



ASTROCHALLENGE 2019
SENIOR OBSERVATION ROUND
(THEORY)

Monday, 3rd June 2019

PLEASE READ THESE INSTRUCTIONS CAREFULLY.

1. This paper consists of 11 printed pages, including this cover page.
2. Do NOT turn over this page until instructed to do so.
3. You have **1 hour and 40 minutes** to attempt all questions in this paper.
4. At the end of the paper, submit this booklet together with your answer script.
5. Your answer script should clearly indicate your name, school, and team.
6. It is your responsibility to ensure that your answer script has been submitted.

1 Cloze Passages

[20%]

Instead of starting with eye-taxing constellation identification, the quiz-masters this year have come up with a fun activity to get you warmed up. You are given **two** cloze passages, and you are required to identify objects (A) to (K) for each. Each blank is worth **2 marks**, and partially-correct answers *may* be awarded 1 mark.

Write your answers in the appropriate blanks on pages 7 and 8.

Passage 1

Constellation (A) is one of the forty-eight original constellations listed by the classical Greek astronomer, Ptolemy. It was named after a vain queen in classical Greek mythology, and is circumpolar North of 34° N. Its α star is Schedar, but is often shaded by its γ Star in the centre of the constellation, which is quite variable. The constellation contains some of the most luminous stars known, including white and yellow hypergiants. An extremely rich section of the Milky Way runs through this constellation.

On one side of (A) lies constellation (B). This is another of the forty-eight classical constellations, and is named after a classical Greek hero, who was most famous for having killed the gorgon, Medusa. This hero rescued and eventually married the daughter of the namesake of (A). Incidentally, constellation (C) was also named after this daughter, not far from (B).

In between (A) and (B) lie many famous star clusters. The most famous of these star clusters is deep sky object (F), also known as H and χ (chi) of (B). The Heart and Soul nebulae are nearby, too.

The α star of (C), star (D), is a binary. It is part of asterism (E), easily visible to the naked eye in moderately dark conditions. Two galaxies, easily visible to the naked eye, are nearby; the dimmer of which is galaxy (J). In between these two galaxies lies the β star of (C), star (K).

On the other side of (A) lies another constellation, (G), and its namesake was the father of the namesake of (C), in Greek mythology. (G) contains the famous Herschel's Garnet Star, a variable red hypergiant located at the edge of the Elephant Trunk Nebula. This star is one of the largest ever known, with an estimated radius of over 1000 solar radii.

Furthermore, (G) also contains the oldest known open cluster, the Polarissima Cluster (Caldwell 1). This cluster is because of its proximity to the North celestial pole. Unlike other open clusters which tend drift apart within a few hundred million years, the Polarissima Cluster is believed to be 6.8 billion years old!

Extending a line from one of the branches of (B), one arrives at open cluster (H), which can be seen easily with the naked eye under moderately dark skies. Unlike the Polarissima Cluster, (H) is estimated to last for only another 250 million years, after which it will likely disperse.

Passage 2

Constellation (A) is the smallest IAU constellation, and is easily distinguishable even in light-polluted Singapore. What distinguishes (A) from other, nearby asterisms of similar shape is the presence of a fifth star, which is rather dim. Coincidentally, the brightness of the stars of this constellation, decrease in a clockwise manner.

Star (C), the brightest star of (A), is a double star. If one were to draw a line from the γ star of the constellation, star (E) (another double star) to (C) and carry on, one would arrive at the South celestial pole. Immediately next to the α star of (A) lies a famous dark nebula, (B).

Star (D) is the β star of (A). This star is well known for being close to a favourite deep sky object, cluster (F); the latter is readily seen with a pair of binoculars from Singapore and is extremely easy to find due to its proximity to (D).

Drawing a line from the δ star of (A) to (E), one arrives at (G), the largest globular cluster in the Milky Way. A line from (D) to the ϵ star of (A), leads to the Pearl Cluster which is only slightly North of (H), a famous emission nebula.

Extending this line further leads to (J), a star famous for its eruptive outburst in the 19th century. Star cluster (K) is slightly South of (J). This star cluster is well known for its resemblance to its northern counterpart located in Taurus.

2 Observation Plan

[20%]

In this section, you are to create an observation plan for a particular location and time, as follows:

LOCATION DATA	Diaz Point, Lüderitz, Namibia
COORDINATES	26° 38' 7.7" S, 15° 5' 17.1" E
TIME	Local sunset, 4 th July, 2019 to local sunrise, 5 th July, 2019.
EQUIPMENT	305 mm/1500 mm classical Newtonian reflector on Dobsonian mount, manually operated. Wide range of Barlow eyepieces, focal reducers and eyepieces.

For each object, you are to state its

- common name or astronomical code, and
- the type of the object.

You should arrange your objects into the order which you recommend people view them in. You are allowed to choose from all celestial objects, *including* man-made satellites and space stations. Up to an additional 10% will be awarded for filling in the Remarks/Object Comments field. You may want to fill this column with information on what users should look out for when trying to observe such an object.

You may assume unrestricted viewing, a completely clear sky, zero light pollution, and a perfectly-collimated telescope.

NOTE: There may be deductions for objects given which do not exist in the night sky at that time and date. Marks may also be deducted for invisible or absurd objects like black holes and the cosmic microwave background.

Each object listed will be awarded as follows:

Type	Marks
Special stars (white dwarves, double and multiple star systems)	3
Open clusters	9
Globular clusters	10
Galaxies (maximum of 9)	15
Nebulae	14

Write your answers in Annex A, provided separately.

3 Constellation Identification

[20%]

In this section, you are to solve a total of six star maps. In each map (1) to (6), you are to

1. Identify and link **one** complete constellation; [4 + 4]
2. name any **two** bright stars; [3 + 3]
3. identify **four** deep-sky objects or double stars. [4 × 4]

The objects in points 2 and 3 do **not** have to be within the complete constellation identified in point 1, but they have to be **within** the image.

Write your answers in the star maps on pages 9 to 11.

4 Celestial Labyrinth

[25%]

In this section, you are to draw a star chart for the rest of your team to solve.

Your team will be limited by the equipment below:

- 50 mm finder (7° FOV, 2× magnification)
- Altitude-azimuth mount
- N8 telescope (200 mm diameter, 1000 mm focal length, inverted image)
- Eyepieces of focal length 32 mm, 10 mm, 5 mm

NOTE: The rest of your team is to simulate navigating (using **only** the equipment above) from a given start point to a given end point, **within 5 minutes**.

5 Race Against Time in Stellarium

[15%]

In this section, you are to find as many objects as possible from the list below, in Stellarium, **within 5 minutes**.

Code	Common name
M31	Andromeda Galaxy
M36	Pinwheel Cluster
M38	Starfish Cluster
M41	Little Beehive
M42	Orion Nebula
M44	Beehive Cluster
M45	The Pleiades
M51	Whirlpool Galaxy
C6	Cat's Eye Nebula
C14	Double Cluster
C20	North America Nebula
C49	Rosette Nebula
C64	τ Canis Majoris cluster
ϵ Lyrae	The Double Double
Mel 20	α Persei cluster

Your time will begin when you touch the keyboard.

MAKE SURE YOU FILL IN YOUR SCHOOL NAME, AND YOUR TEAM NUMBER.
DETACH PAGES 7 TO 11, AND SUBMIT THEM TO THE QUIZ-MASTERS.

School name: _____ Team number: _____

Passage 1

- (A) _____
- (B) _____
- (C) _____
- (D) _____
- (E) _____
- (F) _____
- (G) _____
- (H) _____
- (J) _____
- (K) _____

Passage 2

- (A) _____
- (B) _____
- (C) _____
- (D) _____
- (E) _____
- (F) _____
- (G) _____
- (H) _____
- (J) _____
- (K) _____

Constellation Identification

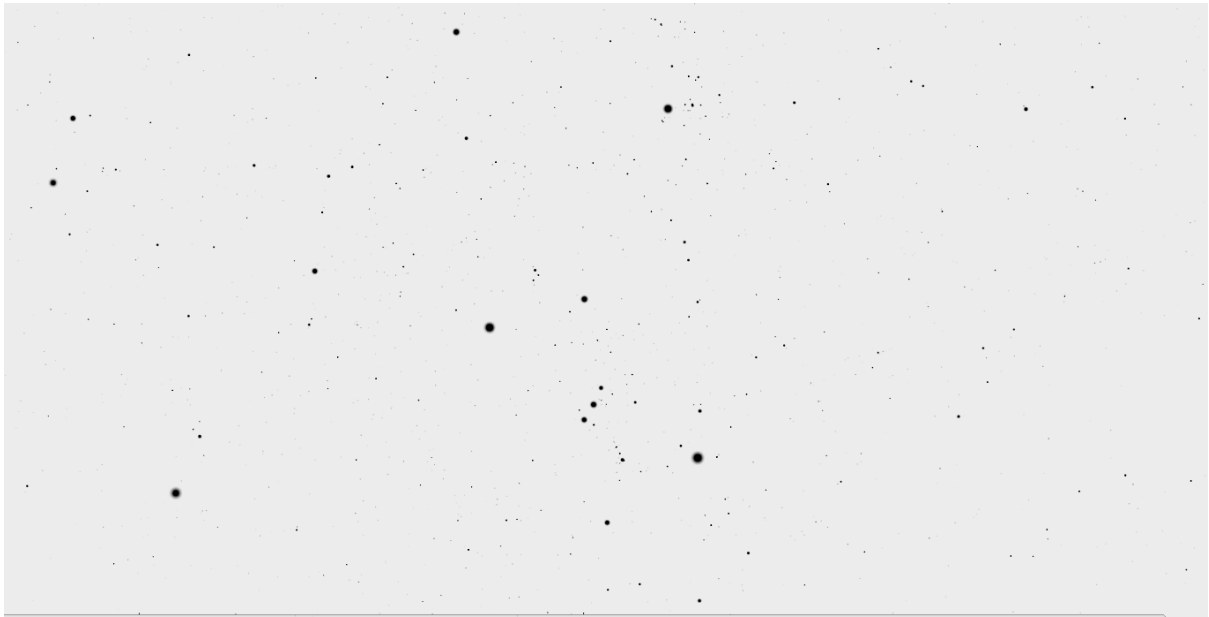
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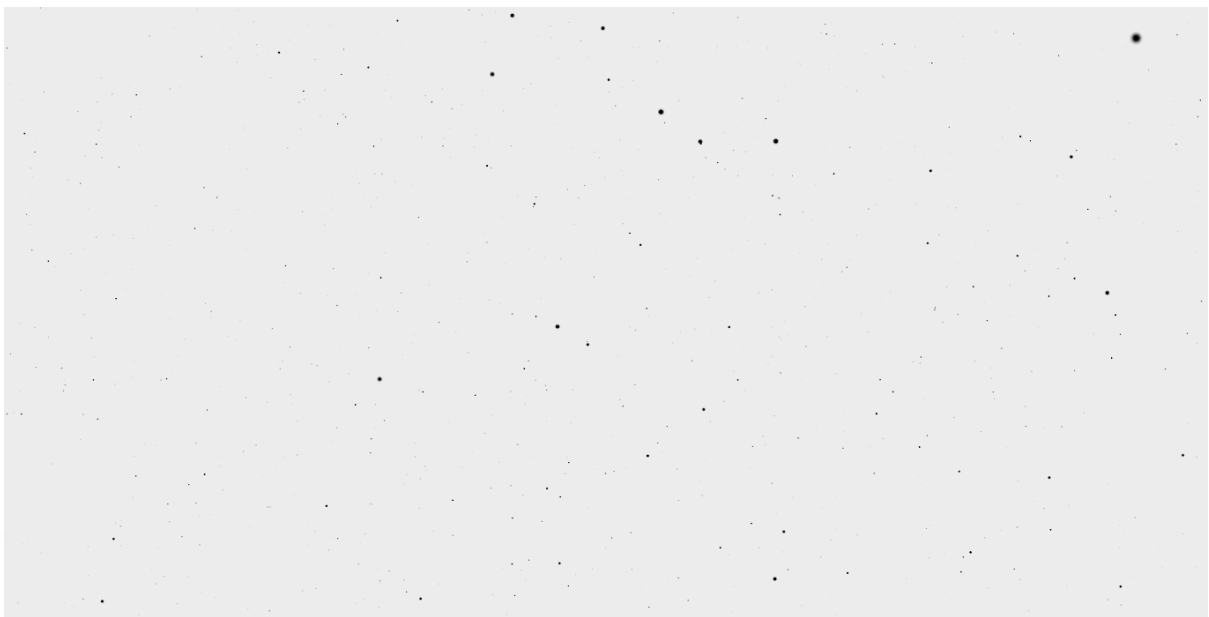
2



3



4



5



6

