Singapore Astronomy Olympiad 2023

Practical

Instructions

1. The practical portion of this Olympiad is worth a total of **44 marks**.
2. When asked to do so, check that you have **8 printed pages**.
3. Write your MCQ answers in the summary answer sheet and answer on the star charts where appropriate.
4. **Detach Sections 2 and 3 and submit them alongside your summary answer sheet**
5. Fill in these details on each side of your answer sheet:
   - Year of competition
   - Your participant code
   - The page number – which should be continuous from 1 to N
   - The section of the paper, and the question number
6. Cross out all workings or answers you do not wish to be evaluated.
7. If you require assistance (e.g. to visit the restroom, enquire about an ambiguity or possible errata, etc.), please get the attention of the invigilators.

Competition Rules and Regulation

1. Only the use of scientific calculators is permitted. No graphing or programmable calculators are allowed.
2. Disruptive behaviour, cheating, collusion to cheat or any integrity-related offences are grounds for immediate disqualification.
3. You may opt to retain the question paper and constants sheet for personal use. Return all unused answer sheets to the Organising Team.

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1 Multiple Choice Questions [24]

Attempt **ALL** questions in this section. Each question is worth 2 marks.

1. Which of the following deep sky objects cannot be found within the same constellation boundary?

   A) Whirlpool Galaxy (M51)
   B) Sombrero Galaxy (M104)
   C) Markarian's Chain
   D) M87
   E) All of the above are within the same constellation

2. Which of the following pairings of stars to a cross asterism is incorrect?

   A) Gacrux, Delta Crucis, Acrux, Mimosa (Southern Cross)
   B) Deneb, Albireo, Delta Cygni, Epsilon Cygni (Northern Cross)
   C) Upsilon Carinae, Theta Carinae, Omega Carinae, Miaplacidus (Diamond Cross)
   D) Antares, Delta Velorum, Kappa Velorum, Aspidiske (False Cross)
   E) None of the above

3. Which of the following deep sky objects are **NOT** in the respective constellations?

   A) Beehive Cluster (M44), Cancer
   B) Crab Nebula (M1), Taurus
   C) Butterfly Cluster (M6), Scorpius
   D) Orion Nebula (M42), Orion
   E) None of the above

4. It is currently December in Singapore. Which of the following objects will not be up in the night sky?

   A) Rosette Nebula
   B) Pillars of Creation
   C) Carina Nebula
   D) Leo Triplet
   E) None of the above

5. Which of the following are **NOT** of the same type of deep sky object?

   A) Butterfly Cluster (M6)
   B) Ptolemy's Cluster (M7)
   C) Great Hercules Cluster (M13)
   D) Wishing Well Cluster (C91)
   E) Pleiades (M45)

6. Using your 8-inch Schmidt-Cassegrain with a 2032mm focal length and a 25mm eyepiece with 100° apparent field of view, which of the following objects would **NOT** fit into your field of view?

   A) Object A ($\sim 32'$)
   B) Object B ($\sim 0.6° \times 0.4°$)
   C) Object C ($\sim 42'$)
   D) Object D ($\sim 0.8°$)
   E) All of the above can fit in the field of view

7. Chinese mythology tells of a tale of two lovers that cross a celestial river to meet once a year. This river cuts through the Summer Triangle. What could be the identity of this river?

   A) Milky Way
   B) Gegenschein
   C) Eridanus
   D) Barnard's Loop
   E) Serpens Cauda and Serpens Caput

8. Which of the following constellations contains the Horsehead Nebula?

   A) Equuleus
   B) Pegasus
   C) Camelopardalis
   D) Sagittarius
   E) None of the above

You have successfully escaped the light-polluted skies of Singapore to a dark sky site. Use the following tables, listing your inventory, to answer **Questions 9 - 12**.

	Aperture	**f-ratio**
Schmidt-Cassegrain	8in (203.2mm)	f/10
Refractor 1	150mm	f/4
Refractor 2	80mm	f/4
Refractor 3	80mm	f/10
Newtonian	6in (152.4mm)	f/4

Table 1: List of OTAs

	Type	**Motorized**
Mount 1	Altitude-Azimuth	Both axes
Mount 2	Equatorial	Both axes
Mount 3	Equatorial	RA-axis only

Table 2: List of mounts

9. You are deciding on a scope to use for photographing Mars. Which of the following pairs the recommended scope with the **correct** reason?

   A) Schmidt-Cassegrain; the presence of a secondary mirror will produce the most contrast out of all scopes
   B) Schmidt-Cassegrain; it will produce the brightest image out of all scopes
   C) Refractor 1; it will produce the brightest image out of all scopes
   D) Refractor 3; according to the Rayleigh criterion, it will produce the sharpest image and resolve the most details out of all scopes
   E) None of the above

10. You are trying to capture the Witch Head Nebula (IC 2118), a faint reflection nebula in Eridanus. Which method would yield the best result?

    Hint: *H-alpha narrowband filters only allow the hydrogen alpha emission lines to pass through and filters out almost all other light*

    A) Schmidt-Cassegrain, monochrome camera, and H-alpha narrowband filter
    B) Refractor 1, monochrome camera, and H-alpha narrowband filter
    C) Newtonian, colour camera, and H-alpha narrowband filter
    D) Refractor 3, colour camera, and a green (550nm) filter
    E) Refractor 2, colour camera, and no filter

11. Trying to capture the Geminids meteor shower, you draw upon your experience in capturing lightning storms and set up your camera to take a long exposure at low ISO. However, the results were disappointing with no meteors. Which of the modifications is most likely to help you image more meteors?

    A) Use Mount 1 to track Gemini
    B) Use Mount 2 to track Gemini
    C) Use a shorter exposure time
    D) Use a higher ISO
    E) None of the above

12. Having polar aligned Mount 1, you take a 300s exposure, only to find that some of the stars are smudged in a circular pattern as shown below:

    What can be done to eliminate this pattern?

    A) Use a derotator
    B) Use a shorter focal length
    C) Use shorter exposures
    D) A and B only
    E) A, B and C

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Participant Code: _____

2 Star Charts [10]

Answer **ALL** questions in this section. **Submit this page with the rest of your answers.**

For **EACH** of the following two images:

a. Trace and name **ONE** fully visible constellation. Draw the constellation lines clearly. **[4]**

b. Cross out **TWO** stars with an 'X' and state their common names or Bayer designations. **[2]**

c. Circle **TWO** bright deep sky objects and state their common names or Messier/Caldwell number. Circles of an unreasonably large size will be penalized. **[4]**

Image 1

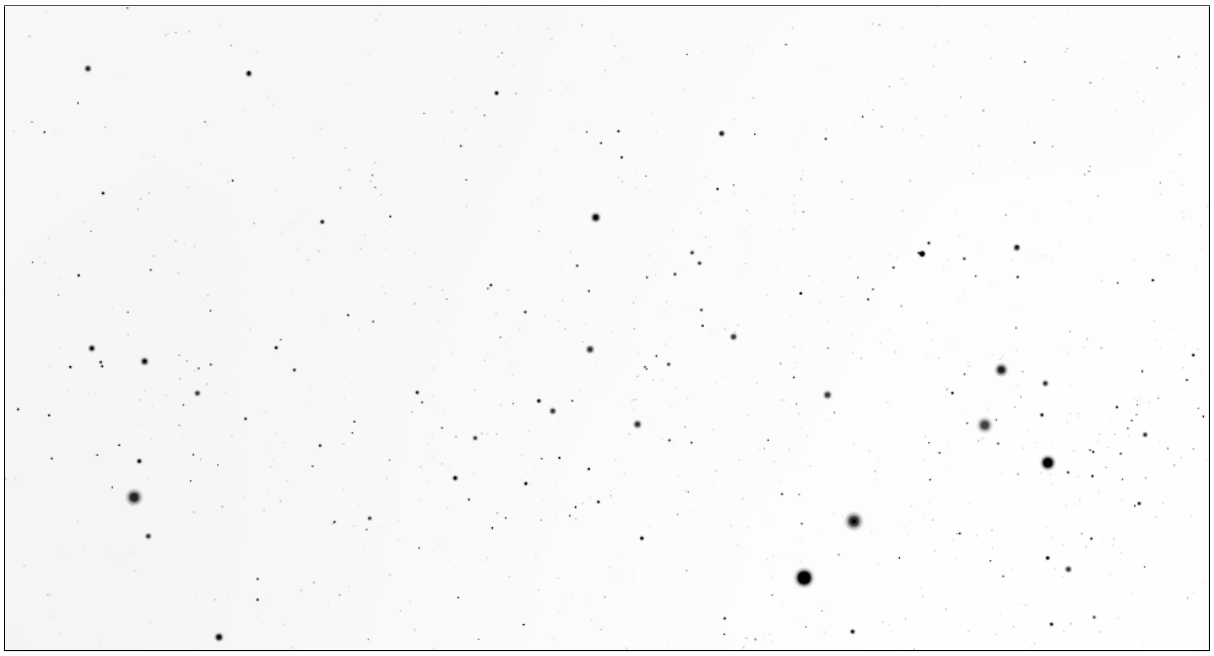
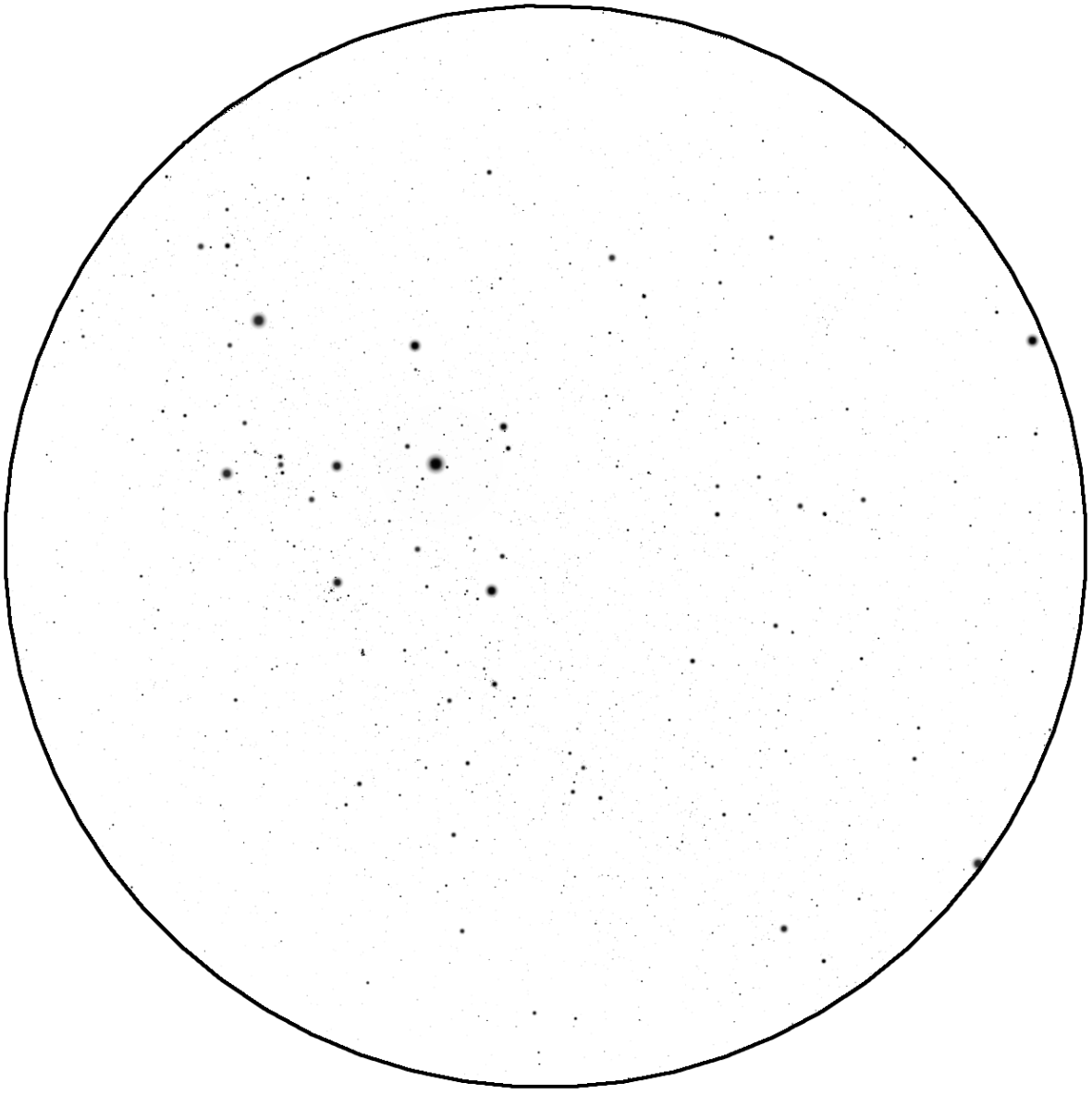


Image 2

3 All Sky [10]

Answer **ALL** questions in this section.

The following is a snapshot of the night sky.



Present your answers on the star chart above for parts (a), (b), and (c). Write your answers for parts (d) and (e) on an answer sheet.

a. Trace the constellation Ursa Major. Circle **ONE** deep-sky object in this constellation and label it. **[3]**

b. Mark the North Celestial Pole with an 'X' and indicate the cardinal directions (N, S, E, W) on the borders of the chart. **[3]**

c. Trace the ecliptic plane on the chart above and label it "Ecliptic". **[1]**

d. Jupiter is the only solar system object visible on the chart. Given that its elongation is currently 150°W, estimate the month this picture was taken in. **[2]**

e. Estimate the local sidereal time this photo was taken at. **[1]**