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.

Stop 01

IESO 2011 – Practical test Geosphere – Mineralogy

Name and surname of the Partecipant: _____
Nationality: _____
Duration time 10 min.

Identification of mineral species

Given five different mineral samples, the candidate is requested to identify each mineral species with the aid of basic chemical/physical tests or macroscopic observations. Each mineral species holds at least one unique feature or character which discriminate it from the others (for example, it is the only one reacting with acids, it is the hardest one, it is the most symmetric one, it is the only one exhibiting metallic luster …). The tests recommended for the identification are: (i)
reactivity to hydrochloric acid attack; (ii) determination of the relative Mohs hardness; (iii) crystal habit indicative of the crystal symmetry; (iv) metallic luster.
The candidate should associate the code number (from 1 to 5) of the mineral sample to the mineral name. (2 points for each right answer)

- **calcite**
- **quartz**
- **fluorite**
- **hematite**
- **sulphur**

STOP 2 15' Name_____ Country _____

Practical test: Preda Ringadora

1) Connect the fossil names with the corresponding figure.

1) AMMONITE

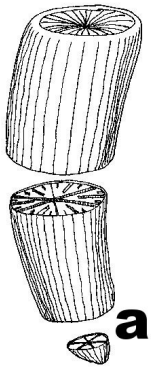
2) BELEMNITE

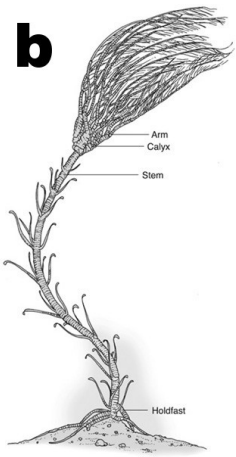
3) CORAL (SCLERACTINIAN)

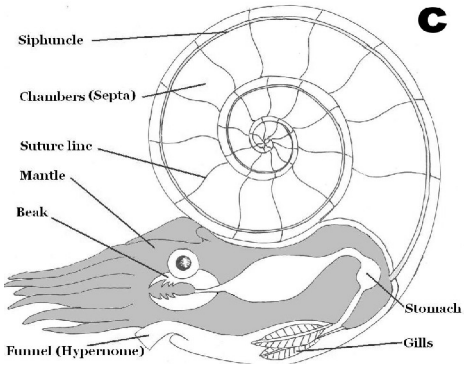
4) CRINOID

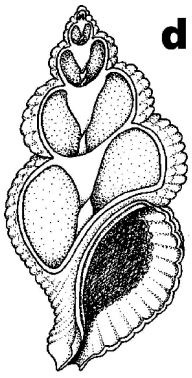
5) GASTROPOD

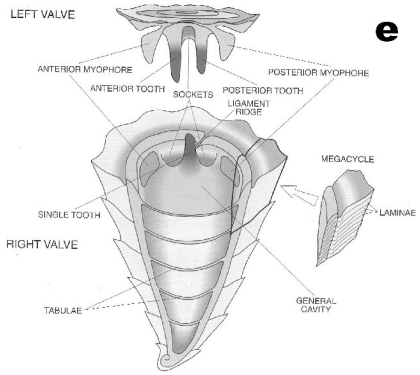
6) RUDIST











1 - __

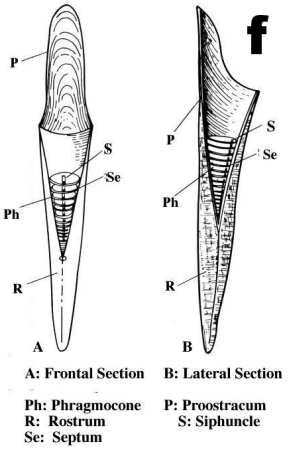
2 - __

3 - __

4 - __

5 - __

6 - __



(0.2 pt for each right answer)

2) Inside the squares A and B there are two of the fossils illustrated above. Write the name of the fossils:

A) _____ (1 pt)

B) _____ (1 pt)

3) The geological feature labelled on the stone as C is a: (0.8 pt)

a) cross bedding

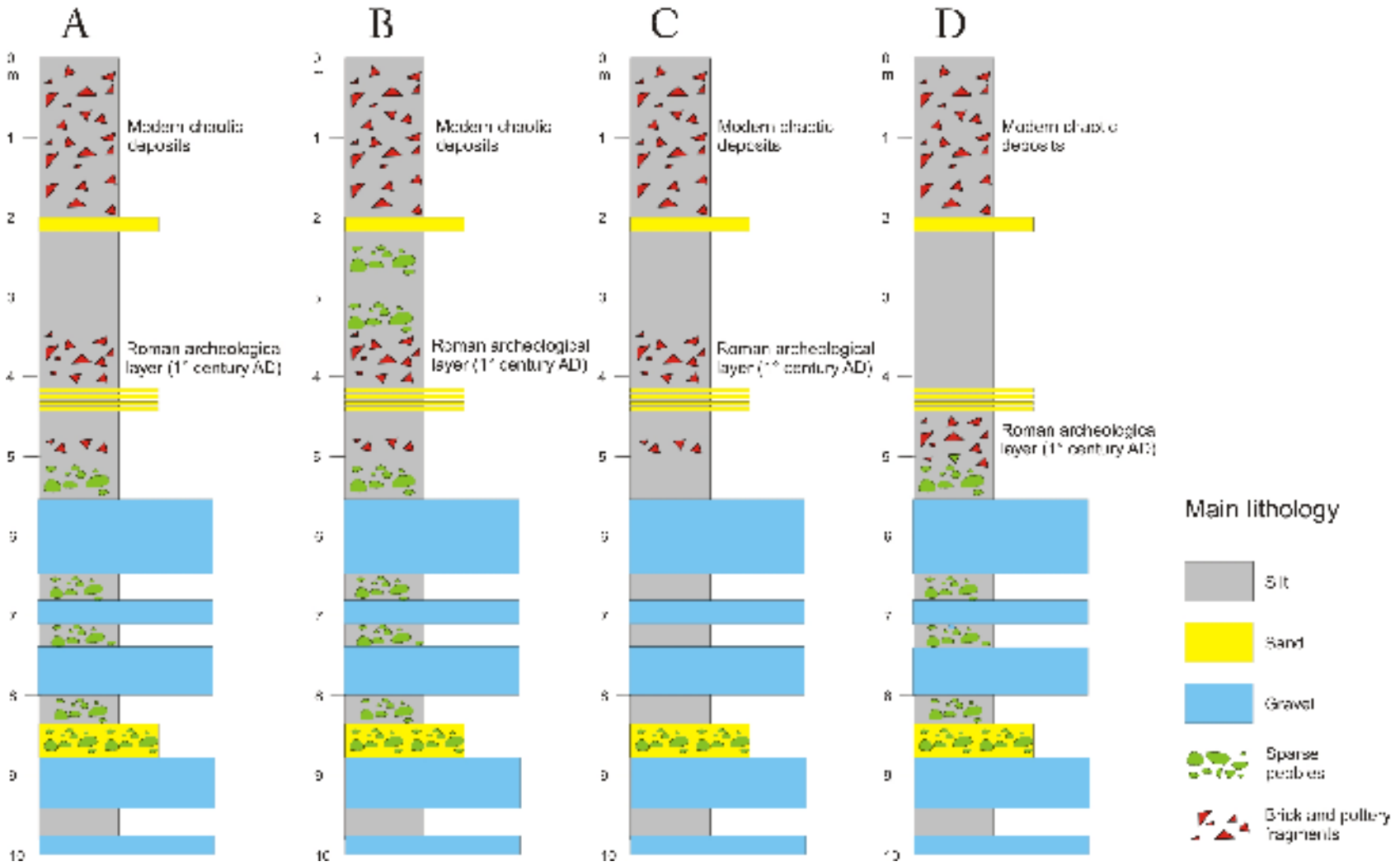
b) flute cast

c) ripple mark

d) stylolite

STOP 3, 20’ Put a cross above the letter of the right column (5 pt) Name_____
Country _____

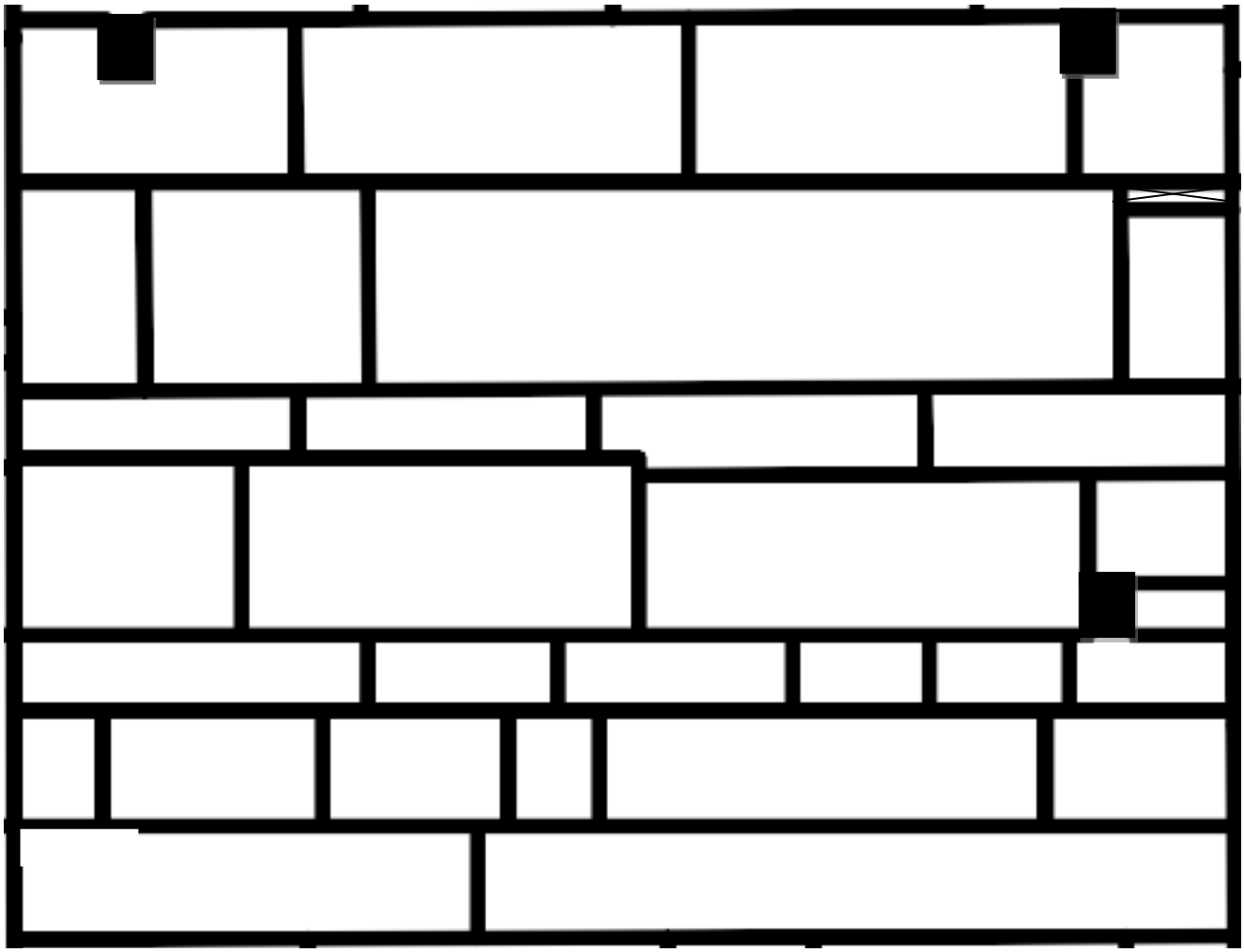
Which one of the stratigraphic columns does correctly illustrate the core?



STOP 4, 20’ Name _____ Country _____

Cathedral, northern side

Identify the stones in the boxed wall portion using the given samples for comparison: fill the slab contour with the appropriate color.



Legend and color key:

Not to be identify	
Marble	
Gray calcarenite	
Yellow-white calcarenite	
Magmatic rock (trachyte)	
Pink-red limestone	

Score

Correct	points
all	5
1 wrong	4
2 wrong	3
3 wrong	2
4 wrong	1

STOP 5, 15’ Name _____Country _____

Roman Lapidary Museum (Lapidario Romano, Museo Civico Archeologico Etnologico)
(1pt for each right answer)

Identify the stones of the following Roman monuments using the given samples for comparison: write the stone letter into the appropriate monument box.

Stone samples
A) Limestone (biocalcarenite)
B) Brecciated marble (“arabesque”)
C) Foliated marble
D) Limestone (biocalcarenite-biocalcirudite)
E) Limestone (rudist mudstone)

N. 9: Altar (ara) of Marcus Numisius Castor

N. 10 Altar (no inscription)

N. 11 Altar of Publius Clodius

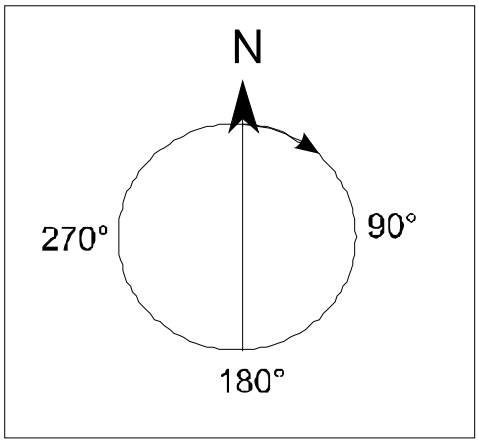
N. 19 Stele of Caius Fadius Amphio

N. 29 Lion

STOP 6, 15’ Name _____ Country _____

QUESTION 1
What is the attitude (strike, dip direction, angle of dip at clockwise measurement) of the exposed surface A : (3pt)

1. 110° - 20° - 65°
2. 340° - 250° - 65°
3. 20° - 110° - 25°
4. 170° - 80° - 25°
5. 250° - 340° - 25°
6. 110° - 20° - 65°
7. 200° - 290° - 65°
8. 20° - 110° - 65°
9. 110° - 200° - 25°
10. 200° - 290° - 25°



QUESTION 2
On the surfaces (A, B, C, D) what geological features can you identify (one or more answers may be correct): (0,5 points for each right answer)

1. wawe ripple marks
2. groove casts
3. flute casts
4. tectonic lineation
5. stylolites
6. fossil traces
7. tool marks
8. fossil shells

Geological map of Friuli Venezia Giulia – SIMPLIFIED LEGENDA stop 7b

Important note:

It’s possible to assume that the litological formation in the Slovenian

side of the hydrographic basin of river Isonzo (called Soca in Slovenia) are the same found

in the Italian side.

Quaternary covers

26

25

24

23

Cenozoic sequence

19 b : sandstone and shale

19 a: sandstone, breccias and shale

18: limestone

Mesozoic sequence

17 c: limestone

16 c: limestone

16 b: limestone

15 a: limestone

14: limestone

13 c: dolomite rock

13 a: dolomite rock

12 c: dolomite rock and limestone

9: dolomite rock and limestone

GEOLOGICAL MAP OF LOMBARDIA - SIMPLIFIED LEGENDA stop 7a

Important note: during past glacial periods, alpine glaciers transported and accumulated sediments to form morains in the pedemontane zone of Alps.
Since the end of the last glaciation, river Oglio carries to *site X* sediments already deposited by alpine glaciers in the past in the pedemontane zone, south of lake Iseo.

Quaternary covers

1

4

5

7

8

Igneous rocks

9: granite

10: diorite

11: diorite and gabbro

13: rhyolite

16: granite

17: diorite and gabbro

Sedimentary covers*:*

different types of limestone, sandstone,

dolomite rock and shale

19b

22a 22b

23

24

25
26
27a
28
29
30
31a
32a
33a
34
35
37a
39
41a
43a
44
45
46b

Crystalline rocks

48: gneiss
49: schist and phyllite
50: quartzite

Crystalline rocks

64: gneiss

65: schist and phyllite

66: schist

67: gneiss

STOP 7 25’

Practical test 2011 – Comparison of sediments and hydrographic basins

Equipment:

- Geological map 1 (Friuli Venezia Giulia), with a simplified legenda
- Geological map 2 (Lombardia), with a simplified legenda
- Pebble samples A and B
- Sand samples 1 and 2
- Stereomicroscope
- Dilute hydrochloric acid.

Exercises:

- Two geological maps are provided (1 and 2)
- Two pebble samples (A and B) are provided
- On each map, two sites (X and Y) along the river are shown. Pebbles and sand samples have been collected from these locations.
- In site X pebbles from the Oglio hydrographic basin have been collected.
- In site Y pebbles from the Isonzo hydrographic basin have been collected.

1) Recognize the rock types of the pebbles, by completing the following table (it’s possible to use the diluted HCl solution): (1,5 points)

Choose among: limestone, sandstone, dolomite rock, diorite, gneiss/micaschist

Number of pebble	Rock type
A 1	
A 2	
A 3	
B 1	
B 2	
B 3	

2) Match correctly the pebble samples with the geological maps.

(1,25 points)

Pebble sample A	Geological map number …….
Pebble sample B	Geological map number …….

3) Observe carefully the two sand samples (1 and 2) at the stereomicroscope. Which minerals are present in each sample? You could tick more than one option.

(1 point)

	Calcite present	Quartz abundant	Quartz very rare	Biotite present
Sand sample 1				
Sand sample 2				

4) Which of the two sand sample comes from site X and which from site Y ?

(1,25 points)

Sand sample 1	Site …….
Sand sample 2	Site …….

Stop 8, 15’

Name_____ Country_____

In this test you are expected to recognize the minerals of the rock, estimate their abundance and classify the rock based on the Strekeisen diagram.
Fill all tables and Strekeisen plot. Report the name of the rock.

Characters of the rock forming minerals (not all are present in the rock):

Plagioclase: White milky appearance, anhedral to subhedral (elongate prismatic habit), sometimes twinning and cleavage detectable.

Quartz: Colourless to greyish, is the most transparent, often anhedral interstitial, conchoidal fractures, no cleavage.

Biotite: Black-dark brown, vitreous lustre, thin cleavage system, hexagonal euhedral sections are in general subequant..

Pyroxene: Black, prismatic elongated, cleavage parallel to the elongation.

Olivine: Green, dark green, prismatic subequant, no cleavage.

Oxides: Equant, fine grained, black metallic lustre.

Tourmaline: Strongly elongated to acicular habit, light brown to greenish.

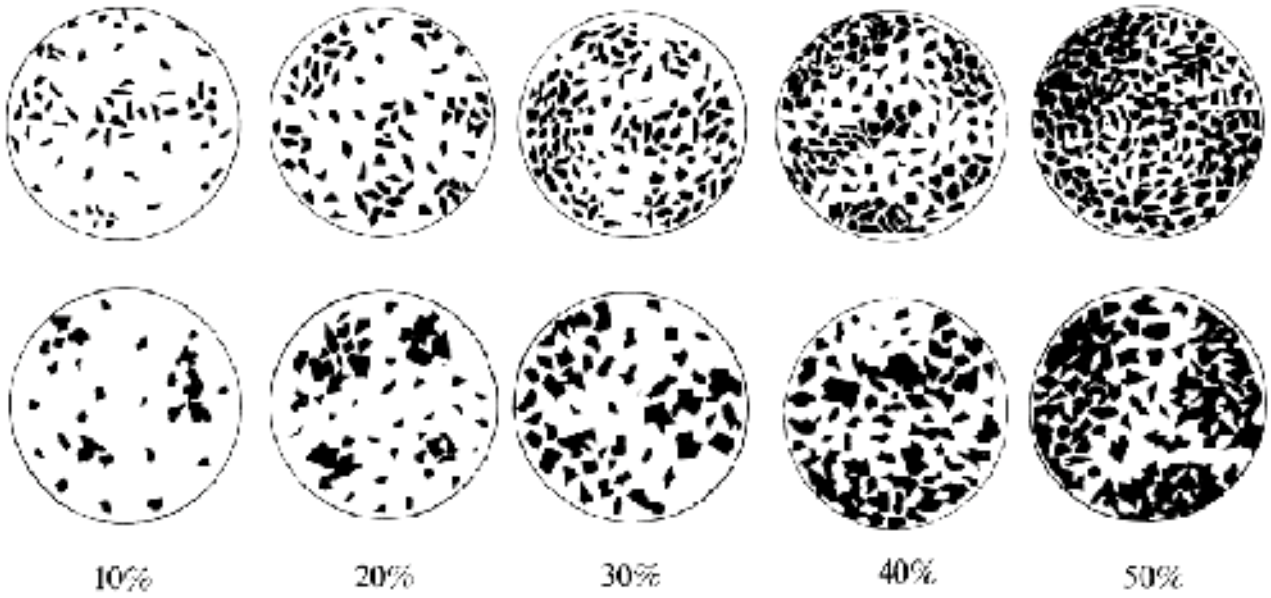
K-Feldspar: Orange to reddish, forms large crystals, anhedral to subhedral, sometimes twinning and cleavage detectable.

In the following table select the minerals you recognize on the selected areas of the pillar, then indicate the amount of each phase. Minerals not recognized must be indicated as 0%. To evaluate the amount of each mineral phase use the reference grids in the next page. Note that indicating the amount of minor phases as <10% means total is not expected to be 100%.

	0	<10%	10%	20%	30%	40%
Tourmaline						
K-feldspar						

Olivine						
Oxides						
Quartz						
Pyroxene						
Biotite						
Plagioclase						

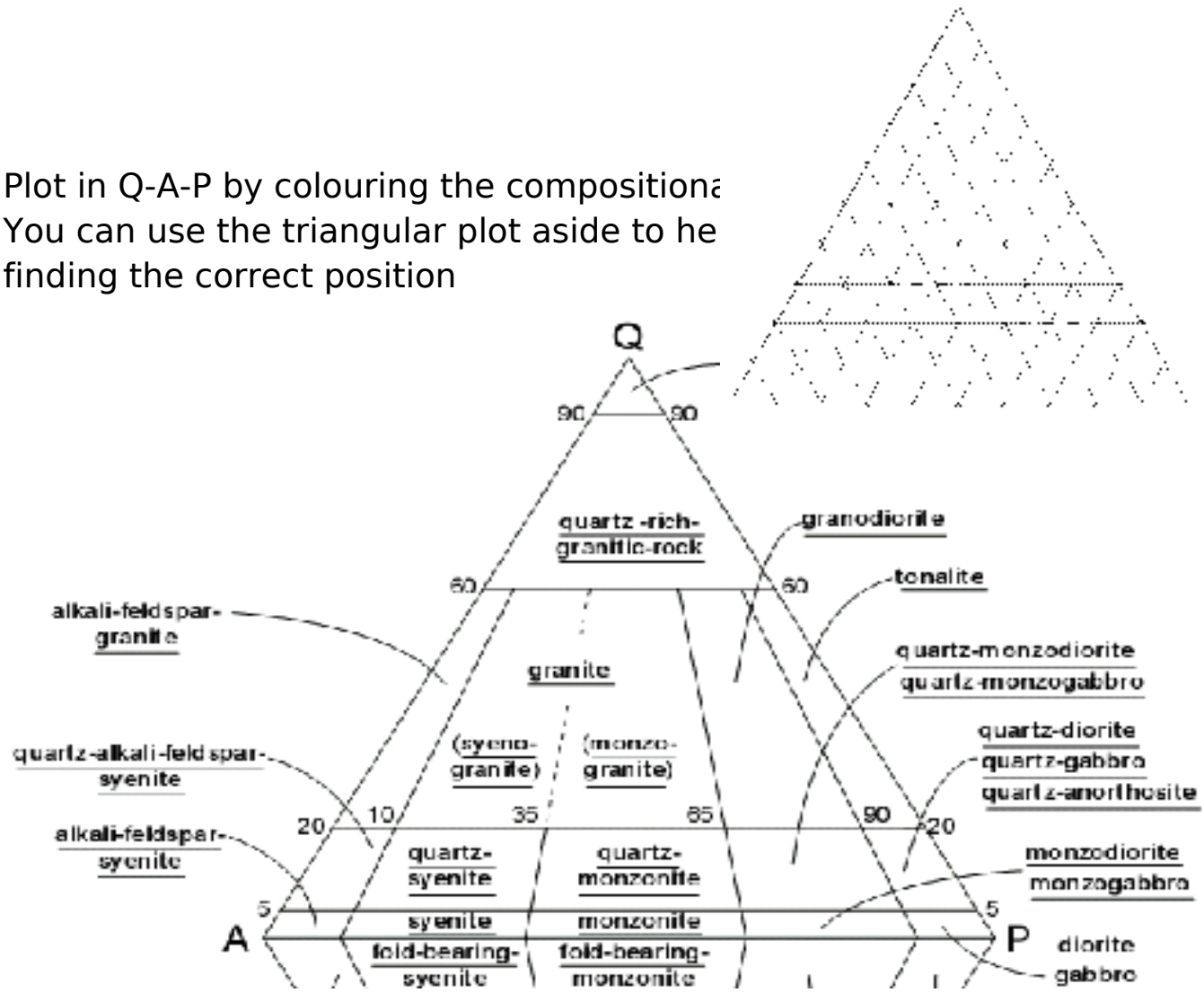
Reference grids



In order to define the rock you must recalculate the relative amount of Q, A and P

	Estimated value	Recalc to 100
Q (Quartz)		
A (K-feldspar)		
P (Plagioclase)		
Sum Q+A+P		Sum =100

Plot in Q-A-P by colouring the compositiona
You can use the triangular plot aside to he
finding the correct position



The observed rock is: _____

Score:

Plot in the right field: 4 points

Plot in the fields adjacent to the correct one: 1 points

STOP 9, 20’ Records from the past

- Instruction sheet -

Background information

To help to make climate forecasts for the future, it is useful to study past climate. The field of science which aims to gain better insight into past climate on Earth and the mechanisms that are causing climate change is called palaeoclimatology.

The floors of oceans and lakes are covered with various layers of mud-like sediments, which contain fossils. One type of fossil from lake or ocean sediments that is often used by palaeoclimatologists is diatoms. Each kind of diatom has a different shape of its skeleton. This difference is used to identify the various fossil types of diatom.

In addition to this, every species grows optimally under a certain temperature called the optimal temperature (To), so the presence of a certain species can provide some clues about the climate at the time when the individuals were still alive.

Scientists can determine the temperature at the time of formation, which is called the balanced average temperature (Tm), by applying the following formula:

$$T_w = \frac{(n_{S1} \times T_{o,S1}) + (n_{S2} \times T_{o,S2}) + (n_{S3} \times T_{o,S3}) + (n_{S4} \times T_{o,S4})}{n_{S1} + n_{S2} + n_{S3} + n_{S4}}$$

T_w – balanced average temperature (°C)
Sn – type of diatom
$T_{o,Sn}$ – optimal temperature of the type of diatom (°C)
n_{Sn} – amount of diatoms of a certain type

Aim

Reconstructing a climate history by analyzing the types of diatoms from a sediment core.

Materials

10 Petri dishes that correspond to sediment samples from different parts of a sediment core. The depth and age are indicated on each Petri dish. (BP years= years Before Present)

Sample number	Age (BP years)	Depth (cm)
1	1000	5
2	2000	10
3	3000	15
4	4000	20
5	5000	25
6	6000	30
7	7000	35
8	8000	40
9	9000	45
10	10000	50

Each Petri dish contains 12 pink, green, yellow and purple beads. Each color represents a specific type of diatom that survives best in certain temperatures (= optimal temperature, To).

Type of diatom	To (°C)
pink	20
yellow	15
green	10
purple	5

Procedure

1. Color the attached diagram (on the worksheet) according to the diatom composition found in each Petri dish. Count the amount of beads of each color found in each Petri dish and color the circles accordingly. From the bottom (horizontal axis) to the top of each column of circles, color first the pink ones, then the yellow ones, the green ones, and the purple ones.
2. Draw a line above the top set of pink dots ; this will give you a line with the age on the X-axis and the number of diatoms per type on the Y-axis.
3. Calculate the balanced average temperature (Tm) for depths at 1000 years BP, 4000 years BP and 7000 years BP . Fill the “Table of the Tm values” and answer the question according to the instructions provided.

This activity has been adapted for IESO2011 from the original version titled “Experiment from the Past” published by International Polar Foundation http://www.educapoles.org/

Records from the past (2,4pt)

– Worksheet , Diagram -

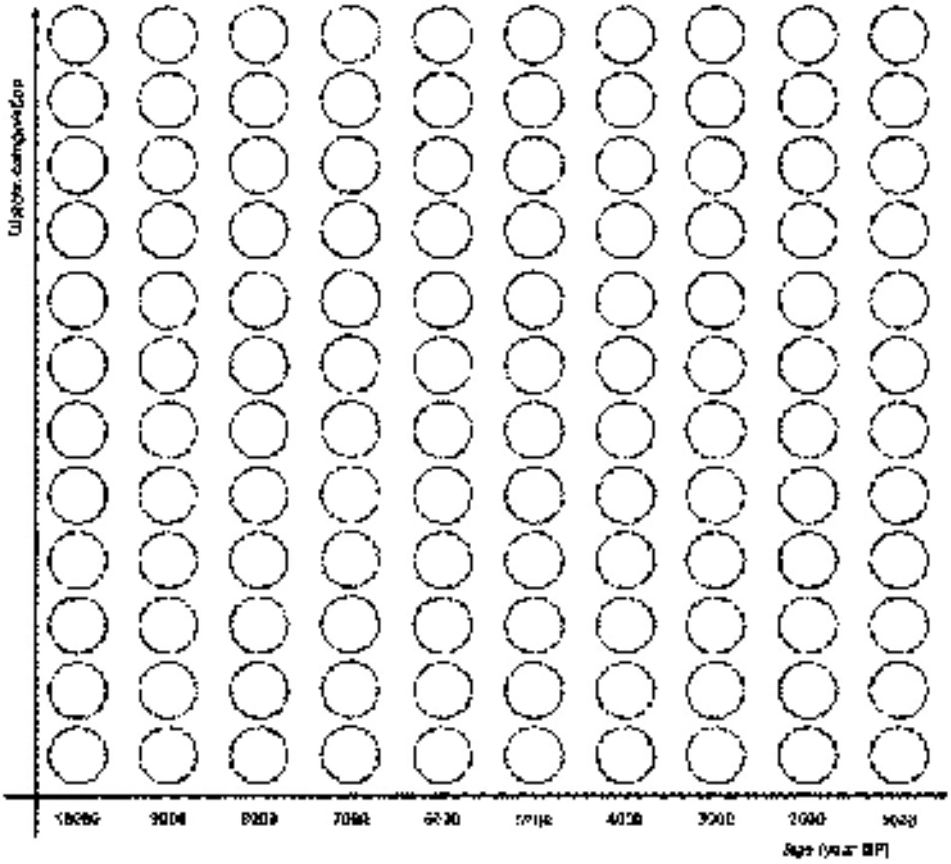


Table of Tm values

Age (years BP)	$n_{pink} * T_{0,pink}$	$n_{yellow} * T_{0,yellow}$	$n_{green} * T_{0,green}$	$n_{purple} * T_{0,purple}$	n_{total}	Tm (°C)
1000						
4000						
7000						

$$T_m = \frac{(n_{S1} \times T_{o,S1}) + (n_{S2} \times T_{o,S2}) + (n_{S3} \times T_{o,S3}) + (n_{S4} \times T_{o,S4})}{n_{S1} + n_{S2} + n_{S3} + n_{S4}}$$

T_m = balanced average temperature (°C)
Sn = type of diatom
$T_{o, Sn}$ = optimal temperature of the type of diatom (°C)
n_{Sn} = amount of diatoms of a certain type

Analysis of the results

Question 1 (0,6pt)
Put the 3 time periods listed in the table above in the following ordinated list from the coldest (1) to the warmest (3)

1 (coldest)	=	time period_____Age (years BP)
2	=	time period_____Age (years BP)
3 (warmest)	=	time period_____Age (years BP)

Question 2 (1,5pt)
The curves for the two warm periods show exactly the same maximum in terms of number of “pink diatoms” while the balanced average temperature (Tm) for these periods differ, how can you explain that? (mark one correct answer)

a) The most recent warm period has more “purple diatoms”
b) The Tm takes into account the relative composition of diatoms present in each sample
c) The Tm takes into account the age of each samples
d) The optimal temperature of the “pink diatoms” changes according to the ages

STOP 10 15'
Practical activity – Remote Sensing
Processing and analysis of digital satellite imagery

Instructions

Name:_____

Country:_____

- Download the data (Landsat satellite imagery of Venice
- Generate computerised colour images in
  - o True colour
  - o False colour
- Answer the questions

1) Data Download

Download all files from http://download.terra.unimore.it/ieso/ and save them on the **Desktop** (double clicking on every file)

2) Open the satellite imagery

a) Start the **LEOWorks3.0** programme (clicking on the **Windows Start button**)

b) Open the following files and press **OK** on the **Image Preview** window (cf. Fig.1):

- *Venice_Band_1.tif* (channel 1, blue).
- *Venice_Band_2.tif* (channel 2, green)
- *Venice_Band_3.tif* (channel 3, red)
- *Venice_Band_4.tif* (channel 4, near infrared NIR)
- *Venice_Band_5.tif* (channel 5, short wavelength infrared SWIR)
- *Venice_Band_7.tif* (channel 7, short wavelength infrared SWIR)

Fig.1: Image Preview window

3) True-colour combination of spectral bands: generate a real colour image

- In the Menu bar click on: **Image → Combine from… → [Red Green Blue]**, a new window called **Combine RGB** appears (cf. Fig.2)
- On the three input windows select the bands:
  - a) for red (*Select Red Band*) select *Venice_Band_3*,
  - b) for green (*Select Green Band*) select *Venice_Band_2*
  - c) for blue (*Select Blue Band*) select *Venice_Band_1*.

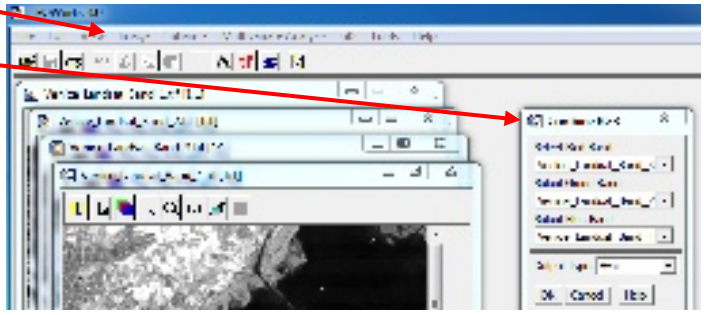


Fig.2: Combination of the spectral bands

- Clicking **OK** the combined true-colour image appears.

  Keep it open in order to compare it with the next results.

4) False-colour combination: generate an infrared false colour image

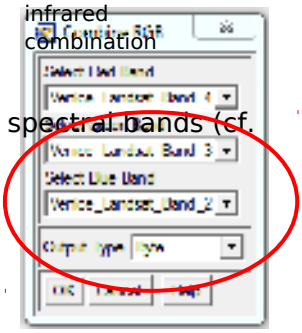


Fig.3: False colour infrared combination

- Repeat the steps of point 3) choosing now the following association of spectral bands (cf. Fig.3):
  a) for red select *Venice_Band_4*,
  b) for green select *Venice_Band_3*
  c) for blue select *Venice_Band_2*.
- Clicking on **OK** you obtain now an infrared false colour image of Venice.

  Keep it open in order to compare it with the next results.

5) Try another combination: generate a different false colour image using other spectral bands (754)

- Repeat the steps of point 3) choosing now this association of spectral bands (cf. Fig.4):
  a) for red select *Venice_Band_7*,
  b) for green select *Venice_Band_5*
  c) for blue select *Venice_Band_4*.
- Clicking on **OK** you obtain now a different false colour image of Venice.

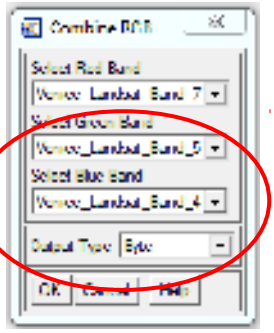


Fig.4: False colour 754 combination

You have now created three different combined images of the same subject. Observe and compare them in order to answer the following questions.

Questions

Only one answer per question is correct, mark the right one.
Every right answer corresponds to 0.35 points. 15'

The LANDSAT system constitutes the longest continuous record of the Earth surface

Name:_____

Country:_____

1) The Landsat satellite is
   a) polar b) geostationary
2) Landsat is used
   a) for weather applications
   b) land use
   c) to constantly monitor a localised region on the Earth surface
   d) none of them

The geometrical resolution of an image is the size of the pixels in meters.

3) Given that the Landsat images cover an area of 20 km × 20 km and that there are 500×500 pixels in the image, which is its resolution?
   a) 20
   b) 40
   c) 400
   d) no answer is correct

In this practical activity you used different spectral bands, every single image reflects a part of the electromagnetic spectrum

4) Which of the following bands are outside the visible spectrum?
   a) red
   b) red and NIR
   c) near and middle infrared
   d) green and blue

The combined images are, respectively, true- and false-colour combinations of the three visible channels red, green, blue, or further spectral channels of a Landsat scene.

5) False-colour images are used to
   a) increase the interpretability of satellite images
   b) provide visually impaired people a mean for detecting the same features in land use

Comparing the combined images obtained from steps 3), 4), 5) in the Instruction sheet:

6) The colours of the different features of the soil depend on the bands selected for the combination, because every object has its own radiation characteristics
   a) true; b) false
7) Which channel is best suited to give information regarding vegetation?
   a) green
   b) infrared
   c) red
   d) none of them
8) The infrared range is very useful for interpreting the Earth's surface because
   a) it consists of reflected and emitted energy
   b) it gives information about the vitality/health status of the vegetation
   c) none of them
   d) both of them

Referring to the image obtained combining the spectral bands 7, 5, 4:

9) For which application is this combination useful?
   a) to detect coast lines and shores that are well defined due to this combination
   b) to find textural and moisture characteristics of soils
   c) both of them
   d) none of them
10) In combined image 754, vegetation appears to be
   a) red

b) green
c) blue

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.**

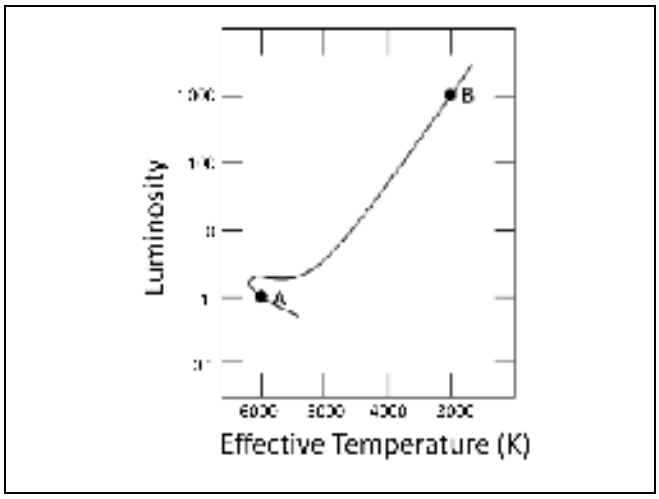
a. yes, the Sun is diametrically opposed to Sirius in the constellation of Hercules
b. no, the Sun is not visible from Sirius

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 $7x10^5$km. 1AU=$1.5x10^8$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

IESO 2011 ASTRONOMY PRACTICAL TEST – STOP 11

NAME:-

_____

COUNTRY:_____

On Friday, September 9, 2011, you will perform 3 trials. Each trial is individual, but in some cases you will have to work together with some of the other participants. This is what happens every day in science: you compete and cooperate at the same time with other scientists, to get an higher level of shared knowledge.

ACT I: THE POLE STAR FOR MARS (60 minutes for each group of individual participants)

Materials: Pocket torch light (red), paper, pencil, rubber

Remember that the celestial poles are the projection of the geographic poles onto the sky. At the present time there is a star, visible from Earth with the naked eye, close to the celestial North Pole: for this reason it is called Polaris. But what if you were at the geographic North Pole of Mars?
The celestial North Pole of the red planet is not the same of the Earth. To do the comparison, recall that the stars are so far that the imaginary designs of the constellations remain the same as seen both from the Earth and Mars. So the orientation of Mars' axis is such that its celestial North Pole has Right Ascension 21h 10m 42s and Declination +52.9°. This means that is in the constellation of Cygnus.

(i) The most brilliant star of the constellation of Cygnus could be a good choice for the martian North Pole star. Which way the modern terrestrial astronomers indicate it? For the Martian sky watcher, who knows... **_/1 pt.**

a. 1 Cyg
b. A Cyg
c. α Cyg
d. β Cyg

(ii) Look at the sky projected by the Planetarium on the inner surface of the dome. At the zenith you have the North Pole of the ecliptic. Find Polaris and thus you know the position of the Earth’s celestial North Pole. Please notice the scale on the celestial meridian joining the Earth’s North Pole with the zenith: every step is 10°. There is the same scale also on the quarter of celestial meridian joining Mars’ North Pole with the zenith. What can you say about the axial tilt of the Earth and Mars with respect to the North Pole of the ecliptic? **_/3 pt.**

a. The axial tilt of Mars is twice the axial tilt of the Earth
b. The two planets have more or less the same axial tilt, but in different directions
c. The axial tilt of Mars is one half of the axial tilt of the Earth
d. The two planets have more or less the same axial tilt, but in opposite directions

(iii) Considering all the information you have collected, can you say something about the inclination of the orbital plane of Mars with respect to that of the Earth, called the ecliptic plane? **_/3 pt.**

a. The orbital plane of Mars has a slight inclination with respect to the Earth's ecliptic
b. The orbital plane of Mars is exactly the same of the Earth and all the other planets in the Solar System
c. The orbital plane of Mars is perpendicular to the Earth's ecliptic
d. The orbital plane of Mars has an inclination of 45° with respect to to the Earth's ecliptic

ACT II: I'LL FOLLOW THE SUN (45 minutes for each group of individual participants)

Materials: Pencil, rubber, paper, chronometer, piece of chalk

In the Solar Laboratory in Modena you can look at the image of the Sun projected on a blackboard without risks for your sight (remember: never look directly at the Sun!). When the tracking of the telescope pointed toward the Sun is on, the image is still and you can appreciate, for instance, if there are sunspots. When the tracking is off, the Sun moves until it disappears from the blackboard. Even when not working, the instrument is useful: the magnification of the Sun's image allow you to measure the time the Sun needs to cover a certain angular distance and thus the angular speed of its apparent daily motion in the sky.

(i) The apparent angular diameter, in degrees, of the Sun as seen from the Earth is about... **_/2 pt.**

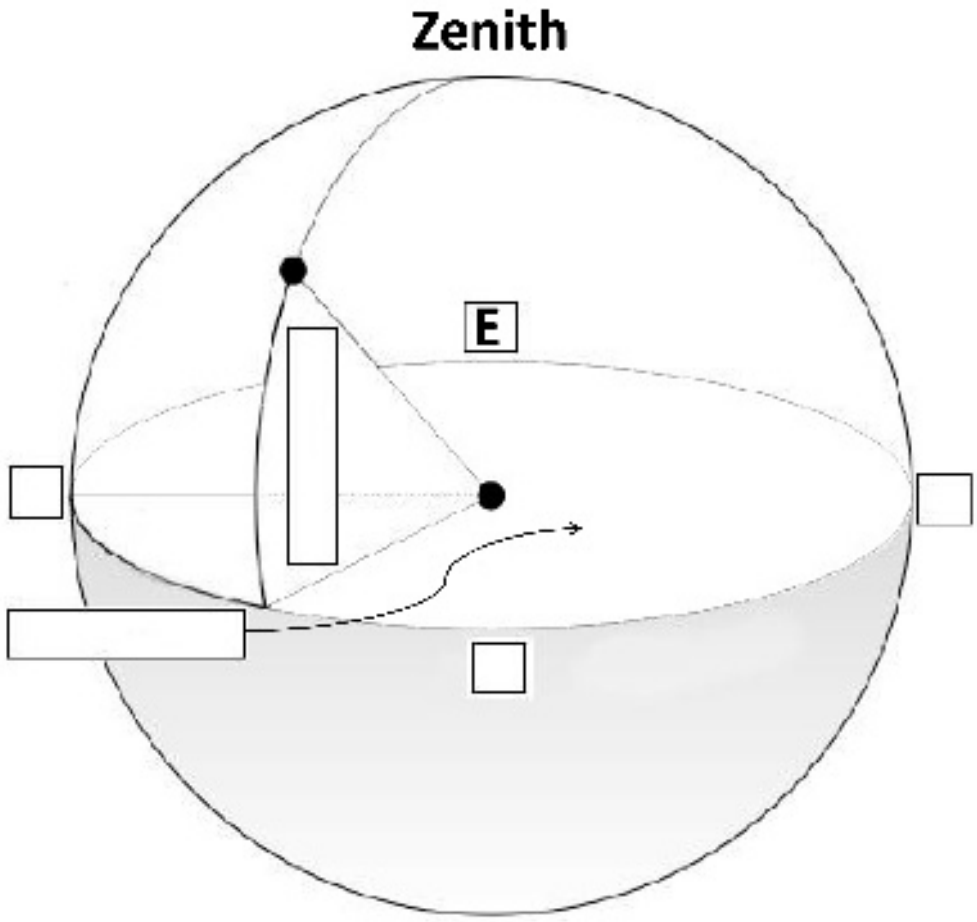
(ii) After taking the measurements in the Solar Laboratory, which is the angular speed for the daily motion of the Sun, in degrees per hour, that you have found? Write your calculation process. **_/4 pt.**

ACT III: NEVER LOOK DIRECTLY AT THE SUN (45 minutes for each group of individual participants)

Materials: Pencil, rubber, paper, aligned telescope with solar filter

… Unless you use the filters as you have on your telescope for the practical test -- but also in this case it is better not to look through it more than few seconds. This is enough time as to point the telescope, already aligned with the celestial poles, toward to the Sun. So you can find some quite interesting information about the position of our star and the position of the celestial North Pole, even if it's daytime!

(i) First complete the following scheme, inserting in the squares the cardinal points (N, E already inserted, S, W) and in the rectangles the name of the local coordinates (Altitude, Azimuth): **_/2 pt**



(ii) Now you can move the telescope, center the Sun and complete the following table:

DATE OF THE OBSERVATION: _____ **_/0.5 pt.**

SUN'S RIGHT ASCENSION: _____ **_/1.5 pt.**

SUN'S DECLINATION: _____ **_/1 pt.**

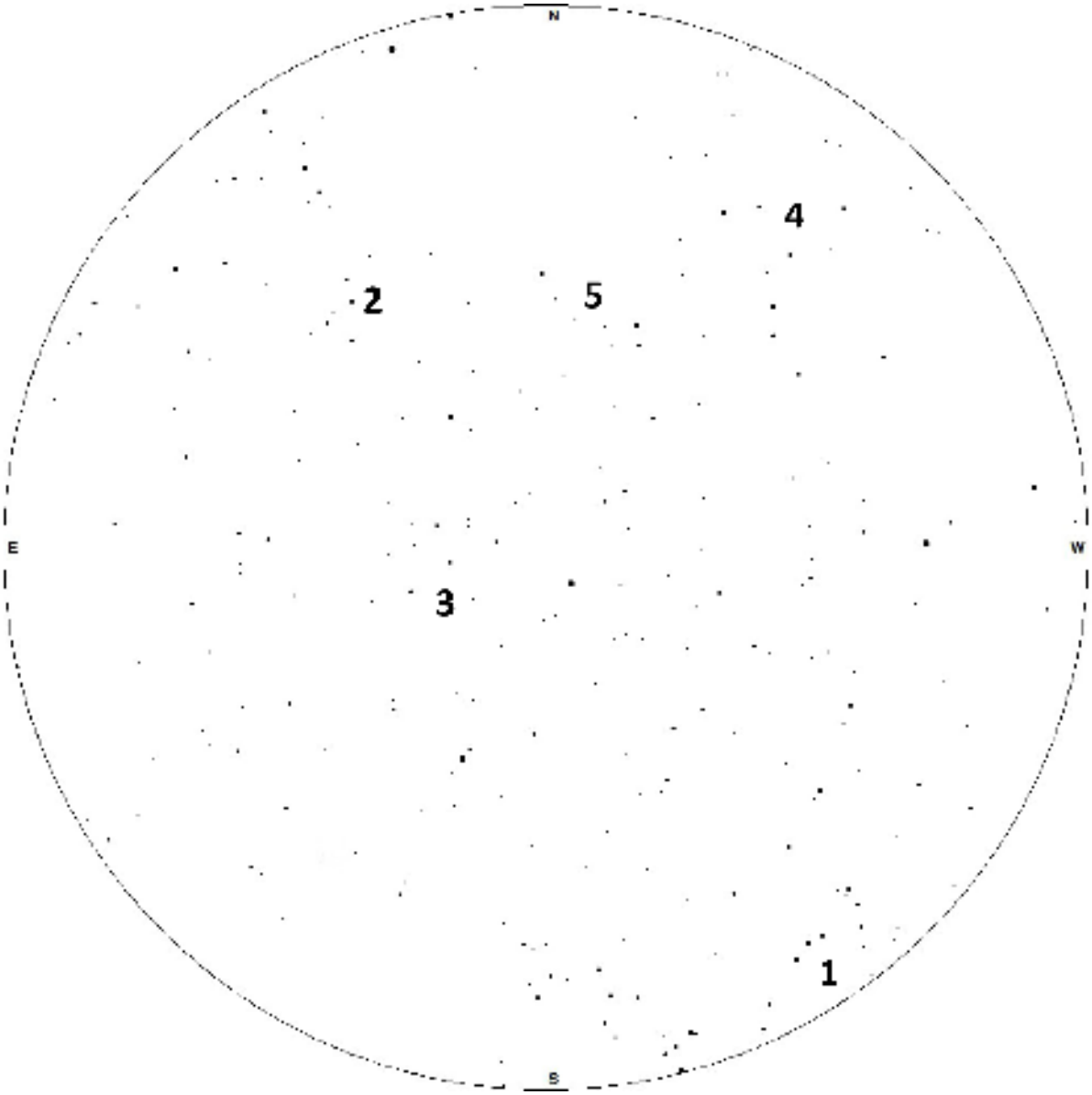
CELESTIAL NORTH POLE ALTITUDE: _____ **_/1 pt.**

LATITUDE OF MODENA: _____ **_/1 pt.**

ACT II PLAN B: THE STARS LOOK DOWN (45 minutes for each group of individual participants)

Materials: Pencil, rubber

… And you look up all the same! Unluckily, the weather is not fine, but you can see the stars: ok, it is only a drawing on your worksheet, but these are the same constellations and stars that will be above your head tonight in Modena -- and that those nasty clouds probably will not allow you to see ☹
Can you identify the constellation indicated by the numbers?



1 is: **_/1 pt.**	**2** is: **_/1 pt.**	**3** is: **_/1 pt.**	**4** is: **_/1 pt.**	**5** is: **_/1 pt.**
a. Libra b. Virgo c. Scorpius	a. Cassiopeia b. Perseus c. Pegasus	a. Delphinus b. Aquila c. Lyra	a. Ursa Major b. Ursa Minor c. Draco	a. Ursa Major b. Ursa Minor c. Draco

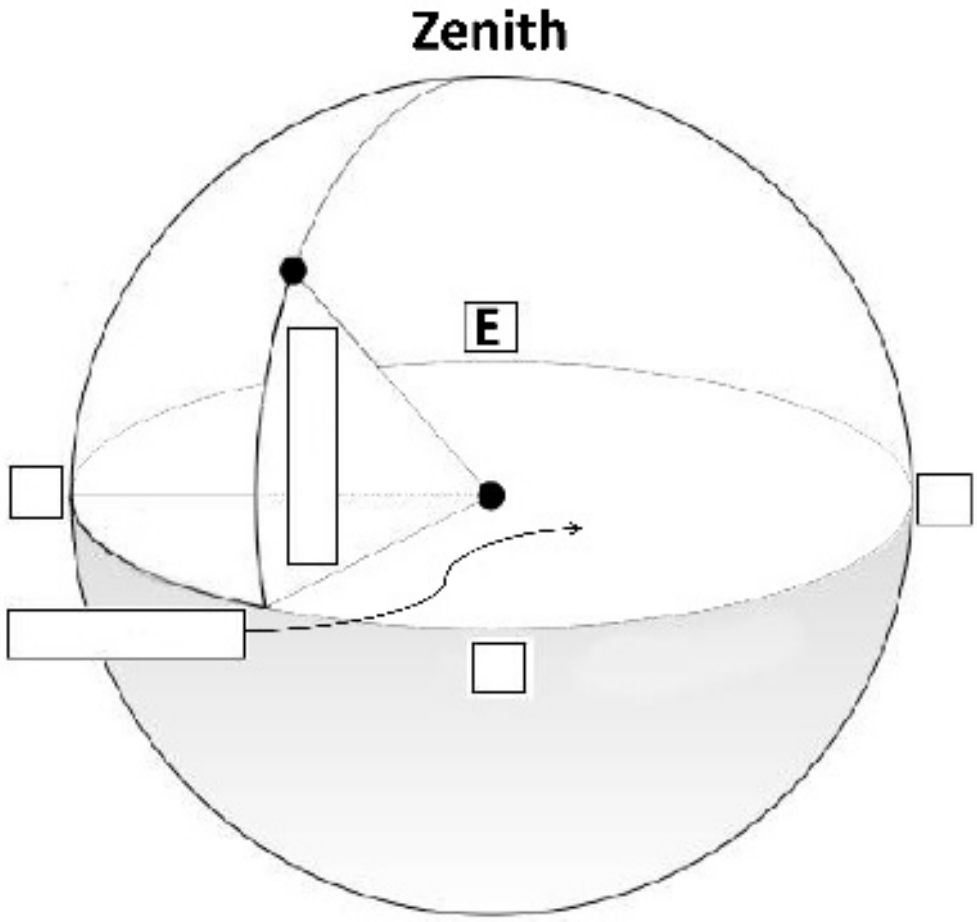
d. Sagittarius	d. Andromeda	d. Cygnus	d. Boötes	d. Boötes

ACT III <u>PLAN B</u>: DISCOVER THE TELESCOPE (45 minutes for each group of individual participants)

Materials: Pencil, rubber, paper, clock, aligned telescope with solar filter, ruler

Unluckily, the weather is not fine and it seems you can not use the telescope… But it has been already aligned by the responsible of the Planetarium in Modena. You can find very quickly and easily some quite interesting information about the telescope itself and the position of the celestial North Pole, even if it's daytime and clouds do not allow to look at the sky.

(i) First complete the following scheme, in the squares insert the cardinal points (N, E already inserted, S, W) and in the rectangles the name of the local coordinates (Altitude, Azimuth): **_/2 pt**



(ii) Now complete the following table:

DATE OF THE OBSERVATION: _____ **_/0.5 pt.**

CELESTIAL NORTH POLE ALTITUDE: _____ **_/1 pt.**

LATITUDE OF MODENA: _____ **_/1 pt.**

REFLECTOR OR REFRACTOR TELESCOPE? _____ **_/1 pt.**

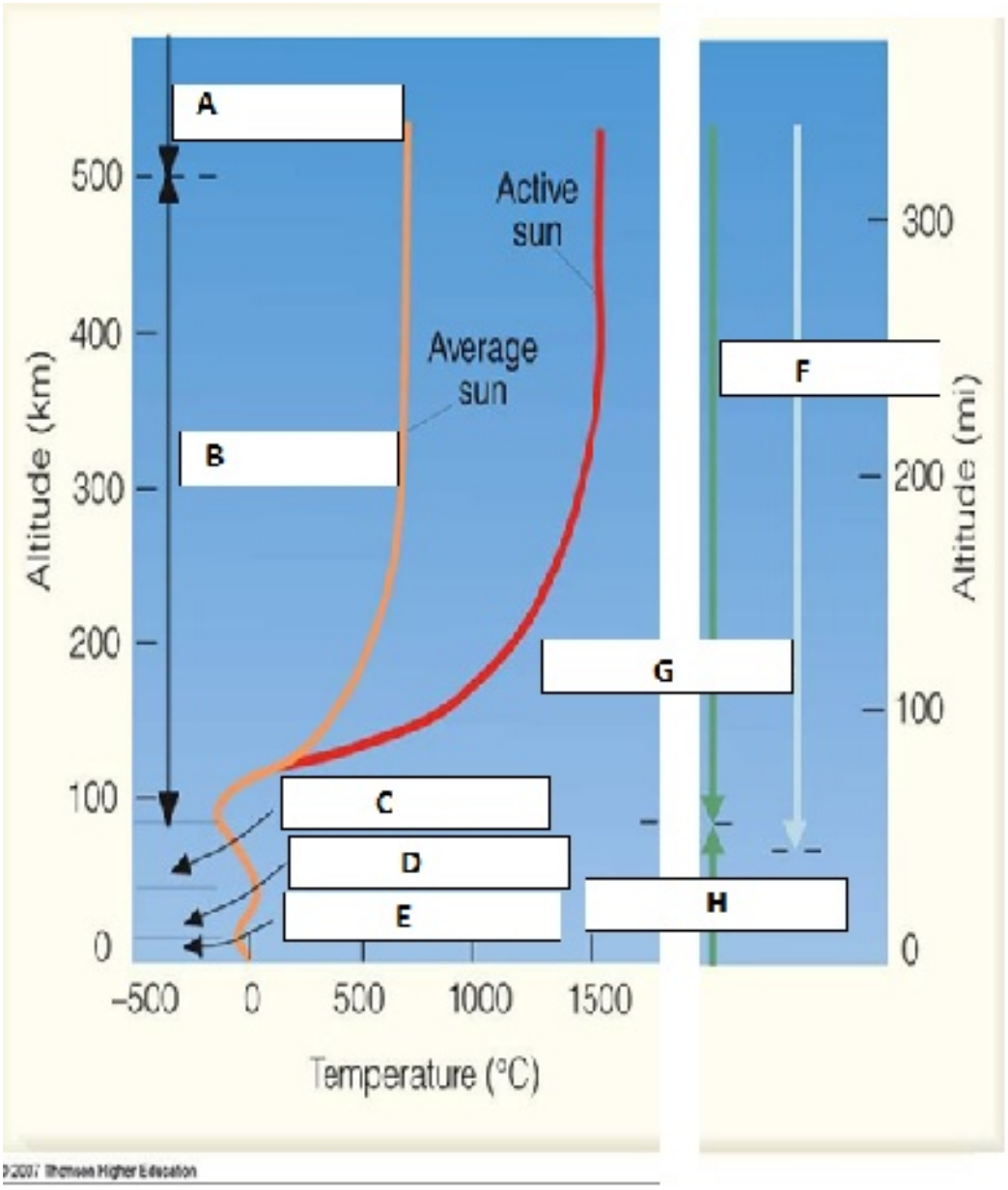
DIAMETER AND FOCAL LENGTH (mm): _____ **_/1.5 pt.**

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, molekular bond and electrical. Match the letter in the boxes with right option from the list given bellow.

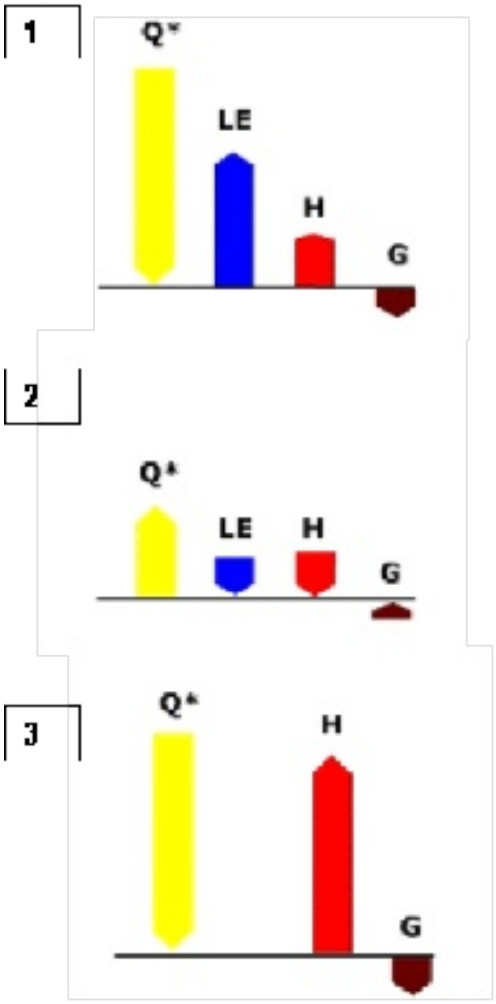
1. Homosphere 2. Heterosphere 3. Ionosphere 4. Exosphere
5. Troposphere 6. Stratosphere 7. Thermosphere 8. Mesosphere

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



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_2 concentration measurements from Mauna Loa, Hawaii.
Which of the following Earth systems and processes are responsible for the increase in CO_2 concentration in the atmosphere during the period described in the graph? **_/1 pt.**

a. CO_2 from the geosphere to the atmosphere by volcanic activity.

b. CO_2 from the geosphere to the hydrosphere and the atmosphere by erosion.

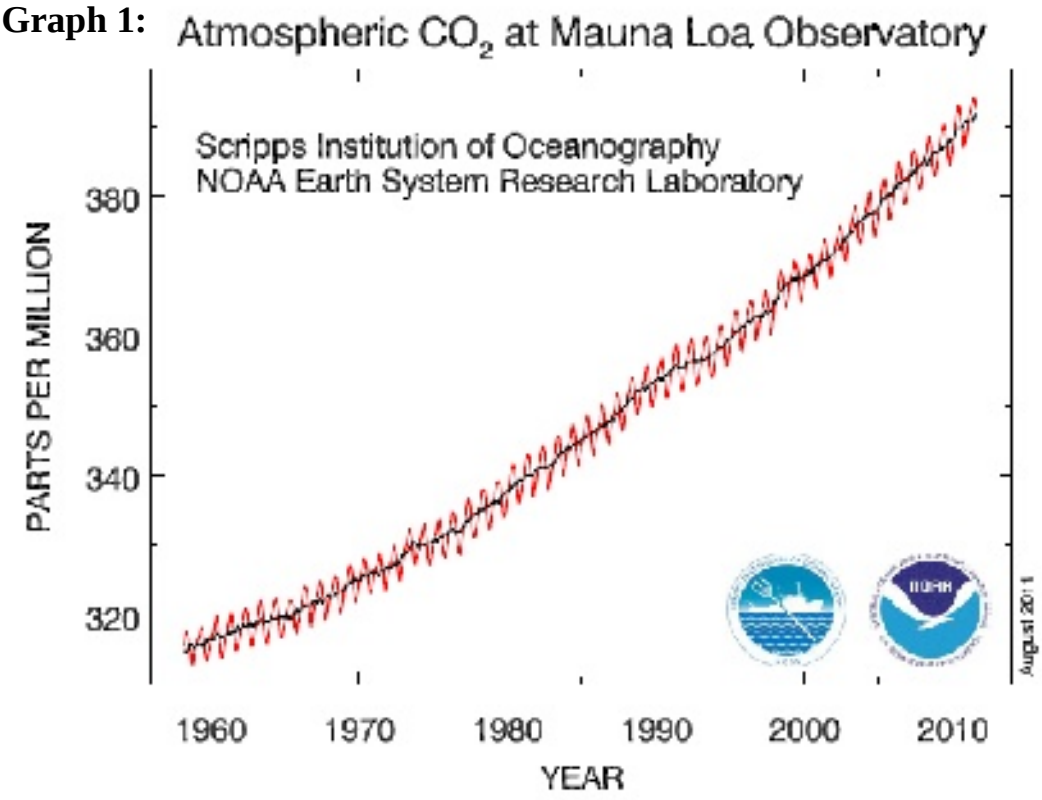
c. CO_2 from the biosphere to the atmosphere and hydrosphere by respiration.

d. CO_2 from the hydrosphere to the atmosphere by diffusion.

e. CO_2 from the geosphere and the biosphere to the atmosphere by anthropogenic activity.

f. CO_2 from the geosphere and the hydrosphere to the atmosphere as a result of global warming.

Graph 1:



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

12) Graph 2 describes the annual changes of atmospheric CO_2 concentration.
The data shown indicates a minimal concentration in October and maximal in June.
The reason for that change is: **_/1 pt.**

a. Increased CO_2 flux from the geosphere to the atmosphere as a result of change in fossil fuel consumption between summer and winter.

b. CO_2 flux between the atmosphere and the hydrosphere as a result of temperature differences.

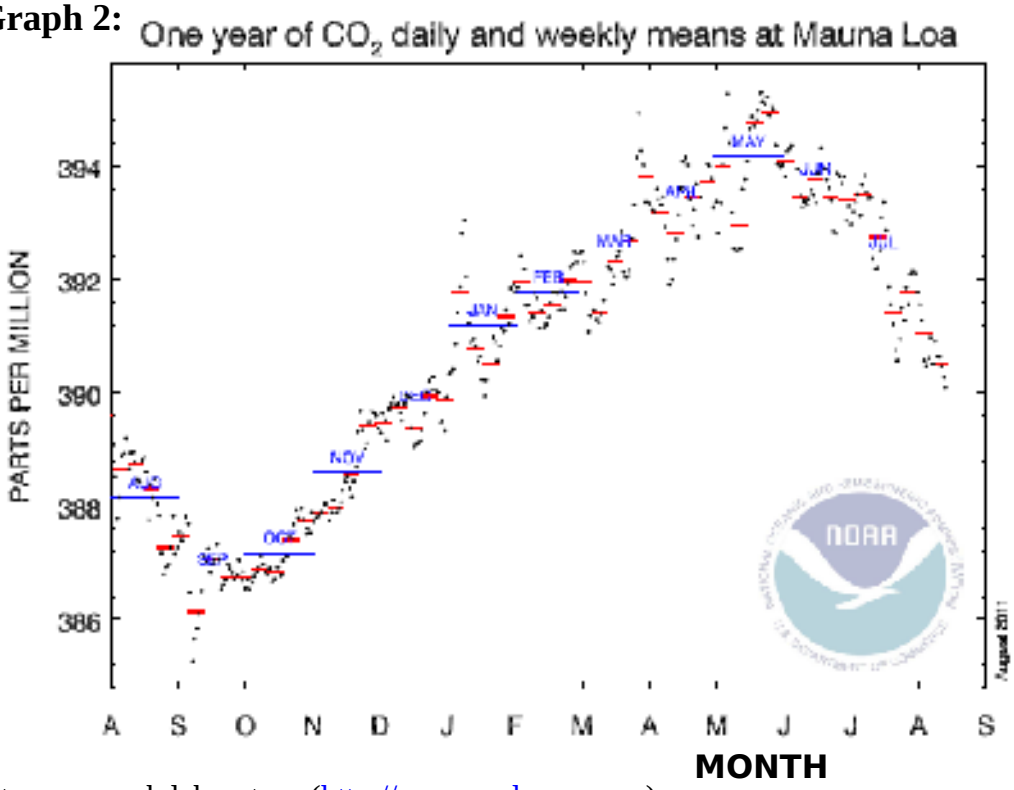
c. CO_2 flux between the atmosphere and the hydrosphere as a result of wind speed and direction.

d. CO_2 flux between the atmosphere and the biosphere as a result of changes in photosynthesis activity.

e. CO_2 flux between the atmosphere and the biosphere as a result of forest fires.

f. Changes in CO_2 flux between the geosphere and the atmosphere as a result of changes in sedimentation rates.

Graph 2:



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

13) Many scientists conclude that the increase in atmospheric CO_2 concentration is a major factor in global warming. The results of continous monitoring of atmospheric CO_2 concentration indicates that some CO_2 from the atmosphere is absorbd by the oceans. What would happen if CO_2 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_2 will increase / decrease

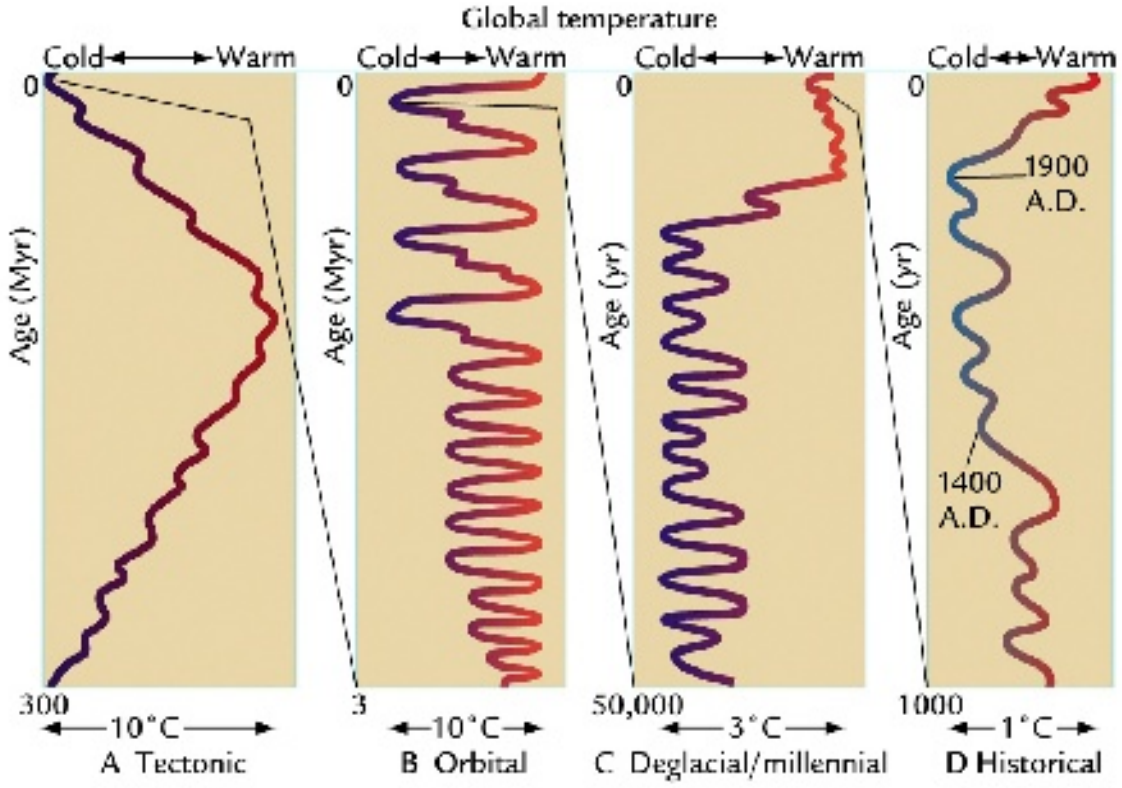
Biosphere

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 $CaCO_3$ sedimentation in the continental shelf.
j. The changes in ocean water pH will increase / decrease the rate of $CaCO_3$ sedimentation below the Calcium Carbonate Compensation Depth (CCD). True/false

TOT. PT. = 20



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

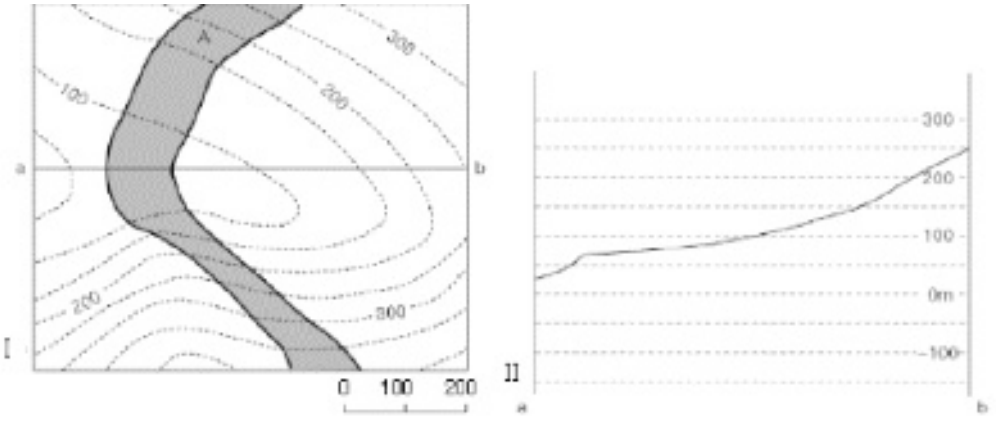
a) The pressure of columns of rock and ocean.
b) The friction that occurs at the plate boundaries.

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 an numerical age of 65.5 Ma. Which chronostratigraphic boundary corresponds to this layer? _/1 pt.

a) Cretaceous/Tertiary
b) Lower Cretaceous/UpperCretaceous
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.



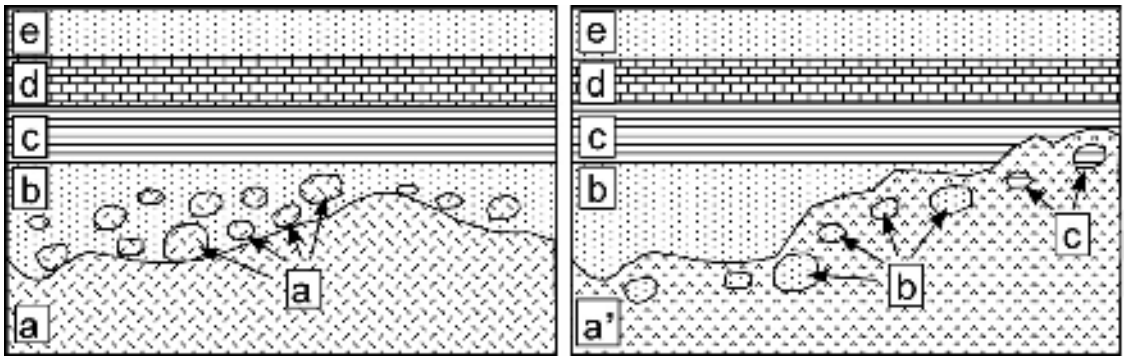
Which of the following is the true strike, dip and thickness of grey strata from the map? Please note that there are two methods used to show strike: quadrant method designated by (Q) and azimuth or magnetic bearing method designated by (A). The chart shows them both as Q and A. 2 pt .

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_2 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

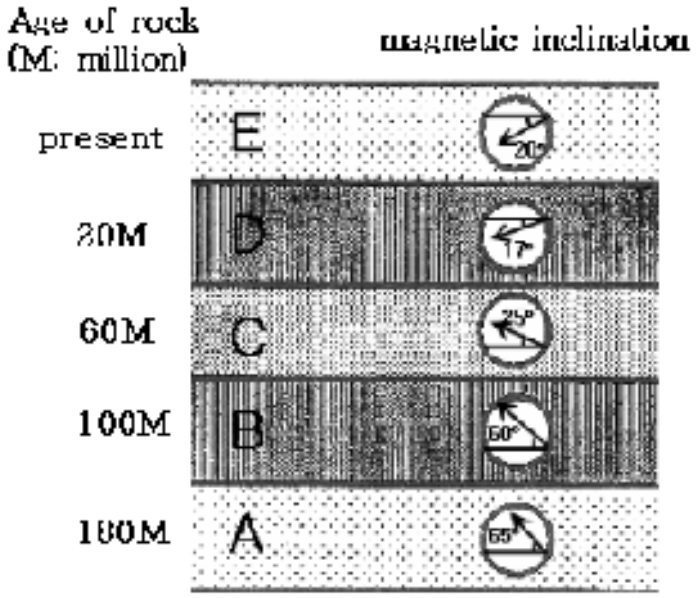
	Rock name	Macroscopic observation	Formation environment
1	Limestone	Sand size grains, spherical to elliptical grain shape, bedded	In the crust several km below the surface
2	Granite	Fine grained, foliated, occurrence of light and dark grains together	In the crust where magma cools slowly
3	Basalt	Coarse 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:_____

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.

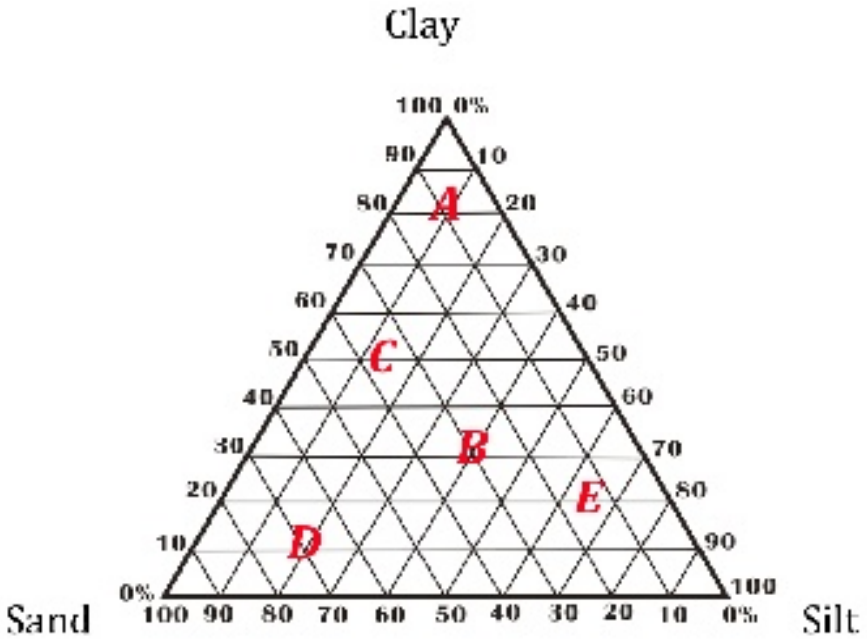


Calculate the average (south to north) velocity of the continent as it moved from position B to position E. Here, we assume that the latitude difference of one degree (1°) is equal to 110 km, and we suppose that paleomagnetic inclination is equal to twice the paleo-latitude. _/1 pt

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

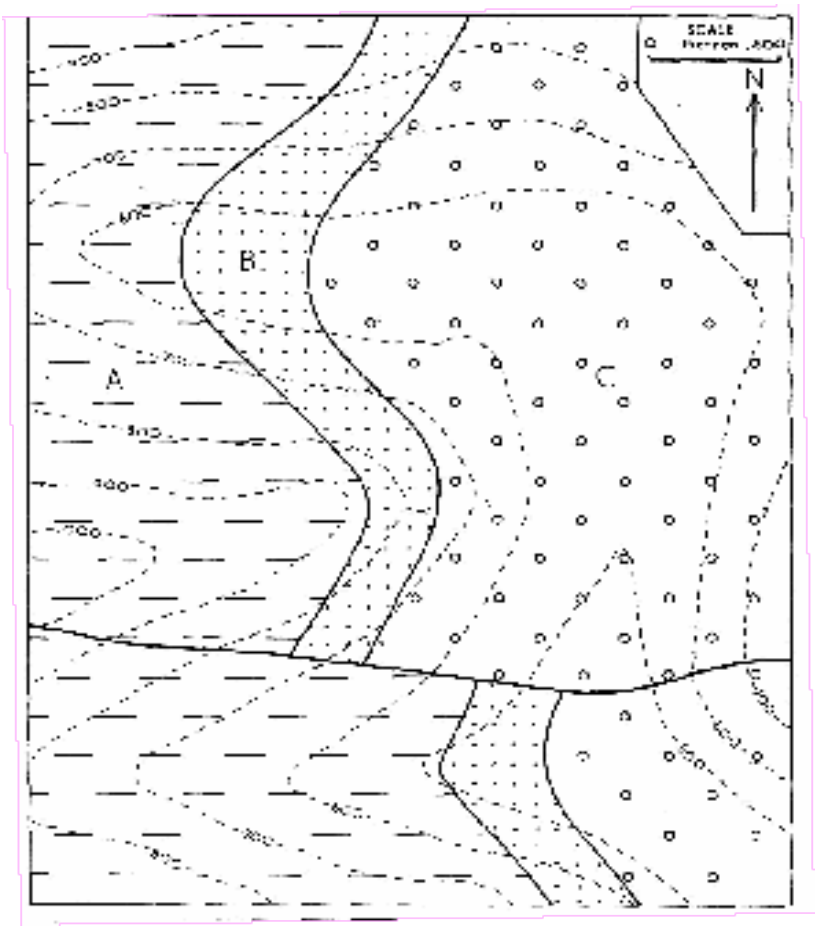
15. The figure below shows the soil texture of samples from five farms (A~E). The soil of which farm has the highest permeability? _/1 pt.

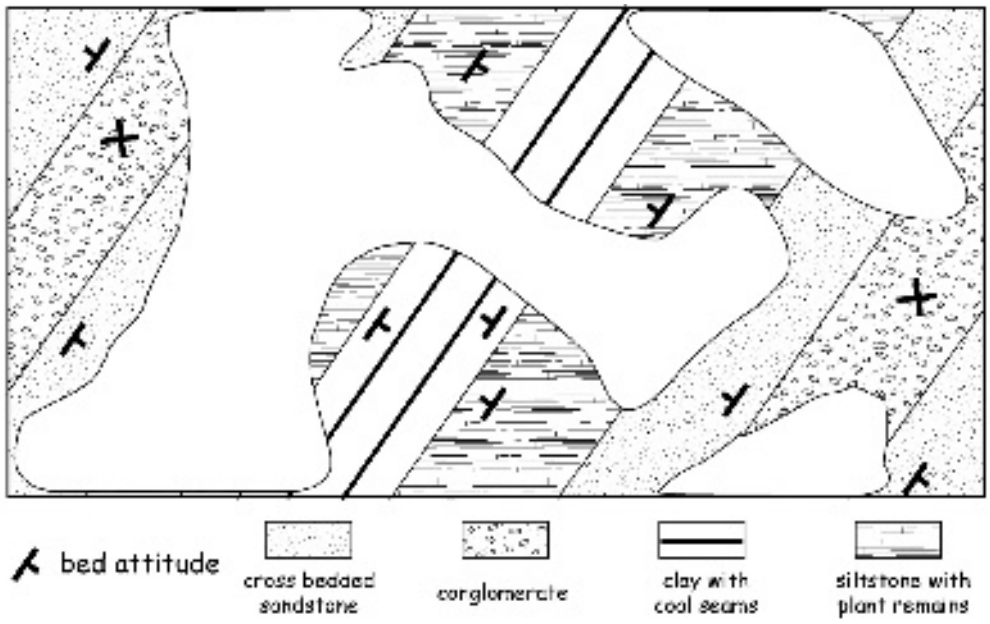
(A) Farm A (B) Farm B
(C) Farm C (D) Farm D
(E) Farm E



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

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

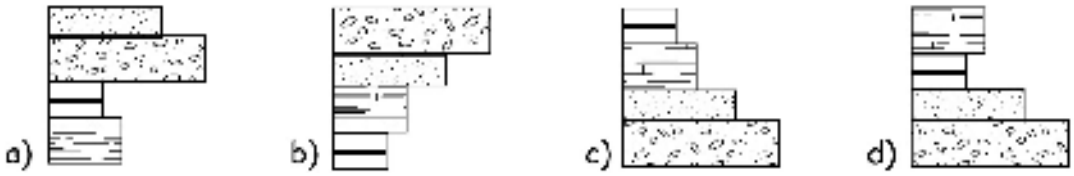




17a. Examine the map above. Which of the choices best describes the type of tectonic structures shown. _/1 pt.

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.


a)
b)
c)
d)

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 (chondrycthyan)
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	Depositional environment
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.

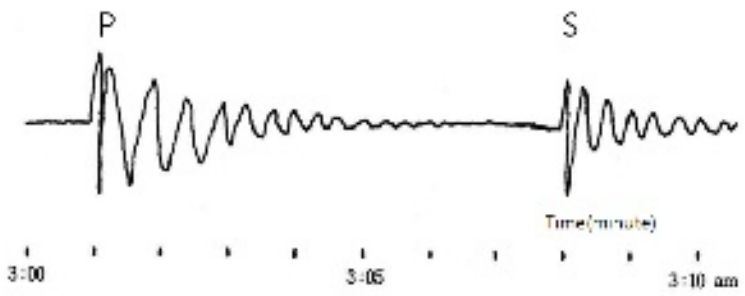
b) What are the periods and the frequencies associated to wavelengths of 1m, 1km, 100km ? _/ 1 pt. (0,5 x 2)

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 (Vp) and S wave (Vs) 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.

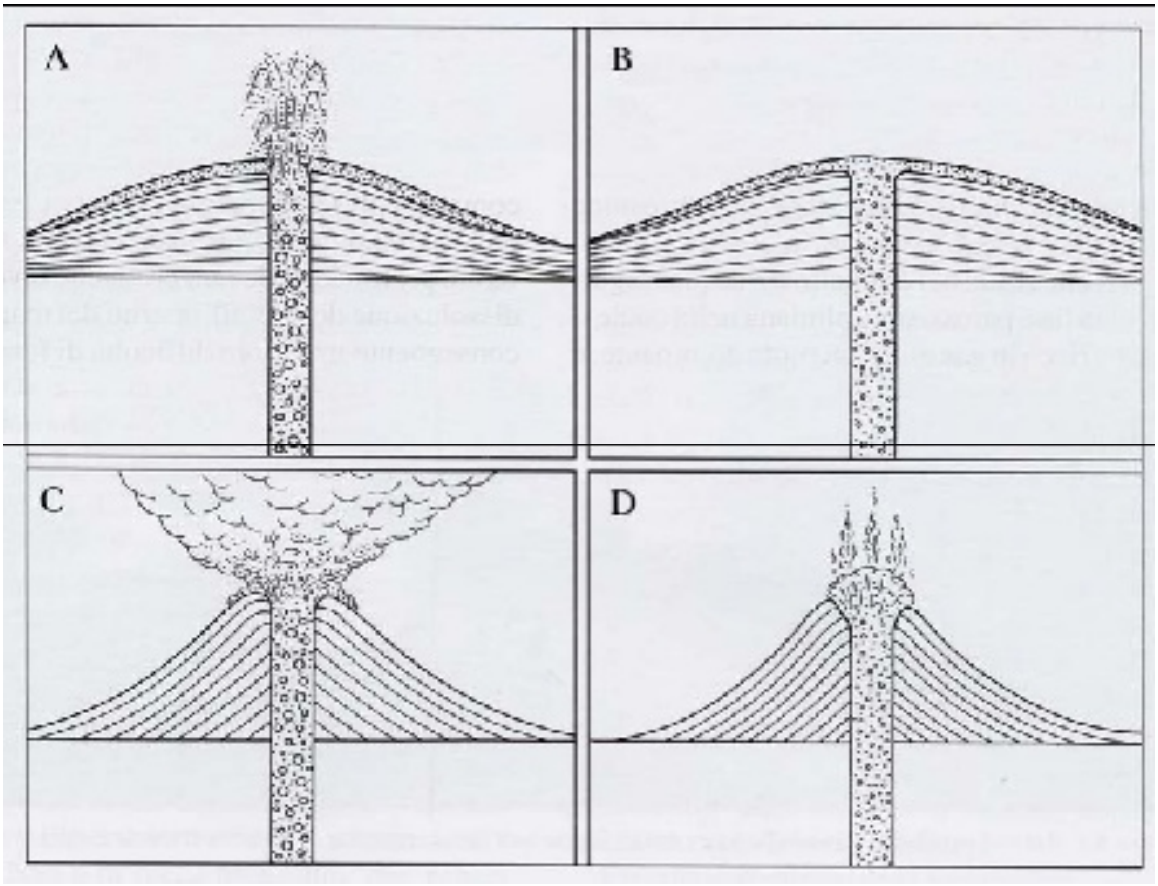
26. Indicate the type of magma characteristically erupted at the following plate tectonics volcanic environments (the same magma type can occur in more than one environment). The choices are: Andesite, Basalt, Obsidian, and Rhyolite
_/ 1,5 pt. (0,5 x 3)

- 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 ($CaCO_3$).
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.

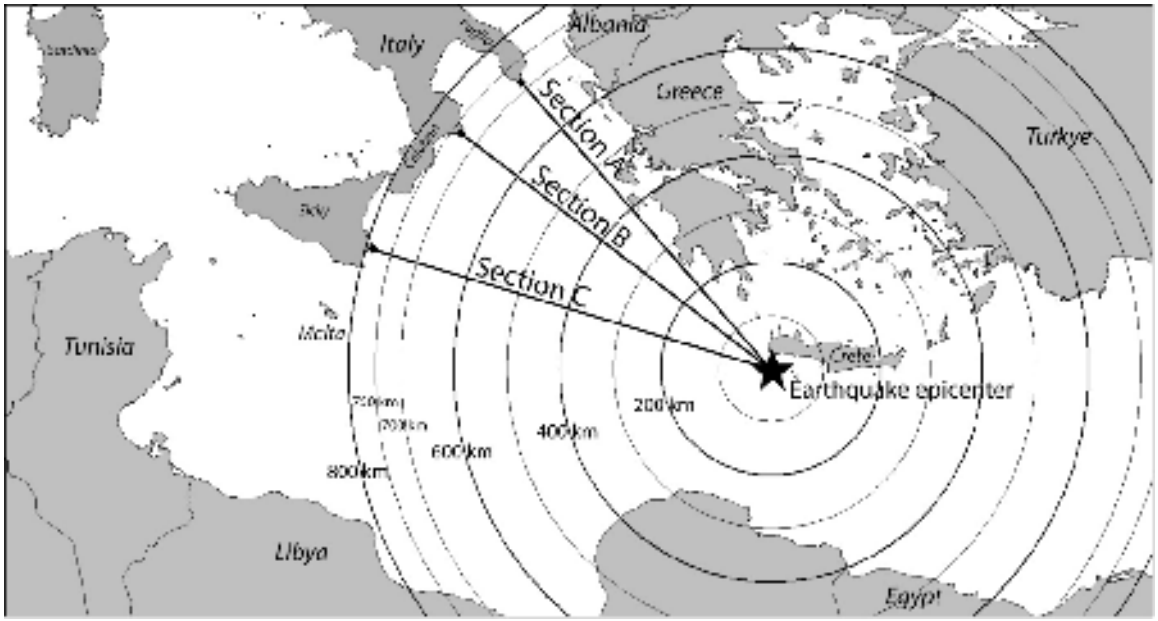
Supposing that at 06:30 am UTC a large subduction zone earthquake hits the south-western coast of Crete, and knowing:

1) the equation of the speed of the tsunami waves
$V = \sqrt{g * D}$
where g is the gravitational costant (m/s2), 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.

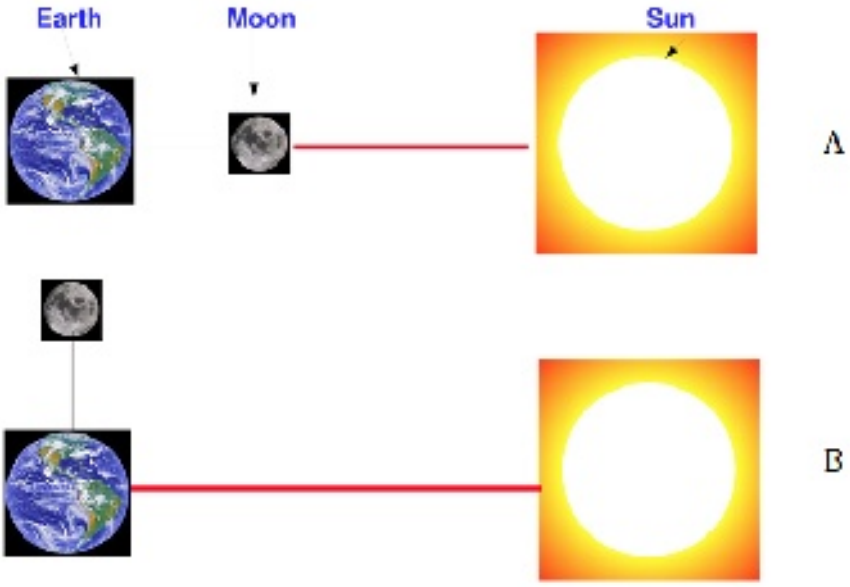


Map of the Central Mediterranean area, showing with the black star the epicenter of the subduction zone earthquake, and the trace of the three sections. Circles centered on the epicenter can be used to measure the distance.

HYDROSPHERE written test IESO 2011

Name_____ Country_____

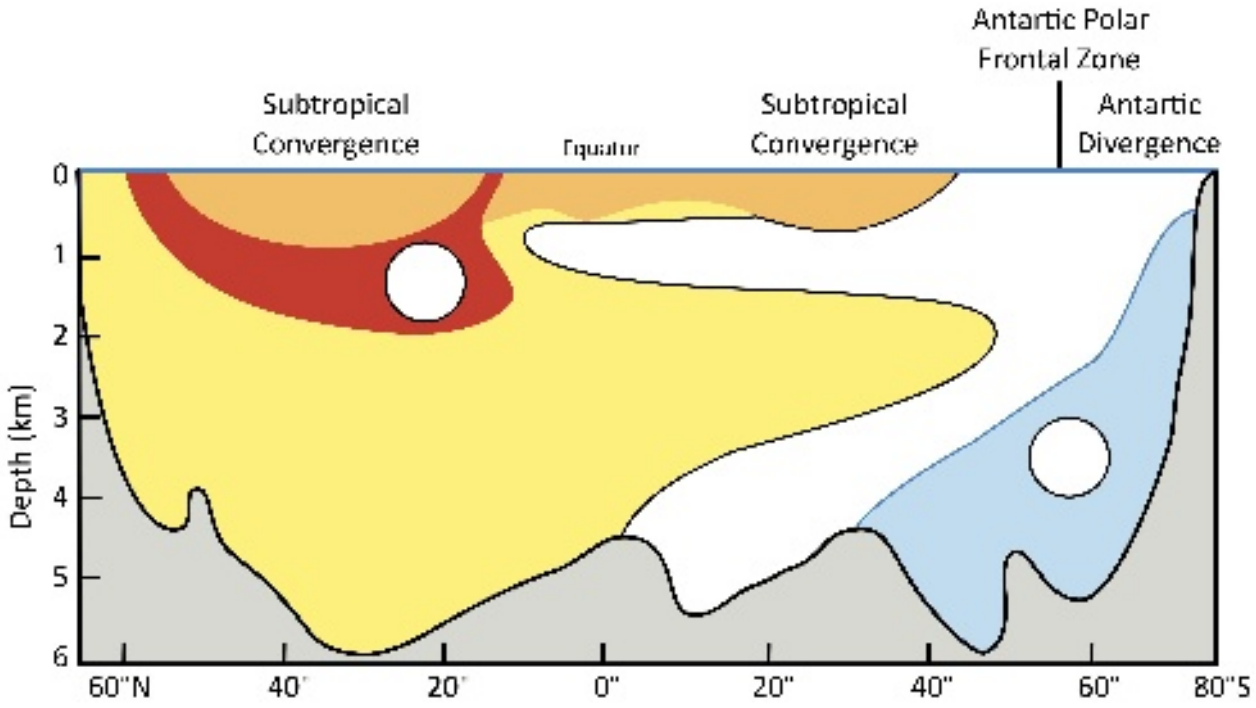
1. Tides in the Earth system.



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



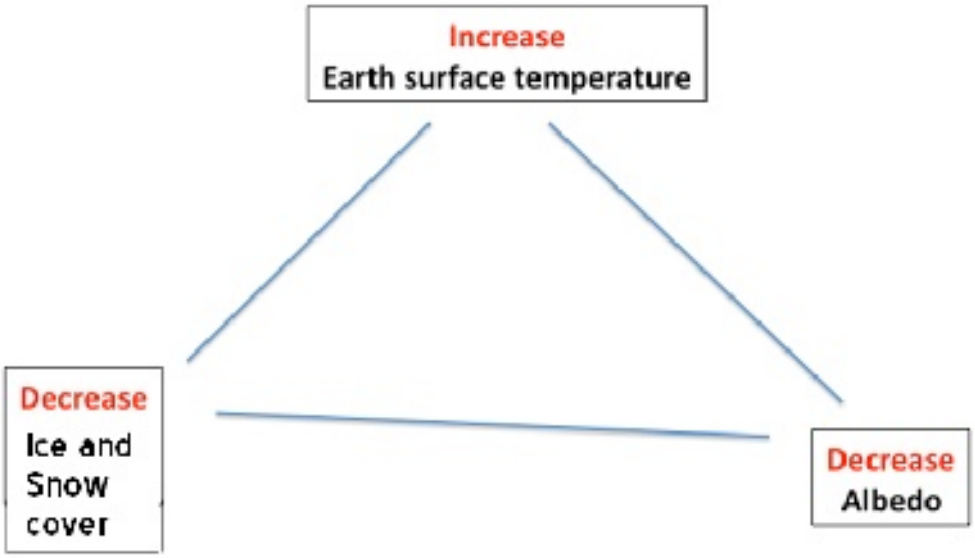
i) Match the corresponding water masses listed below by letter (a-e) to the correct location in the map. Each water mass category applies only to a single color (grey excluded since it indicates the bottom topography) **_/1 pt (0.20x5)**

a. North Atlantic Deep Water (NADW)
b. Antartic Intermediate Water (AAIW)
c. Mediterranean Water (MedW)
d. Surface Water (SW)
e. Antartic 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

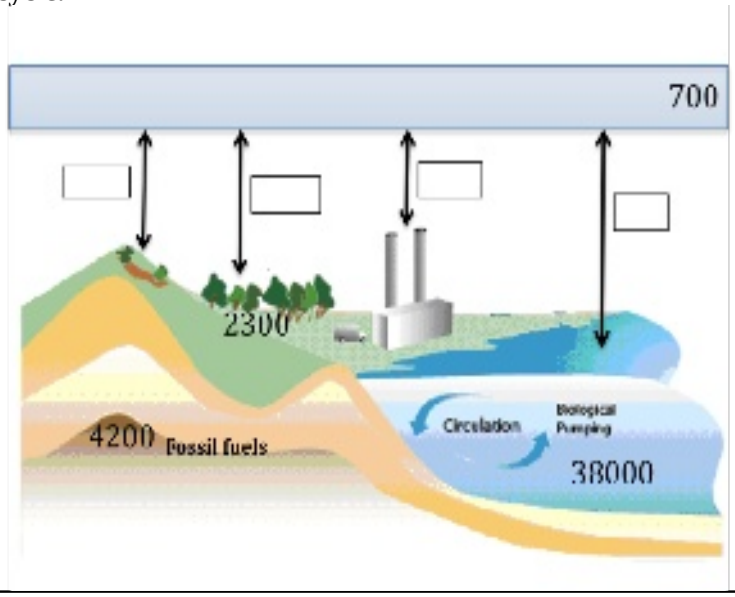
3. Climate feedbacks in the Earth system



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. 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)**

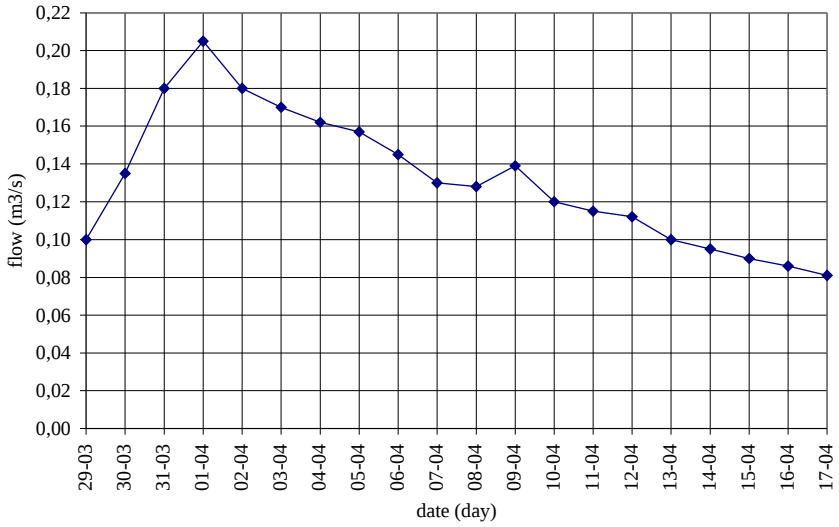
3. Label the fluxes in the four blank boxes by writing the corresponding letter from the list below: **_/1 pt. (0,25 x 4)**

    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 CO_2. Estimated fossil fuel reserves contain at least 4200 **…** C, mostly in the form of coal. At present, about half the 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 CO_2 rise in the longer term? (Express the answer in terms of the new CO_2 stock divided by the current one) **_/1.5 pt.**

Question 5

The graph represents the mean daily discharges, expressed in m^3/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 dd-mm	Discharge (m^3/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 m^3
b) 48700 m^3
c) 0.5 m^3
d) 0.6 m^3

Practical Test Atmosphere

Name_____ Country _____

Fog in a jar

- Instruction sheet -

Background information

Formation of fog, cloud and several other meteorological events share the same physical phenomenon: the condensation of water vapor that happens when water passes from the gaseous to liquid state. During this lab you will simulate the formation of fog in a jar through the creation of suitable conditions.

Materials

2 glass jars
1 stick of incense
1 matchbox
2 aluminum boxes previously filled with ice
1 laser pointer
Cold water
Warm water

Procedure

1. Fill jar 1 with cold water (T approx 10°C) and jar 2 with warm water (T approx 35°C).
2. Wait for 10 min approx in order to allow that the glass of both jars to come to the same temperature of the surrounding water. This helps you to prevent condensation inside the jars.
3. Measure the water temperature in both jars. Write the results in question 1.
4. Remove 3/4 of the water from both jars.
5. Light the stick of incense and try to put some smoke into jar 1. Blow gently the incense smoke into the jar.
6. Quickly place the aluminum box containing ice on the top of jar.
7. Repeat the same procedure (steps 5 – 6) with jar 2.
8. Carefully observe what happens inside both jars.
9. Use the laser pointer to observe the progress of the phenomenon and try to compare them estimating which one of the two jars produces more fog.

Fog in a jar

– Worksheet -

Question 1: 2 point

Write down the temperatures of the water of the two jars:

Jar no.	Temperature °C
1 (cold water)	
2 (warm water)	

Question 2: 1 point

In most climate areas fog is more common during the cold season; does this experiment help you to understand this phenomenon?

a) yes
b) no

Question 3: 3 points

In your opinion which of the following sentences explain better the role played by the smoke inside the jars (**mark ONE** of the following answers)

a) Warm up the air inside the jar further
b) Warm up the water inside the jar further
c) Give tiny particles that provide surfaces on which water vapor can condense
d) Give tiny and warm particles that increase the difference in temperature between air and water. This affects the condensation positively.

Question 4: 4 points

In the atmosphere which one of the following processes, in your opinion and most likely, emits substances that could play the same role of the smoke you use in this lab? (mark **no more then TWO** of the following answers)

a) The erosion of a river
b) A volcanic eruption
c) The respiration of living organisms
d) Fossils fuels burning
e) An earthquake

Question 5: 4 points

Which of the following situations, in your opinion, is more suitable for fog formation? (**mark ONE** of the following answers)

a) Close to a shoreline there is an upwelling of a deep and cold ocean current. Here the water meets warm air coming from the inland area covered with forest
b) An hilly area has no vegetation cover since is quite arid, ther are only rock

outcrops facing south forming very warm air masses meeting cool ones coming from the adjacent peaks

c) A very wide area is covered with snow in the mid of winter season. Here cold air masses meet slightly cool ones coming from an adjacent and dense woods

Question 6: 2 points

One of the conditions that helps the formation of fog is the ice presence that decreases the temperature of air inside the jar. Which one of the following conditions could lead to the formation of fog? (**mark ONE** of the following answers)

a) increasing of air pressure inside the jar
b) decreasing of air pressure inside the jar
c) An increase or decrease of the air pressure inside the jar leads to fog formation
d) An increase of the pressure coupled with heating of the air inside the jar

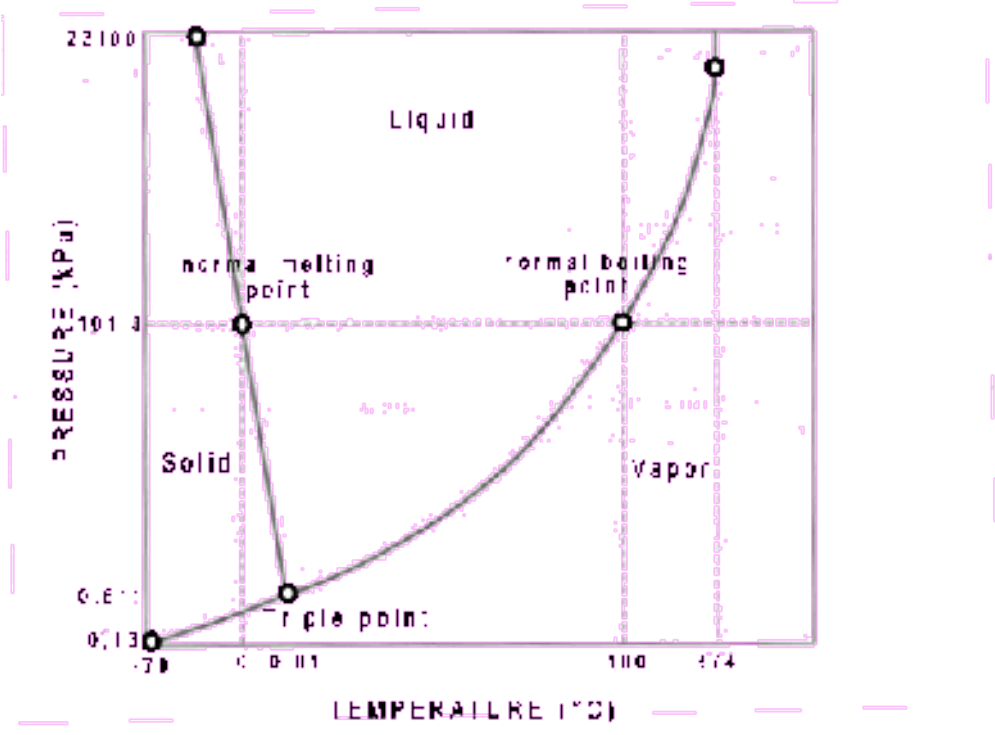
Question 7: 2 points

Which one of the following substances of the atmosphere does NOT act as condensation nucleus? (**mark ONE** of the following answers)

a) marine aerosol made by waves
b) carbon dioxide
c) particles lifted during a sand storm
d) particles emitted during a forest fire

Question 8: 2 points

Mark on the following graph two points that represent the conditions of the water inside the two jars (mark the point 1=cold jar; mark the point 2=warm jar).



IESO 2011
PRACTICAL TEST
“Oceanography”
Temperature and Depth Measurements
- Instruction sheet -

During this practical test you will measure the temperature of water at different depths at a sampling site. With the data collected, you will construct a thermal profile and conduct an investigation based on the data.
You will use thermometers fastened at fixed distances along a line called “mooring rope” ending with a weight. The upper end will be fixed to the boat. This system is called “mooring system”. During scientific measurements, it is generally fixed to a floating buoy.
The thermometers are actually micro-data-loggers that measure and record temperature data at desired time intervals. This operation is called a “mission”. The data loggers and the computers have already been configured for this mission.

Materials

- Temperature micro-data-loggers (thermochron iButton, Dallas-Maxim model DS1921G)
- Data-logger/PC cabling system (named LinkUSB)
- Computer with drivers and software already installed (named OneWireViewer)

Procedure

- **PAY SPECIAL ATTENTION TO SAFETY INSTRUCTIONS**
- **Preparation phase.** Using the hardware and software provided, you have to program all the data loggers in order to start your “mission” with the following characteristics:
  Measurement rate: 1 min.
  Format of temperature data: °C.
  Alarm: off
- **Start** the “mission” of each data logger.
- **Preparation of the mooring line**. Put the data loggers inside the chambers. Tightly close the chamber with a suitable o-ring using the given keys. Then fix the thermochrons at the following depths: sea floor, +10m above sea floor (asf), +20m asf, +30m asf.
- **Measurement**. Put the mooring line in the water following the instructions from the staff of the boat. Pay special attention to them!
- **Leave the mooring line** in the water for at least 10 minutes.
- Carefully raise the mooring line. Collect all the data from the loggers following the instructions provided by the student staff. For each data logger you have to choose (among all the collected values) a single value of temperature that, in your opinion, is representative of the temperature of the water at that depth where the thermometer was placed.
- **Go to the worksheet and answer the questions.**

IESO 2011
PRACTICAL TEST
"Oceanography"
Temperature and Depth Measurements

NAME_____ _____ country _____

- Worksheet –

Question 1

Record the data in the following table:

Depth (meter below sea level)	**Temperature (°C)**
0 m (sea level)	
- m	
- m	
- m (sea floor)	

5 points

Question 2

Draw a graph using the data you collected. Place the temperature on the horizontal axis (Scale the axis from -5°C to +30°C). Place the depth on the vertical axis. Be sure to place the sea surface at the top and the sea floor at the bottom of the axis.

5 points

Question 3

According to the data collected, this water mass is characterized by: (Choose only ONE of the following answers)

a) no thermal stratification
b) strong thermal stratification
c) weak thermal stratification
d) I would need more data to say something definitively.

5 points

Question 4

In your opinion, which of the following statements is most likely the main cause of the present condition of the water column; This should reflect your answer to question 3. (Choose only ONE of the following answers)

1. absence/presence of differences in density as a consequence of differences in temperature and/or salinity.
2. differences in the concentration of dissolved oxygen.
3. differences in the phytoplankton concentration.
4. Wave action
5. Non-natural causes such as the transit of boats and ships.

5 points

Question 5

Which of the following events, in your opinion, COULD CERTAINLY NOT affect the present

situation of stratification. (Choose ONE of the following answers)

a) inflow of water with a different salinity
b) inflow of water with a different temperature
c) a very strong wind
d) inflow of water with similar salinity and temperature
e) release of phosphorous from the sediment 5 points

Question 6

Which of the following best explains the importance of the stratification of a water mass? (Choose ONE of the following answers)

a) Because stratification affects the erosional processes carried on by the water mass
b) Because stratification and the temperature of the water affect only the primary production. (warm water means more productivity)
c) Because stratification could affect anoxic conditions at the bottom.

5 points

Question 7

Using the graph that you prepared for question 2, draw a thermal profile of this water mass during a hypothetical winter when the sea surface had frozen.

8 points

NAME_____ _____ country _____