



# **MARKSCHEME**

**November 2010**

## **ENVIRONMENTAL SYSTEMS AND SOCIETIES**

**Standard Level**

**Paper 2**

18 pages

1. Follow the markscheme provided, do **not** use decimals or fractions and mark only in **RED**.
2. Make sure that the question you are about to mark is highlighted in the marks table.
3. Where a mark is awarded, a tick (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded.**
4. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases write a brief annotation to explain your decision. You are encouraged to write comments where it helps clarity, especially for moderation and re-marking. Use a text box for those additional comments. It should be remembered that the script may be returned to the candidate.
5. Personal codes/notations are unacceptable.
6. If a part question is worth no marks or has been left blank, put a zero in mark entry box.
7. If a candidate has attempted more than the required number of questions within a paper or section of a paper, mark all the answers **even if the candidate has indicated the question(s) to be marked on the front cover.**
8. A mark should not be awarded where there is contradiction within an answer. Make a comment to this effect using a text box or the ‘CON’ stamp.

## Subject Details: Environmental Systems and Societies SLP2 Markscheme

### General

A markscheme often has more marking points worthy of a mark than the total allows. This is intentional. Do **not** award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- Each marking point has a separate line and the end is signified by means of a semicolon (;).
- An alternative answer or wording is indicated in the markscheme by a “/”. Either wording can be accepted.
- Words in ( ... ) in the markscheme are not necessary to gain the mark.
- Words that are underlined are essential for the mark.
- The order of points does not have to be as written (unless stated otherwise).
- If the candidate’s answer has the same meaning or can be clearly interpreted as being the same as that in the markscheme, then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing **OWTTE** (or words to that effect).
- Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalizing them for what they have got wrong.
- Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with “**ECF**”, error carried forward.
- Units should always be given where appropriate. Omission of units should only be penalized once. Indicate this by “**-1(U)**” at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.
- Do not penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

**SECTION A**

1. (a) (i) mountain forests / temperate grasslands / deserts; **[1 max]**  
*Award [1] for any two of the above.*

(ii) *Natural factor:* grazing from the Plains bison / fire;  
*Human factor:* fire / keeping livestock; **[2]**

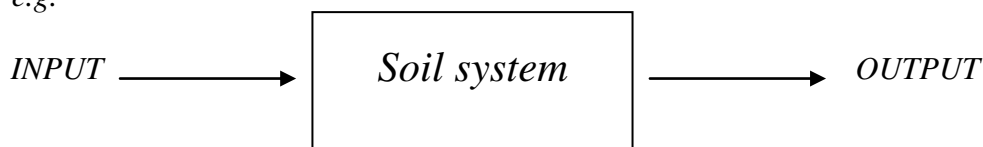
*Do not accept "fire" for both natural factor and human factor.*  
*Do not accept "hunting".*

(iii) *Mutualism: [1 max]*  
*e.g. birds eating insect pests on the Plains bison;*  
*e.g. Plains bison dispersing seeds in their fur/droppings;*  
  
*Predation: [1 max]*  
*e.g. coyote eating mice;*  
*e.g. frog eating insect/fly;*  
*e.g. wolf eating caribou/elk;*  
*e.g. prairie dog eating squirrels/rabbit/mice;*  
*e.g. mice eating insects;*  
*e.g. birds eating worms;*  
*e.g. humans eating bison;* **[2 max]**

*Award [0] if interactions are described without reference to organisms from the resource booklet.*

(b) diagram showing soil as a system with inputs and outputs;

*e.g.*



*inputs:*

- nutrients added from Plains bison droppings/wastes;*
- nitrogen added from urine;*
- seeds in droppings;*
- trampling from Plains bison hooves causing compaction;*
- nutrients added from decomposing (dead) Plains bison;*

*outputs:*

- nutrients lost as Plains bison eat grass/plants;*
- Plains bison may die/produced wastes outside the system, so less organic matter;*
- soil erosion increases as Plains bison trample/create trails;*
- water drunk by Plains bison;*
- wallows used by Plains bison;*

**[4 max]**

*Award [3 max] for correct inputs and outputs but no diagram.*

*Award [2 max] if answer does not include both inputs and outputs.*

- (c) (i) only the natural income was being used rather than the capital / this means that American Indians lived sustainably within the means of nature and did not deplete the natural capital;  
the bison provided them with many things such as meat and leather / when food was scarce they even consumed them down to the last bit of marrow;  
the population was large enough to withstand the amounts being removed;  
the natural habitat was not destroyed by American Indians;  
American Indians used fire to help create a habitat and allow recovery;  
populations of American Indians were sufficiently low;  
hunting techniques were relatively small scale / basic technology;  
in times of shortage Plains bison were not used wastefully; [2 max]
- (ii) less economic value for hunting because products for which the Plains bison were once hunted are no longer considered valuable;  
more symbolic value as Plains bison has a new value as an iconic/cultural symbol;  
the ecological value of the species has now been recognized;  
Plains bison inspire/help connect human cultures today;  
as the Plains bison population diminished it increased in value due to rarity;  
hunting practices changed as the dominant social group changed from American Indians to settlers;  
Plains bison were considered of value by American Indians and then for commercial value by settlers;  
Plains bison are now seen as a problem by some – damage farmland/disease transmission/damage fences/vehicle collisions; [3 max]
- (d) (i) range has shrunk in size;  
range has become fragmented;  
first split into two large ranges and then in to six small isolated areas;  
greatest population of Plains bison has shifted north/west;  
now found in the centre of its former range;  
Plains bison populations only found in Great Plains; [2 max]

*Accept other reasonable responses.*

- (ii) populations of rabbits could decline as coyotes hunt/eat more as Plains bison numbers decline;  
populations of rabbits decline as habitat declines due to lack of grazing pressure from Plains bison;  
populations of rabbits might increase as more grass available;  
predator will switch prey to hunt the rabbits more (a clear understanding of the relationship without an explicit mention of change in population size); [2 max]

*The response must show a clear understanding of the relationship even if no mention is made of the change in population size (as illustrated by the final marking point).*

*Accept other reasonable responses.*

- (e) humans are responsible to a large extent for whether or not Plains bison are able to thrive;  
they control the amount of habitat available to the Plains bison;  
Plains bison can have an impact on economic activities such as farming, so local communities need to support the idea of their reintroduction / economic costs and benefits need to be weighed;  
if there are economic rewards to be gained from Plains bison (e.g. from ecotourism revenue) this can be an incentive for people to protect them;  
cultural benefits to humans and the American Indians today with aesthetic/moral/spiritual values;

[3 max]

*An ecological factor is not needed as the question focus is on economic and cultural factors.*

- (f) (i) Plains bison are very symbolic in the history/art/cultural consciousness of the region;  
Plains bison were once very common/wide ranging and were pushed to the brink of extinction by humans / Plains bison are iconic as once managed sustainably by Native Americans and then nearly wiped out by settlers from Europe;  
the fact that numbers have recovered shows that environmental efforts can be successful;  
they are a physically large species/easily recognized;  
they are a keystone species and play an important role in their ecosystem;
- (ii) *Deep ecologist: [1 max]*  
biorights/the rights of living things to exist unmolested/inherent right to life;  
intrinsic value of Plains bison;

[2 max]

*Environmental manager: [1 max]*

- believes that economic growth and resource exploitation can continue if carefully managed;  
believes that legislation and laws/regulation can manage natural capital/resources such as bison;  
appreciate that preserving Plains bison can have economic/ecological advantages;  
those who experience adverse effects (e.g. damage to land from Plains bison) can be compensated;

[2 max]

*Do not accept "because it is our duty".*

## SECTION B

### General Essay Markscheme

Each essay is marked out of [20] of which [2] are for clarity of expression, structure and development of ideas.

[0] Quality of expression, structure and development is poor.

[1] Quality of expression, structure and development is limited.

[2] Quality of expression is clear, structure is good and ideas are well developed.

*Do not penalize candidates for writing in bullet pointed lists – if this technique is used appropriately i.e. to summarize or outline a list of points within an essay at an appropriate point. However, a candidate who has not shown **any** evidence of being able to write a paragraph with a developed, logical line of reasoning would not be able to achieve maximum marks.*

2. (a) *e.g.* for wheat cultivation in California

*environmental impact:*

compaction of soil due to use of heavy machinery leading to soil erosion;  
high level of human inputs, agrochemicals/machinery, so soil structure is lost;  
topsoil is more easily removed by the agents of erosion (wind/water);  
once topsoil is lost, organic material is gone and the fertility of the soil is reduced;  
over-irrigation can lead to salinization of soil;  
run-off of agrochemicals/fertilizers into water bodies/rivers/lakes leading to eutrophication;  
pesticides run-off into lakes/streams and build up in tissues of organisms (bioaccumulation);  
monoculture in California leading to loss of biodiversity in the local systems;  
heavy machinery usage releases greenhouse gases into the atmosphere;  
gases that can lead to increased acidic precipitation/global warming;

*e.g.* for beef livestock in Argentina

*environmental impact:*

livestock can trample the vegetation leading to loss of vegetation/exposed soil;  
loss of biodiversity as only hardy vegetation can grow once soil has been trampled;  
exposed soil is more easily eroded;  
habitat lost as forested areas are cleared so that the grass can be grown for the livestock to eat;  
livestock leads to increased levels of methane in the atmosphere contributing to greenhouse effect/global warming;

[4 max]

*Award [2 max] if impacts for only one named food production system are mentioned.*

*Award [2 max] if only impacts mentioned with no named food production system.*

*Do not accept examples such as “large scale farming”.*

- (b) many policies that lower death rates increase population growth as they do not change birth rates and fertility which remain high;  
investment in family planning education and the availability of birth control lowers the birth rate;  
agricultural development which improves yields decreases death rates by allowing more food to be consumed / lowers prices so more food can be bought;  
lowering barriers to agricultural exports through free trade agreements can lower death rates as the LEDC has more money to spend on other areas;  
transfer of technology (e.g. to have rural electrification) improves standards of living and so lowers death rates in LEDCs;  
millennium development goals of the United Nations (e.g. providing clean water) can reduce infant mortality;  
improved sanitation lowers death rates;  
provision of vaccines and drugs to prevent deaths from preventable diseases will lower infant mortality;  
lower infant mortality rates tend to lower birth rates as parents can be more confident that children will survive / improve/provide improved healthcare will lower infant mortality;  
world bank/international monetary fund (IMF) strategies to stimulate economic growth will decrease birth rates and so lower population growth;  
international money/programmes to enable education of women/girls will lower birth rates and so lower population growth;

[5 max]

*Responses should combine the international policy and show how this will impact population growth in an LEDC.*

*Award [2 max] if only a list of ways to reduce population growth is produced and no links to international policy is made.*



- (c) high population growth is usually in countries of high rural population *e.g.* Uganda;  
low population growth is in countries with a low rural population *e.g.* UK;  
Uganda needs many children to work in the subsistence farming they practice;  
the low level of technology in the farming system means that the labour needed is high and so the fertility rate is high;  
low yields as no agrochemicals are used means more land has to be farmed and so more workers are needed;  
the economic costs of children in Uganda are low as the social system is for low consumption so many children are not a monetary burden;  
UK affords to feed its population, with a surplus, despite having changed from labour intensive to capital intensive farming;  
subsidies in MEDCs lower production costs, encouraging increased food production;  
poor infrastructure in LEDC may mean sufficient food production but insufficient distribution to population;  
LEDC/Uganda exports large volume of food produce at low costs to MEDC/UK (which then adds value to the produce) but this benefits only a small percentage of the rural population in LEDC;  
surplus food can be sold to buy the few items they need and to pay for education/medical expenses;  
rural life is hard and so they have many children so that some will reach adulthood;  
the lack of social security in Uganda means that the parents have many children so that they can look after them when they are old;  
UK has less than 5 % of the population working in farming so not many children are expected or want to work in farming;  
high levels of mechanization mean few people are needed on the farm (population growth is linked to other factors);  
large amounts of food are produced per person working, most UK people buy their food;  
economic costs of children are high as food has to be bought;  
the social system encourages consumption and a high standard of living which is expensive with many children;

[9 max]

*Award [9 max] for responses that refer to at least two countries of contrasting development.*

*Award [5 max] if only one country is mentioned.*

*Award [4 max] if no countries are mentioned.*

*Responses must demonstrate a link between population growth & social systems/food production and social systems/population growth and food production at least once. The response could mainly focus on one set of relationships, as long as the others are mentioned.*

*Expression of ideas: [2 max]*

*Total: [20]*

3. (a) *e.g.* for tropical rainforest

*distribution:*

found between 5 degrees north and south of the equator;  
close to/around the equator;

*Allow responses up to 20 degrees.*

*structure:*

a number of layers from ground level to canopy to emergent plants/trees of up to 50 metres with lower layers of shrubs and vines;

*relative productivity:*

high levels of productivity; *give credit if figures used*

*distribution affected by global warming:*

the anticipation is that the rainforests will move further north and south;  
rainforests may disappear from the equator as the climate may become too dry;  
as sea levels rise, lowland rainforests/coastal rainforests/mangroves may become flooded;

*structure affected by global warming:*

the complex structure may become more simplified as organisms cannot migrate fast enough to the new distribution areas;

*relative productivity affected by global warming:*

productivity declines as plants cannot carry out photosynthesis as efficiently under the new climatic conditions;

productivity increases as higher levels of CO<sub>2</sub> increase rates (of photosynthesis); **[6 max]**

*Award [3 max] for a named biome and its distribution, structure and relative productivity. Award [3 max] for the links to global warming. Award [5 max] if no named biome.*

- (b) complexity of the issue leads to uncertainty / climate models are incomplete and leave out aspects of the climate/oceans for simplicity;  
the impact of positive and negative feedback is unclear;  
the climate models use differing data and so give different results;  
scientists interpret the model results in different ways leading to a range of predictions;  
the reliability of the instruments is not certain;  
the long-term climate trends are not clear / climate fluctuates all the time;  
the lack of old data/shortage of old data/use of old instruments/different ways of measuring data give a high level of uncertainty in the models that use them;  
just because the climate may be changing this may not be linked to emissions of gases by humans / climate change may be a natural phenomenon *e.g.* related to sunspot activity/natural pattern;  
the climate has warmed before, prior to humans adding extra CO<sub>2</sub>;  
the models do not include/find it hard to include data on human behaviour/attitudes and how this may impact future trends;  
not all scientists are in agreement about whether there is a problem/the amount of warming to expect;

**[6 max]**

- (c) small changes in individual lifestyles can make a huge difference when added together;  
demand for products that are local rather than from afar to reduce food/product miles and so reduce the consumption of fossil fuels by individuals;  
living a simpler lifestyle that uses less, so your emissions of greenhouse gases are reduced;  
global warming is a non-point source pollution so blame cannot be pinned down on a map therefore comes down to individual action;  
action on a local level promotes responsibility and intergovernmental action would be cumbersome and bureaucratic;  
using renewable energy sources/switching to renewable energy;  
conservation of energy and using more efficient products will reduce the amount of electricity used/reduce carbon footprint;  
there is a moral dilemma for each person to make, now that the issue of global warming has been made apparent, to do something or do nothing;  
without change at an individual level there will be no incentive for governments to change;  
buying a more efficient vehicle to use less gas/a hybrid vehicle / increase use of public transport / car-pool / walk/ride to work/play/school;  
consumption of less meat will reduce the number of ruminants and reduce the amount of methane released;  
consumption of less meat will free up good agricultural land to feed more people so less agrochemicals used;  
if the MEDCs lifestyles do not change and the LEDC people want to emulate them then global warming will increase; **[6 max]**

*Accept any other reasonable response linked to global warming.*

*Expression of ideas: [2 max]*

*Total: [20]*

4. (a) *e.g. Rachel Carson and her book A Silent Spring:*  
raised awareness of the threat of the pesticide DDT to organisms high up the food chain;

*e.g. Greenpeace 1970s:*  
direct action to prevent whaling;

*e.g. Chernobyl nuclear meltdown 1986:*  
reinforced negative perceptions of nuclear power in society;

**[3 max]**

*Award [1 max] for two named historical influences, which can be a person, group or event.*

*Award [2 max] for a description of each named historical influence.*

- (b) carrying capacity is the maximum number of a species or “load” that can be sustainably supported by a given environment;  
environmental value systems are a particular world view or set of paradigms that shapes the way an individual or group of people perceive and evaluate environmental issues;  
*Award [2 max] for a definition of carrying capacity and environmental value systems.*

*carrying capacity in the Gandhi quotation:*

at the current rate of resource consumption Earth’s carrying capacity is being exceeded;  
Gandhi is suggesting that Earth’s current resources are adequate for Earth’s current population;  
provided we meet our needs sustainably;  
far fewer people could live sustainably if each lived like the average person from an MEDC;  
however one might disagree with Gandhi and say that technology can increase carrying capacity so that more demands can be met;

*carrying capacity in the traditional Kenyan proverb:*

we need to leave resources so that future generations, “our children”, can also use them;  
unsustainable use means we do not leave choices for future generations;  
carrying capacity for future will be reduced if our generation uses up the resources;

*environmental value systems in the Gandhi quotation:*

Gandhi’s quote shows that he has an ecocentric/deep ecologist/self-reliance soft ecologist value system;  
the language used in the quotation reflects/reinforces the underlying values e.g. that consuming resources beyond the basic level is greedy;  
some value systems encourage greed/unsustainable consumption;  
many economic systems assume continued economic growth/increasing consumption of resources, and Gandhi is perhaps challenging this;  
other value systems e.g. cornucopians/technocentrism are more optimistic than Gandhi about our ability to improve standards of living/meet needs;

*environmental value systems in the traditional Kenyan proverb:*

Kenyan proverb reflects an ecocentric/environmental manager/anthropocentric value system;  
the value system in the Kenyan proverb prioritizes the rights/needs of future generations;  
and would endorse/support a sustainable approach to resource consumption/development;  
traditional views often help preserve the environment;  
notions of stewardship are not a modern phenomenon;

**[7 max]**

*Only credit the fact that both quotations are ecocentric once.*

*Award [4 max] if only one quotation is referred to, or if only carrying capacity or environmental value systems are mentioned.*

(c) *description of ecocentric responses: [2 max]*

responses will try to minimize the impact on the environment by encouraging people to be restrained;  
using methods which are more in harmony with natural systems;  
*e.g.* use of organic fertilizers/manure on agricultural fields;  
*e.g.* practice of mixed cropping/crop rotation so less or no fertilizers are needed;  
*e.g.* educational campaigns to encourage people to use less detergent/more environmentally friendly detergent;  
*e.g.* plant a buffer zone between the fields and the water courses to absorb any run-off;

*description of technocentric responses: [2 max]*

responses will emphasize the use of technology/human ingenuity in managing environment/resource issues;  
*e.g.* developing an alternative to phosphates in detergents;  
*e.g.* applying fertilizers more carefully so there is reduced run-off/wastage;  
*e.g.* using technology to screen water to remove pollutants;  
*e.g.* pumping air through lakes to avoid the low oxygen conditions;  
*e.g.* dredging sediments;

*evaluation: [4 max]*

people are reluctant to adapt lifestyles/accept lowered standard of living so ecocentric approaches can be hard to enforce;  
alternative approaches *e.g.* organic fertilizers/manure may not work so effectively/can still cause run-off and eutrophication;  
technocentric solutions may increase the costs of *e.g.* detergents/may require a financial commitment;  
technocentric can be a short term solution but is unsustainable;  
technocentric solutions may not be an option in less-developed areas/for less wealthy farmers;  
some solutions are time consuming/do not get at the root cause *e.g.* pumping air;  
can be hard to identify who is the cause of the pollution so hard to target educational campaigns effectively;  
alternative products may still cause other environmental problems;

[8 max]

*Give credit for candidates who recognize that the same response may be classified as technocentric or ecocentric.*

*Award [8 max] if both viewpoints are mentioned and each point made is evaluated.*

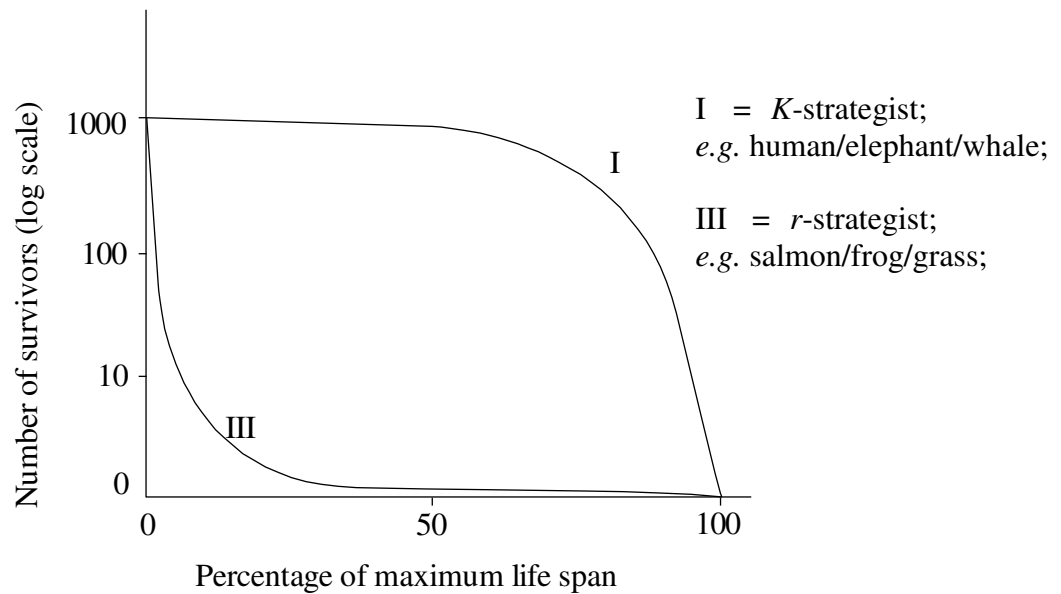
*Award [5 max] if only one viewpoint is given.*

*Award [4 max] for description of ecocentric and technocentric responses or for statements which explain the principles behind ecocentric or technocentric responses.*

*Expression of ideas: [2 max]*

*Total: [20]*

5. (a)



[4 max]

Award [3 max] if labels on axis are not correct. Accept "time" as label on x axis.  
Accept "number of individuals" as label on y axis.

(b) *K*-strategies:

*K*-strategists climax sere;  
are large organisms that need a developed soil and food web;  
slow growers;  
so outcompete other organisms for light and nutrients;  
few offspring;  
can only grow to maturity when a space appears in the ecosystem;

*r*-strategies:

*r*-strategists are pioneers;  
so in initial colonization of a piece of land/water;  
have rapid growth;  
so can get through lifecycle quickly;  
many offspring;  
so some can reach new areas that need colonization;  
small size;  
so cannot compete in later seres;

*succession*:

the orderly process of change over time in a community;  
changes in the community of organisms frequently cause changes in the physical environment;  
seres are formed through competition in a changing environment;

[6 max]

Award [4 max] if only one population strategy is mentioned.

Award [2 max] if only succession is outlined.

(c) *conservationists need to know:*

the size of conservation area needed for that species to have a viable population, so the gene pool is mixed;

what the carrying capacity of an area is for a particular species so the conservation area is not too small;

how long it takes for the individuals to mature, so that they have enough space and time to breed;

how many offspring are produced in a season/a year so that the growth of the species can be monitored and overpopulation does not occur;

what the life expectancy of the species is so it can be determined how many offspring they are likely to have in a lifetime;

how many offspring reach maturity and whether they are *K*-strategist or *r*-strategist/*K*-selected species or *r*-selected species/*K* or *r* species, so that enough breeding pairs are available to ensure genetic diversity;

what size of territory may an individual or a breeding pair need, so enough space is given for breeding;

the geographical range needed by groups of the population so that groups can mix and interbreed;

if the conservation area is too fragmented successful individuals may not meet and therefore cannot breed;

*e.g. Bwindi National Park for the Mountain Gorillas:*

this is joined to national parks in the Democratic Republic of the Congo and Rwanda to allow the remaining populations space to move across the borders; [8 max]

*Award [4 max] for examples of successful case studies that clearly support the marking points.*

*Expression of ideas: [2 max]*

*Total: [20]*