



# **MARKSCHEME**

**May 2012**

## **ENVIRONMENTAL SYSTEMS AND SOCIETIES**

**Standard Level**

**Paper 2**

20 pages

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## General Marking Instructions

*Assistant Examiners (AEs) will be contacted by their team leader (TL) through Scoris™, by e-mail or telephone – if through Scoris™ or by e-mail, please reply to confirm that you have downloaded the markscheme from IBIS. The purpose of this initial contact is to allow AEs to raise any queries they have regarding the markscheme and its interpretation. AEs should contact their team leader through Scoris™ or by e-mail at any time if they have any problems/queries regarding marking. For any queries regarding the use of Scoris™, please contact [emarking@ibo.org](mailto:emarking@ibo.org).*

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1. Follow the markscheme provided, award only whole marks and mark only in **RED**.
2. Make sure that the question you are about to mark is highlighted in the mark panel on the right-hand side of the screen.
3. Where a mark is awarded, a tick/check (✓) **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 use Scoris™ annotations to support your decision. You are encouraged to write comments where it helps clarity, especially for re-marking purposes. Use a text box for these additional comments. It should be remembered that the script may be returned to the candidate.
5. Personal codes/notations are unacceptable.
6. Where an answer to a part question is worth no marks but the candidate has attempted the part question, enter a zero in the mark panel on the right-hand side of the screen. Where an answer to a part question is worth no marks because the candidate has not attempted the part question, enter an “NR” in the mark panel on the right-hand side of the screen.
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. Scoris™ will only award the highest mark or marks in line with the rubric.
8. Ensure that you have viewed **every** page including any additional sheets. Please ensure that you stamp ‘seen’ on any page that contains no other annotation.
9. 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. However, 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

### Mark Allocation

Candidates are required to answer **ALL** questions in Section A [**25 marks**] and **TWO** questions in Section B [**40 marks**]. Maximum total = [**65 marks**].

1. A markscheme often has more marking points than the total allows. This is intentional.
2. Each marking point has a separate line and the end is shown by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. Words in brackets ( ) in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity 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 ***OWTTE*** (or words to that effect).
8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script.
10. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

**SECTION A**

1. (a) desert; [1]
- (b) (i) population size/number of individuals;  
growth/reduction in population size/population growth rate;  
numbers of mature individuals/reproductive adults;  
geographic range;  
degree of fragmentation;  
quality of habitat / habitat loss/threat to habitat;  
area of occupancy;  
probability of extinction / vulnerable/endangered; [1 max]  
*Award [1] for any two of the above criteria.*
- (ii) food from fish/buffalo;  
building material/reeds;  
feed for cattle/livestock;  
drinking/irrigation water;  
ecological services *e.g.* reeds trap pollutants/release O<sub>2</sub>/carbon sequestration;  
facilitate desalinization of salty water / *OWTTE*;  
water transport;  
supporting biological diversity; [2 max]  
cultural and heritage value;
- (c) *Award [1] for any two inputs:*  
river Tigris;  
river Euphrates;  
precipitation/rainfall/rain;  
snow melt/river/run-off;  
groundwater/aquifers;
- Award [1] for any two outputs:*  
evaporation/evapotranspiration/transpiration;  
run-off/river flow/rivers;  
abstraction/extraction/drains/drainage canals/irrigation/people taking it for crops;  
infiltration; [2 max]

- (d) (i) (stage) two/2; **[1]**
- (ii) *Award [1] for each observation from the data plus identifying the impact on water resources.*  
expanding pyramid/growing population so (absolute) demand for water will increase;  
Iraq is developing so (relative) demand for water will increase;  
increased demand for food/crops/cultivation so more irrigation;  
more dams/hydroelectricity production demanding water;  
more industry demanding water;  
more people polluting so increased pollution levels in the water;  
more land for farming/habitation so marshes drained;  
increased pressure/demand may lead to water stress/water scarcity;  
increased demand over scarce resources so conflict likely to increase; **[3 max]**  
*Accept other reasonable responses.*
- (e) (i) number of bird species has decreased significantly / *OWTTE*;  
number of plants/aquatic plant species has decreased significantly;  
number of fish species has remained similar/decreased slightly;  
overall number of species has decreased by about a third / *OWTTE*; **[2 max]**  
*Accept other reasonable responses.*  
*Award [1 max] if no quantification/sense of the degree of change is given.*
- (ii) all values for re-flooded marshes are higher than for natural;  
Al-Hammar has similar/slightly higher values for pH/salinity than natural marsh;  
Al-Hammar has significantly higher values for nitrogen than natural marsh;  
both re-flooded marshes are significantly higher in total nitrogen than natural marsh;  
Al-Sanaf has much higher values for all three criteria than natural marsh;  
Al-Sanaf shows a greater overall difference than Al-Hammar to natural marshes; **[3 max]**  
*Award [1 max] if no distinction is made between re-flooded marshes (does not refer to specific named marshes).*
- (iii) concentrated salts/high salinity in soils/water;  
re-flooded water becomes toxic/polluted (because reeds have gone);  
populations of local species have diminished/not recovered;  
desertification of soil beyond point of being restored;  
migratory birds find alternative feeding grounds;  
not enough time has elapsed for restoration to occur;  
insufficient water for complete re-flooding/marshes have only been partially re-flooded;  
ecosystems relied on human presence and people have not come back; **[3 max]**  
*Allow any other reasonable suggestions.*

- (f) (i) wealth/ability to pay/economic status;  
value systems / cultural beliefs / environmental world view/paradigm;  
quality of individual's environment;  
proximity to marshes/location;  
level of education/environmental awareness;  
immediate personal/economic benefit from the marshes;  
level of use of/dependence upon marshes / occupation; [2 max]

- (ii) *arguments for complete re-flooding:*  
important habitat for certain threatened species / protect endangered/endemic species;  
marshlands contribute to overall biodiversity/improve biodiversity;  
marshlands provide important ecological services/resources;  
important ethical/biorights/cultural rights arguments;  
local communities show high willingness to pay;  
could provide local people with employment/jobs/economic opportunities;  
flooding will remove salts/reduce salinization;

*implications/limitations/issues:*

- increasing demand/competition for water resources in Iraq;  
people may have become accustomed to water that has been diverted;  
water may not be available due to dams/irrigation/HEP;  
different groups have different willingness to pay/values;  
not all may agree equally with allocating more water to re-flooding;  
source of water is in the hands of other countries;  
re-flooding may not be successful (because of soil/water contamination);  
may not have had enough time to evaluate success;  
may need more active management, (e.g. habitat management and reintroduction of plant species);  
may be very costly; [5 max]

*Accept other reasonable points, but **only** where they are of similar **significance** and **validity** to those exemplified above.*

*Award [4 max] for responses which examine only one side of the argument.*

*Note: do not credit responses that re-flooding has **caused** pollution/salinization.*



## 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.

2. (a) succession is change over time/temporal change in an ecosystem;  
whereas zonation is change over distance/spatial change;  
succession is caused by changing conditions through biotic influences of (seral) communities;  
zonation is caused by environmental gradients/changes in abiotic factors;  
zonation can be caused by the process of succession but not always;

*Award [1 max] for an example which illustrates succession and [1 max] for an example which illustrates zonation. The example does not need to be tied to a specific location but must be an example of a type of succession/zonation (e.g. succession of plants on the slopes of a volcano which has erupted.*

*e.g. (sand dune ecosystem) from bare inorganic substrate to climatic climax community/fully grown forest;*

*e.g. (the main biomes/ecosystem show) zonation in relation to latitude/climate;*

*e.g. zonation with altitude on a mountain;*

**[4 max]**

- (b) *Climax community is more diverse and therefore stable because:*  
climax community is more productive;  
making more energy to support consumers/decomposers;  
more niches are available;  
abiotic conditions have been improved *e.g.* soil fertility/pH/aeration/infiltration;  
more complex food webs provide alternative food sources if one is lost;  
they have evolved over long periods of time;  
creating balanced relationships/feedback mechanisms leading to a steady state;  
they have established effective cycles of nutrients;

*human activity/interruption of a community may:*

decrease productivity through removal of primary producers;  
reduce niches;  
which especially threatens more specialized species;  
cause deterioration in abiotic factors (leading to harsh conditions to which few species adapt);  
remove certain species creating simpler/shorter food webs;  
generate rapid change;  
so relationships have insufficient time to evolve a stable balance/steady state;  
interfere with cycles by removing/harvesting key organisms/material/nutrients;

**[6 max]**

*Allow any other reasonable explanations.*

*Award [1 max] for a well integrated, **named** example.*

*Award [5 max] for explanation.*

- (c) *Candidates must show an understanding of ecosystem function. Key ideas must have a valid link to effective resource management.*

*interdependence/interconnectedness/ecosystems as systems: [3 max]*

the role of one component/species in an ecosystem affects many others / species are parts of food webs;  
all components have significance to overall stability of system, and need to be valued by management;  
particularly keystone species;

*rates of replenishment/natural income/sustainable harvesting: [3 max]*

the natural income of any component is the rate at which it can be replenished;  
resource exploitation must be managed within these limits to allow for long-term availability;  
exceeding such limits will lead to reduced stock/future replenishment;

*laws of thermodynamics/pyramidic structure of trophic levels: [3 max]*

energy/biomass is lost as it is passed along food chains/trophic levels;  
so top predators are most vulnerable and need large areas of plant communities to be maintained for their support;  
harvesting resources at higher trophic levels is less efficient use of available areas;  
management using pesticides/herbicides/inorganic compounds/chemicals will lead to build up (biomagnification) along food chains so should be avoided;

*cycling of matter: [3 max]*

ecosystems depend on recycling of nutrients;  
and effective decomposer communities;  
so decomposer communities need to be valued/protected by management;  
and nutrients lost through harvesting need replacement;

*succession: [3 max]*

ecosystems tend to develop into climax communities;  
management of plagioclimax/cultivations will require management/intervention  
(which uses energy);  
so it is more efficient to get natural income from a climax community than to  
interrupt succession;

*feedback mechanisms: [3 max]*

negative feedback mechanisms are essential for stability of ecosystems;  
positive feedback mechanisms lead to the loss/shift of equilibrium;  
so negative feedback mechanisms need to be protected/valued by management  
strategies;  
causing a disturbance to equilibrium may initiate positive feedback mechanisms  
leading to further and further deviation from equilibrium;  
*e.g.* heavy cultivation of soils may lead to loss of soil fertility requiring even  
heavier cultivation and further loss of fertility *etc.*;

*diversity: [3 max]*

diversity is the key to stability of ecosystems;  
which highlights the dangers of *e.g.* monocropping;  
and the advantages of polycultures/hedgerows *etc.*;

**[8 max]**

*Award [3 max] if no link is made between resource management and key ideas.*

*Expression of ideas: [2 max]*

*Total: [20]*

3. (a) biodiversity is the amount of living/biological diversity (per unit area);  
biodiversity includes species, genetic, and habitat diversity;  
species diversity is number of different species and relative abundance/number of individuals of each / biodiversity includes measure of abundance;  
abundance is a measure of the amount/number of individuals (in a population);  
*e.g.* population of a particular species of butterflies in a particular habitat;

**[4 max]**

- (b) Deep Ecologists and Cornucopians are at opposite ends of the environmental values system spectrum/continuum;  
Deep Ecologists would probably be opposed to the exploitation of oil reserves /Cornucopians are likely to support it;  
Deep Ecologists would be concerned that nature will be damaged, and that it is more important than material gain for its own sake;  
Cornucopians feel that resources are there to be exploited/generate income;  
and that with sufficient ingenuity/technical expertise, potential environmental obstacles could be overcome/technocentric approach;  
Deep Ecologists would favour the rights of species to remain unmolested over the rights of humans who wish to exploit resources for economic gain;  
Deep Ecologists distrust/lack faith in the modern large-scale technology;  
and its associated demands on elitist expertise (which would be required for oil exploitation);

**[5 max]**

*Award [3 max] for an understanding of one of the value systems but not the other.*

- (c) *Award [4 max] for an explanation of ecological footprint and why it should be reduced.*

ecological footprint is the area of land (and water) required to support a (defined) population (at a given standard of living) / a measure of the (hypothetical) amount of land needed by a population to meet their needs/absorb waste and provide their resources;

ecological footprints greater than size/bicapacity of country indicate unsustainability;

many countries currently have an ecological footprint that is greater than their earthshare (currently about 2.1 hectares per person);

*i.e* if everyone consumed resources at the same rate as they do, we would need more Earths than one to meet everyone's needs;

there is inequality/imbalance as people in MEDCs have a higher ecological footprint than people in LEDCs;

*e.g.* the US ecological footprint has been calculated at over 9 (global) hectares per person whereas in Bangladesh it is 1.4;

reducing footprints will also reduce other environmental problems;

**[4 max]**

*Award [5 max] for an ecocentric/technocentric approach. Responses can argue either position.*

*e.g. Technocentric approach:*

emphasizes technological solutions to environmental problems;

can reduce footprints by increasing the biocapacity/productivity of space *e.g.* hydroponics / intensive agriculture;

enables people to maintain their lifestyles while they are reducing their footprints;

is more likely to be (politically) popular and therefore adopted;

can also help to generate new resources/access new resources economically;

can increase efficiency of energy use *e.g.* through halogen light bulbs;

can reduce waste *e.g.* recycling;

can be introduced at a country wide level so can have a broader impact;

whereas ecocentric approach requires individual change of heart/self-imposed restraint on resource use;

which is less likely to be successful because people are too selfish/apathetic/ignorant of the potential importance;

*e.g. Ecocentric approach:*

emphasizes minimum disturbance of natural processes;  
emphasizes need for sustainability/that we need to live within our earthshare;  
encourages individual responsibility for reducing the resources they use/waste and  
lots of individual actions lead to big change;  
can reduce waste *e.g.* growing own food would reduce food miles;  
are local/community based/bottom up so people feel part of the process;  
can be simple/cheap *e.g.* composting, so are possible even in LEDCs;  
can still involve technology *e.g.* community sharing cost of a wind turbine;  
can be introduced in schools quite easily so can have a (broader) impact over the  
long term;  
involves education and therefore lead to changes in values/mindsets, so  
environmentalism won't be just a "fad";

whereas technocentric approaches require political will/more capital;  
and often gives rise to further increases in ecological footprint;

a combination of the two approaches is probably pragmatic/most useful;

**[5 max]**

*Award [1 max] for a definition of what a technocentric/ecocentric approach is.*

*Award [1 max] for a specific example of a technocentric/ecocentric approach.*

*Award [3 max] for arguments why technocentric/ecocentric is more likely to  
be successful.*

*Expression of ideas: [2 max]*

*Total: [20]*

4. (a) *Award [2 max] for an outline of Gaia hypothesis:*  
compares Earth to a living organism;  
in which feedback mechanisms maintain equilibrium/homeostatic state;  
an approach which sees the Earth as a global ecosystem (Daisyworld);

*Award [2 max] for suggestions on how traditional views differ.*

*Traditional views:*

tend to break up/fragment the Earth into smaller systems/ecosystems;  
or see the Earth in a more static way;  
or see the Earth as something which just supplies us with resources;  
give more significance/centrality to the role of humans;  
allow for possibility that humanity could irreversibly destroy life-supporting conditions of the planet (Gaia suggests Earth will continue despite us);  
it is possible to have a systems approach to the Earth without believing that the Earth is alive;

**[4 max]**

- (b) *Award [1] for a flow diagram which shows a clear causal/feedback link where the change itself **causes** or **leads to** a reversal/inhibition of that change (it is not sufficient to simply show an increase/decrease being followed by a decrease/increase).*  
*A graph with oscillation is acceptable if it is annotated in sufficient detail to identify the causal link.*

*Award [1 max] for written definition of negative feedback.*

feedback that tends to damp down/neutralize/counteract any deviation from an equilibrium/promotes stability;

*Award [4 max] for examples of complete negative feedback loop (credit non-ecosystem examples).*

*e.g. more CO<sub>2</sub> in atmosphere leads to increased temperatures and more evaporation;  
which creates more cloud cover, reducing rates of incoming solar insolation and reducing temperatures;*

*e.g. increase in predator population will increase consumption of prey species making them more scarce;  
which in turn will represent a limiting factor for predator species allowing prey numbers to recover;*

**[5 max]**

*Award [4 max] if diagram is inadequate or absent. Do not credit both examples if they are too similar.*

- (c) *Credit different interpretations of what is meant by “bigger” in this context e.g. bigger can refer to the scale/number of effects, or to how immediate/frightening/concrete the threat may seem, or in terms of whether the threat is to humans or to living systems in general.*

*Award [1] for a explicit statement of their view on which is the **bigger** threat.*

*global warming is a bigger threat than biodiversity;*

*biodiversity is a bigger threat than global warming;*

*Do not credit if the viewpoint is only implied in the response.*

*Award [8 max] for relevant arguments for why one issue is a **bigger** threat than the other.*

*Award [4 max] if response is simply a description of the threat/effects not a comparison with the other threat.*

*e.g. global warming is the bigger threat because:*

*it will have big effects e.g. melting ice caps/shifting biomes/changing the world’s weather/flooding land;*

*its effects will be more widespread than biodiversity/every country will be affected;*

*whereas the loss of diversity in, e.g. a tropical rainforest, may have little direct impact on people elsewhere;*

*larger numbers of people will be affected e.g. Bangladeshi delta region low-lying and densely populated affected by sea level rises;*

*it will affect a bigger range of human activity, such as food supply/living space, health/disease;*

*it will lead to biodiversity loss as well (whereas loss of diversity will not cause global warming);*

*many biodiversity hotspots are particularly vulnerable e.g. coral reefs;*

*it has a higher public/global profile;*

*it can lead to significant social consequences e.g. wars / mass migrations;*

*is harder to solve than biodiversity loss which can be helped by e.g. seedbanks;*

*current rate of warming is unprecedented, whereas there have been mass extinctions in the past and the biodiversity has recovered;*

*it may lead to positive feedback loops/potentially devastating tipping points/exponential change;*



*e.g. biodiversity is the bigger threat because:*

biodiversity provides/ensures key essential ecological services;  
*e.g.* a balance of atmospheric O<sub>2</sub> and CO<sub>2</sub>/soil preservation/mineral cycles;  
without these there would be no life-supporting conditions on the planet;  
once biodiversity is lost it is gone forever;  
and whereas global warming may be mitigated by negative feedback mechanisms  
there are no feedback mechanisms to maintain diversity;  
to restore biodiversity it can take very long periods of time;  
whereas climatic variations are reversible/happen in cycles (and have occurred in  
the past);  
from a human point of view, loss of biodiversity may mean loss of critical  
resources;  
biodiversity provides many forms of natural income, *e.g.* aesthetic, economic,  
ecological services;  
at a point in human population growth where resources are possibly limiting;  
it is biodiversity that gives living systems the ability to adapt to change;  
and the more it is reduced, the lower the chances of adapting to change;  
biodiversity is being lost now/threats seem more immediate to people;  
there are some positive benefits of global warming but no benefits to biodiversity  
loss;

**[9 max]**

*Expression of ideas: [2 max]*

**Total: [20]**

5. (a) sustainability is the use of global resources at a rate that allows natural regeneration and minimizes damage to the environment;  
*e.g.* harvesting renewable resources at a rate that will be replaced by natural growth demonstrates sustainability;  
sustainable development is development that meets current needs without compromising the ability of future generations to meet their own needs;  
sustainable development is a harder concept to define because different groups emphasize different aspects of it;  
sustainability focuses on the rate of resource use, whereas sustainable development is more about a general approach to development;  
sustainability suggests maintaining a balance/equilibrium, whereas development suggests progress/improvement/change for the better;  
sustainability has a wider application, possibly including, but going beyond “development” as such (*e.g.* personal lifestyles, a particular farm *etc.*); **[4 max]**  
*Award [2 max] for responses that define but do not distinguish between the terms.*

- (b) *Award [2 max] for definition of GPP and NPP.*  
gross primary productivity/GPP is the (total) gain in energy or biomass (per unit area per unit time) by photosynthesis/plants/primary producers;  
net primary productivity/NPP is the amount available to consumers in an ecosystem;  
that is, the gain in energy or biomass after allowing for respiratory losses/  
 $NPP = GPP - R$  where  $R =$  respiratory loss;

*Award [5 max] for explanation of productivity in biomes.*

*e.g. tropical rainforests:*

light/insolation/sunlight and rainfall/precipitation (2500mm per annum) are not limiting/optimal;  
and temperatures are high throughout the year;

*e.g. deserts:*

do not have enough rainfall/precipitation (250mm per annum);

light is not limiting/have high temperatures (in the day);

distribution of rainfall throughout the year is as important as the total amount;

*Award [1] for correctly identifying difference in productivity between two biomes.*

*e.g.* tropical rainforests have higher rates of productivity than deserts;

other limiting factors *e.g.* availability of nutrients/plant diversity play a part; **[7 max]**

*Award [3 max] if two named biomes are not included/used correctly or general responses.*

- (c) *Award [4 max] for appropriate criteria together with justification.*
- sustainability of approach, because the reserve needs to be successful in the long term;
  - local involvement/ownership, because if local people are involved they will be more likely to cooperate with efforts to preserve species/habitats;
  - habitat preservation/restoration of degraded habitats/management (in situ), because species cannot survive unless their habitats are also preserved;
  - enforcement/maintenance/physical barriers, because unless rules are enforced people may continue to poach/degrade habitats;
  - maximizing natural income, because it will provide an incentive for local people to preserve the area;
  - minimizing change to traditional activities, because these may be an integral part of the maintenance of the ecosystem;
  - minimizing cost, because funds will always be limited, especially in LEDCs;
  - maintenance of ecological services, because these are a useful measure of the health of an ecosystem;
  - promoting environmental education/awareness because it is a good way to change behaviour;
  - using “optimum” design features for the reserve/minimize edge effects/sufficient size/corridors/core and buffer zones, because this means more species are likely to survive;
  - preservation of biodiversity/biodiversity hotspots because this ensures system stability;
  - maintenance/restoration of species' population sizes because this ensures system stability/diversity;
- Accept other equally significant and valid criteria and justifications to those above.*

*Award [4 max] for an evaluation of a named protected area based on the candidates' criteria.*

*Award [1] mark for a sufficiently specific named example.*

*e.g. in the Kisite-Mpunguti Marine National park off the coast of Kenya;*

the managers have limited potentially harmful activities such as anchoring boats near reefs/swimming with dolphins;  
enforcement of rules is undertaken by the Kenya Wildlife Service (KWS) and visiting the park can only be done with a permit, but it is hard for the KWS to patrol all parts of the park at once;  
economic activities are allowed within the park, such as running dhow trips for tourists to the reef so that locals have an incentive to preserve them;  
information is available to tourists visiting the area about how not to damage coral so there is an educational role, though not all dhow captains mention this to tourists;

*[7 max]*

*Expression of ideas: [2 max]*

*Total: [20]*

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