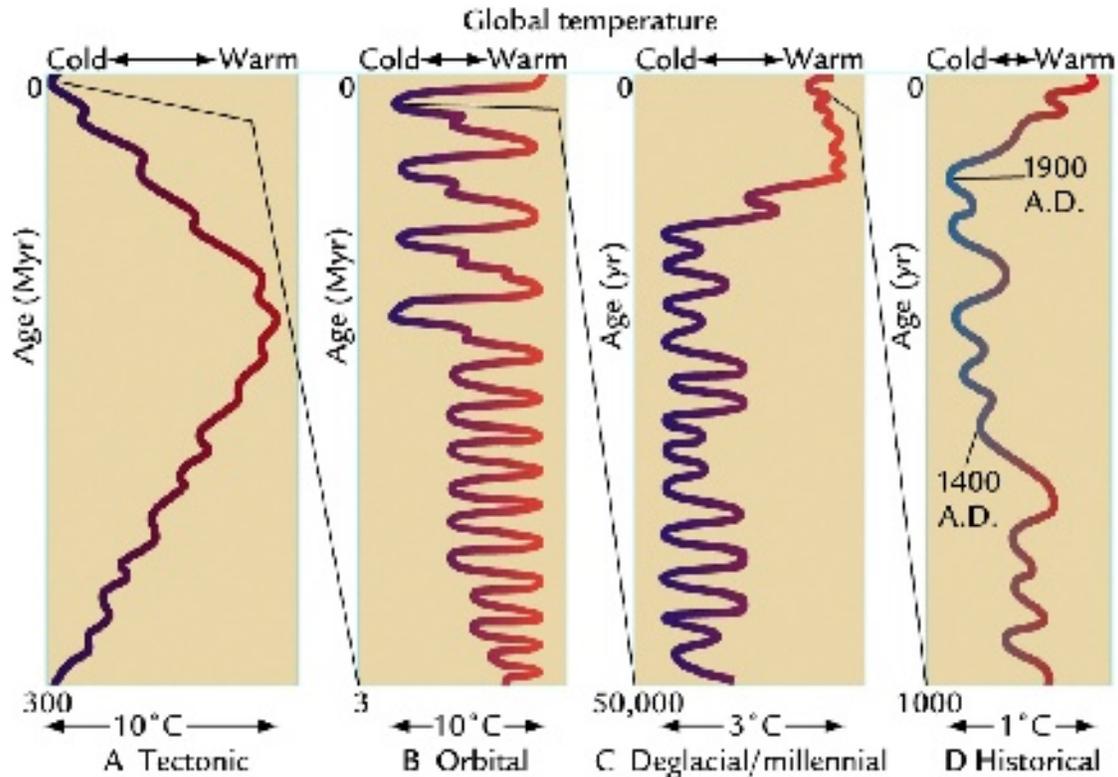


Name \_\_\_\_\_ Country \_\_\_\_\_

**Instructions:**

- 1. Please write your name and nationality in English on the cover page.**
- 2. The time allocated for this examination is four hours.**
- 3. Please write your answers legibly. Illegible answers will be counted as incorrect.**
- 4. Please keep your answers short and focus on the key points.**
- 5. You may respond to questions either in English, your native language, or a combination of both.**
- 6. Read the entire question group carefully before starting to answer.**  
Each question has a point value assigned, for example, (1 pt).
- 7. For some questions, you will be asked to provide your answers on the figures. Please do so carefully.**
- 8. Any inappropriate examination behaviour will result in your withdrawal from the IESO.**



GEOSPHERE written test IESO 2011

Name \_\_\_\_\_

Country \_\_\_\_\_

1. Based on Ruddiman (2001), the global temperature fluctuation can be distinguished into four different time scales due to different mechanisms. Use the following figures provided. Which figure best shows the fluctuation of temperature in Antarctica ice core records during more than one interglacial phase? /1 pt

(A) Fig. A (B) Fig. B (C) Fig. C (D) Fig. D

2. Seafloor drilling and seismic analysis reveal a thick layer of salt at a certain depth in a very large part of the Mediterranean Sea. What can you conclude from these observations? /0.5 pt

- a) The Mediterranean Sea has an important economic value that has not been exploited yet.
- b) There was a period when the Mediterranean Sea almost dried out.
- c) The Mediterranean Sea is very young.
- d) The Mediterranean Sea is a relic of the Tethys Sea.

3. In the field, you found an outcrop with three horizontal undeformed layers, one above the other. The lower unit is a layer of Dolomite, the middle layer is basalt, and the upper layer is Limestone . Which of the following observations would lead you to the conclusion that the basalt is a lava flow? /1 pt

- a) There are “baking signs” only in the lower part of the limestone layer.
- b) There are “baking signs” in the lower part of the dolomite layer.
- c) There are “baking signs” only in the upper part of the dolomite layer.
- d) All of the above.

4. To which cycle of matter is Limestone connected? /0,5 pt

- a) Phosphorus cycle
- b) Carbon cycle
- c) Sulfur cycle
- d) Nitrogen cycle

5. The reason that the magnetic anomaly stripes of the same age are wider in the Pacific ocean than the Atlantic Ocean is: /0,5 pt

- a) The rate of magmatic intrusions at the East Pacific Rise is faster than the rate of this process at the Mid-Atlantic Ridge.
- b) The Mid-Atlantic Ridge is located exactly in the middle of the ocean and therefore the rate of the opening of the ridge is equal on both sides.
- c) The Pacific Ocean is older than the Atlantic Ocean.
- d) The ring of fire around the Pacific Ocean reduces the rate of reversals of the Earth’s magnetic field.

6. During the last three billion years the main internal energy source of the Earth has been: /0,5 pt

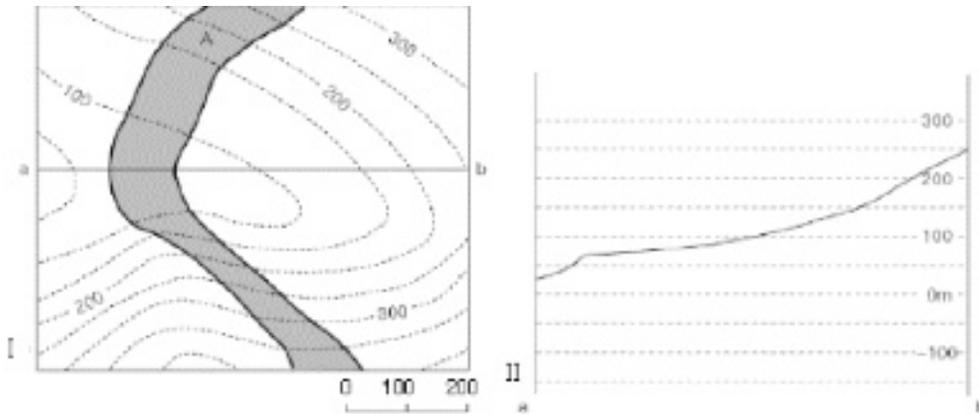
- a) The pressure of columns of rock and ocean.
- b) The friction that occurs at the plate boundaries.

- c) Radioactive decay of isotopes.
- d) The radiation of the sun.

7. In the Bottaccione Gorge, near Gubbio (Italy), there is an outcrop of interest. It contains a thin clay layer with significant geochemical anomalies such as high iridium concentrations. It is dated to a numerical age of 65.5 Ma. Which chronostratigraphic boundary corresponds to this layer? \_/1 pt.

- a) Cretaceous/Tertiary
- b) Lower Cretaceous/Upper Cretaceous
- c) Paleocene/Eocene
- d) Cambrian/Pre-Cambrian

8. Use the two graphics below. On the left is a geologic map of a region where north is to the top of the map. On the right is a topographic section along line a to b. Contours are in meters. A structure is shown in grey.



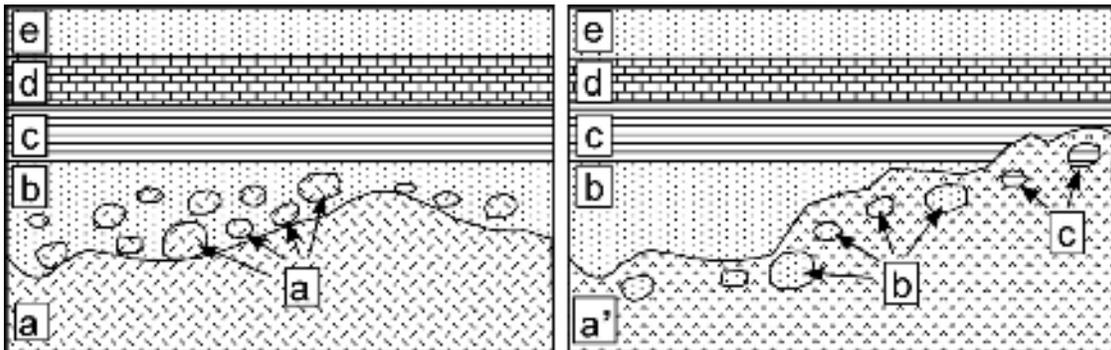
Which of the following is the true strike, dip and thickness of grey strata from the map? Please note that there are two methods used to show strike: quadrant method designated by (Q) and azimuth or magnetic bearing method designated by (A). The chart shows them both as Q and A. 2 pt .

choice	Strike	Dip (degrees)	Thickness (m.)
A	Q N-S A 180 degrees	45	70 to 75
B	Q S 60 degrees E A 120 degrees	45	90 to 100
C	Q E - W A 90 degrees	30	70 to 75
D	Q N-S A 180 degrees	30	90 to 100

9. Which one of the following minerals is used as a gem in jewelry, is used as an industrial abrasive, is a silicate, and has an isometric mineral symmetry. Circle the best answer above. /0,5 pt.

a.	quartz	b.	biotite	c.	Hornblende	d.	rutile	e.	garnet
f.	orthoclase	g.	calcite	h.	halite	i.	beryl	j.	diamond
k.	basalt	l.	gabbro	m.	andesite	n.	granite	o.	rhyolite
p.	shale	q.	marble	r.	slate	s.	chalk	t.	chert

10. The following stratigraphic sections show two cross sections which are located near each other. Symbols a and a' represent an igneous rock and b to e represent sedimentary rocks. Answer the following question. /0,5 pt



Which rock is older, a or a'? \_\_\_\_\_

11. The precipitation of which of the following minerals is regulated by the concentration of CO<sub>2</sub> in the solution? /0,5 pt.

a) halite; b) gypsum; c) apatite; d) calcite; e) opal; f) barytes.

12. The following table shows explanation of rocks and their formation environment. Choose the one that has the correct relationship between formation environment and rock type. /1 pt

	Rock name	Macroscopic observation	Formation environment
1	Limestone	Sand size grains, spherical to elliptical grain shape, bedded	In the crust several km below the surface
2	Granite	Fine grained, foliated, occurrence of light and dark grains together	In the crust where magma cools slowly
3	Basalt	Coarse to very coarse grained, dark color, occurrence of vesicles	Mid-oceanic ridge
4	Sandstone	Medium grained, parallel laminae or cross bedded	River or beach
5	Gneiss	Alternating dark and light bands, foliated, coarse grained	Contact zone between magma and surrounding rocks near surface

Correct answer: \_\_\_\_\_

13. The following picture shows an outcrop of Paleozoic age deposited in the ocean. The strata largely consist of sand and shale layers. Answer the questions. /1,5 pt (0,5 x 3)

(1) Which layer is sandstone and shale respectively in A and B?

Shale: \_\_\_\_\_ Sandstone: \_\_\_\_\_

(2) What is the depositional process of layer A and B?

\_\_\_\_\_ is deposited by settling from suspension whereas \_\_\_\_\_ is deposited by turbidity current.

(3) Can you expect to find trilobite fossil from this outcrop? Yes/no Answers: \_\_\_\_\_

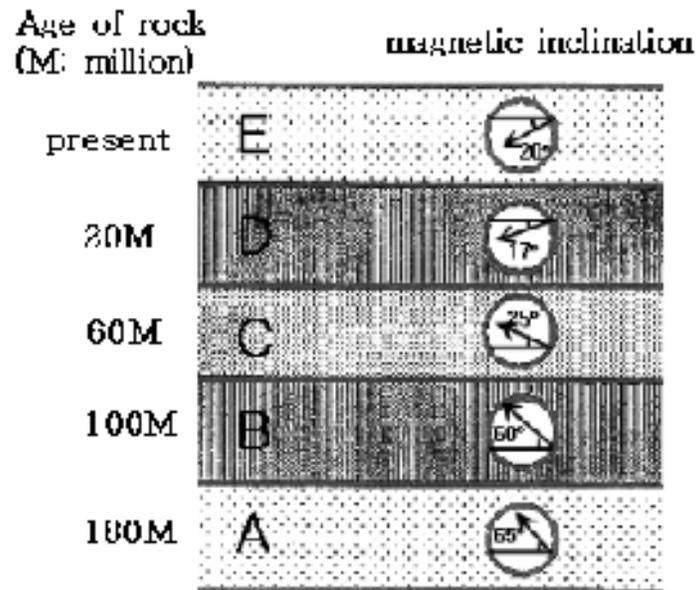


A

B



14. The figure below is the stratigraphic section and paleomagnetic inclination in some area assuming the rocks were deposited from 180 million years to the present without deformation. The paleomagnetic inclination of rock in each layer is shown within a circle. The arrows indicate the direction of paleo-magnetization at the time of rock formation.



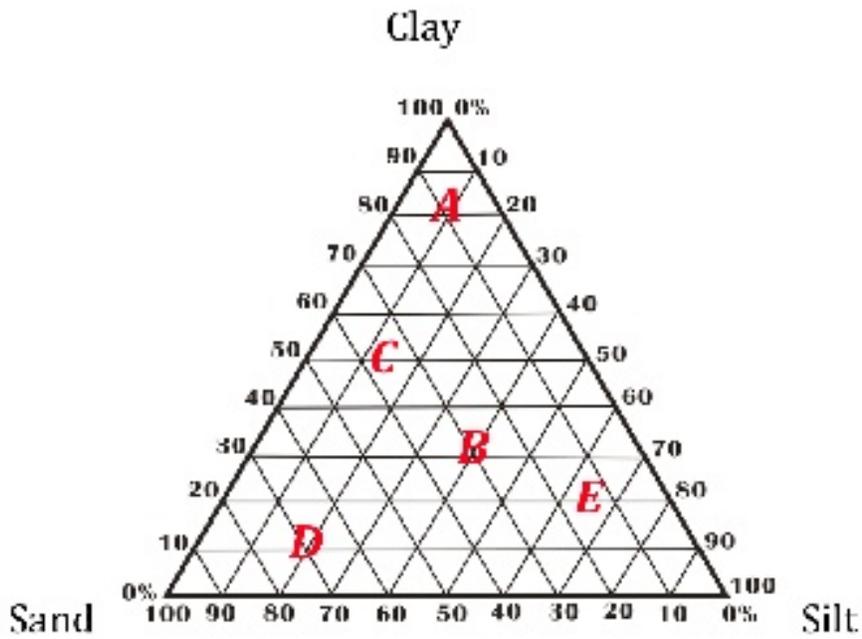
Calculate the average (south to north) velocity of the continent as it moved from position B to position E. Here, we assume that the latitude difference of one degree ( $1^\circ$ ) is equal to 110 km, and we suppose that paleomagnetic inclination is equal to twice the paleo-latitude. /1 pt

- A) 2.3 cm/yr
- B) 4.4 cm/yr
- C) 8.8 cm/yr
- D) 9.7 cm/yr

15. The figure below shows the soil texture of samples from five farms (A~E). The soil of which farm has the highest permeability? /1 pt.

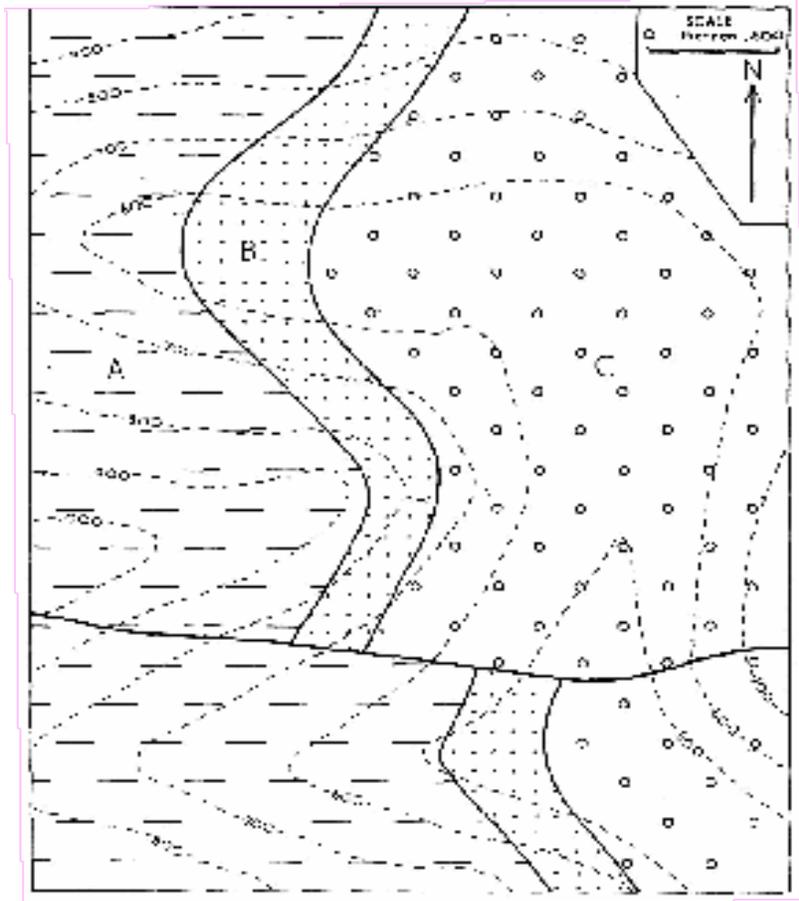
- (A) Farm A
- (B) Farm B
- (C) Farm C
- (D) Farm D
- (E)

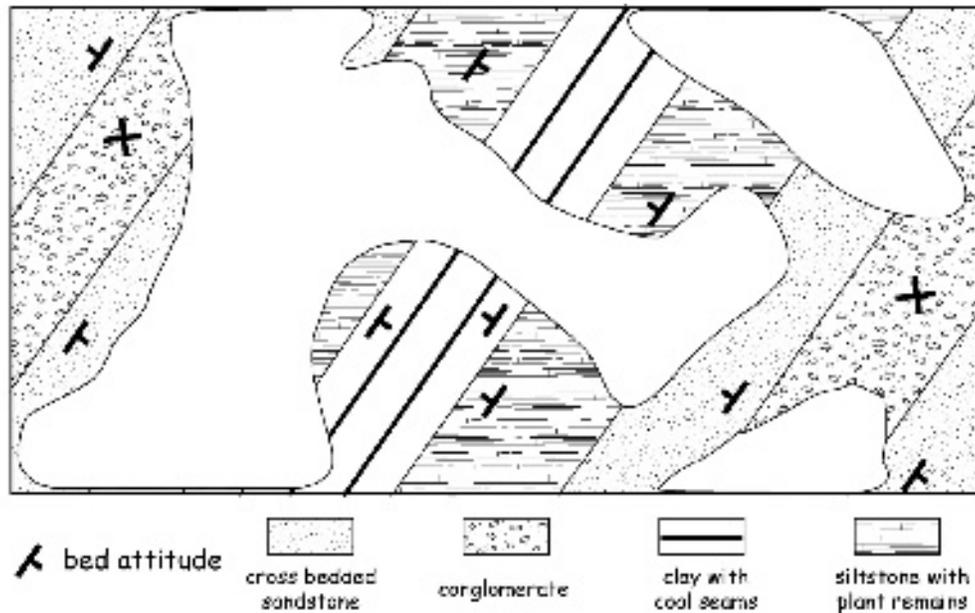
Farm



16. Which type of fault is shown in the geological map below? /0,5 pt.

- a. normal
- b. inverse
- c. vertical
- d. obtuse

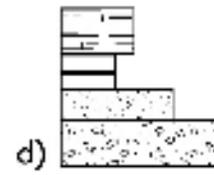
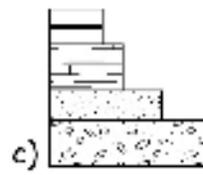
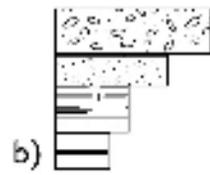




**17a.** Examine the map above. Which of the choices best describes the type of tectonic structures shown. /1 pt.

- a) two anticlines with an intervening syncline
- b) two synclines with an intervening anticline
- c) a salt dome
- d) flat stratigraphy

**17b.** Reconstruct the stratigraphy of the region shown above choosing among the following stratigraphic columns. /0,5 pt.



**18.** Trace fossils are the remnants of the activities of ancient animals. According to the patterns of trace fossils, geologists can infer the substrate condition, sedimentation rate, water flow energy, and paleoenvironment. Figure 9 is a trace fossil found in sandstone showing how an organism utilized the limited resource with high efficiency. What is the most likely environment to find this kind of trace fossil? /1 pt.

(A) inter tidal flat (B) rivers or lakes (C) mountains (D) deep marine



9a. Trace fossil on sandstone. Scale bar is 1 cm

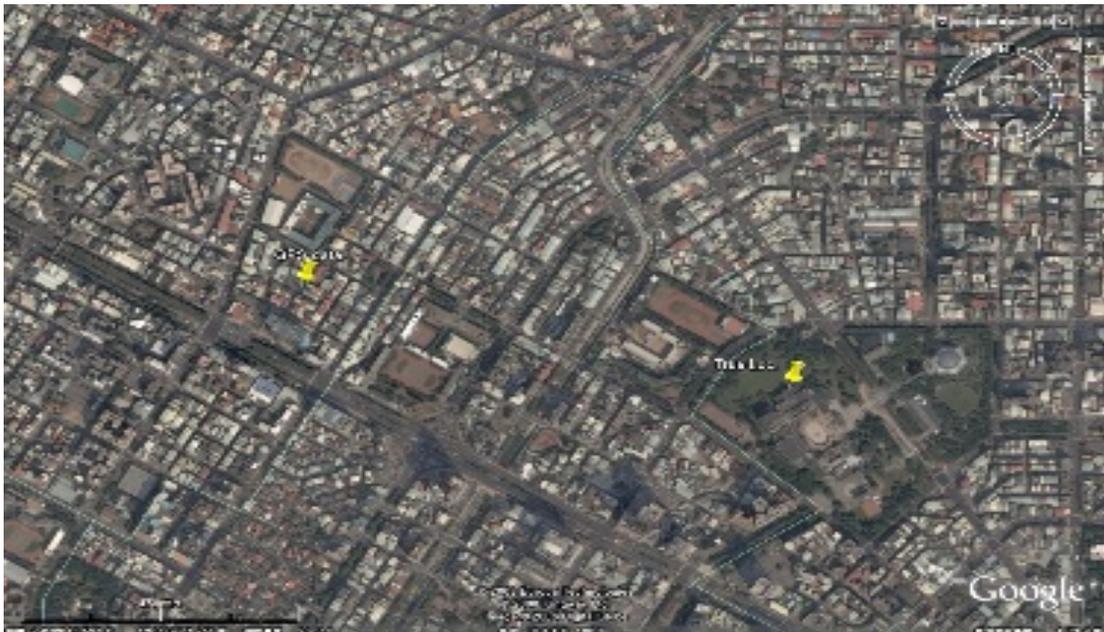


9b. Close up view of Fig. 9a. Each divide on the scale bar on the bottom is 1 mm.

Fig. 9

19. A student used a portable Global Positioning System (GPS) to record the coordinates of his positions. The signal and the receiving conditions were good during the measurement. After the student entering the coordinates he got into GoogleEarth, he noticed that the position drawn in GoogleEarth (GPS data) shifted hundred of meters away from the true location (True Loc). However, the relative positions among different locations measured in the same day were correct. Which of the following factors is the most likely cause of this problem? \_/0,5 pt.

- (A) influence by the ionosphere
- (B) malfunction of the GPS
- (C) sheltered from the buildings
- (D) different coordinate systems



20. The baby mammoth fossil shown below was found in Siberia in 1977. The fossilization process it underwent is known as: /0,5 pt.

- a) carbonification
- b) cryo-conservation
- c) inclusion in amber
- d) permineralization
- e) pyritization
- f) silicification



21. This fossil shown above is: \_/0,5 pt.

- a) shark (chondrycthan)
- b) a bony fish (osteichthyan)
- c) an amphibian (salamander)
- d) a reptile (ichthyosaur)
- e) a bird (penguin)
- f) a mammal (cetacean)

22. Match all of the rock features/sedimentary structures on the left with all possible depositional environment found on the right.

\_/1,5 pt. (0,25 x 6)

Rock feature/Sedimentary structure environment

Depositional

- |  |                            |
|--|----------------------------|
| 1 ___ coal and siltstone with plant remains    | a. shallow ephemeral lake  |
| 2 ___ stromatolites and intraclastic limestone | b. quiet marine deep water |
| 3 ___ laminated evaporites                     | c. delta swamp             |
| 4 ___ mud cracks                               | d. peri-glacial lake       |
| 5 ___ varves                                   | e. lagoon in arid climate  |
| 6 ___ thin-bedded shales                       | f. carbonate tidal flat    |

23. Consider seismic waves which propagate at 4.5 km/s in the Earth crust.

a) What are the wavelengths associated to periods of  $T=0.1s$ ,  $1s$  and  $100 s$ ? \_/0,5 pt.

- (a) 250m, 2.5 km and 250 km.
- (b) 450m, 4.5 km and 450 km.
- (c) 150m, 4.5 km and 500 m.
- (d) 750m, 7.5 km and 750 km.

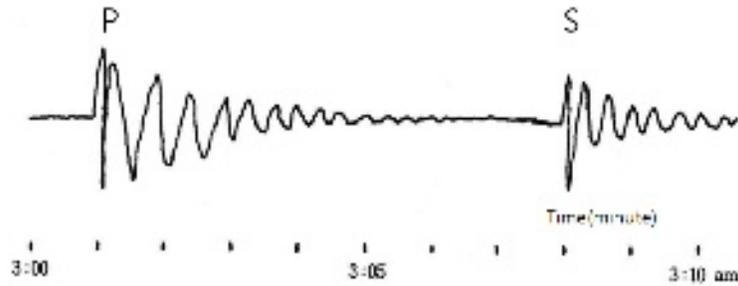
b) What are the periods and the frequencies associated to wavelengths of 1m, 1km, 100km ? 1 pt. (0,5 x 2)

periods:

- |     |            |        |     |          |
|-----|------------|--------|-----|----------|
| (e) | 0.00444 s, | 4.4 s  | and | 444.4 s. |
| (f) | 0.00034 s, | 0.22 s | and | 24.6 s.  |
| (g) | 0.00006 s, | 0.06 s | and | 60.0 s.  |
| (h) | 0.00022 s, | 0.22 s | and | 22.2 s.  |

frequencies:

- |     |          |        |     |           |
|-----|----------|--------|-----|-----------|
| (i) | 4500 Hz, | 4.5 Hz | and | 0.045 Hz. |
| (j) | 34 Hz,   | 24 Hz  | and | 44 Hz.    |
| (k) | 1200 Hz, | 1.2 Hz | and | 0.012 Hz. |
| (l) | 22 Hz,   | 2.2 Hz | and | 220 Hz.   |



24. The figure above shows the observed seismogram at some earthquake observatory. Here, the velocity of P wave ( $V_p$ ) and S wave ( $V_s$ ) is 7km/sec and 4km/s, respectively. /1,5 pt (0,5 x 3)

- (a) How far the observatory is located from epicenter?  
 (b) What time the earthquake occurred?  
 (c) What time the first S wave arrive at the place 4000 km far from epicenter?

- a)  
 3150 km  
 3920 km  
 4140 km

- b)  
 2 h: 51 min: 40 sec;  
 2 h: 40 min: 33 sec;  
 3 h: 03 min: 22 sec.

- c)  
 2 h: 55 min: 20 sec;  
 3 h: 22 min: 15 sec;  
 3 h: 08 min: 20 sec.

25. Volcanic eruption in a mid ocean ridge leads to matter and energy transformation between the following earth systems (choose the most complete option): /1 pt

- a. From geosphere to atmosphere.  
 b. From hydrosphere to geosphere.  
 c. From geosphere to hydrosphere and then to biosphere.  
 d. Only from geosphere to hydrosphere.

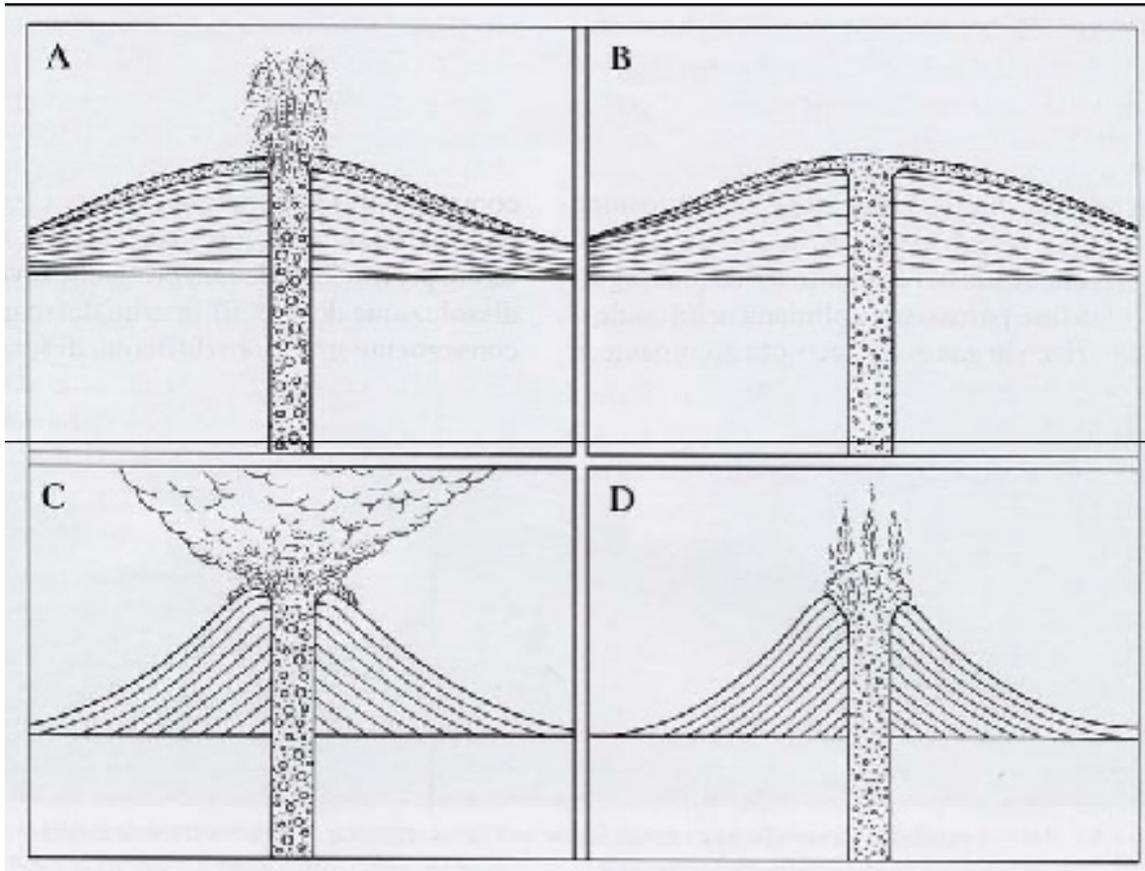
**26.** Indicate the type of magma characteristically erupted at the following plate tectonics volcanic environments (the same magma type can occur in more than one environment). The choices are: Andesite, Basalt, Obsidian, and Rhyolite  
\_/ 1,5 pt. (0,5 x 3)

- MidOceanic ridge
- Island arc
- Withinplate – Hot spots

**27.** Mark three of the following phenomena that are precursors of impending volcanic eruptions. \_/ 0,5 pt.

- a. Landslides
- b. Anomalous seismicity
- c. Heavy rains
- d. Increase of temperature and chemical changes in fumarolic gases
- e. Strong winds
- f. Ground uplift

28. Looking closely at the figure representing the eruptive behavior of magmas depending on their chemical composition and their dissolved gas content. 0,5 pt.



- a Basic and de-gassed magma
- b Basic magma rich in glass
- c Acid magma rich in glass
- d Acid and de-gassed magma

Figure A shows eruptive behavior from which type of magma? \_\_\_\_\_

Figure B shows eruptive behavior from which type of magma? \_\_\_\_\_

Figure C shows eruptive behavior from which type of magma? \_\_\_\_\_

Figure D shows eruptive behavior from which type of magma? \_\_\_\_\_

**29.** Michelangelo Buonarroti (1475-1564) was one of the greatest sculptors of the Renaissance. In this historical period, several discoveries and innovations in the field of art, science, and technology were made. Michelangelo carved his statues from the “Carrara marble” a very fine metamorphic rock characterized by a uniform white color, coming from quarries near the town of Carrara (Italy).

Which two of the following features are NOT associated with the formation of a marble?  
\_/1 pt.

- a) Marbles are formed by recrystallization of feldspars found in sandstones.
- b) Marbles have a hardness of 6-7 on the Mohs scale of mineral hardness.
- c) Marble is a metamorphic rock composed primarily of calcium carbonate ( $\text{CaCO}_3$ ).
- d) The color of marble depends on the presence of mineral impurities (such as clay, iron oxides etc)
- e) Marble is a rock resulting from metamorphism of sedimentary carbonate rocks, such as limestone or dolomite rock.
- f) Marble is a non-foliated metamorphic rock with a crystalline structure.

**30.** How is called this geological phenomenon? \_/0.5 pt.

- a) Volcanic chimney
- b) meteor impact crater
- c) rockfalls
- d) sinkhole



**31.** The north – south trending Gulf of Aqaba is located along the south part of the Dead Sea and the Arava Rift valley. It is 15 km wide and active rift since the early Miocene. The rift valley is the north part of the Syrian-African tectonic system. 5000 BP, 3 meters, above sea level, 5000 years old marine terraces were found 3 meters above sea level along the east and the west margins of the gulf. These terraces are continuously mapped for several kilometers with a constant elevation. These terraces may represent: /1 pt.

- A. More warm climate comparing to the Late Pleistocene climate
- B. Colder climate comparing to the recent climate
- C. Tectonic uplifting
- D. Remnants to high tide event

32. Tsunami waves can be generated by several natural phenomena. One of the most frequent cause are large subduction zone earthquakes, generated at the interface between two lithospheric converging plates where one of the two subduces beneath the other. Central Mediterranean tectonics is dominated by the slow relative converging motion of the African and European Plates. Italy sits on the converging plate margin, and its volcanic and seismic activity are related to this first order phenomena. In the central Mediterranean area subduction is continuously going on under Calabria in Southern Italy, and to the east under the island of Crete. Here, large subduction zone earthquakes occurred in historical times, such as in the A.D. 365 M 8+ earthquake, and generated widespread devastating tsunami waves that hit the coasts of North Africa, mainland Greece and Southern Italy.

Earthquake generated tsunamis are produced by the coseismic displacement of the sea bottom. The speed of a tsunami is directly correlated to the depth of the sea, i.e. it moves faster in deep waters and slow in shallower waters.

Early warning systems are fundamental for mitigating the tsunami hazard along the coasts, and are based on models of tsunami generating and of propagation.

Supposing that at 06:30 am UTC a large subduction zone earthquake hits the southwestern coast of Crete, and knowing:

1) the equation of the speed of the tsunami waves

$$V = \sqrt{g \cdot D}$$

where g is the gravitational constant (m/s<sup>2</sup>), and D is the depth of the water

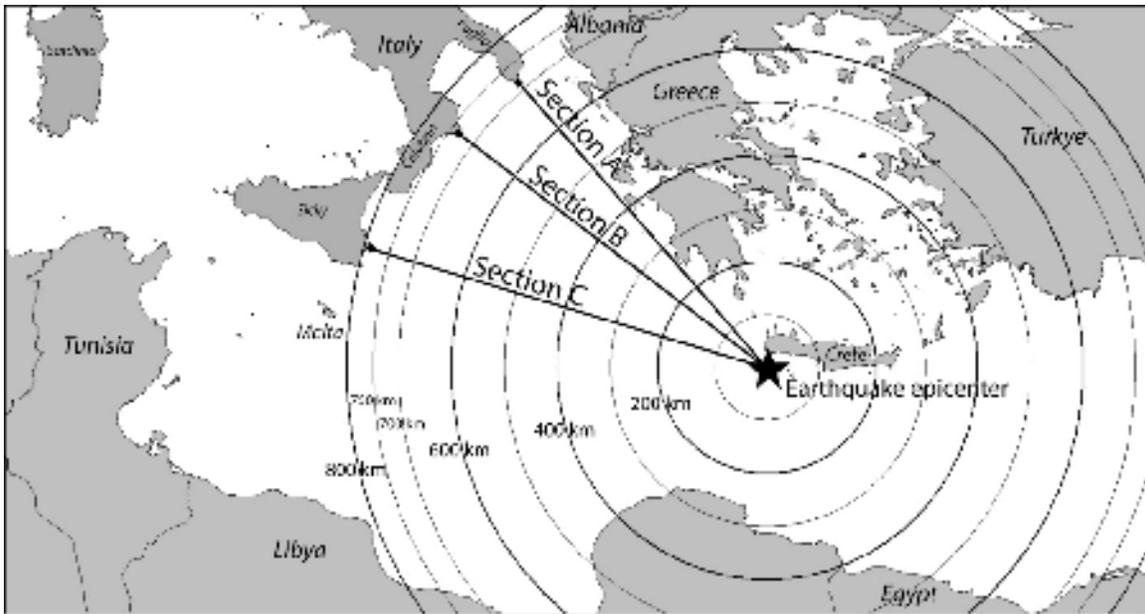
2) the average depth of the Jonian Sea along the three sections shown in the map: Section A, 2000 m; Section B, 2500 m; and Section C, 3000 m.

Measure on the map the distance of the three sites from the earthquake epicenter and calculate the arrival time (UTC) of the waves at destination filling in the table. /2 pt.

	Mean depth (m)	1-Mean speed (m/s)	2-Mean speed (km/h)	3-Distance (km)	4-Time to destination (h)	5-Arrival time (UTC)
Site A	2000					
Site B	2500					
Site C	3000					

On the basis of your calculation the three sites will be inundated in the following order:

- 1) First Site A, then B and last C;
- 2) First Site B, then C and last A;
- 3) First Site C, then B and last A.

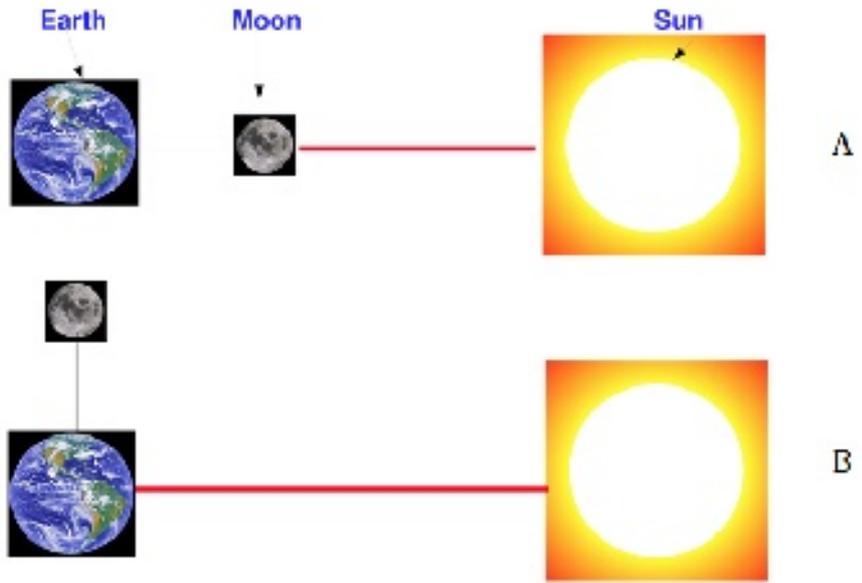


Map of the Central Mediterranean area, showing with the black star the epicenter of the subduction zone earthquake, and the trace of the three sections. Circles centered on the epicenter can be used to measure the distance.

**HYDROSPHERE written test IESO 2011**

Name \_\_\_\_\_ Country \_\_\_\_\_

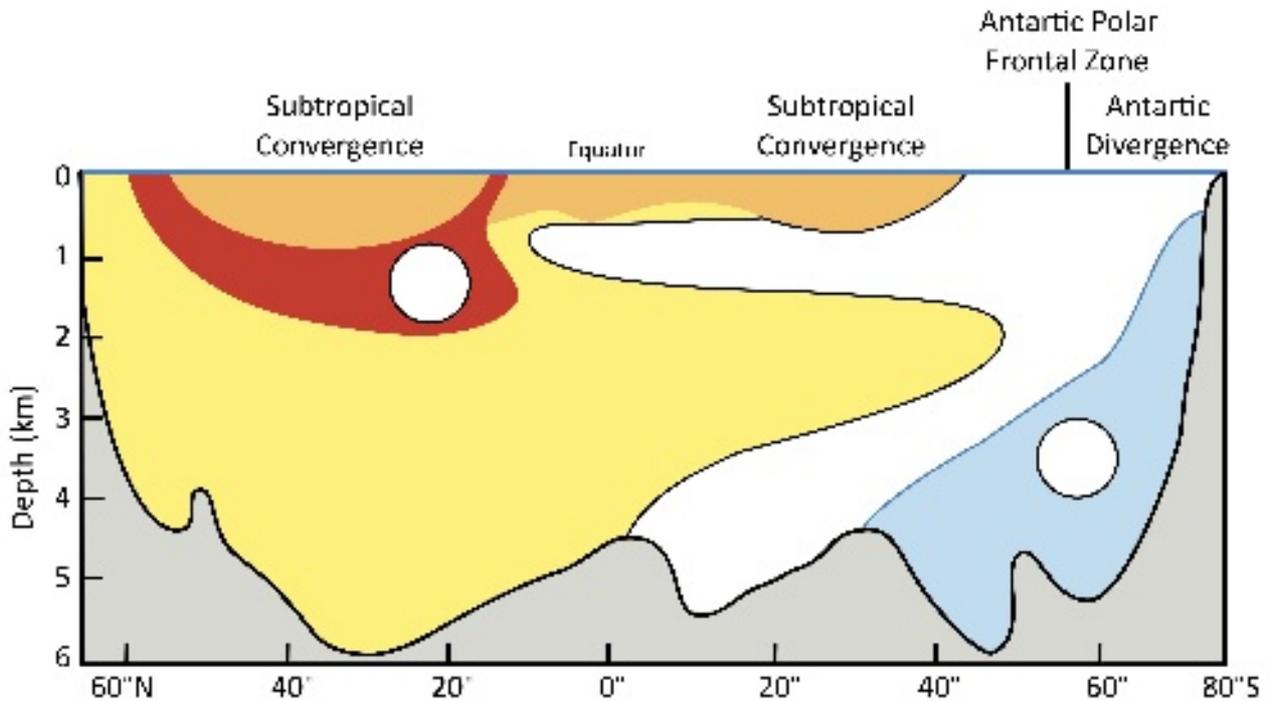
**1. Tides in the Earth system.**



The Figure illustrates two (labelled A and B) different configurations of the Earth-moon-sun system. Which of the three statements below is correct? /1 pt

- a. Configuration A represents a spring tide, while configuration B represents a neap tide
- b. The two configurations represent a spring tide
- c. Configuration B represents a spring tide, while configuration A represents a neap tide
- d. The two configurations represent a neap tide

## 2. Water Masses in the Atlantic Ocean



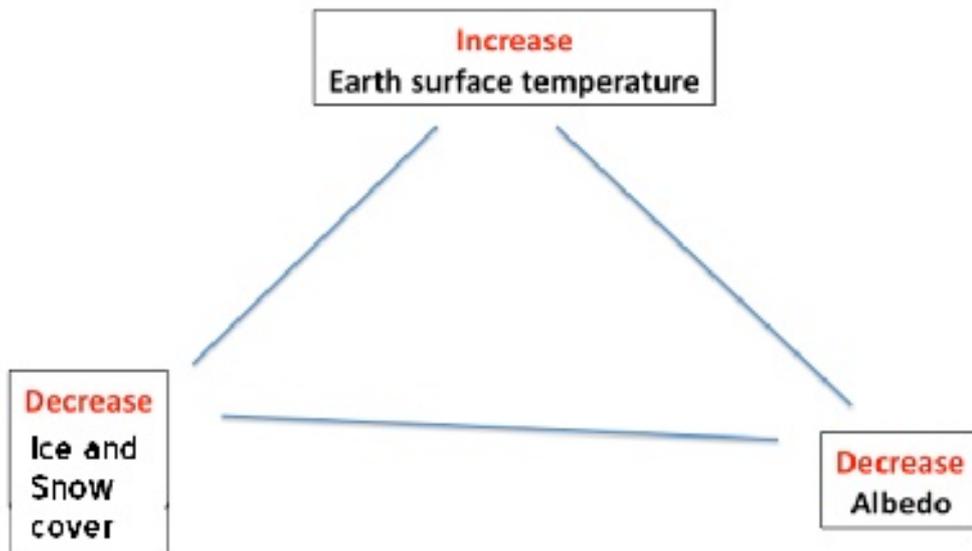
i) Match the corresponding water masses listed below by letter (a-e) to the correct location in the map. Each water mass category applies only to a single color (grey excluded since it indicates the bottom topography) **\_/1 pt (0.20x5)**

- a. North Atlantic Deep Water (NADW)
- b. Antarctic Intermediate Water (AAIW)
- c. Mediterranean Water (MedW)
- d. Surface Water (SW)
- e. Antarctic Bottom Water (AABW)

ii) Oceanographers were able to collect two water samples as reported in the table below. Indicate in the two circles in the figure which is Station A and which is Station B. **\_/0.5 pt**

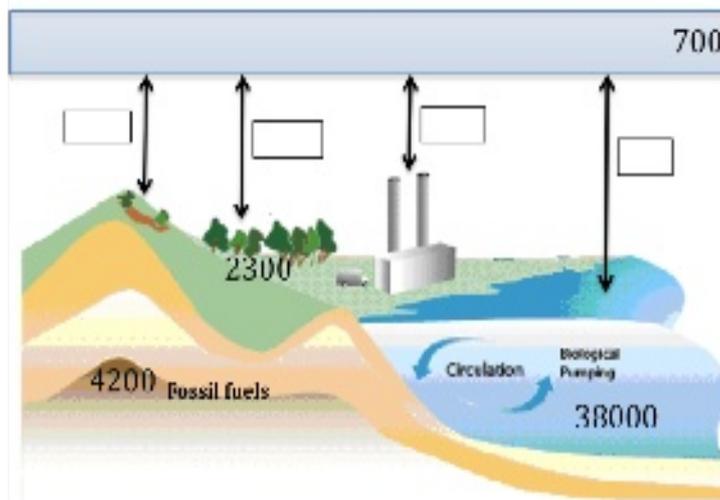
Station	Temperature (C)	Salinity
A	-2	34.6
B	8	35.4

### 3. Climate feedbacks in the Earth system



1. Put the correct arrow heads to complete the albedo feedback loop sketched in the figure above  
\_/0,5pt.
2. The feedback is \_/0,5 pt.
  - a. Always positive
  - b. Always negative
  - c. Neutral
  - d. Some times positive and some times negative

4. The global carbon cycle.

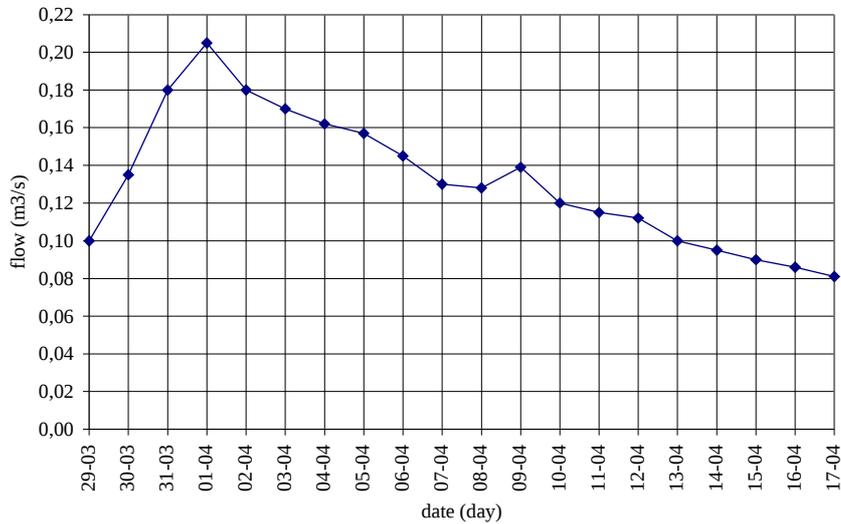


This is a schematic picture of the global carbon cycle with some estimates of the major carbon (C) reservoirs and fluxes from IPCC (2007).

1. What are the units of the values on the graph? (C is the symbol for carbon) **\_/1 pt.**
  - a.  $\text{kg C m}^{-3}$
  - b. Pg C
  - c. mol C
  - d. Gt C
  - e. answers b. and d. are true
  - f. answers b. and c. are true
2. Indicate the estimated direction(s) of the flux by circling the correct arrow head. **\_/1,5 pt. (0,25 x 6)**
3. Label the fluxes in the four blank boxes by writing the corresponding letter from the list below: **\_/1 pt. (0,25 x 4)**
  - a. ocean pump
  - b. terrestrial net production
  - c. anthropogenic emissions
  - d. soil respiration
  - e. land-use change
  - f. weathering
4. The present atmosphere contains about 700 ... C in the form of  $\text{CO}_2$ . Estimated fossil fuel reserves contain at least 4200 ... C, mostly in the form of coal. At present, about half the  $\text{CO}_2$  produced by the burning of fossil fuels remains in the atmosphere. If this ratio remained constant and we burned up all of our fossil fuels instantaneously, by how much would atmospheric  $\text{CO}_2$  rise in the longer term? (Express the answer in terms of the new  $\text{CO}_2$  stock divided by the current one) **\_/1.5 pt.**

### Question 5

The graph represents the mean daily discharges, expressed in  $\text{m}^3/\text{s}$ , of a spring in the Central Apennines registered between March 29 and April 17. The table shows the data used to build the graph. Compute in the most accurate way the water volume coming from the spring between April 12 and April 17. /2 pt.



Date	Discharge ( $\text{m}^3/\text{s}$ )
29-03	0.100
30-03	0.135
31-03	0.180
01-04	0.205
02-04	0.180
03-04	0.170
04-04	0.162
05-04	0.157
06-04	0.145
07-04	0.130
08-04	0.128
09-04	0.139
10-04	0.120
11-04	0.115
12-04	0.112
13-04	0.100
14-04	0.095
15-04	0.090
16-04	0.086
17-04	0.081

- a)  $39700 \text{ m}^3$
- b)  $48700 \text{ m}^3$
- c)  $0.5 \text{ m}^3$
- d)  $0.6 \text{ m}^3$

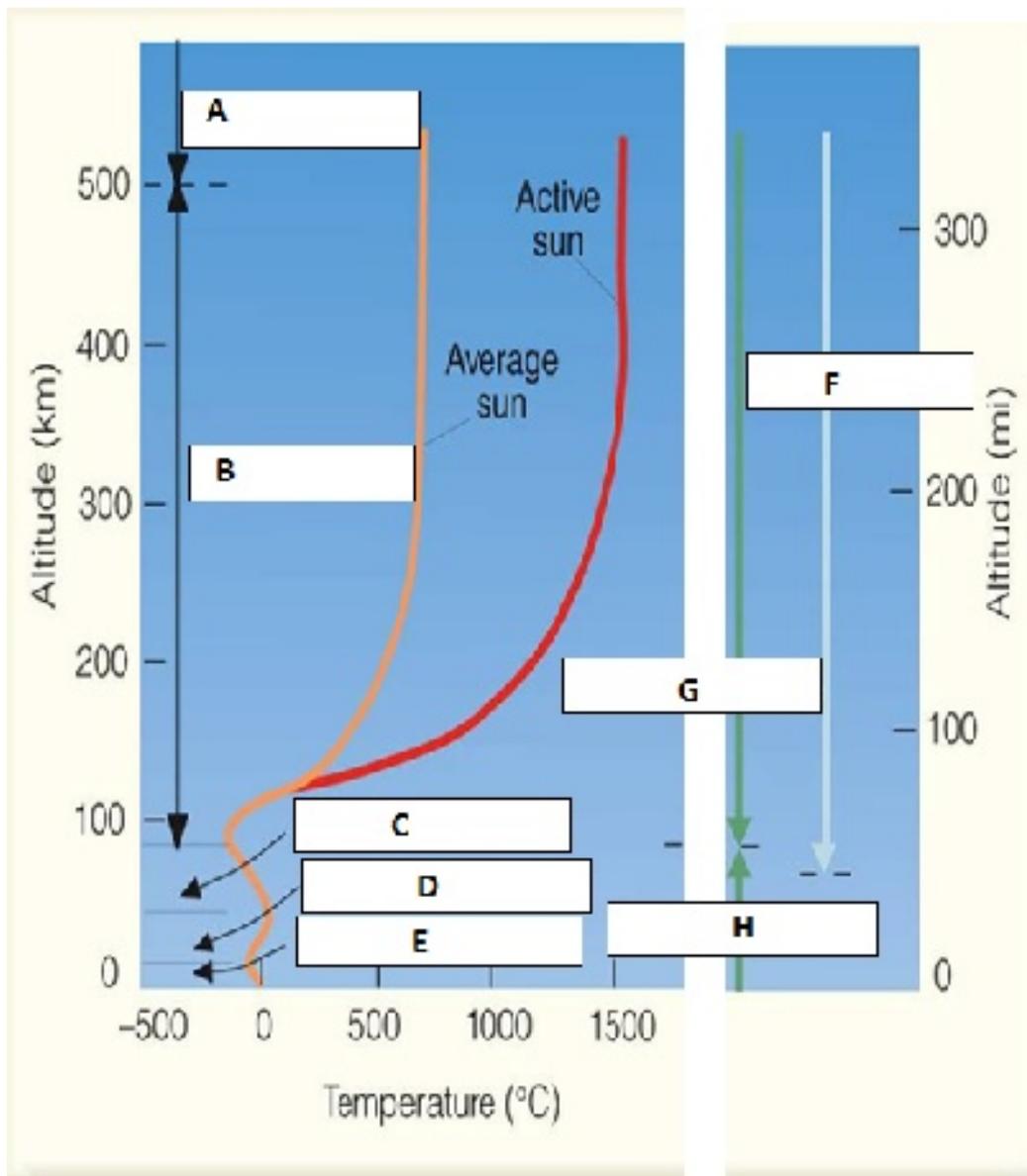
**ATMOSPHERE written test IESO 2011**

Name \_\_\_\_\_ Country \_\_\_\_\_

1) The diagram bellow showed the average structures of the atmosphere based on its properties i.e. temperature, molecular bond and electrical. Match the letter in the boxes with right option from the list given bellow.

- |                |                 |                 |               |
|----------------|-----------------|-----------------|---------------|
| 1. Homosphere  | 2. Heterosphere | 3. Ionosphere   | 4. Exosphere  |
| 5. Troposphere | 6. Stratosphere | 7. Thermosphere | 8. Mesosphere |

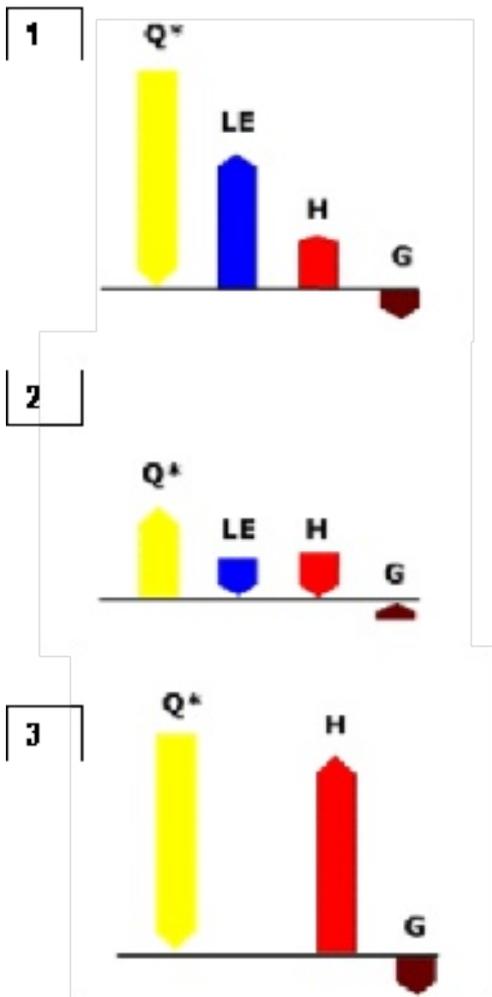
. \_/2 (0,25 x 8)



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2) Consider the following figure where are reported the surface energy balance terms for different surface and day/night conditions. \_/3 pt.

- Q\* = net radiation
- LE = latent heat flux
- H = sensible heat flux
- G = soil heat flux



Choose the correct surface description for each case:

- 1)
  - a) moist surface-day
  - b) moist surface-night
  - c) dry surface-day
  - d) dry surface-night
  
- 2)
  - a) moist surface-day
  - b) moist surface-night
  - c) dry surface-day
  - d) dry surface –night
  
- 3)
  - a) moist surface-day
  - b) moist surface-night
  - c) dry surface –night
  - d) dry surface-day

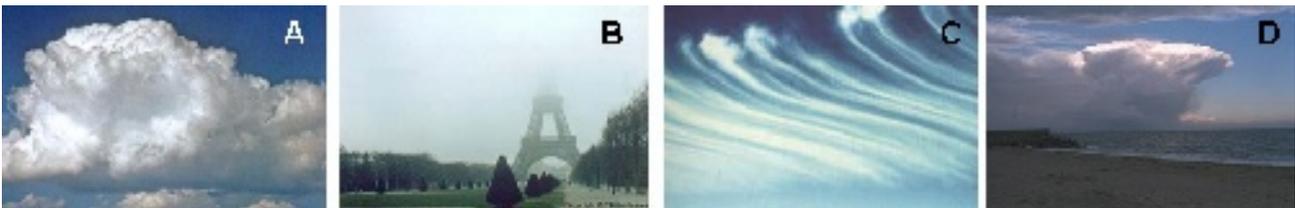
3) Which two gases are responsible for the absorption of very shortwave (e.g., ultraviolet) incoming solar radiation? **/1 (0,5 x 2)**

- 1) molecular oxygen
- 2) ozone
- 3) carbon dioxide
- 4) water vapour
- 5) nitrogen

4) Join with lines the surface types with the corresponding surface albedo **/1. (0.25 x 4)**

Fresh snow	0-10 %
Soil	22-35 %
Water	80-90%
Crops	18-23 %

5) The following images represent different kinds of clouds.



Join with lines the images (from A to D) with the cloud type classification: **/1 pt. (0,25 x 4)**

- |   |              |
|---|--------------|
| A | STRATUS      |
| B | CUMULUS      |
| C | CUMULONIMBUS |
| D | CIRRUS       |

6) What is the frictional effect on the geostrophic wind? **/1 pt.**

- A) In the northern hemisphere the effect of the friction is to deflect the wind in direction of high pressure
- B) In both hemispheres the effect of the friction is to deflect the wind in direction of low pressure
- C) In the southern hemisphere the effect of the friction is to deflect the wind in direction of high pressure
- D) In both hemispheres the effect of the friction is to deflect the wind in direction of high pressure

7) An aircraft departs from A (airfield elevation 1700ft) with QFE 960 hPa set. The altimeter is not reset. When landing at B (airfield elevation 2700ft), the QNH is 1005 hPa. What will the altimeter read? **/3 pt**

Assume that 1hPa is equivalent to 27ft and remember that

QNH = atmospheric pressure at sea level

and

QFE = atmospheric pressure at field elevation

A) 1700 ft

B) 1000 ft

C) 1485 ft

D) 2700 ft

8) With a classical warm front there are: **/1 pt.**

A) high cloud with no precipitation

B) cumulus and cumulonimbus

C) no significant cloud

D) high cloud, middle cloud, mostly stratiform cloud, and light/moderate rainfall

9) According to the three cell general circulation model, in which direction do winds blow in the upper troposphere in the tropics in the northern hemisphere? **/1 pt.**

A) From SW

B) From S

C) From W

D) From SE

10) The increasing of the Earth's rotation velocity could most likely lead to **/1 pt.**

A) decreasing number of circulation cells

B) increasing number of circulation cells

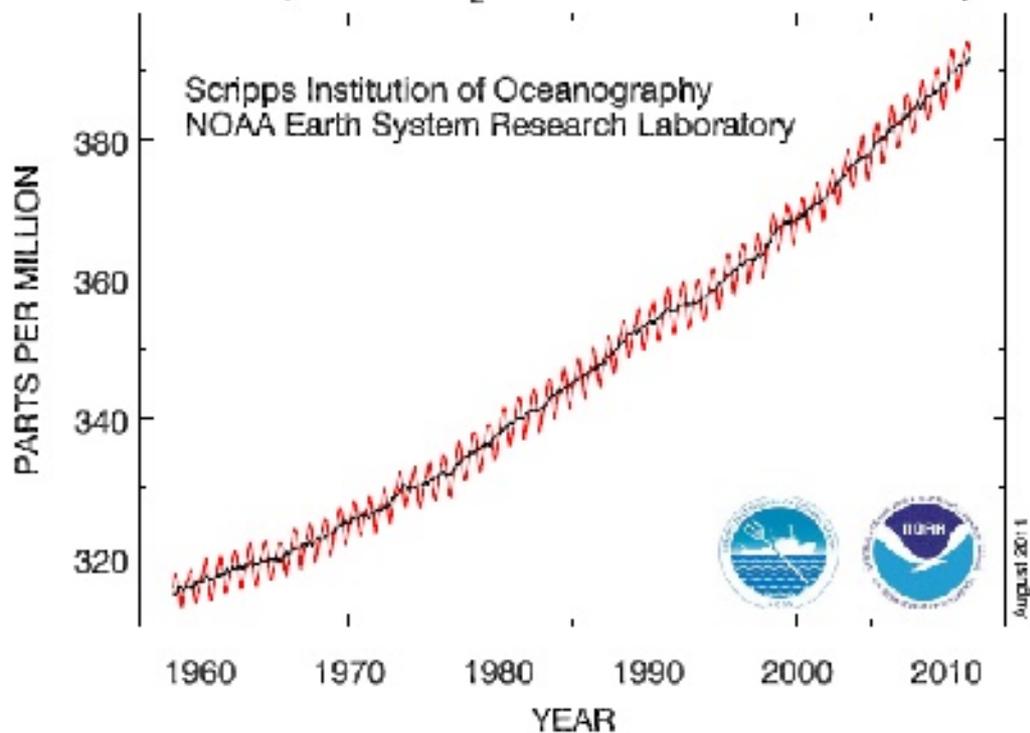
C) no change in the number of circulation cells

11) Graph 1 describes data of atmospheric CO<sub>2</sub> concentration measurements from Mauna Loa, Hawaii.

Which of the following Earth systems and processes are responsible for the increase in CO<sub>2</sub> concentration in the atmosphere during the period described in the graph? **/1 pt.**

- CO<sub>2</sub> from the geosphere to the atmosphere by volcanic activity.
- CO<sub>2</sub> from the geosphere to the hydrosphere and the atmosphere by erosion.
- CO<sub>2</sub> from the biosphere to the atmosphere and hydrosphere by respiration.
- CO<sub>2</sub> from the hydrosphere to the atmosphere by diffusion.
- CO<sub>2</sub> from the geosphere and the biosphere to the atmosphere by anthropogenic activity.
- CO<sub>2</sub> from the geosphere and the hydrosphere to the atmosphere as a result of global warming.

**Graph 1:** Atmospheric CO<sub>2</sub> at Mauna Loa Observatory



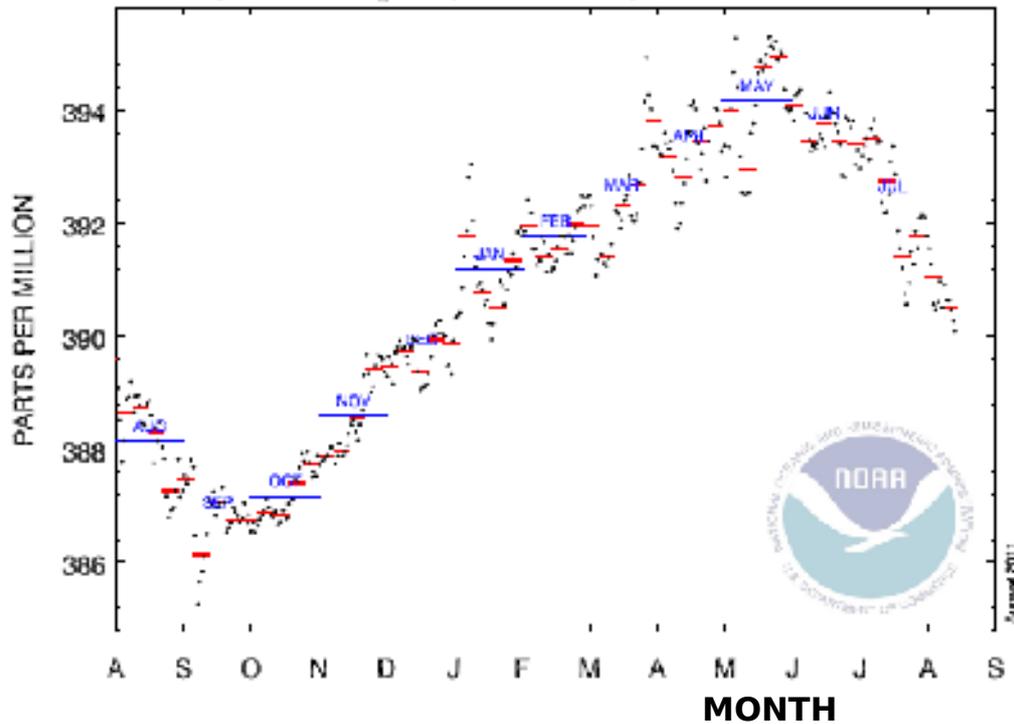
From: Earth system research laboratory (<http://www.esrl.noaa.gov>)

12) Graph 2 describes the annual changes of atmospheric CO<sub>2</sub> concentration. The data shown indicates a minimal concentration in October and maximal in June. The reason for that change is: /1 pt.

- Increased CO<sub>2</sub> flux from the geosphere to the atmosphere as a result of change in fossil fuel consumption between summer and winter.
- CO<sub>2</sub> flux between the atmosphere and the hydrosphere as a result of temperature differences.
- CO<sub>2</sub> flux between the atmosphere and the hydrosphere as a result of wind speed and direction.

- d. CO<sub>2</sub> flux between the atmosphere and the biosphere as a result of changes in photosynthesis activity.
- e. CO<sub>2</sub> flux between the atmosphere and the biosphere as a result of forest fires.
- f. Changes in CO<sub>2</sub> flux between the geosphere and the atmosphere as a result of changes in sedimentation rates.

**Graph 2:** One year of CO<sub>2</sub> daily and weekly means at Mauna Loa



From: Earth

system research laboratory (<http://www.esrl.noaa.gov>)

13) Many scientists conclude that the increase in atmospheric CO<sub>2</sub> concentration is a major factor in global warming. The results of continuous monitoring of atmospheric CO<sub>2</sub> concentration indicates that some CO<sub>2</sub> from the atmosphere is absorbed by the oceans. What would happen if CO<sub>2</sub> in the atmosphere increases? (Mark all correct answers) **\_/3 pt. (0,30 x 10)**

**Hydrosphere:**

- a. The pH of ocean water will become higher / lower
- b. The temperature of ocean water will increase / decrease
- c. The amount of sea-ice in the Arctic will increase / decrease
- d. Ocean capacity to absorb CO<sub>2</sub> will increase / decrease

**Biosphere**

- e. The amount of organisms with carbonate skeleton will increase / decrease
- f. The distribution of marine organisms will change as result of the changes in water temperature. True / false.
- g. The change in water pH will expand / reduce coral reefs

**Geosphere**

- h. The changes in ocean temperature will affect volcanic activity in ocean ridges. . True / false.
- i. The changes in ocean water pH will increase / decrease the rate of  $\text{CaCO}_3$  sedimentation in the continental shelf.
- j. The changes in ocean water pH will increase / decrease the rate of  $\text{CaCO}_3$  sedimentation below the Calcium Carbonate Compensation Depth (CCD). True/false

**TOT. PT. = 20**

## ASTRONOMY written test IESO 2011

Name \_\_\_\_\_ Country \_\_\_\_\_

1. Imagine that a new planet, named Pippo, is discovered beyond Pluto. Its revolution period is 320 years. What would be its average distance from the Sun in Astronomical Units (AU), assuming circular orbit? **\_/1 pt.**

- a. 23.4 AU
- b. 30.7 AU
- c. 46.8 AU
- d. 93.6 AU

2. A person weights 70 kg on Earth, if he goes to the surface of the Moon and Jupiter, he weights: **\_/1 pt.**

- a. more on the Moon and Jupiter than on Earth
- b. more on Jupiter and less on the Moon than on Earth
- c. more on the Moon and less on Jupiter than on Earth
- d. less on the Moon and Jupiter than on Earth

3. Given your passion for Astronomy, your friends have given you a sidereal watch as a present for your birthday. At 10 a.m. you adjust it with the time of your clock. Following the time given by the sidereal watch, when arriving at the railway station next day to catch the 8.00 a.m. train, you find that the train is not there. What do you do? **\_/1.5 pt.**

- a. I wait for the train because it will be there in few minutes
- b. I go home because the train has already left few minutes before my arrival
- c. I wait for the train because it will be there in some hours
- d. I guess the train has been cancelled today.

4. In a science fiction movie, the main character decides to look for his friends' spaceship, lost on Mars surface, using an optical telescope placed on the Earth. The resolution of the telescope is 1 arcsec and Mars is at a distance of 60 million km. What is the minimum size of the spacecraft to allow him to see it? **\_/1,5 pt.**

- a. 2.90 m
- b. 290.9 km
- c. 290.9 m
- d. 2.90 km

5. Looking at the given stellar map, can you estimate the position of the Sun as seen from Sirius, using the same map? **\_/ 2 pt.**

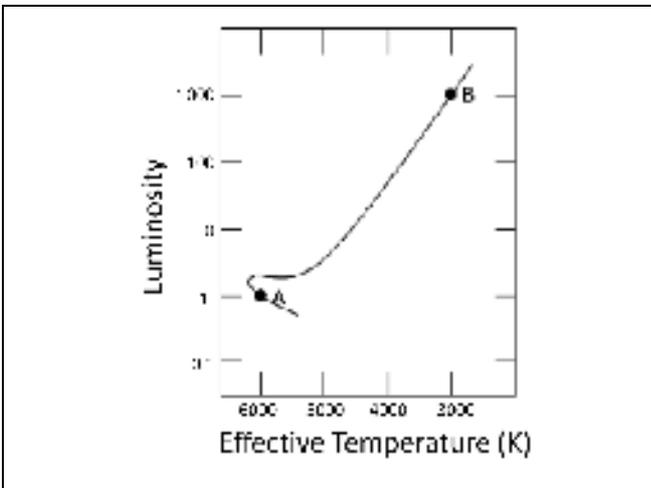
- a. yes, the Sun is diametrically opposed to Sirius in the constellation of Hercules
- b. no, the Sun is not visible from Sirius

- c. yes, the Sun is diametrically opposed to Sirius in the constellation of Ursa Minor
- d. yes, the Sun is diametrically opposed to Sirius in the constellation of the Octans

6. Assume the diameter of the Moon to be 20% smaller than the reality, what should the average distance between the Earth and the Moon be, in order to still have total solar eclipses on the Earth?  
 \_/1.5 pt.

- a. 20% bigger than the reality
- b. 80% smaller than the reality
- c. 20% smaller than the reality
- d. 80% bigger than the reality

7. The following illustration shows the Hertzsprung–Russell (H-R) diagram for an evolutionary track of our Sun. The Sun currently locates at position A, but it will to move to position B after 5 billion years. (Assume the Sun is a blackbody and its current radius is  $7 \times 10^5 \text{ km}$ .  $1 \text{ AU} = 1.5 \times 10^8 \text{ km}$ .)



(i) When the Sun evolves to B, what is its radius? Calculate it by using the information of the diagram. \_/1.5 pt.

- a) 100 times larger
- b) 57.8 times larger
- c) 126.4 times larger
- d) 157.3 times larger

(ii) Write your process of calculation. \_/1.5 pt.

8. The synodic period of a certain asteroid is  $8/7$  years. Assume the Earth revolution speed is 30 km/s. Answer with the rounded-off figure below decimal point. In the assumption of circular orbit, find:

(i) the period of the revolution of the asteroid (year) \_/1 pt.

(ii) the radius of the revolution orbit (AU) \_/1 pt.

(iii) the speed of the asteroid (km/s) **/1 pt.**

**TOTAL SCORE: 14.5**