

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

**MARK SCHEME for the May/June 2009 question paper
for the guidance of teachers**

9693 MARINE SCIENCE

9693/02

Paper 2 (AS Data-Handling and Free-Response),
maximum raw mark 50

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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- 1 (a) (i) zooxanthellae contain, pigment / chlorophyll ; [1]
- (ii) zooxanthellae photosynthesise ;
produce, sugars / carbohydrates / other named substance ;
coral (animals) rely on this as nutrient source ;
ref to effect of zooxanthellae on calcium carbonate deposition ; [max 2]
- (b) (i) **C** found deeper than **E** ;
where less light penetrates ;
at 6–12 m **E** found only on top of reef and not sides ; [max 2]
- (ii) on Rio Carti only **E** found, whereas at Cayos Limones **A, B, C** and **E** found ;
greater diversity at Cayos Limones ;
13 coral colonies at CL but only 2 at RC ; [max 2]
- (c) (i) RC more sediment (than CL) ;
only **E** found (near surface) at RL / **A** not found at RC ;
whereas **A** survives near surface at CL ;
ref to light penetration through sediment ;
ref to **A** needing more light / converse for **E** ;
use of figures ; [max 2]
- (ii) colonies of *M franksi* ;
some with zooxanthellae **A** and some with **E** ;
at least five colonies containing each type ;
taken from same, environment / place ;
keep some (of each type) in clear water and some in water with sediment ;
different amounts of sediment / range ;
two other stated variables kept constant – temp, light, salinity, chemical composition of
water, pH , oxygen, food availability ; ;
repeats ;
description of what is counted, e.g. length of time zooxanthellae survive / length of time
to coral bleaching / extent of bleaching after set time ; [max 5]

[Total: 14]

- 2 (a) magnetic stripes in sea floor (rocks) are symmetrical / AW ;
sequence of stripes matches known sequence of field orientation changes / matches (b) ;
youngest rocks nearest to, rift / ridge ;
idea that magnetism is 'frozen' in magma as it solidifies ; [max 3]
- (b) shallow seas formed at aseismic margin / AW ;
tectonic plates / crust, floats (according to its density) ;
oceanic crust denser than continental crust ;
isostasy means that crust lies lower where it is, thinner / denser ;
detail of isostasy, e.g. total downwards force the same ;
ref. to sediment deposited at continental margin has lower density (than crust) ;
use of figures from Fig. 2.2, e.g. density of continental crust beneath the sea is more than
that over land related to isostasy ;
AVP ; [max 3]

[Total: 6]

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- 3 (a)** develops in June to September ;
following absorption of heat by the land / ref to higher specific heat capacity of water ;
land absorbs heat faster than, water / sea ;
air masses over land absorb heat from the land ;
and become less dense / lower pressure ;
so they rise ;
draws in cooler and moister air from over the oceans ;
onshore winds ;
heavy precipitation ; [max 5]
- (b)** hurricanes / typhoons, evolve from, low pressure areas / cyclones, with high wind speeds ;
form in tropical latitudes during, late summer / early autumn ;
when sea temperature (in top 45m) is above 26°C ;
when upper level winds are weak ;
air above water gets warmer and gathers water ;
rises and cools ;
water vapour condenses and releases energy ;
energy causes spiralling movement (of air mass) ;
wind convergence near sea surface / wind divergence in the upper levels (of atmosphere) ;
to sustain hurricane / typhoon, requires constant input of heat and water vapour ; [max 6]
- (c)** high winds cause structural damage ;
to, property / homes ;
damage, communication infrastructure / roads ;
damage trees / defoliation ;
which may reduce protection of shore (e.g. if mangroves destroyed) ;
high water levels / storm surge, cause flooding ;
coastal wetlands flooded with salt water ;
destroy sea-based industries ; (e.g. mussel beds, shrimp farms, tourism) [max 4]

[Total: 15]

- 4 (a)** runoff from land ;
brings mineral ions from rocks ;
brings organic nutrients from, agricultural waste / sewage / fertilisers ;

decomposition of, dead organisms / waste from organisms ;
happens, in deep water / on sea floor ;
generates nutrients / named ion (e.g. nitrate, phosphate) ;
upwelling brings nutrients to surface ;
occurs at edge of landmasses / along equator (in Pacific / Atlantic oceans) ;

gases from atmosphere dissolve ;
carbon dioxide forms, hydrogen carbonate / carbonate, ions ;
AVP ; [max 6]

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(b) calcium present in sea water as, Ca^{2+} / calcium ions ;
brought into the sea, by runoff from land / in rivers ;
used by marine organisms to make bones ;
used by marine organisms to make, shells / coral skeletons;
fall to sea bed when organisms die ;
compression (by new sediments) ;
form, limestone / chalk ;
uplifting / fall in sea level ;
exposure of rocks on land ;
ref. to weathering / erosion ;

[max 5]

(c) photosynthesis happens in upper levels of the sea ;
because light only penetrates to a certain depth ;
idea that limiting factors for photosynthesis limit productivity ;
ref. to macronutrients plus one example (nitrate, phosphorus, sulfate) ;
ref. to micronutrients plus one example (iron, copper, manganese) ;
nitrate / phosphate, usually in the shortest supply / most usual limiting factor ;
ref. to nutrients being lost from the surface and 'sinking', so shortages in, upper layers /
photic zone ;
other valid point ;

[max 4]

[Total: 15]