

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

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International Examinations

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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]