/  
 Wrong wavelength/  
 reflected; 2

[7]

23. (a) does not need repeated treatment;  
maintains low level of pest/ not allowing pest numbers to rise  
 (above economic threshold); 2

(b) only feeds on pest species/does not affect non-target population;  
 can live in environment of the host/ establish/maintain its population/  
 can reproduce under conditions of use/active during the season;  
 (ignore references to effect on crop) 2

[4]

24. (a) (i) (clover) gains ammonium compounds/ammonia/amino acids;  
 (reject nitrogen/nitrates) (accept nitrogen compounds) 1

(ii) (bacteria) get ATP/carbohydrate/organic compounds; 1

(b) (max 2 marks for each advantage and explanation)  
 clover is a natural/green fertiliser; }  
 adds organic material/humus to the soil; }  
 clover adds nitrogen compounds/nitrates; }  
 needed by crop for protein production; }  
 clover releases minerals slowly; }  
 less run-off/less pollution; }  
 clover cheaper than fertiliser; }  
 therefore more profitable/fertilizer applied several times; } 4 max

[6]

25. (a) rate of photosynthesis increased;  
normal atmospheric concentration a limiting factor;  
more/faster production of biomass or sugars / more products of  
photosynthesis transported to fruits; 2 max
- (b) (increased temperature) increases rate of respiration;  
rate of photosynthesis too low to replace respiratory loss 2
- (c) lower water potential of nutrient solution;  
less water absorbed into roots (by osmosis); 2  
(*not: water lost from roots*)

[6]

26. (a) faster rate of growth;  
reduced movement / lower respiratory losses;  
more sustained/plentiful food supply;  
high survival rate, e.g. due to protection from predators;  
reduced fishing effort; 2 max
- (b) activity of decomposers / microorganisms;  
reduced oxygen content;  
few species adapted to low oxygen conditions; 2 max
- (c) not all fishmeal digestible / consumed;  
used in respiration for movement / other valid use;  
synthesis of biomass inefficient / involves energy or heat loss; 2 max

[6]

27. (a) 250 1
- (b) grebes eat many fish;  
accumulation of many doses;  
insecticide not excreted / not biodegradable / remains in fat stores; 2 max
- (c) (i) concentration which kills 50% / a certain percentage; 1
- (ii) alter tertiary structure of proteins;  
disrupt enzyme activity;  
detail described, e.g. non-competitive inhibition / change to active site;  
reference to nerve or brain damage, or kidney failure; 3 max

[7]

28. (a) (i) presence of grass causes less nutrients/minerals/nitrates/  
ammonium ions to be leached; 1  
(*do not allow references to less nitrogen*)

- (ii) clover contains nitrogen-fixing bacteria;  
(do not allow references to nitrifying bacteria)  
decomposition (of ploughed clover) introduces nitrates/  
ammonium ions into soil; 2
- (b) (i) minimal effect/no significant effect on yield/small  
increase up to 25 kg ha<sup>-1</sup>;  
increase in protein content of grain with all  
fertiliser applications; 2
- (ii)  $(37 \div 44 \Rightarrow) 0.84 : 1.0$  (allow 0.8 : 1); 1
- [6]**
- 29.** (i) increased use of insecticides/greater selection pressure; 1
- (ii) mutations;  
producing alleles/genes giving resistance;  
natural selection/described;  
leads to increased frequency of alleles/genes in population/insect; 3 max
- [4]**
- 30.** (a) (i) very long/deep roots, to reach water deep in the soil/  
nitrogen-fixing bacteria, to provide a source of nitrogen  
for growth in poor soil; 1
- (ii) interspecific; 1
- (iii) (mesquite) proteins/amino acids (ploughed) into soil/  
nodules ploughed in;  
(decomposers) bacteria/ fungi feed on these;  
excrete ammonia;  
nitrifying bacteria convert these to nitrites/nitrates;  
absorbed by roots of grasses and increase their growth;  
increases recycling of other ions/phosphate/potassium; 3 max
- (b) control organism a parasite/ predator;  
specific to pest;  
population varies with population of pest;  
controls size of pest population but does not kill all;  
keeps pest population low enough to prevent significant (economic)  
damage; 3 max
- [8]**
- 31.** (a) chemical controls initial surges in pest numbers / less chemicals used;

biological gives longer term control of pests; 2

*(accept biological controls pests resistant to chemical);*

- (b) (i) normal virus reduces area eaten by  $40\text{cm}^2$   
genetically engineered reduces by  $64\text{cm}^2$   
 $64 - 40 = 24$

$$\frac{24}{40} \times 100 = 60\% \text{ more effective}$$

1 mark for principle of calculation;  
60% more effective = 2 marks;

*or*

$$\frac{64}{40} = 1.6 \text{ times more effective}$$

1 mark for principle of calculation;  
1.6 times more effective = 2 marks;

2

*(if only difference in area eaten given, 1 mark)*

- (ii) toxin kills the caterpillars faster than just the virus;  
so less time for leaves to be eaten/energy for eating; 2

[6]

32. (a) accumulation of insecticide within individual/tissue;  
peregrines eat large numbers of birds;  
biomagnification/high concentration of insecticide kills peregrine;

*OR*

seed-eating birds eat large numbers of seeds;  
biomagnification/high concentration of insecticide in seed-eating birds  
kills them;

no/less food for peregrine;

3 max

- (b) kills only those insects which eat seed/specific in action/named  
environmental effect e.g. reduced leaching/spray drift/more efficient delivery; 1

[4]

33. (a) contain nitrogen-fixing bacteria in roots/nodules (so don't need fertiliser);  
nitrogen containing compounds added to the soil  
when plant dies/after harvest of crop; 2

- (b) increase in yield up to 500-600 kg ha<sup>-1</sup>;  
at 500-600 kg ha<sup>-1</sup> rate of increase slows/ no significant increase  
(with extra fertiliser); 2
- (c) low(er)/more negative water potential in soil (than in the plant);  
prevents roots from taking up water (from the soil);  
plants still lose water by transpiration; plants lose water to soil by osmosis; 2 max

[6]

34. (a) (accumulates) in (fatty) tissue/ is not excreted/ not metabolised/broken down;  
becomes concentrated higher up the food chain/ bioaccumulation/  
biomagnification; 2
- (b) prevents disease/pest organisms from reaching crop plants/prevents  
herbicides from reaching hedgerow/enables machinery to manoeuvre  
without damaging crop/hedgerow; 1
- (c) some weeds provide habitats/niche for (beneficial) insects/animals:  
allow (insect) pest predators to survive;  
conserve (common) weed plants;  
weeds are producers in food chains/food source; 2 max
- (d) decomposers/saprophyte/ bacteria/ fungi /micro organisms;  
(organisms) excrete/ produce nitrogenous waste/ e.g.;  
bacteria convert to nitrate/nitrifying bacteria;  
(increased) nitrates(in soil) taken up/used by plants;  
release of phosphate/potassium;  
organisms respire and produce carbon dioxide;  
used by plants in photosynthesis; 4 max

[9]