

Practical Test
Astronomy Questions

Time: 90 Minutes

Maximum Marks: 34

Instructions:

1. Please write your student code on the cover page as well as on the top right of every page of answer sheet / calculations sheets.
2. Please write your answers legibly. Illegible answers will be counted as incorrect.
3. Please write your final answers in appropriate boxes in the main answer sheet.
For numerical questions, show the calculations on blank calculation sheets provided.
4. For numerical questions, you may attempt part of the answer even if you don't know the final result. There will be stepwise marking.
5. You can get as many calculations sheets as you want. Just raise your hand to ask for extra sheets. The volunteers will bring extra sheets to your table.
6. Write question number clearly at the top of the calculations sheet.
7. Read the entire question group carefully before starting to answer. Each question has a point value assigned and indicated on the right hand side of the question.
8. Any inappropriate examination behaviour will result in your withdrawal from the IESO.

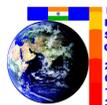


1. Construct a Sundial for Mysore (Latitude = +12° 16' N, Longitude = 77° 33'E). You can ignore corrections due to equation of time.
Materials given: a square plastic board of size of 40 cm x 40 cm, a 1 metre long metal rod, 2 nut bolts, a 30 cm scale and marker pens to make Sundial markings on the plasticboard. Use the following procedure.
To make a simple Sundial, you should make the shadow of the rod fall in the equatorial plane. For this, push the rod through the hole at the centre of the board.
Now put this device on a flat surface such that it rests on a board edge and one end of the rod. The board should be exactly perpendicular to the rod. For this, fix the nut bolts on the rod on both the sides of the board. The other end of rod should be pointing towards the north celestial pole. Write your student code on the plastic board. Show this arrangement to the examiner. **(1 point)**
 - (a) Measure length of the rod from the end towards the North Celestial Pole to the board and write on the answer sheet. Mark North facing and South facing sides of the board with letters **N** and **S** respectively. **(3 points)**
 - (b) Mark lines showing the direction of the shadow of the rod on the board for the winter solstice day. Make markings for every 2 hours. **(4 points)**
 - (c) Mark the similar lines for summer solstice day. **(3 points)**
 - (d) Where do you expect the shadow of the rod will be seen on the equinox days? Write answer as N (North side) / S (South side) / B (both sides) / X (neither side). **(1 point)**

2. You are given a sky map which shows sky for 24 hours x 120 degrees. You are also given a list of all constellations with their IAU designations. Assume that today is the date of closing ceremony i.e. 19th September 2013 and you are told that it is a full moon day. **(2 points each)**
 - (a) Mark the Celestial Equator on the map at appropriate place. Denote it with letter '**Q**'.
 - (b) Mark the Ecliptic (apparent path of the Sun over one year) on the map at appropriate place. Denote it with letter '**E**'.
 - (c) Mark the Sun's position on the map for the noon of given day. Denote it with letter '**S**'.
 - (d) Mark the Moon's position on the map for the noon of given day. Denote it with letter '**M**'.
 - (e) Write the three letter IAU code of the constellation you will observe on the zenith at the time of Moonrise. Mark the position of the zenith on the map as '**Z**'.
 - (f) Write the three letter IAU code of the constellation you will observe on the nadir at the time of Moonrise. Mark the position of the nadir on the map as '**N**'.

3. Picture 1 shows star trails captured by an Astronomy Olympiad student.
- (a) Identify constellation(s) in the picture. Write the three letter IAU code of the constellation(s) in your answer sheet. There are more than one constellations / parts of constellations visible in the picture. Identify as many as you can. **(4 points)**
- (b) Write the letters from the following table, corresponding to the stars, if they are present in the picture. **(2 points)**
- | | | | | | |
|----|-------|----|---------|----|------------|
| A. | Deneb | D. | Dubhe | G. | Denebola |
| B. | Rigel | E. | Algol | H. | Mizar |
| C. | Spica | F. | Regulus | I. | Betelgeuse |
- (c) Let us assume that stars numbered as 1 and 2 have nearly the same Right Ascension (R.A.) Find exposure time of the photograph. **(4 points)**



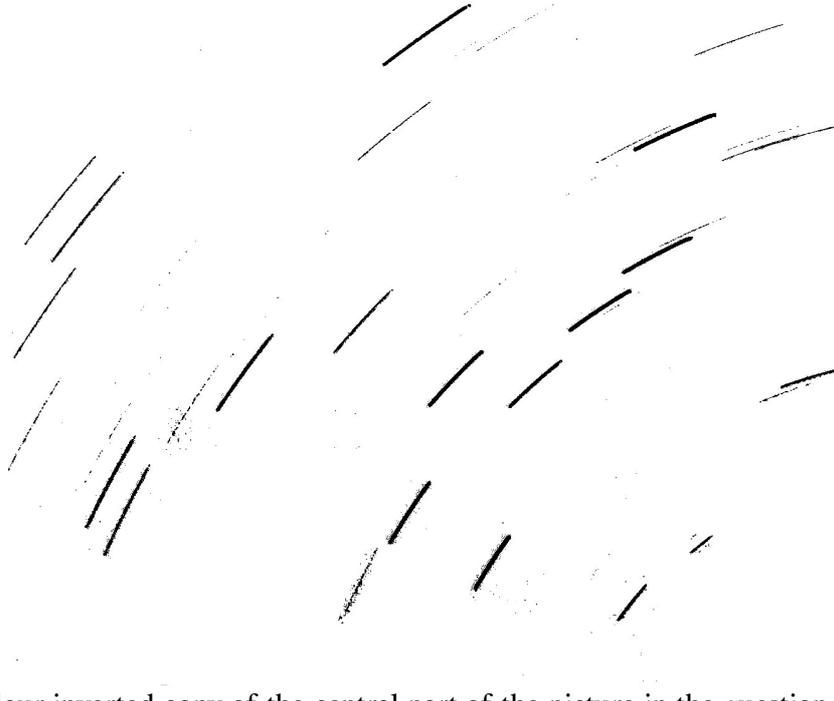


List of Constellations with IAU Codes

No.	Constellation	Code
1	Andromeda	And
2	Antlia	Ant
3	Apus	Aps
4	Aquarius	Aqr
5	Aquila	Aql
6	Ara	Ara
7	Aries	Ari
8	Auriga	Aur
9	Bootes	Boo
10	Caelum	Cae
11	Camelopardalis	Cam
12	Cancer	Cnc
13	Canes Venatici	CVn
14	Canis Major	CMa
15	Canis Minor	CMi
16	Capricornus	Cap
17	Carina	Car
18	Cassiopeia	Cas
19	Centaurus	Cen
20	Cepheus	Cep
21	Cetus	Cet
22	Chamaleon	Cha
23	Circinus	Cir
24	Columba	Col
25	Coma Berenices	Com
26	Corona Australis	CrA
27	Corona Borealis	CrB
28	Corvus	Crv
29	Crater	Crt
30	Crux	Cru

No.	Constellation	Code
31	Cygnus	Cyg
32	Delphinus	Del
33	Dorado	Dor
34	Draco	Dra
35	Equuleus	Equ
36	Eridanus	Eri
37	Fornax	For
38	Gemini	Gem
39	Grus	Gru
40	Hercules	Her
41	Horologium	Hor
42	Hydra	Hya
43	Hydrus	Hyi
44	Indus	Ind
45	Lacerta	Lac
46	Leo	Leo
47	Leo Minor	LMi
48	Lepus	Lep
49	Libra	Lib
50	Lupus	Lup
51	Lynx	Lyn
52	Lyra	Lyr
53	Mensa	Men
54	Microscopium	Mic
55	Monoceros	Mon
56	Musca	Mus
57	Norma	Nor
58	Octans	Oct
59	Ophiucus	Oph

No.	Constellation	Code
60	Orion	Ori
61	Pavo	Pav
62	Pegasus	Peg
63	Perseus	Per
64	Phoenix	Phe
65	Pictor	Pic
66	Pisces	Psc
67	Pisces Austrinus	PsA
68	Puppis	Pup
69	Pyxis	Pyx
70	Reticulum	Ret
71	Sagitta	Sge
72	Sagittarius	Sgr
73	Scorpius	Sco
74	Sculptor	Scl
75	Scutum	Sct
76	Serpens	Ser
77	Sextans	Sex
78	Taurus	Tau
79	Telescopium	Tel
80	Triangulum	Tri
81	Triangulum Australe	TrA
82	Tucana	Tuc
83	Ursa Major	UMa
84	Ursa Minor	UMi
85	Vela	Vel
86	Virgo	Vir
87	Volans	Vol
88	Vulpecula	Vul



This is colour inverted copy of the central part of the picture in the question paper.

**Practical Test
Astronomy Answer Sheet**

1. Sundial

(a) Length of the rod = (d)

2. (e) IAU code =

(f) IAU code =

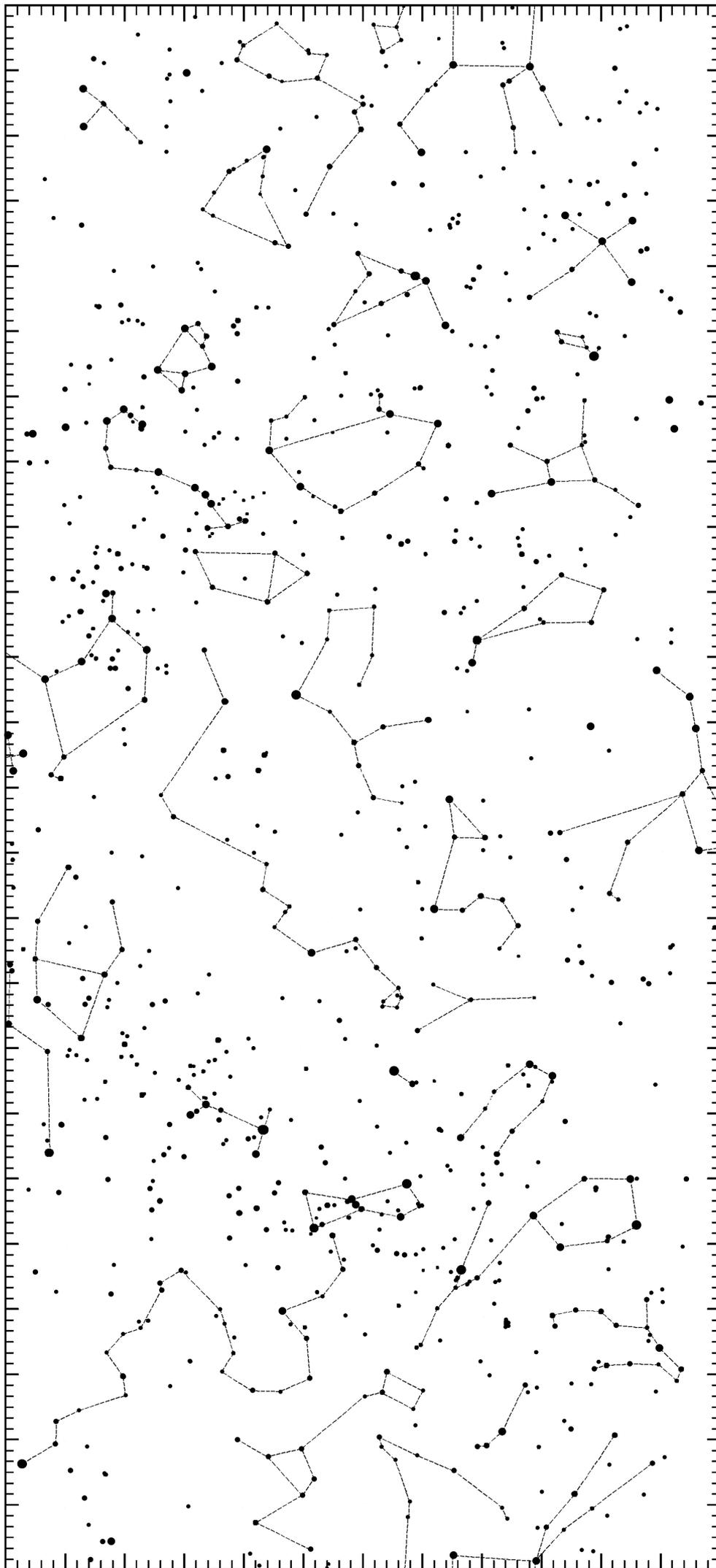
3. Star Trails

(a) Constellation Names

(b) Star Letters

(c) Exposure time =

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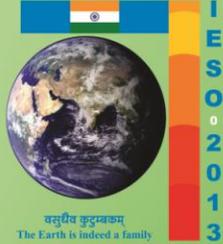
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Sheet for numerical calculations (write question number clearly)



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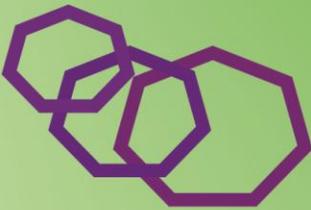


HYDROSPHERE 

+

ATMOSPHERE 

PRACTICAL TEST



Student's Name and Code:



Instructions:

1. Please write your name and nationality in English on the cover page.
2. The time allocated for this examination is 30 minutes.
3. Please write your answer legibly, illegible answer will be counted as incorrect.
4. Please write your answer only on this test booklet.
5. You may respond to questions in English. For objective type questions, circle the most appropriate answer.
6. Read the entire question carefully before starting to answer. Marks for each question are indicated on the right.
7. Any inappropriate examination behavior will result in disqualification.



Instruction to participants about field measurement:

1. Students will be taken to the meteorological observatory located in the Agricultural farm station at Naganahalli.
2. All participants should wear cap, non-skid shoes, T-shirt and trousers suitable for carrying out the field experiment.
3. All participants must strictly follow the instruction of the instructor.
4. Care should be taken while climbing the ladder not to slip and also mind your head not to get hurt while take the reading for wind speed
5. Initial reading for serial number 3 will be announced on the day of the test.

Measurement of the meteorological parameters

The following observations were carried out by the student:

- a) Dry bulb temperature
- b) Wet bulb temperature
- c) Wind speed
- d) Wind direction
- e) Cloud types



DATA SHEET

1. Name of the Student
2. Student Code

Serial Number	Parameter	Unit	Reading
1	Dry bulb temperature	Degree Centigrade	
2	Wet bulb temperature	Degree Centigrade	
3	Wind speed	Initial Reading=	
4	Wind direction	Degrees	
5	Cloud type		

1. Using the above data/observation answer the following questions:**Questions:****a) The wet bulb and dry bulb temperatures differ because (2 marks)**

- A. They are of different types –one is mercury thermometer, the other, resistance thermometer.
- B. Water has a higher specific heat than air.
- C. Air has a higher specific heat than water.
- D. Water loses energy due to evaporation.



b) Circle the correct option:

(2 marks)

- A. Evaporation increases with decreasing temperature, and also with increasing humidity.
- B. Evaporation decreases with increasing temperature and humidity.
- C. Evaporation decreases with increasing wind speed and temperature.
- D. Evaporation increases with increasing wind speed and temperature.

c) What is the wind speed (m/s) and direction measured by you at the met station you visited?

3 marks

d) Circle the types of cloud that were observed by you at the met station you visited?

2 marks

- A. Cumulus
- B. Cirrus
- C. Stratus
- D. Nimbus
- E. Altocumulus
- F. Altostratus



- e) The water level in the evaporimeter on 5 September 2013 was 14 cm at 09:00 Hrs. There were two episodes of rain on 7th September and 10th September with rainfall of 3 cm and 5 cm respectively. If the water level in the evaporimeter was 19 cm on 11th September 2013 , 09:00 Hrs. what is the average rate of evaporation during the entire period of observation in mm/hr? **5 marks**



Instruction to participants about field measurement:

1. Students will be taken to the meteorological observatory located in the Agricultural farm station at Naganahalli.
2. All participants should wear cap, non-skid shoes, T-shirt and trousers suitable for carrying out the field experiment.
3. All participants must strictly follow the instruction of the instructor.
4. Care should be taken while climbing the ladder not to slip and also mind your head not to get hurt while take the reading for wind speed

Measurement of the meteorological parameters

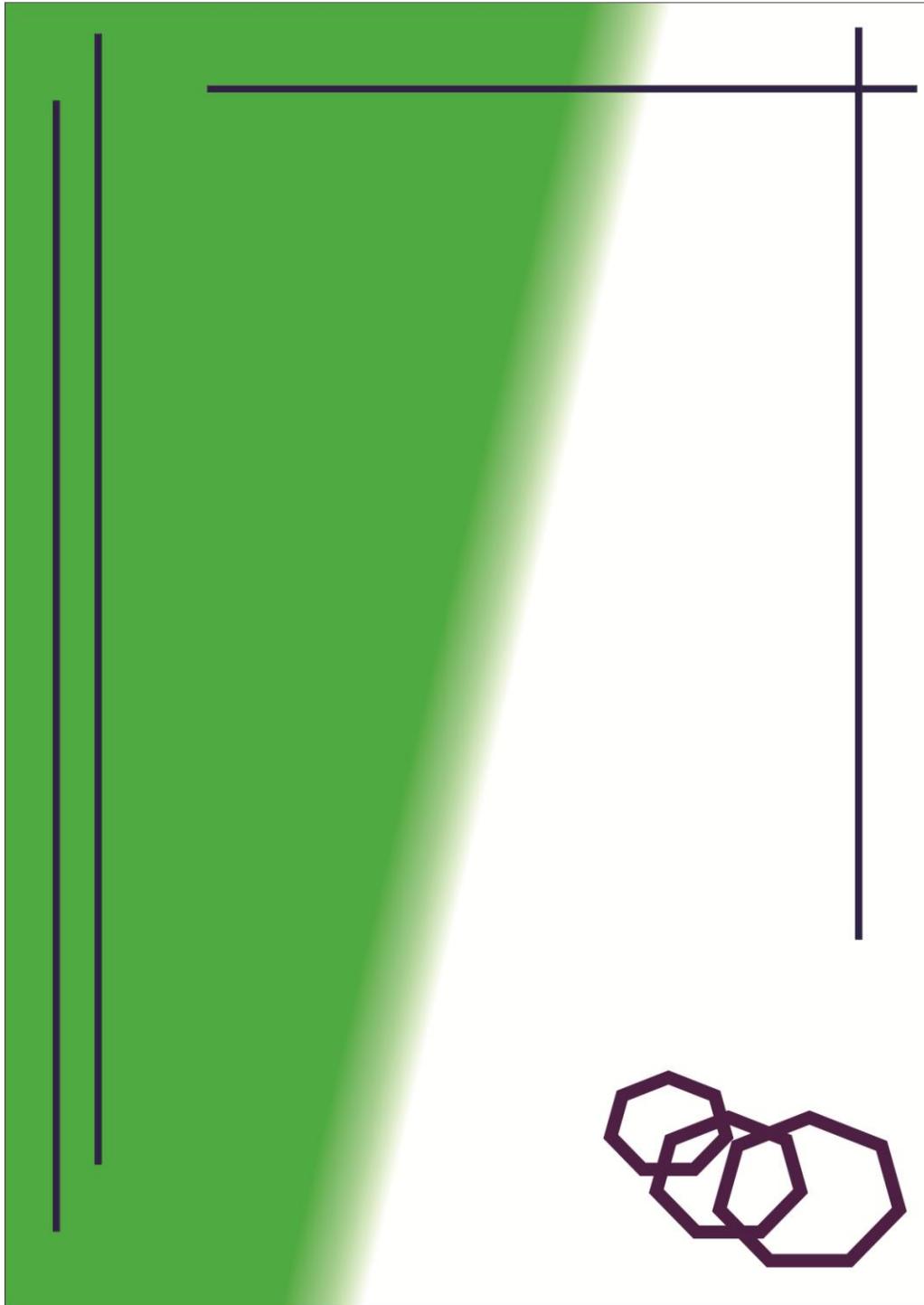
The following observations would be carried out by the student:

- a) Dry bulb temperature
- b) Wet bulb temperature
- c) Wind speed
- d) Wind direction
- e) Cloud types

DATA SHEET

3. Name of the Student
4. Student Code

Serial Number	Parameter	Unit	Reading
1	Dry bulb temperature	Degree Centigrade	
2	Wet bulb temperature	Degree Centigrade	
3	Wind speed	Initial Reading=	
4	Wind direction	Degrees	
5	Cloud type		





7th International Earth Science Olympiad
GEOSPHERE PRACTICAL TEST
PART 1 – INFOSYS CAMP

EXERCISE #1

Study the set of samples in locations 1 – 4 and answer the following five questions. **Time: 40 MINUTES (20 POINTS)**

Instructions: Complete the following 5 questions based on the rock sample provided.

Location 1:

1. Which of the following features can you observe in the sample? (You may choose more than 1 answer).

1. Fossil
2. Cross bedding
3. Horizontal bedding
4. Crystalline structure
5. A multi-minerallic rock (more than one mineral)
6. A mono-minerallic rock (one mineral)
7. Lineation (Elongated minerals are arranged in a parallel manner)
8. Foliation (Marked with bands of different minerals)
9. Vesicular structure
10. Minerals cannot be seen with the naked eye
11. Glassy texture

2. What conclusion(s) can you draw about the formation of this rock sample? (You may choose more than 1 answer).

- a) This rock formed in a shallow marine environment.
- b) This rock formed in an open sea environment.
- c) This rock formed in a deep sea environment.
- d) Sedimentation in an oversaturated environment.
- e) Sedimentation in a cave environment.
- f) This rock formed in a lake environment.
- g) This rock formed in a river environment.
- h) This rock formed in a dune environment.
- i) This rock formed in an (igneous) plutonic environment.
- j) This rock formed in an (igneous) volcanic environment.

- k) This rock underwent regional metamorphism.
- l) This rock underwent contact metamorphism.

3. What observation/ principle helped you draw the conclusion? (You may choose more than 1 answer).

- a) The principle of original horizontality.
- b) The principle of “the present is the key to the past”.
- c) The principle of superposition.
- d) The size of a mineral crystal in an igneous rock is dependent on the rate of cooling.
- e) Slow cooling of magma occurs when the surrounding temperature is relatively high.
- f) Fast cooling of magma occurs when the surrounding temperature is relatively low.
- g) The temperature is relatively high at deeper levels of the crust.
- h) The temperature is relatively low towards the surface of the crust.
- i) The pressure is relatively high deep in the crust.
- j) Linear minerals grow with a parallel orientation under conditions of high pressure.
- k) Rocks can behave elastically under conditions of high pressure and high temperature.
- l) The roundness of a grain is a result of both the distance of transport and hardness of the mineral.
- m) Cross bedding structure is a result of sedimentation by moving air (wind) or water.
- n) Sedimentation in a river environment leads to all the layers inclined in the same direction and the thickness of the layers is on the order of a few tens of centimeters.
- o) Sedimentation in a wind environment leads to inclination of the layers in different directions and the thickness of the layers is on the order of meters.

4. Which processes are **directly** relevant to the formation of the sample? (You may choose more than 1 answer).

- a) Sedimentation
- b) Uplift
- c) Erosion
- d) Weathering

- e) Burial
- f) Lithification
- g) Melting
- h) Slow crystallization
- i) Fast crystallization
- j) Regional metamorphism
- k) Contact metamorphism

5. Which of the following Earth Systems are involved in the formation and exposure of the rock?. (Note: Choose only ONE response, which represents all the systems that DIRECTLY influenced the formation AND exposure of the sample).

- a) Geosphere and Atmosphere.
- b) Geosphere and Hydrosphere.
- c) Geosphere and Biosphere.
- d) Hydrosphere and Atmosphere.
- e) Hydrosphere and Biosphere.
- f) Atmosphere and Biosphere.
- g) Geosphere and Atmosphere and Hydrosphere.
- h) Geosphere and Atmosphere and Biosphere.
- i) Geosphere and Hydrosphere and Biosphere.
- j) Hydrosphere and Atmosphere and Biosphere.
- k) Geosphere and Atmosphere and Hydrosphere and Biosphere.

Location 2:

1. Which of the following features can you observe in the sample? (You may choose more than 1 answer).

- 1. Fossil
- 2. Cross bedding
- 3. Horizontal bedding
- 4. Crystalline structure
- 5. A multi-minerallic rock (more than one mineral)
- 6. A mono-minerallic rock (one mineral)
- 7. Lineation (Elongated minerals are arranged in a parallel manner)

8. Foliation (Marked with bands of different minerals)
9. Vesicular structure
10. Minerals cannot be seen with the naked eye
11. Glassy texture

2. What conclusion(s) can you draw about the formation of this rock sample? (You may choose more than 1 answer).

- a) This rock formed in a shallow marine environment.
- b) This rock formed in an open sea environment.
- c) This rock formed in a deep sea environment.
- d) Sedimentation in an oversaturated environment.
- e) Sedimentation in a cave environment.
- f) This rock formed in a lake environment.
- g) This rock formed in a river environment.
- h) This rock formed in a dune environment.
- i) This rock formed in an (igneous) plutonic environment.
- j) This rock formed in an (igneous) volcanic environment.
- k) This rock underwent regional metamorphism.
- l) This rock underwent contact metamorphism.

3. What observation/ principle helped you draw the conclusion? (You may choose more than 1 answer).

- a) The principle of original horizontality.
- b) The principle of “the present is the key to the past”.
- c) The principle of superposition.
- d) The size of a mineral crystal in an igneous rock is dependent on the rate of cooling.
- e) Slow cooling of magma occurs when the surrounding temperature is relatively high.
- f) Fast cooling of magma occurs when the surrounding temperature is relatively low.
- g) The temperature is relatively high at deeper levels of the crust.
- h) The temperature is relatively low towards the surface of the crust.
- i) The pressure is relatively high deep in the crust.

- j) Linear minerals grow with a parallel orientation under conditions of high pressure.
- k) Rocks can behave elastically under conditions of high pressure and high temperature.
- l) The roundness of a grain is a result of both the distance of transport and hardness of the mineral.
- m) Cross bedding structure is a result of sedimentation by moving air (wind) or water.
- n) Sedimentation in a river environment leads to all the layers inclined in the same direction and the thickness of the layers is on the order of a few tens of centimeters.
- o) Sedimentation in a wind environment leads to inclination of the layers in different directions and the thickness of the layers is on the order of meters.

4. Which processes are **directly** relevant to the formation of the sample? (You may choose more than 1 answer).

- a) Sedimentation
- b) Uplift
- c) Erosion
- d) Weathering
- e) Burial
- f) Lithification
- g) Melting
- h) Slow crystallization
- i) Fast crystallization
- j) Regional metamorphism
- k) Contact metamorphism

5. Which of the following Earth Systems are involved in the formation and exposure of the rock?. (Note: Choose only ONE response, which represents all the systems that DIRECTLY influenced the formation AND exposure of the sample).

- a) Geosphere and Atmosphere.
- b) Geosphere and Hydrosphere.
- c) Geosphere and Biosphere.
- d) Hydrosphere and Atmosphere.

- e) Hydrosphere and Biosphere.
- f) Atmosphere and Biosphere.
- g) Geosphere and Atmosphere and Hydrosphere.
- h) Geosphere and Atmosphere and Biosphere.
- i) Geosphere and Hydrosphere and Biosphere.
- j) Hydrosphere and Atmosphere and Biosphere.
- k) Geosphere and Atmosphere and Hydrosphere and Biosphere.

Location 3:

1. Which of the following features can you observe in the sample? (You may choose more than 1 answer).

- 1. Fossil
- 2. Cross bedding
- 3. Horizontal bedding
- 4. Crystalline structure
- 5. A multi-minerallic rock (more than one mineral)
- 6. A mono-minerallic rock (one mineral)
- 7. Lineation (Elongated minerals are arranged in a parallel manner)
- 8. Foliation (Marked with bands of different minerals)
- 9. Vesicular structure
- 10. Minerals cannot be seen with the naked eye
- 11. Glassy texture

2. What conclusion(s) can you draw about the formation of this rock sample? (You may choose more than 1 answer).

- a) This rock formed in a shallow marine environment.
- b) This rock formed in an open sea environment.
- c) This rock formed in a deep sea environment.
- d) Sedimentation in an oversaturated environment.
- e) Sedimentation in a cave environment.
- f) This rock formed in a lake environment.
- g) This rock formed in a river environment.
- h) This rock formed in a dune environment.
- i) This rock formed in an (igneous) plutonic environment.

- j) This rock formed in an (igneous) volcanic environment.
- k) This rock underwent regional metamorphism.
- l) This rock underwent contact metamorphism.

3. What observation/ principle helped you draw the conclusion? (You may choose more than 1 answer).

- a) The principle of original horizontality.
- b) The principle of “the present is the key to the past”.
- c) The principle of superposition.
- d) The size of a mineral crystal in an igneous rock is dependent on the rate of cooling.
- e) Slow cooling of magma occurs when the surrounding temperature is relatively high.
- f) Fast cooling of magma occurs when the surrounding temperature is relatively low.
- g) The temperature is relatively high at deeper levels of the crust.
- h) The temperature is relatively low towards the surface of the crust.
- i) The pressure is relatively high deep in the crust.
- j) Linear minerals grow with a parallel orientation under conditions of high pressure.
- k) Rocks can behave elastically under conditions of high pressure and high temperature.
- l) The roundness of a grain is a result of both the distance of transport and hardness of the mineral.
- m) Cross bedding structure is a result of sedimentation by moving air (wind) or water.
- n) Sedimentation in a river environment leads to all the layers inclined in the same direction and the thickness of the layers is on the order of a few tens of centimeters.
- o) Sedimentation in a wind environment leads to inclination of the layers in different directions and the thickness of the layers is on the order of meters.

4. Which processes are **directly** relevant to the formation of the sample? (You may choose more than 1 answer).

- a) Sedimentation
- b) Uplift
- c) Erosion

- d) Weathering
- e) Burial
- f) Lithification
- g) Melting
- h) Slow crystallization
- i) Fast crystallization
- j) Regional metamorphism
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- g) Geosphere and Atmosphere and Hydrosphere.
- h) Geosphere and Atmosphere and Biosphere.
- i) Geosphere and Hydrosphere and Biosphere.
- j) Hydrosphere and Atmosphere and Biosphere.
- k) Geosphere and Atmosphere and Hydrosphere and Biosphere.

Location 4:

1. Which of the following features can you observe in the sample? (You may choose more than 1 answer).

- 1. Fossil
- 2. Cross bedding
- 3. Horizontal bedding
- 4. Crystalline structure
- 5. A multi-minerallic rock (more than one mineral)
- 6. A mono-minerallic rock (one mineral)

7. Lineation (Elongated minerals are arranged in a parallel manner)
8. Foliation (Marked with bands of different minerals)
9. Vesicular structure
10. Minerals cannot be seen with the naked eye
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2. What conclusion(s) can you draw about the formation of this rock sample? (You may choose more than 1 answer).

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- h) This rock formed in a dune environment.
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- e) Hydrosphere and Biosphere.
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- g) Geosphere and Atmosphere and Hydrosphere.
- h) Geosphere and Atmosphere and Biosphere.
- i) Geosphere and Hydrosphere and Biosphere.
- j) Hydrosphere and Atmosphere and Biosphere.
- k) Geosphere and Atmosphere and Hydrosphere and Biosphere.

EXERCISE #2

Measure and record the strike and dip of the inclined plane at location 5 & 6. ***Time: 10 minutes (10 POINTS)***

EXERCISE #3

Measure the porosity of sand using the apparatus provided at location 7. ***Time: 15 minutes (10 POINTS)***.

7th International Earth Science Olympiad
GEOSPHERE PRACTICAL TEST
PART 2 – LOCATION: KARIGHATTA

Instructions: Study the rocks at locations 1 to 4 and answer the following questions.

Please surrender your papers with the answers marked to the mentor on site before you get into the bus. (Time 30 minutes; 20 points).

1. Which of the following features can you observe in the sample? (You may choose more than 1 answer).

- 12. Fossil
- 13. Cross bedding
- 14. Horizontal bedding
- 15. Crystalline structure
- 16. A multi-minerallic rock (more than one mineral)
- 17. A mono-minerallic rock (one mineral)
- 18. Lineation (Elongated minerals are arranged in a parallel manner)
- 19. Foliation (Marked with bands of different minerals)
- 20. Vesicular structure
- 21. Minerals cannot be seen with the naked eye
- 22. Glassy texture

2. What conclusion(s) can you draw about the formation of this rock sample? (You may choose more than 1 answer).

- m) This rock formed in a shallow marine environment.
- n) This rock formed in an open sea environment.
- o) This rock formed in a deep sea environment.
- p) Sedimentation in an oversaturated environment.
- q) Sedimentation in a cave environment.
- r) This rock formed in a lake environment.
- s) This rock formed in a river environment.
- t) This rock formed in a dune environment.
- u) This rock formed in an (igneous) plutonic environment.
- v) This rock formed in an (igneous) volcanic environment.
- w) This rock underwent regional metamorphism.
- x) This rock underwent contact metamorphism.

3. What observation/ principle helped you draw the conclusion? (You may choose more than 1 answer).

- p) The principle of original horizontality.
- q) The principle of “the present is the key to the past”.
- r) The principle of superposition.
- s) The size of a mineral crystal in an igneous rock is dependent on the rate of cooling.
- t) Slow cooling of magma occurs when the surrounding temperature is relatively high.
- u) Fast cooling of magma occurs when the surrounding temperature is relatively low.
- v) The temperature is relatively high at deeper levels of the crust.
- w) The temperature is relatively low towards the surface of the crust.
- x) The pressure is relatively high deep in the crust.
- y) Linear minerals grow with a parallel orientation under conditions of high pressure.
- z) Rocks can behave elastically under conditions of high pressure and high temperature.
- aa) The roundness of a grain is a result of both the distance of transport and hardness of the mineral.
- bb) Cross bedding structure is a result of sedimentation by moving air (wind) or water.
- cc) Sedimentation in a river environment leads to all the layers inclined in the same direction and the thickness of the layers is on the order of a few tens of centimeters.
- dd) Sedimentation in a wind environment leads to inclination of the layers in different directions and the thickness of the layers is on the order of meters.

4. Which processes are **directly** relevant to the formation of the sample? (You may choose more than 1 answer).

- l) Sedimentation
- m) Uplift
- n) Erosion
- o) Weathering
- p) Burial
- q) Lithification

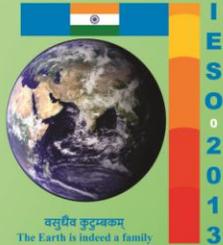
- r) Melting
- s) Slow crystallization
- t) Fast crystallization
- u) Regional metamorphism
- v) Contact metamorphism

5. Which of the following Earth Systems are involved in the formation and exposure of the rock?.
(Note: Choose only ONE response, which represents all the systems that DIRECTLY influenced the formation AND exposure of the sample).

- l) Geosphere and Atmosphere.
- m) Geosphere and Hydrosphere.
- n) Geosphere and Biosphere.
- o) Hydrosphere and Atmosphere.
- p) Hydrosphere and Biosphere.
- q) Atmosphere and Biosphere.
- r) Geosphere and Atmosphere and Hydrosphere.
- s) Geosphere and Atmosphere and Biosphere.
- t) Geosphere and Hydrosphere and Biosphere.
- u) Hydrosphere and Atmosphere and Biosphere.
- v) Geosphere and Atmosphere and Hydrosphere and Biosphere.



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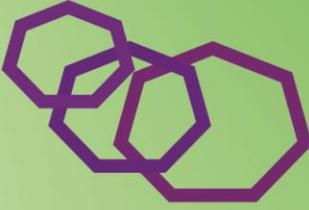
मसुरीस कुटुम्बकम्
The Earth is indeed a family

HYDROSPHERE 

+

ATMOSPHERE 

PRACTICAL TEST



Student's Name and Code:



Instructions:

1. Please write your name and nationality in English on the cover page.
2. The time allocated for this examination is 30 minutes.
3. Please write your answer legibly, illegible answer will be counted as incorrect.
4. Please write your answer only on this test booklet.
5. You may respond to questions in English.
6. Read the entire question carefully before starting to answer. Marks for each question are indicated on the right.
7. Any inappropriate examination behavior will result in disqualification.



Two sets of data pertaining to profiles of temperature, salinity and (density-1000) from two locations on from the north Indian Ocean are given below. Draw the vertical distribution of temperature and salinity. Use **one graph sheet each** to draw the Data SET-1 and Data SET-2 and answer the following questions.

Data – SET-1

Depth (m)	Temperature (°C)	Salinity (PSU) (also parts per mil)	Density-1000 (kg m ⁻³)
0	29.03	31.04	19.09
-10	28.99	31.05	19.10
-20	28.98	31.06	19.11
-30	28.96	32.56	20.35
-40	28.97	33.41	21.80
-50	28.96	34.38	22.98
-75	23.54	34.69	23.94
-90	23.21	34.73	24.56
-100	19.79	34.79	24.98
-125	17.85	34.86	25.57
-150	15.87	34.91	25.71
-200	13.43	34.99	26.30



Data – SET-2

Depth (m)	Temperature (°C)	Salinity (PSU) (also parts per mil)	Density-1000 (kg m ⁻³)
0	26.00	36.54	24.20
-10	25.98	36.53	24.20
-20	25.95	36.53	24.21
-30	25.92	36.53	24.22
-40	25.90	36.51	24.21
-50	25.89	36.52	24.22
-75	25.87	36.5	24.21
-90	23.91	36.3	24.65
-100	21.78	36.14	25.15
-125	20.33	36.03	25.46
-150	18.97	35.94	25.75
-200	17.17	35.93	26.19

Questions:

- a) Plot the vertical profiles of temperature and salinity for SET-1 & SET-2 in the two graph sheets provided. **5 marks**



b) Determine the Mixed layer depth (in m) in SET-1& SET-2? 2 marks

SET-1	
SET-2	

c) Using the plots you made and the (density-1000) values from the tables, if needed, determine the thickness of the barrier layer (in m) in SET-1& SET-2? (barrier layer refers to the depth zone within the isothermal layer where the salinity increases rapidly). Circle the correct option. 2 marks

- A. 30 m for SET-1 and 0 m for SET-2
- B. 20 m for SET-1 and 75 m for SET-2
- C. 50 m for SET-1 and 75 m for SET-2
- D. 10 m for SET-1 and 0 m for SET-2

d) What are the temperature and salinity gradients in the barrier layer for SET-1 & SET-2 data? 4 marks

- A. 0 per m in salinity for SET-1 and 0 per m in temperature for SET-2
- B. 0.09 per m in salinity for SET-1 and 0 per m in temperature for SET-2
- C. 0.09 per m in salinity for SET-2 and 0 per m in temperature for SET-1
- D. 0.09 per m in temperature for SET-1 and 0.09 per m in salinity for SET-2

e) Identify which SET pertains to the Arabian Sea (less river discharge), and which SET the Bay of Bengal (more river discharge): Write AS for Arabian Sea and BB for Bay of Bengal, in the appropriate row. 2 marks

SET-1	
SET-2	

