

The Written Test

**The 9th
International Earth Science Olympiad
Pocos de Caldas
Brazil**

September, 2015

1. The rock unit in the picture below consists of rounded grains ranging in size from sand to small pebbles.

In which sedimentary environment did this rock form? (Correct answer = 1 point)

下圖岩層由磨圓的砂與細礫所組成，下列何環境最可能形成此岩石？(正確答案=1 分)



- a) Dune 沙丘
 - b) River 河流
 - c) Lake 湖泊
 - d) Beach 沙灘
2. The surface wind is a result of the balance between the pressure gradient force, Coriolis force, and frictional force. If the surface wind blows from west to east in the Northern Hemisphere, in which direction would the pressure gradient force point? (Correct answer = 1 point)

近地面風是氣壓梯度力，柯氏力和摩擦力平衡的結果，如果北半球的地面風向是從西向東吹，下列何者是氣壓梯度力指的方向？(正確答案 1 分)

- a) Northwest 東北
- b) Southeast 東南
- c) Southwest 西南
- d) Northwest 西北

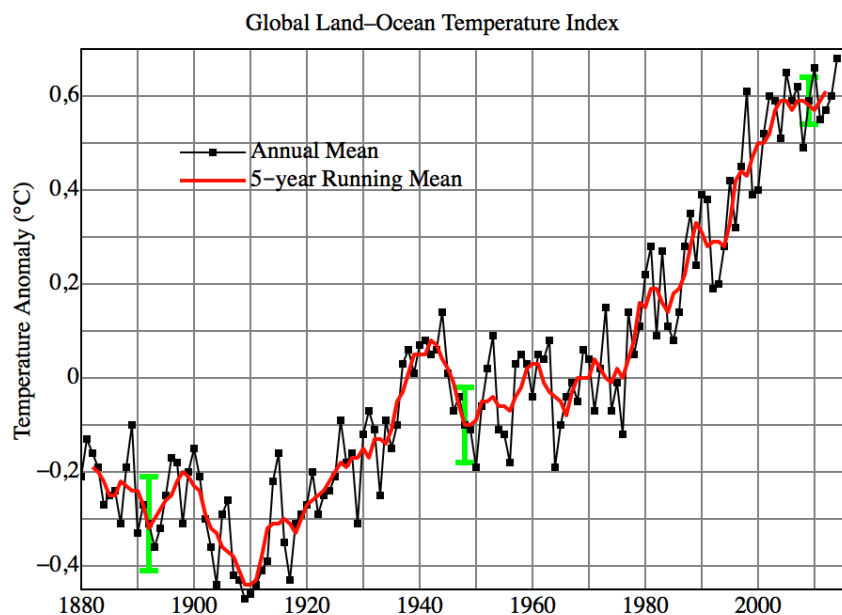
3. Choose the correct description for the evidence that the Earth's outer core is liquid. (Correct answer = 1 point)

地球外部地核為液態之證據，下列敘述何者正確？(正確答案=1 分)

- a) In some places, the first arriving seismic waves are refracted waves instead of direct waves.
部分區域的首到初波為反射波，而非直達波
- b) There is a seismic shadow zone.
有震波陰影帶的存在
- c) S-waves do not reach the opposite side of an epicenter.
S 波無法到達震央的地球對面
- d) Weak P-waves are detected in the P-wave shadow zone.
P 波陰影帶仍可偵測到微弱的 P 波

4. The figure below shows the global mean surface temperature anomaly and the 5-year running mean. The green bars show uncertainty estimates. The Earth's temperature has remained relatively constant for the past 15 years. Which one of the following options would possibly cause this warming slowdown (or warming pause)?(Correct answer = 1 point)

下圖顯示全球陸地與海洋平均溫度之距平(和氣候平均之差異)以及五年滑動平均分布。綠色線段顯示估計之不確定性，地球溫度在過去 15 年大約維持平穩沒什麼大變化，下列選項何者最可能是導致暖化變緩(或暖化停滯)的原因？(正確答案 1 分)



- a) Amount of cirrus cloud cover and an increase in the amount of water vapor
卷雲覆蓋量和水氣量之增加
- b) Concentration of tropospheric ozone has increased
對流層臭氧濃度之增加
- c) An increase in the number of sunspots
太陽黑子數之增加
- d) The frequency of La Nina events has increased.
反聖嬰事件發生之頻率增加

5. According to the Big Bang theory, approximately how many years ago was the universe at a very high density state and then expanded? (Correct answer = 0.5 point)

依據霹靂說，大約在多少年以前宇宙處於一個非常濃密狀態然後膨脹？(正確答案=0.5 分)

- a) 130×10^6
- b) 1.3×10^9
- c) 13.8×10^9
- d) 138×10^9

6. Which of the following statements is correct and only related to the study of seismic waves that pass through the Earth and based on rock rheology characteristics (the response of rock to stress)? (Correct answer = 1 point)

下列針對岩石流變學的特性與震波穿越地球之敘述何者為對？(正確答案=1 分)

- a) The asthenosphere lies entirely within the mantle and behaves in a semi-fluid (plastic) manner on which the lithosphere slips.
軟流圈完全存在於地函且為半流體(塑性)性質，因此岩石圈可於其上滑移
- b) The theory of plate tectonics states that the crust is segmented into several pieces of a spherical jigsaw puzzle.
板塊學說定義地殼可被分為如同拼圖般互相吻合的塊體
- c) The crust and the outermost mantle comprise the asthenosphere that behaves plastically.
軟流圈由地殼與上部地函所組成，且具塑性
- d) The crust and mantle define a plate that moves relative to one another by floating on and gliding over the liquid outer core.
板塊是由地殼與地函所組成。板塊會相互漂浮滑移於液態的外部地核之上

7. The figures below represent two different types of cyclones. Which of the statements below is correct?
(Correct answer = 1 point)

下圖代表兩種不同型態之氣旋，下列有關這兩種氣旋之敘述，何者正確？(正確答案=1 分)

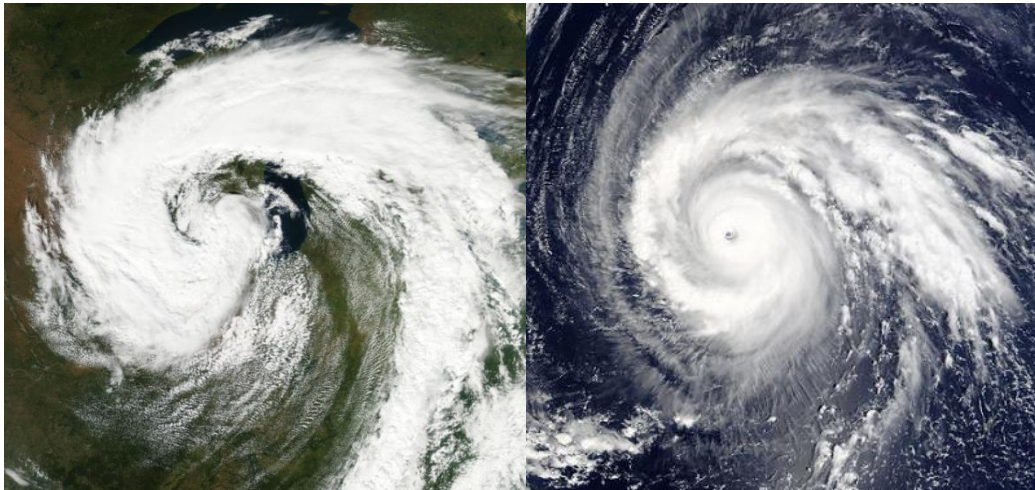


Figure 1

Figure 2

- a) Fig. 1 cyclone forms over cold tropical water.
圖 1 氣旋形成在冷的熱帶海面上
- b) Fig. 2 cyclone gains energy from condensation.
圖 2 氣旋從水氣凝結得到能量
- c) Fig. 1 cyclone is caused by upper air convergence.
圖 1 氣旋是因高空輻合所造成
- d) Fig. 2 cyclone has boundaries separating air masses of different temperatures.
圖 2 氣旋有一邊界以隔開不同溫度之氣團
8. Which of the statements below describe the interaction among CaCO_3 , CO_2 and H_2O ? (**EACH** correct answer = 1 point; **EACH** wrong answer = -1 point)
下列針對化學物質 CaCO_3 、 CO_2 、 H_2O 之交互作用意義哪些正確？
(每一正確答案= 1 分；每一錯誤答案=-1 分)
- a) The formation of limestone. 造成石灰岩的形成
- b) The dissolution of limestone. 造成石灰岩的溶解
- c) The interaction between atmosphere and geosphere. 造成氣圈與地圈之互動
- d) The interaction among biosphere, hydrosphere and geosphere.
造成生物圈，水圈與地圈間之互動
9. How many years ago did the solar system form due to the gravitational collapse of a giant interstellar molecular cloud? (Correct answer = 0.5 point)
多少年前，一個巨大的星際分子雲由於重力潰縮而形成太陽系？(正確答案=0.5 分)
- a) 46×10^6
- b) 460×10^6
- c) 4.6×10^9
- d) 46×10^9

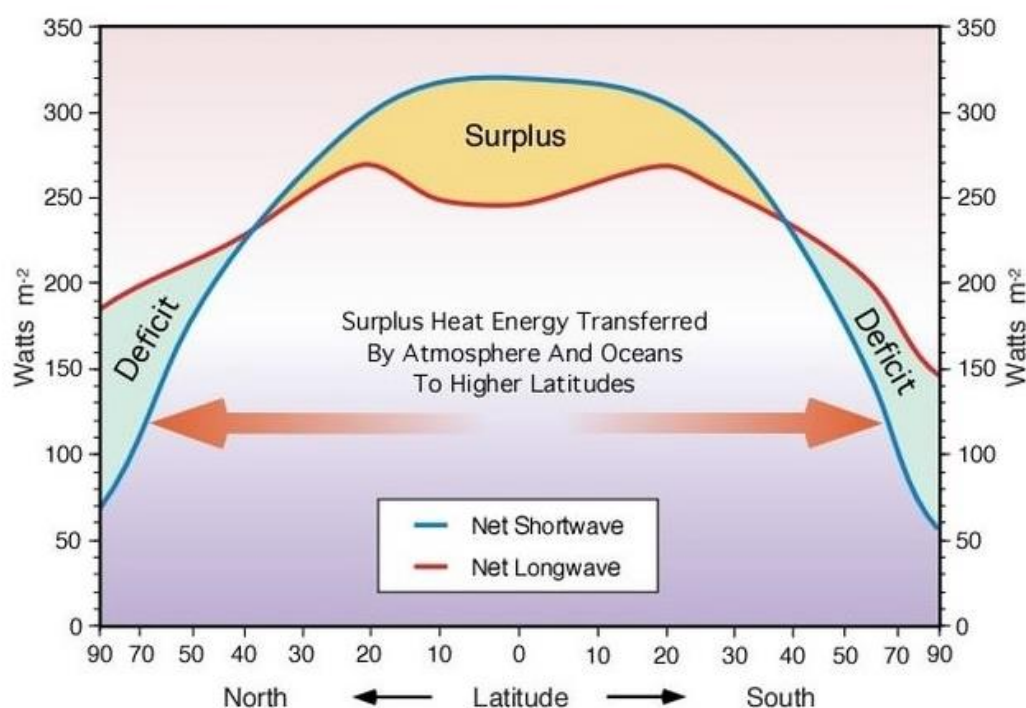
10. If a massive formation of stalactites takes place in caves, which of the statements below describe the outcome? (**EACH** correct answer = 1 point; **EACH** wrong answer = -1 point)

一個洞穴中鐘乳石大量生成，可能是下列那些事件所導致？

(每一正確答案=1分；每一錯誤答案=扣1分)

- a) Accelerate the present climate change. 氣候變遷加劇
- b) Slow down the present climate change. 氣候變遷減緩
- c) Accelerate the precipitation rate of limestone in the ocean. 海洋中石灰岩的沈積加速
- d) Slow down the precipitation rate of limestone in the ocean. 海洋中石灰岩的沈積減緩

11. The figure below shows the annual mean of solar (shortwave) and terrestrial (long-wave) radiation. In the tropics, incoming solar radiation exceeds the outgoing terrestrial radiation and, hence, a surplus of energy exists. The reverse holds good for the high latitudes. Thus, tropical surplus heat should be transferred towards the poles to balance the energy budget. Which one of the following statements does **NOT** reduce the latitudinal energy imbalance? (Correct answer = 1 point) 下圖顯示太陽短波輻射與地球長波輻射之年平均分佈，熱帶地區輻射進來的太陽輻射大於向外之地球輻射，因此能量有存餘(過剩)，但在高緯度剛好相反，能量是不足的，因此熱帶過剩的熱量必須向極區傳送以達到能量收支平衡，下列哪一個敘述不是降低不同緯度間能量不平衡之原因？(正確答案=1分)



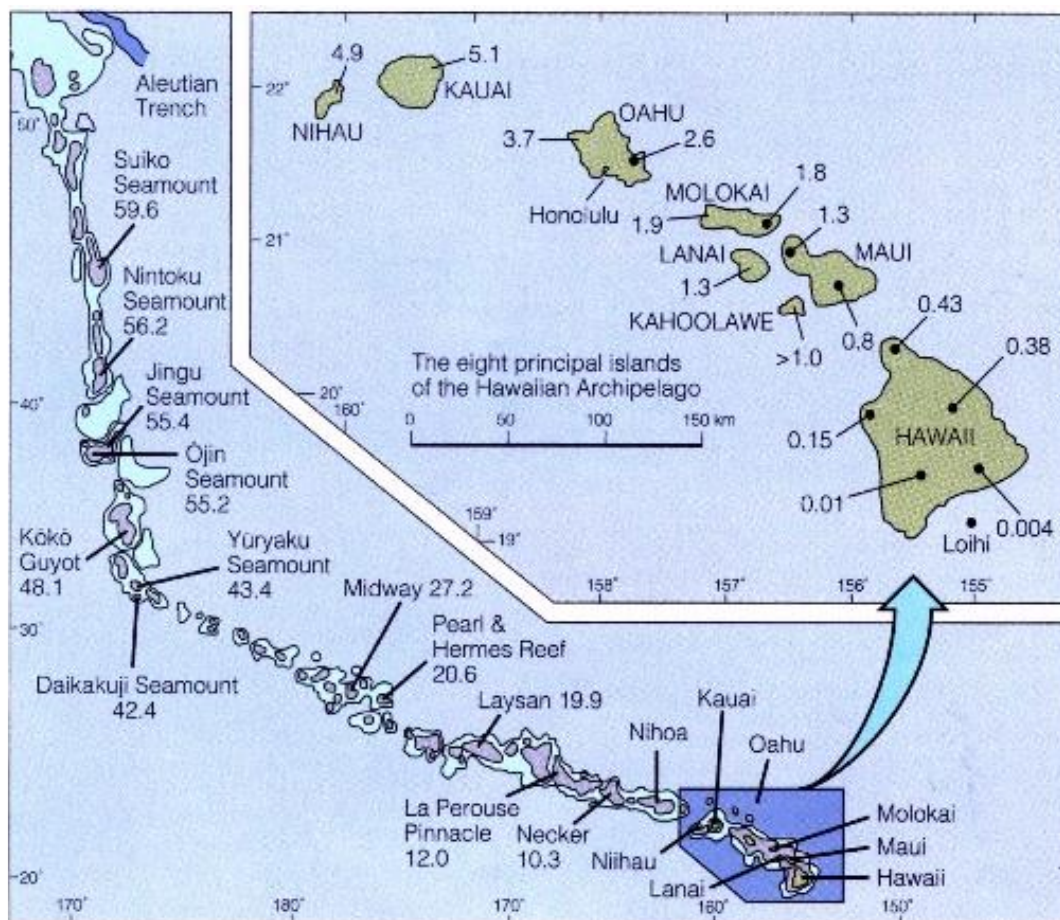
- a) Hurricanes (typhoons) move poleward.
颶風或颱風向極區移動
- b) Cold currents flow towards the equator
冷氣流或海流向赤道流動
- c) Atmospheric circulation in the mid-latitudes
中緯度的大氣環流
- d) Cyclones develop in mid-latitudes
中緯度氣旋的發展

12. For a given gas, a decrease in temperature increases its solubility in water. How will global warming influence the carbonate rocks on Earth? Choose the correct statement below. (Correct answer = 1 point)
 對某一種氣體而言，溫度降低會增加在水中之溶解度，全球暖化如何影響地球上之碳酸岩類？下列哪一選項正確？(正確答案=1 分)

- a) It will only increase the dissolution of limestone.
只會增加石灰岩的溶解
- b) It will increase the dissolution of all the carbonate rocks.
會增加所有碳酸岩類的溶解
- c) It will have no effect on the dissolution or formation of carbonate rocks.
不會影響碳酸岩類之形成或溶解
- d) It will increase the formation of carbonate rocks.
會增加碳酸岩類之形成

13. The figure below shows the distribution of the Hawaiian and Emperor chains with the geological age of volcanic rocks (unit: 10^6 years). What is the velocity of the Pacific plate movement at present on the basis of this distribution? Choose the correct statement from the list below: (Correct answer = 1 point)

下圖顯示夏威夷群島與帝王島鏈之分布與其火山岩之地質年代(單位：百萬年)。依據此分佈，現今太平洋板塊的移動速率為何？(正確答案=1 分)



- a) 6 cm/year 6 公分/年
- b) 60 cm/year 60 公分/年
- c) 3 cm/year 3 公分/年
- d) 30 cm/year 30 公分/年

14. Which of the statements below describe the outcome of the increase of CO₂ in the atmosphere?

(**EACH** correct answer = 1 point; **EACH** wrong answer = -1 point)

下列哪些選項會增加大氣中的二氧化碳？(每一正確答案=1分，每一答錯答案=扣1分)

- a) A decrease in the formation of CaCO₃ in the oceans.
減少在海洋中碳酸鈣的形成
- b) The formation of CaCO₃ in the oceans.
海洋中碳酸鈣的形成
- c) Acidification of the oceans.
海洋酸化
- d) An increase in the growth of coral reefs.
增加珊瑚礁的生長

15-16

The following paragraph (concerning sunspots) contains numbered blanks. Please match the numbered blanks with the correct letters from the word bank provided below. (Correct answer = 0.5 point)

下列短文(有關太陽黑子)包含幾個空格。將題號數與下列詞庫中的正確字母配合。(正確答案=0.5分)

A sunspot is a relatively colder part on the sun's surface. The number of sunspots typically changes with a periodicity of (15) years; solar activity is (16) when there are many sunspots.

在太陽表面的太陽黑子是相對較冷的區域。黑子數量典型的變化週期是(15)年；當有很多太陽黑子時，太陽活動處於(16)。

Word bank 詞庫：

- (a) 11 (b) 110 (c) 1100 (d) low 低峰 (e) high 高峰 (f) constant 定值

Blank number in the paragraph 短文中的空格欄位	The matching letter from the word bank 適當詞庫代碼
15	
16	

17. How many times bigger is the diameter of the Sun compared to that of the Earth?

(Correct answer = 0.5 point):

太陽直徑是地球的幾倍？(正確答案=0.5分)

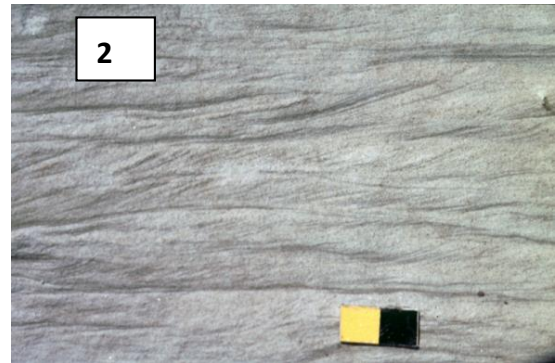
- a) About 100 times 約 100 倍
- b) About 1,000 times 約 1000 倍
- c) About 10,000 times 約 10000 倍
- d) About 100,000 times 約 100000 倍

18. Both the figures below show medium-grained sandstone.

Figure (1) shows horizontal lamination and Figure (2) shows ripple cross-lamination

Choose the correct answer that explains these sedimentary structures? (Correct answer = 1 point).

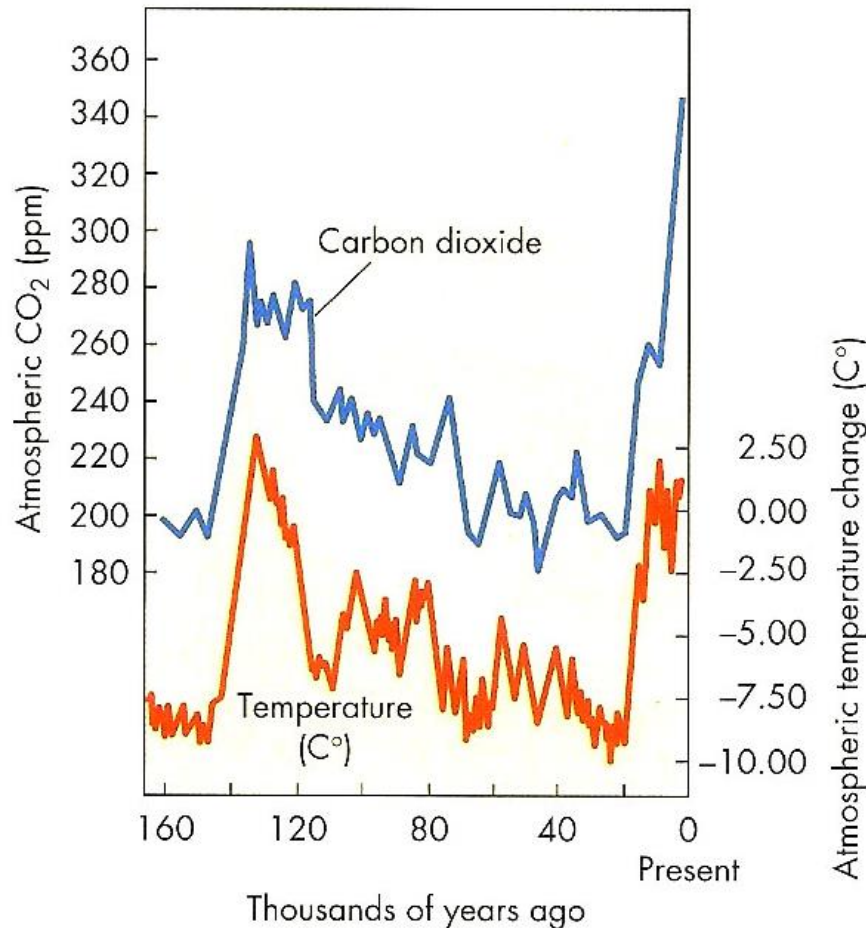
下列兩圖皆為中粗顆粒之砂岩。圖一顯示水平之層理，圖二顯示具有波紋的層理。下列何者為針對此沈積構造之正確敘述？(正確答案=1 分)



- a) The water depth to form sedimentary structure (2) is deeper than that to form sedimentary structure (1).
形成圖二沈積構造的水深深於圖一
- b) Sedimentary structure (2) is formed in a delta.
圖二之沈積構造形成於三角洲
- c) Sedimentary structure (1) is formed by the settling of grains in water.
圖一之沈積構造形成於水中的顆粒沉降
- d) Sedimentary structure (1) requires water flow of a higher velocity when compared to that needed for sedimentary structure (2).
形成圖一沈積構造的水流流速高於圖二

19. The following figure shows the inferred changes in the concentration of atmospheric carbon dioxide and temperature during the past 160,000 years. Choose the correct answers to explain the geologic processes related to this figure. (**EACH** correct answer = 1 point; **EACH** wrong answer = -1 point)

下圖顯示過去十六萬年推估得到之大氣二氧化碳濃度和氣溫的變化，選擇所有正確答案以解釋和此圖相關之地質過程。(每答對一答案=1分，每答錯一答案=扣1分)



- a) The high concentration of atmospheric CO₂ at present is mainly caused by global warming.
現今之大氣二氧化碳濃度較高主要是因為全球暖化所引起
- b) Ocean acidification is expected and already recorded at present due to an increase of atmospheric CO₂.
由於大氣二氧化碳的增加，海洋酸化是可預期的，而且在現今也已被觀測記錄到
- c) Development of glaciers in polar regions is expected when the atmospheric CO₂ concentration is below 220 ppm.
當大氣二氧化碳濃度低於 220 ppm 時，可預期極區的冰河會發展
- d) Dissolution of limestone exposed on continents is thought to have occurred more effectively 20,000 years ago than 120,000 years ago.
可以推論過去兩萬年前比過去 12 萬年前陸地上有更多石灰岩溶解

20. Diagrams A and B show the development pattern of sequences in a coast-to-continental shelf setting.

Choose the correct answer to explain the balance between the rate of sea level rise and the rate of sediment supply to the sea to form the sequences in (A) and (B). (Choose the correct answer = 1 point)

圖 A 與 B 顯示海岸至大陸棚之沉積層序。選出圖 A 與 B 中關於海水面上升速率與沈積物供應速率之正確敘述(正確答案=1 分)

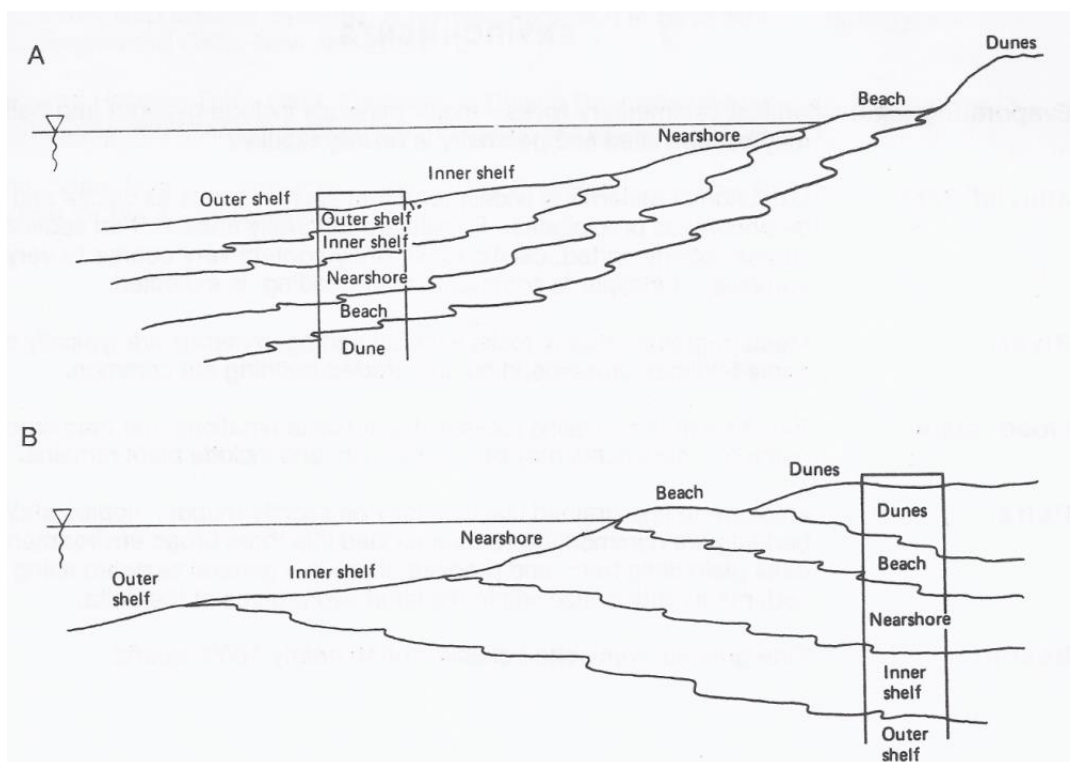
Dunes 沙丘

Beach 沙灘

Near Shore 近濱

Inner shelf 內大陸棚

Outer shelf 外大陸棚



a) In section A: rate of sea level rise = rate of sediment supply

圖 A 海水面上升速率 = 沈積物供應速率

In section B: rate of sea level rise < rate of sediment supply

圖 B 海水面上升速率 < 沈積物供應速率

b) In section A: rate of sea level rise > rate of sediment supply

圖 A 海水面上升速率 > 沈積物供應速率

In section B: rate of sea level rise = rate of sediment supply

圖 B 海水面上升速率 = 沈積物供應速率

c) In section A: rate of sea level rise > rate of sediment supply

圖 A 海水面上升速率 > 沈積物供應速率

In section B: rate of sea level rise < rate of sediment supply

圖 B 海水面上升速率 < 沈積物供應速率

d) In section A: rate of sea level rise < rate of sediment supply

圖 A 海水面上升速率 < 沈積物供應速率

In section B: rate of sea level rise > rate of sediment supply

圖 B 海水面上升速率 > 沈積物供應速率

21. The Sun produces nuclear fusion by converting _____.

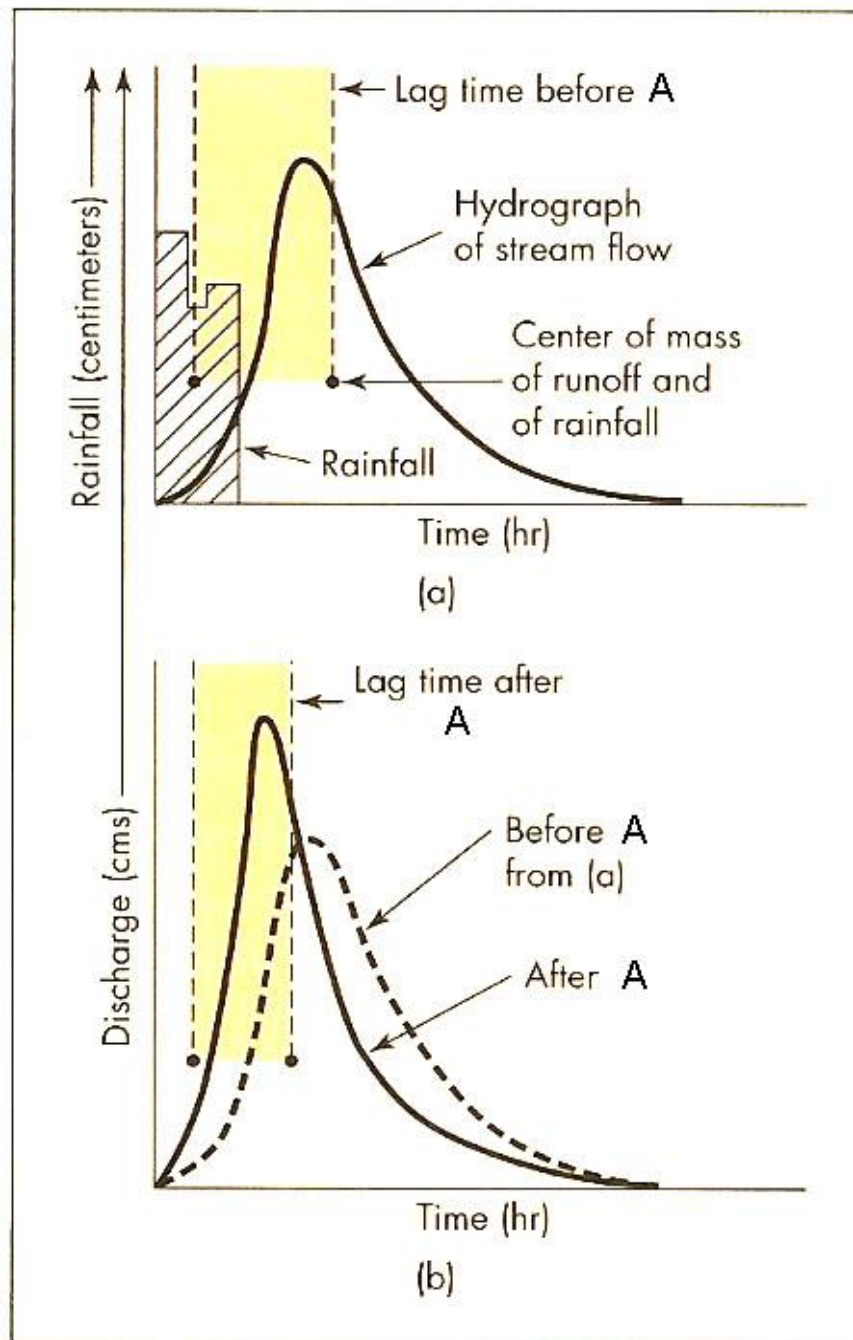
(Correct answer = 0.5 point)

太陽產生核融合反應是藉著將_____ ? (正確答案=0.5 分)

- a) Helium to Hydrogen 氦轉成氫
- b) Hydrogen to Lithium 氫轉成鋰
- c) Helium to Carbon 氦轉成碳
- d) Hydrogen to Helium 氫轉成氦

22. A hydrograph shows the rate of flow (discharge) versus time past a specific point in a river. The unit cms is cubic meters per second. Figure (a) is a hydrograph showing the typical lag between the time when most of the rainfall occurs and the time when the stream floods. "A" in the hydrographs below represents a factor which influences lag time. In Figure (b) there is a decrease in lag time with the same amount of rainfall as in figure (a). What is the correct reason for this decrease? (Correct answer = 1 point).

下面之水文歷線圖顯示某一河流特定點之流量速率和時間關係圖,單位 cms 是立方公尺/秒, 圖 (a)是典型之降雨量最大時間和河川洪水的时间延遲。下圖"A"代表影響時間延遲的某種原因。圖 (b)在和圖(a)相同的雨量條件下,由於某種原因 A 使前述的時間延遲減少,下列哪一選項是減少時間延遲的正確原因?(正確答案 = 1 分)



- a) Construction of upstream retention ponds 上游建造滯洪池
- b) Storm 暴風雨
- c) Urbanization 都市化
- d) Restoration of catchment forestation 恢復集水區造林

23. Which of the statements below correctly describes the outcome of the formation of limestone and chalk?

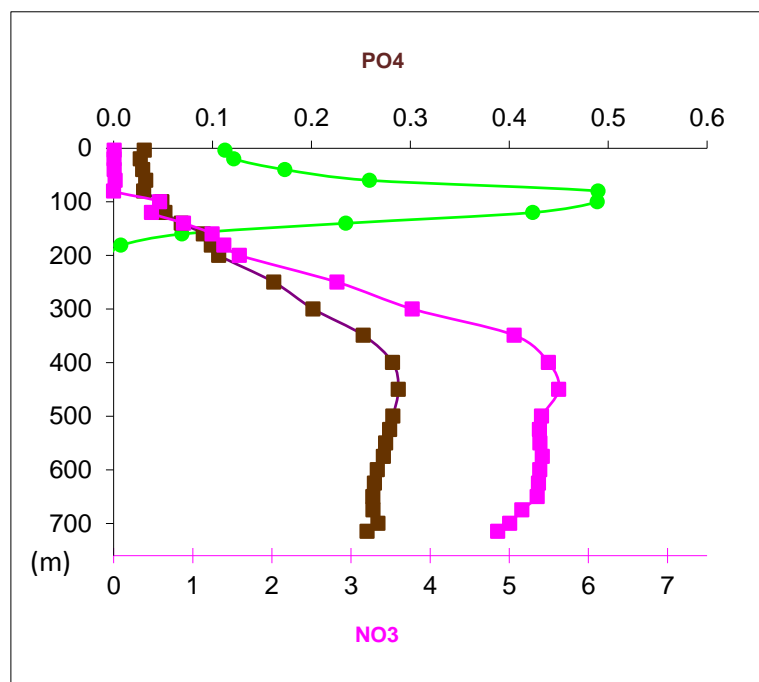
(Correct answer = 1 point)

石灰岩與白堊土生成所造成之影響，下列敘述何者正確？(正確答案=1 分)

- a) An increase in the amount of CO₂ in the hydrosphere and in the atmosphere.
導致水圈與氣圈之 CO₂ 含量增加
- b) An increase in the amount of CO₂ in the atmosphere only.
導致只有氣圈之 CO₂ 含量增加
- c) A decrease in the amount of CO₂ in the atmosphere and in the hydrosphere.
導致氣圈與水圈之 CO₂ 含量減少
- d) A decrease in the amount of CO₂ in the hydrosphere only.
導致只有水圈之 CO₂ 含量減少

24. The green line in the graph below presents the chlorophyll content (water depth-wise) in the Gulf of Aqaba (latitude 29°). Which of the items below is related to the high amount of chlorophyll at shallow depth (~ 100 m)? (Correct answer = 1 point)

下圖中綠色線代表亞喀巴灣(緯度 29 度)葉綠素含量隨水深之變化，下列何者和近 100 公尺表層高葉綠素含量有關？(正確答案=1 分)



- a) The concentration of CO₂ in the atmosphere
大氣中的二氧化碳濃度
- b) The sun light and water
太陽光和海水
- c) The salinity of the water
海水的鹽度
- d) The amount of nitrate and phosphate
硝酸鹽和磷酸鹽含量

25. Which of the options below do **NOT** reflect the interrelationships between the earth systems and the formation of limestone and chalk? (**EACH** correct answer = 1 point; **EACH** wrong answer = -1 point)

下列那些敘述無法說明地球系統與石灰岩及白堊土生成的關聯性？

(每一正確答案=1 分；每一錯誤答案=扣 1 分)

a) Geosphere, atmosphere, hydrosphere and biosphere.

地圈，氣圈，水圈與生物圈

b) Only the geosphere, atmosphere and hydrosphere.

只有地圈，氣圈與水圈

c) Only the biosphere, hydrosphere and geosphere.

只有生物圈，水圈與地圈

d) Only the biosphere, atmosphere and geosphere.

只有生物圈，氣圈與地圈

26. What is the average surface temperature of the Sun? (Correct answer = 0.5 point)

太陽的平均表面溫度是多少？(正確答案=0.5 分)

a) 3750°C

b) 4750°C

c) 5750°C

d) 6750°C

e) 7750°C

27-40

The following paragraph (concerning our solar system) contains numbered blanks. Please match the numbered blanks with the correct letters from the word bank provided below. (Each correct answer = 0.5 point)

下列短文(有關我們太陽系)包含幾個空格。將題號數與下列詞庫中的正確字母配合。(正確答案=0.5 分)

The four inner planets - Mercury, Venus, Earth and Mars - are called (27), which are made up of (28) and (29). The four outer planets are (30).

四顆內行星-水星、金星、地球與火星-稱為 (27)，是由 (28) 與 (29) 組成。四顆外行星是(30)

Jupiter and Saturn, are (31), and are mainly composed of (32) and (33). Uranus and Neptune are (34), and are mainly composed of (35), (36) and (37).

木星與土星是(31)，其主要組成為(32)與(33)。天王星與海王星是(34)，其主要組成是(35)、(36)與(37)。

Smaller objects also exist in the Solar System, mostly between (38) and (39), which is called (40).

小天體也存在太陽中，多數在 (38) 與 (39) 間，稱為 (40)。

Word bank 詞庫:

a) Rock 岩石	m) Ice giants 冰巨行星(複數)
b) Ice giant 冰巨行星	n) Scattered disc 擴散盤
c) Methane 甲烷	o) Water 水
d) Mars 火星	p) Venus 金星
e) Neptune 海王星	r) Saturn 土星
f) Kuiper belt 海王星	s) Ammonia 氨
g) Metal 海王星	t) Earth 地球
h) Hydrogen 氫	u) Uranus 天王星
i) Helium 氦	v) Gas giants 氣態巨行星
j) Giant planets 巨行星	w) Asteroid belt 小行星帶
k) Mercury 水星	x) Rocky planets 岩石行星
l) Jupiter 木星	y) Planetesimals 微行星

Blank number in the paragraph 短文中的空格欄位	The matching letter from the word bank 適當詞庫代碼
27	
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41. Which of the options below is the correct order of the size of carbon reservoirs on Earth?

(Correct answer = 1 point).

地球上碳蘊藏量由大至小之排序為(正確答案=1 分)

- a) Atmosphere (the largest). 氣圈最大
Biosphere 生物圈
Hydrosphere 水圈
Geosphere (the smallest) 地圈最小
- b) Atmosphere (the largest). 氣圈最大
Biosphere 生物圈
Geosphere 地圈
Hydrosphere (the smallest) 水圈最小
- c) Biosphere (the largest). 生物圈最大
Atmosphere 氣圈
Geosphere 地圈
Hydrosphere (the smallest) 水圈最小
- d) Geosphere (the largest). 地圈最大
Atmosphere 氣圈
Biosphere 生物圈
Hydrosphere (the smallest) 水圈最小
- e) Geosphere (the largest). 地圈最大
Hydrosphere 水圈
Biosphere 生物圈
Atmosphere (the smallest) 氣圈最小

42. Which of the following statements is true about the conditions under which carbonate sedimentation occurs in oceans? (Correct answer = 1 point).

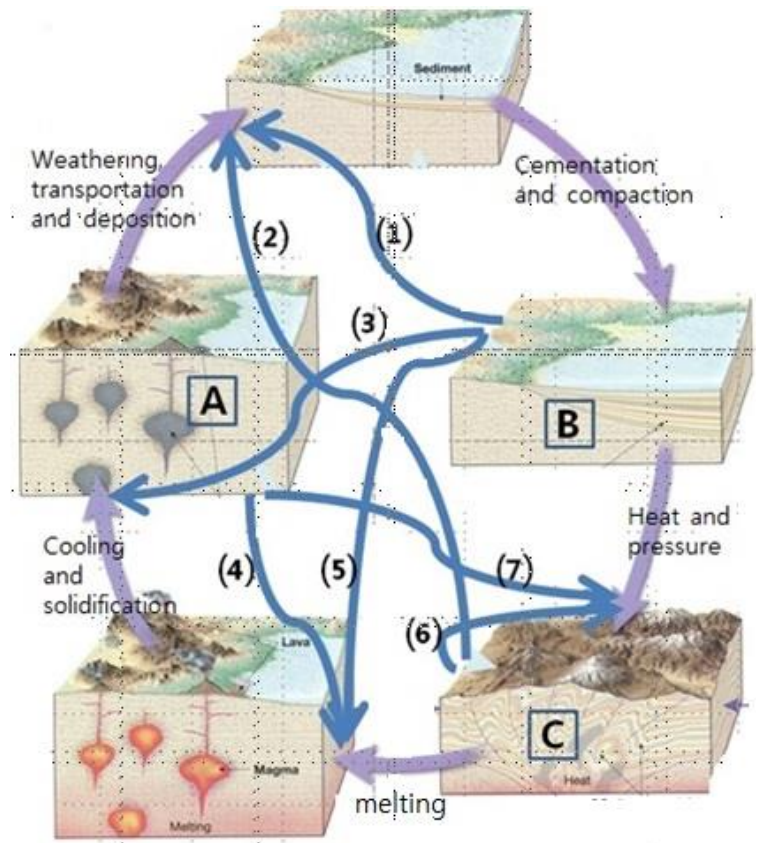
關於海洋中可發生碳酸鹽類沉積的環境條件，下列敘述何者正確？(正確答案=1 分)

- a) The formation of carbonate sediments is promoted through respiration of living organisms.
生物的呼吸作用可提升碳酸鹽類沉積的形成
- b) Carbonate sedimentation is relatively high in oceans with conditions for rapid photosynthesis.
光合作用劇烈的海域亦有較多碳酸鹽類的沉積
- c) Oceanic carbonate sediments are primarily derived from the erosion of limestone deposits in continents.
海洋碳酸鹽類沉積物的主要來源是陸地上石灰岩風化而來
- d) Carbonate sedimentation is relatively high in warmer oceans.
溫暖海域中有較多的海洋碳酸鹽類沉積

43. Which of the pathways (1-7 in the diagram below) cannot occur in nature? (Correct answer = 1 point)

下圖中 1~7 那條路徑在自然界中不會發生？(正確答案=1 分)

- a) 1
- b) 2
- c) 3
- d) 4
- e) 5
- f) 6
- g) 7



44. While walking in a mountain range, you find a fossil reef in a limestone layer. What might you conclude based on this field observation? (Correct answer = 1 point)

行走山嶺間，你在一套石灰岩層中發現礁相化石，據此發現你可做出何項結論？

(正確答案=1 分)

- a) It is most likely that this area was an ancient deep ocean floor.
這個地區很有可能是古代的深海海床
- b) It is most likely that this area was a continental shelf located in an area with rather warm water.
這個地區很有可能是溫暖水域的大陸棚區
- c) It is most likely that this area was a continental shelf located in a rather cold area.
這個地區很有可能是寒冷水域的大陸棚區
- d) It is most likely that this area was a former continental slope beneath which detrital sediments have been accumulating.
這個地區很有可能是堆積碎屑沉積物的大陸坡區

In the photograph below, the darker units are metamorphic rocks with some igneous intrusions and the lighter unit consists of limestone, dolomite, chalk and chert. Question numbers 45, 46 and 47 are related to this photograph.

在下圖中，黑色地區是有火成岩入侵的變質岩體，淺色區域則為石灰岩，白雲岩，白堊土及燧石所組成。依此回答 45，46 及 47 題。



45. Which of the structures below is most likely the reason for this appearance of the rocks units? (Correct answer = 1 point)

下列哪個構造最適合解釋此圖的岩石分佈情形(正確答案=1 分)

- a) Syncline 向斜構造
- b) Anticline 背斜構造
- c) Horst 地壘
- d) Graben 地塹

46. What are the geologic processes that took place in the area? Choose the correct answers.

(EACH correct answer = 1 point, EACH wrong answer = -1 point)

那些地質作用曾在這個地區發生過？(每一正確答案=1 分；每一錯誤答案=扣 1 分)

- a) Sedimentation 沉積作用
- b) Metamorphism 變質作用
- c) Volcanic eruptions 火山噴發
- d) Magmatic intrusions 岩漿入侵
- e) Erosion 侵蝕作用
- f) Chemical weathering 化學風化作用
- g) Lithification 成岩作用
- h) Melting 熔融作用
- i) Burial 深埋作用
- j) Uplift 抬升作用

47. Which of the sequences given below best describes the order of the geological processes that took place in the area? (Correct answer = 1 point)

下列哪個選項為此地區地質作用發生順序最佳排列(正確答案=1分)

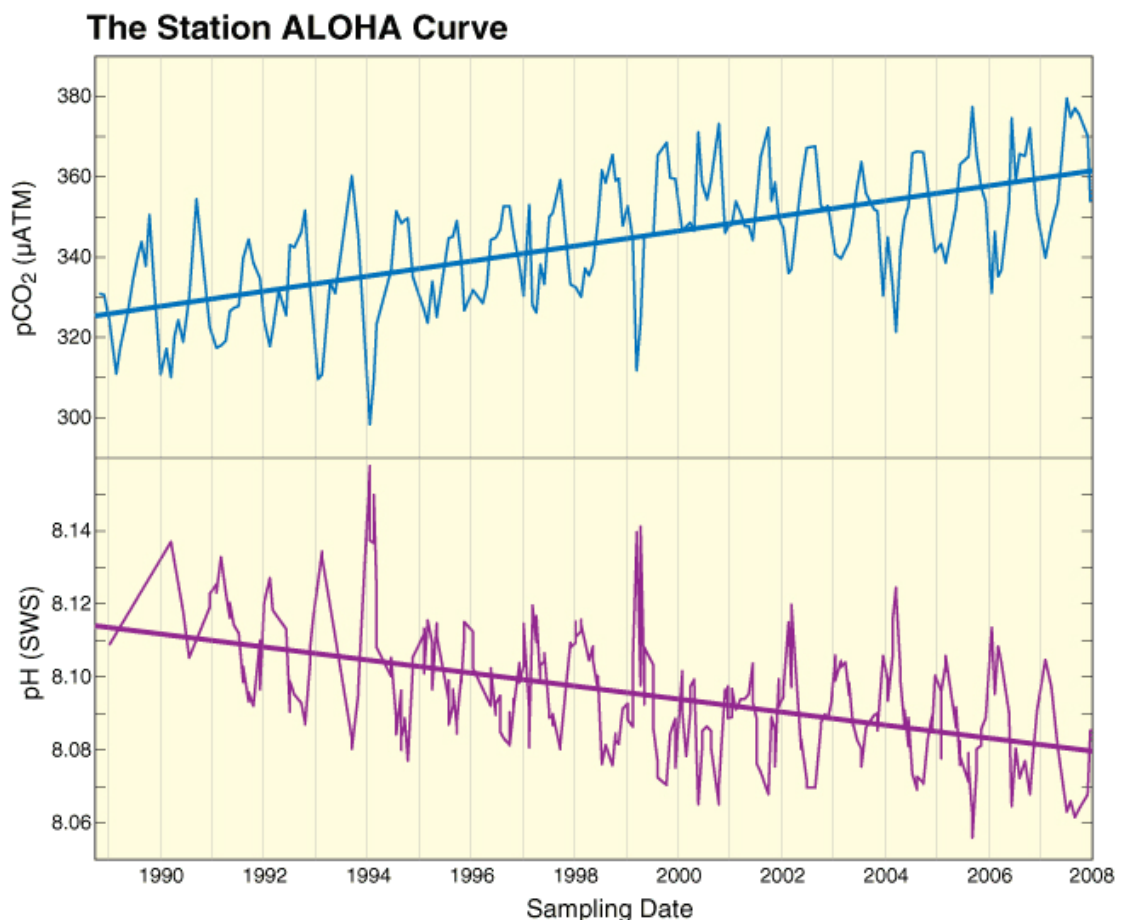
- a) Metamorphism, erosion, magmatic intrusions, sedimentation, erosion.
變質作用，侵蝕作用，岩漿入侵，沉積作用，侵蝕作用
- b) Metamorphism, magmatic intrusions, erosion, sedimentation, erosion.
變質作用，岩漿入侵，侵蝕作用，沉積作用，侵蝕作用
- c) Metamorphism, sedimentation, magmatic intrusions, erosion.
變質作用，沉積作用，岩漿入侵，侵蝕作用
- d) Metamorphism, magmatic intrusions, volcanic eruptions, sedimentation, erosion.
變質作用，岩漿入侵，火山噴發，沉積作用，侵蝕作用

48. The graph below depicts the changes of atmospheric CO₂ concentration and the pH of the Pacific Ocean water. The measurements were made in Hawaii from 1990 to 2008.

Based on the graph, mark the correct statements in the list below.

(EACH correct answer = 1 point; EACH wrong answer = -1 point)

下圖顯示大氣二氧化碳濃度和太平洋海水 PH 值之變化，該量測是自 1990 年至 2008 年，在夏威夷進行的。參考此圖選出下列選項中所有正確的答案。(每一正確答案=1分，每一錯誤答案=扣1分)



- a) When the pH increases, CO₂ is released from the ocean to the atmosphere.
當 pH 值增加，二氧化碳會從海洋釋放到大氣
- b) Global warming causes an increase in atmospheric CO₂ concentration and the ocean water becomes more acidic.
全球暖化會引起大氣二氧化碳濃度增加，而且海水會變得更酸
- c) When atmospheric CO₂ concentration increases, CO₂ gets into the ocean and the ocean water becomes more acidic.
當大氣二氧化碳濃度增加，大氣二氧化碳會進入海洋而使海水變得更酸
- d) If only the atmospheric CO₂ concentration was increasing and the oceanic pH was constant, global warming would be more rapid.
如果只有大氣二氧化碳濃度增加，但是海洋 pH 值維持不變，則全球暖化會更快速
- e) If only atmospheric CO₂ concentration was increasing and the oceanic pH was constant, global warming would be slower.
如果只有大氣二氧化碳濃度增加，但是海洋 pH 值維持不變，則全球暖化會減緩
- f) An increase in oceanic CO₂ concentration can affect coral reefs.
海洋二氧化碳濃度增加會影響珊瑚礁
- g) The annual variation of the atmospheric CO₂ concentration is a result of biological activity.
大氣二氧化碳濃度的年變化是生物活動所造成
- h) The common explanation for the increase of atmospheric CO₂ concentration is human activity, mostly fossil fuel burning and forest fires.
有關大氣二氧化碳濃度增加原因的普遍解釋是導因於人類之活動，而且大部分來自化石燃料之燃燒與森林火災
- i) The atmospheric CO₂ data shown represent only the changes in the Pacific Ocean.
圖中大氣二氧化碳資料僅代表太平洋地區的變化

49. What is the dated age of the rocks in which the first evidence of life forms appeared?

(Correct answer = 0.5 point)

記錄最早生命證據的岩石，其定年結果為何？(正確答案=0.5 分)

- a) Approximately 380×10^6 years ago. 大約 380 個百萬年前
- b) Approximately 550×10^6 years ago. 大約 550 個百萬年前
- c) Approximately 3.8×10^6 years ago. 大約 38 億年前
- d) Approximately 4.6×10^6 years ago. 大約 46 億年前

50. Which of the statements below correctly describe the change in the CO₂ concentration in the primitive atmosphere of the Archaean Earth? (EACH correct answer = 1 point; EACH wrong answer = -1 point):

對於早期地球原始大氣中二氧化碳濃度的變化，下列敘述哪些正確？

(每一正確答案=1 分；每一錯誤答案=扣 1 分)

- a) Increased following the appearance of life on earth.
隨著地球生命的出現，逐漸上升
- b) Decreased following the appearance of photosynthetic organisms.
隨著光合作用生物的出現，逐漸減少

- c) Decreased following the formation of calcium carbonate by living organisms.
隨著生物製造碳酸鈣，逐漸減少
- d) Increased following the formation of calcium carbonate by living organisms.
隨著生物製造碳酸鈣，逐漸增加
- e) Decreased following the weathering of igneous minerals.
隨著火成礦物的風化，逐漸減少
- f) Increased following the weathering of igneous minerals.
隨著火成礦物的風化，逐漸增加

51-52

The following paragraph (concerning the Sun) contains numbered blanks. Please match the numbered blanks with the correct letters from the word bank provided below. (Correct answer = 0.5 point)

下列短文(有關太陽)包含幾個空格。將題號數與下列文字庫中的正確字母配合。

(正確答案=0.5 分)

The Sun ejects charged particles, referred to as **(51)**, with the speed of several **(52)** of km/s

太陽噴射帶電粒子稱為 **(51)**，其速率是 **(52)** km/s。

Word bank: 文字庫

- a) Corona 日冕
- b) Solar wind 太陽風
- c) Solar flare 太陽閃焰
- d) Tens 數十
- e) Hundreds 數百
- f) Thousands 數千
- g) Ten thousands 數萬

Blank number in the paragraph 短文中的空格欄位	The matching letter from the word bank 適當詞庫代碼
51	
52	

53-56

The following paragraph contains numbered blanks. Please match the numbered blanks with the correct letters from the word bank provided below. (Correct answer = 0.5 point)

下面敘述存留一些空格，請將下列適當詞庫的代碼填入空格中。(正確答案=0.5 分)

Fossils of (53), which derive energy through (54), existed in the ocean and produced (55). This created (56) in the Archaean oceans.

生長在海中的 (53) 利用 (54) 所產生的能量製造出 (55)，同時也在古代海洋中形成 (56)。

Word bank 詞庫:

- a) Cyanobacteria 藍綠藻
- b) Burgess Shale 伯吉斯頁岩
- c) Oxygen 氧氣
- d) Brachiopoda 腕足動物
- e) Zooplankton 浮游動物
- f) Nickel ore 鎳礦床
- g) Photosynthesis 光合作用
- h) Trilobites 三葉蟲
- i) Uranium ore 鈾礦床
- j) Stromatolites 疊層石
- k) Nitrogen 氮氣
- l) Banded Iron Formation 條帶鐵礦床
- m) Crinoids 海百合

Blank number in the paragraph 短文中的空格欄位	The matching letter from the word bank 適當詞庫代碼
53	
54	
55	
56	

57. Which of the statements below correctly describe the tendency of weathering of feldspars?

(**EACH** correct answer = 1 point; **EACH** wrong answer = -1 point)

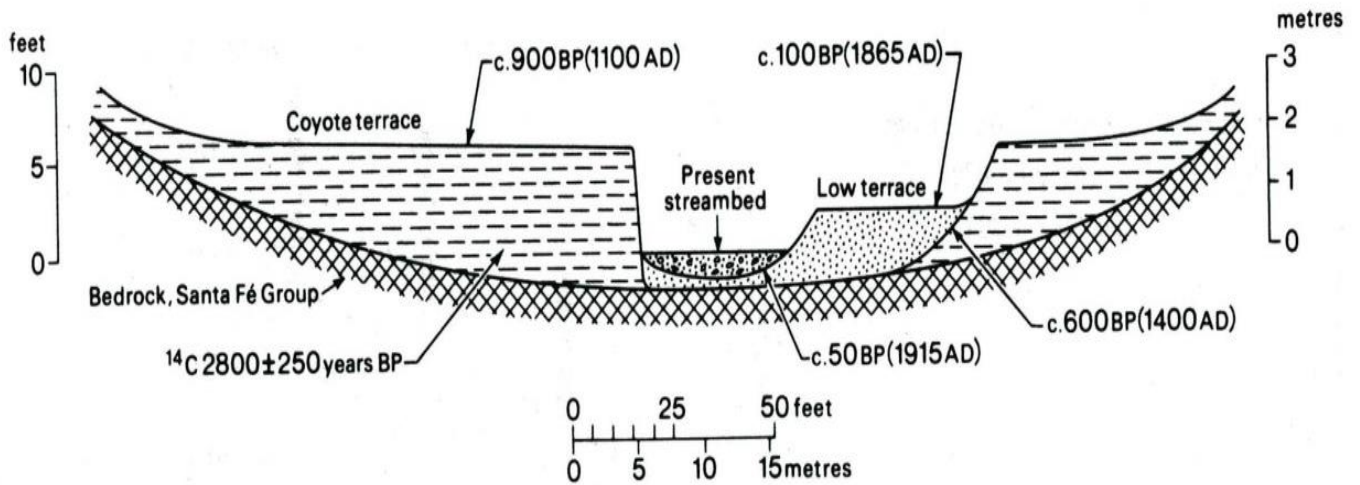
對於長石風化所造成的影響，下列敘述那些正確。(每一正確答案=1分；每一錯誤答案=扣1分)

- a) Decreases the amount of CO₂ in the atmosphere.
會減少大氣中二氧化碳的含量
- b) Increases the amount of CO₂ in the atmosphere.
會增加大氣中二氧化碳的含量
- c) Enhances the acidification of the oceans.
會促進海洋的酸化
- d) Limits the acidification of the oceans.
會限制海洋的酸化
- e) Increases the formation of calcium carbonate.
會增加碳酸鈣的生成
- f) Decreases the formation of calcium carbonate.
會減少碳酸鈣的生成

The cross section below represents terraces in a desert. The terraces were dated and their ages are presented in the figure.

Question numbers 58 and 59 are related to this diagram.

下圖為沙漠中的河階橫剖面。河階中各處的定年結果亦顯示於圖中。請就此圖回答 58 及 59 題。



58. What is the rate of deposition in the older terrace? (Correct answer = 1 point)

圖中最老河階的沈積速率是多少？(正確答案=1 分)

- a) One meter in 1000 years.
每 1000 年 1 公尺
- b) One meter in 100 years.
每 100 年 1 公尺
- c) One meter in 300 years.
每 300 年 1 公尺
- d) Three meters in 1000 years.
每 1000 年 3 公尺

59. What can be the reasons for the incision of the valley? Choose the correct answers.

(**EACH** correct answer = 1 point; **EACH** wrong answer = -1 point)

河道下切的可能因素有哪些？(每一正確答案=1 分；每一錯誤答案=扣 1 分)

- a) Change in the base level. 侵蝕基準面發生變化
- b) Climate became drier. 氣候變乾燥
- c) Climate became wet. 氣候變潮濕
- d) Changes in the drainage basin over time. 流域盆地隨時間發生變化

The following paragraph (concerning the Earth's early evolution) contains numbered blanks. Please match the numbered blanks with the correct letters from the word bank provided below.

(Correct answer = 0.5 point)

下面敘述存留著一些空格，請將下列適當詞庫的代碼填入空格中。(正確答案=0.5 分)

The Earth formed (60) years ago by accretion from the solar nebula. The early Earth was (61) from the surface to the core and heavy (62) sunk, leading to the formation of the (63). The surface was covered with a (64) and volcanic outgassing created the primordial atmosphere with (65) oxygen.

Then Earth cooled and formed a crust, with the ocean at the surface. This is the beginning of the (66) age, which occupies the (67) span of time in the Earth's history.

地球是在(60)年前經由太陽星雲吸積而成。早期的地球從裡到外都是(61)態，由於較重的(62)向下陷入造成(63)的形成。當時地表遍佈(64)，火山噴氣所製造的原始大氣中(65)氧氣。地球慢慢冷卻形成地殼，其上並覆蓋海洋。這是(66)時代最初的狀態，這個狀態佔據了地球歷史的(67)時間。

Word bank(詞庫):

a) hydrogen 氫氣	l) iron 鐵
b) oxygen 氧氣	m) mantle 地函
c) reductive 還原的	n) core 地核
d) nitrogen 氮氣	o) magma ocean 岩漿海
e) water 水	p) set of plates 一系列板塊
f) 460×10^6 460 百萬	q) plenty of 充滿
g) 4.6×10^9 46 億	r) no 沒有
h) 46×10^9 460 億	s) smallest 少部份
i) solid 固態	t) largest 大部份
j) molten 熔融態	u) Cambrian 寒武紀
k) silicon 矽	v) Precambrian 前寒武紀

Blank number in the paragraph 短文中的空格欄位	The matching letter from the word bank 適當詞庫代碼
60	
61	
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64	
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66	
67	