



THIS PAPER MUST NOT BE REMOVED -
TO BE RETURNED AT THE END OF THE EXAMINATION

**UNIVERSITY OF
TECHNOLOGY,
SYDNEY**

NAME: _____

STUDENT NUMBER: _____

COURSE: _____

AUTUMN SEMESTER EXAMINATION 2011

MARINE GEOSCIENCES

SUBJECT N^o: 66513

THURSDAY 16TH JUNE, 2011

TIME ALLOWED: 2 hours + 10 minutes

START: 2:00 pm - FINISH: 4:10 pm

This paper is designed to be completed in 2 hours. An extra 10 minutes has been added to the time allowed and it is recommended that you use this time to read the paper before commencing to answer the questions.

THERE ARE FOUR (4) QUESTIONS

ANSWER ALL QUESTIONS ON THE EXAM PAPER

THERE IS INTERNAL CHOICE WITHIN SOME QUESTIONS

EACH QUESTION IS WORTH 25 MARKS.

USE DIAGRAMS WHERE NECESSARY TO ILLUSTRATE YOUR
ANSWERS

ANSWER ALL QUESTIONS ON THE EXAM PAPER**THERE ARE FOUR (4) QUESTIONS, EACH WORTH 25 MARKS.****Question 1 (25 marks)**

In each case circle, or otherwise mark, **all correct** answers in each multiple choice question. Each question has **at least** one correct answer, but some questions have **more than one (1) correct answer**. There are 25 correct answers in the following 21 multiple choice options with 1 mark for each correct answer. *However, if you mark more than thirty (30) answers then a mark will be deducted for each incorrect answer.*

1. Water, including ocean water, has the ability to store large amounts of heat (= energy) because:
 - (a) it occupies such a large volume at the Earth's surface
 - (b) water molecules vibrate at the frequency of light energy
 - (c) primary producers living in the water column convert the heat energy to sugar
 - (d) its polar bonds resist individual molecular motion

2. Milankovitch Cycles:
 - (a) can explain upwelling events in the major ocean basins
 - (b) have three (3) main frequencies at 23ka, 41ka and 200 ka
 - (c) are the main cause of ice ages
 - (d) is the name given to regular variations in the Earth's orbital and rotational parameters

3. Turbidity currents are deep marine currents that:
 - (a) only operate on the continental shelf
 - (b) contain only silt to medium sand particles
 - (c) generally form after a severe rain storm
 - (d) are maintained by the density of suspended sediment

4. Topographic relief of the Earth's solid surface is currently about:
 - (a) 10 km
 - (b) 20 km
 - (c) 30 km
 - (d) 40 km

5. The oxygen isotope record is a good proxy for sea level because:
 - (a) the light stable isotope ^{16}O is preferentially evaporated during ice ages
 - (b) the light stable isotope ^{16}O is preferentially evaporated at all times, but during ice ages it is retained on the continents in glaciers
 - (c) the rate of evaporation of water is less during an ice age as a result of lower temperatures
 - (d) the light stable isotope ^{16}O is preferentially evaporated at all times, but during ice ages precipitation in the oceans is much reduced

Question 1 continued over page

6. The West (or Indo-) Pacific Warm Pool:
 - (a) is responsible for coral bleaching
 - (b) is characterised by slight sea surface elevation compared with the eastern tropical Pacific
 - (c) drives the East Australia Current
 - (d) contains the highest salinity water in the surface ocean
7. The pattern of the advance and retreat of glaciers during the Pleistocene ice age:
 - (a) is useful for time correlation because these events were globally synchronous
 - (b) is only useful where the glaciers eroded u-shaped valleys
 - (c) shows that sea ice in the southern hemisphere behaved like continental ice in the northern hemisphere
 - (d) can be delineated by the occurrence of tills and moraines.
8. The *lysocline* and the *pycnocline* respectively are the:
 - (a) ocean depth at which the rate of dissolution of calcite exceeds supply, and the depth at which there is a rapid increase in pressure and temperature of seawater
 - (b) ocean depth at which the rate of dissolution of calcite falls below the supply, and the depth at which there is a rapid increase in salinity and/or temperature of seawater
 - (c) ocean depth at which the rate of dissolution of calcite exceeds supply, and the depth at which there is a rapid increase in salinity and/or temperature of seawater
 - (d) ocean depth at which the rate of dissolution of calcite exceeds supply of radiolarians, and the latitude at which there is a rapid increase in salinity and/or temperature of seawater
9. The statement that best fits with knowledge about the pattern of magnetic stripes on the sea floor is:
 - (a) They are produced by different magmas having different magnetic properties
 - (b) The pattern is symmetrical either side of the mid ocean ridge
 - (c) Hot magma produces a magnetic signature at a mid ocean ridge
 - (d) A change in the rate of sea floor spreading results in the pattern being uninterpretable
10. The instrumental record of climate extends back:
 - (a) to the beginning of the period of industrialisation
 - (b) to the Renaissance period about 600 years ago
 - (c) to the time of the Romans and Greeks at about 200 BC
 - (d) only for about 160 years
11. Average salinity of the global ocean is
 - (a) 35 % TDS
 - (b) 3.5 parts per thousand TDS
 - (c) 350 parts per million TDS
 - (d) 3.5 % TDS
12. A depositional coastline with a high (>4 m) tidal range is mostly characterised by:
 - (a) a well-developed barrier island system
 - (b) sand bodies that are perpendicular to the coast
 - (c) strong long-shore drift transport
 - (d) sandy beaches with long spits

13. Water bodies in the global ocean remain separate because:
 - (a) they are mostly moving in opposite directions
 - (b) the Ekman Spiral causes them to separate out
 - (c) they have different densities
 - (d) they are contained between continental land masses
14. The role of the Sun in determining interannual climate variation of the Earth is unclear because:
 - (a) interannual variation in solar radiation is very small
 - (b) cycles of variation in solar output do not correspond with any known periods of climate variability
 - (c) there is no regular pattern to solar variability
 - (d) overall, the amount of solar radiation reaching the Earth is constant; it is only the distribution that changes on interannual scales
15. Shallow water waves are defined as those in which:
 - (a) water particle motion decreases with water depth
 - (b) water particle motion increases with water depth
 - (c) water particle motion does interfere with the substrate
 - (d) water particle motion does not interfere with the substrate
16. About ten (10) half-lives is the maximum span of any radiometric dating method because:
 - (a) count times are far too long to give statistically significant results
 - (b) beyond this range we cannot be sure that the natural production rate of the isotope has remained constant
 - (c) prohibitively large mass spectrometers are needed to measure the very small amounts of daughter products being produced
 - (d) after this time there is generally insufficient remaining parent material to produce a signal that is above background noise level
17. Ekman Transport is:
 - (a) the main driver of thermohaline currents
 - (b) responsible for ocean ventilation
 - (c) a direct result of the Coriolis Effect
 - (d) the name given to wind friction on the surface of the ocean
18. The age of ocean crust at any one location can be determined by:
 - (a) dating the fossils at the base of the stratigraphic section
 - (b) radiometric dating of basalt underlying marine sediments
 - (c) comparing the gravity anomaly with the gravity time scale
 - (d) using the pattern of magnetic anomalies at the site
19. "Mixing time" of the oceans is best described as:
 - (a) synonymous with residence time
 - (b) the time it takes to homogenise the mixed layer
 - (c) the time it takes after a glaciation to restore the oxygen isotopic balance
 - (d) the average length of time it takes for the oceans to become homogenised for any particular element

20. Among other reasons, calibration of carbon-14 dates needs to be carried out because:
- (a) the rate of radioactive decay changes with time
 - (b) there is a fractionation effect between the oceans and the atmosphere
 - (c) the rate of radiocarbon production in the atmosphere changes with time
 - (d) radiocarbon ages are severely distorted by atmospheric nuclear bomb testing
21. The Holocene Optimum was a period during which:
- (a) although warmer than today, atmospheric CO₂ levels did not change markedly
 - (b) unusually high levels of global volcanic activity were recorded
 - (c) global average temperature fell by at least 2°C
 - (d) sea level was as much as 10 m higher than at present

Question 2 (25 marks)

Each of the following twenty five (25) statements is either true (T) or false (F). Clearly mark only the correct answer in the box adjacent to the question. Each correct answer is worth 1 mark.

- 1 The critical factor leading to acceptance of the Theory of Plate Tectonics was the discovery of sea floor spreading in the early 1960s.....
- 2 Average temperature of the oceans is $\sim 4^{\circ}\text{C}$
- 3 The tidal range at any one location depends only on the distance from the equator...
- 4 Neap tides occur when the Sun and the Moon are aligned along a single axis.....
- 5 Significant amounts of carbonate sediment can only accumulate in tropical settings..
- 6 It is possible for parts of the ocean to be at different temperature and salinity, but have the same density.....
- 7 The dissolved content of both CO_2 and O_2 in the ocean decreases with depth.....
- 8 In terms of its average crustal composition, the continental shelf is part of the oceanic lithosphere.....
- 9 The average sedimentation rate in the deep oceans is much less than one millimetre per year.....
- 10 Oceans account for $\sim 70\%$ of global surface area.....
- 11 Kelvin and Rayleigh waves are two examples of global-scale very low frequency, cm-scale oceanic waves.....
- 12 Sediments described as *carbonaceous* are composed mainly of the mineral calcite..
- 13 The growth of sea ice does not contribute to glacial oxygen isotope fractionation or to global sea level change.....
- 14 The high latent heat of vapourisation for water is caused by the need to break all the hydrogen bonds.....
- 15 The random reversal of the Earth's magnetic field is the property that allows sea floor stripes to be used for age dating.....
- 16 By volume, most of the sediment entering the oceans is terrestrial in origin, and it is deposited around the margins.....
- 17 One kilogram of ocean water on average contains 20 ± 2 gm of chloride (Cl^-).....
- 18 Glaciations have been relatively common in the geological history of the Earth.....

Question 2 continued over page

- 19 *Mode water* is a term used for the average composition of the ocean.....
- 20 Average depth of the oceans is 3,800 m \pm 200 m, and average elevation of land is 850 m \pm 100.....
- 21 The Δr (delta r) value for a marine radiocarbon calibration is a measure of the average global "age" of sea water compared with the atmosphere.....
- 22 The error reported on a radiocarbon age assumes the measurements made during the age determination have a *normal* or *Gaussian* distribution.....
- 23 Ooze is a general term for a marine sediment comprising at least 30% biogenic material of mostly planktonic origin.....
- 24 Thermo-haline circulation is the global process of energy redistribution involving the entire ocean.....
- 25 In palaeoclimate studies, a proxy is an indicator of climate found near to the source..

Question 3 starts on the next page

3. Explain why oceans are considered to be geologically “young” and continents “old”

4. Explain in detail how long shore drift currents are produced

5. Explain what is meant by the term *ocean ventilation* and define the areas where it takes place today
