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_2 (in air) OR "greenhouse effect" – trees remove CO_2 / trees photosynthesise / burning releases CO_2;
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;
Involves greater energy input/example; 2

(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 <u>variety</u> of niches/habitats;
since smaller <u>variety</u> 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 <u>large numbers</u> of organisms at lower trophic level; 2

(ii) different <u>shaped</u> 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_2 from 0.03 to 0. 12% nearly doubles the rate of photosynthesis/ temperature change from 20 to 30° C only small increase in photosyntesis;
More CO_2 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_2 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; 2
(*ignore references to effect on crop*)

[4]

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

(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^{-1};
increase in protein content of grain with all fertiliser applications; 2

(ii) (37 ÷ 44 =) 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 $40cm^2$
genetically engineered reduces by $64\ cm^2$
64 - 40 = 24

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

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

or

$\frac{64}{40} = 1.6$ 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 tem;

no/lessfood 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
<u>when plant dies/after harvest of crop;</u> 2

(b) increase in yield up to 500-600 kg ha^{-1};
at 500-600 kg ha^{-1} 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]