Part A: Cloze Passage [20]

Cloze Passage 1:

Answer	Remarks
A: Orion	
B: Betelgeuse	
C: Rigel	
D: Orion's Belt	
E: Aldebaran	A few teams spelt this wrongly.
F : Hyades	
G : Achernar	
H : Eridanus	
J : Grus	Some teams put Aquila as the answer. Aquila is a duck not a crane.
K : SMC/Small Magellanic Cloud	

Cloze Passage 2:

Answer	Remarks
A: Teapot/Sagittarius Teapot	
B: Sagittarius	
C: Messier 22	A few people put M28, close but not correct. M28 is near M22 but much smaller in angular size.
D: Messier 13	
E: Keystone of Hercules	
F: Aquarius	
G: Great Square of Pegasus	
H: Alpheratz	
J: Andromeda	
K: Andromeda Galaxy	

Part B: Finder Chart [20]

Finder Chart Question #1 (Aldebaran find Uranus)

Location: Singapore

Time: 11 Jan 2026, 0000hrs

Starting position: Aldebaran

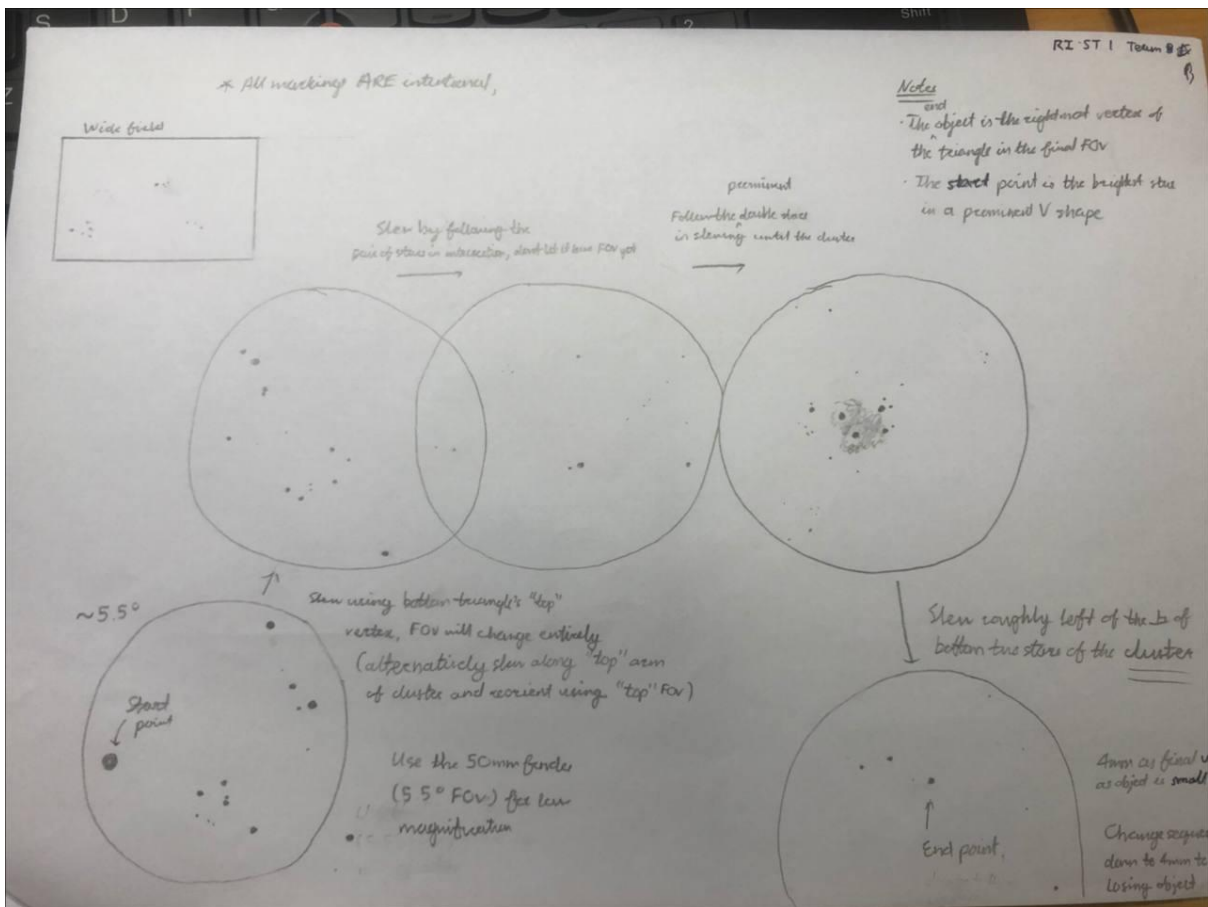End position: Uranus
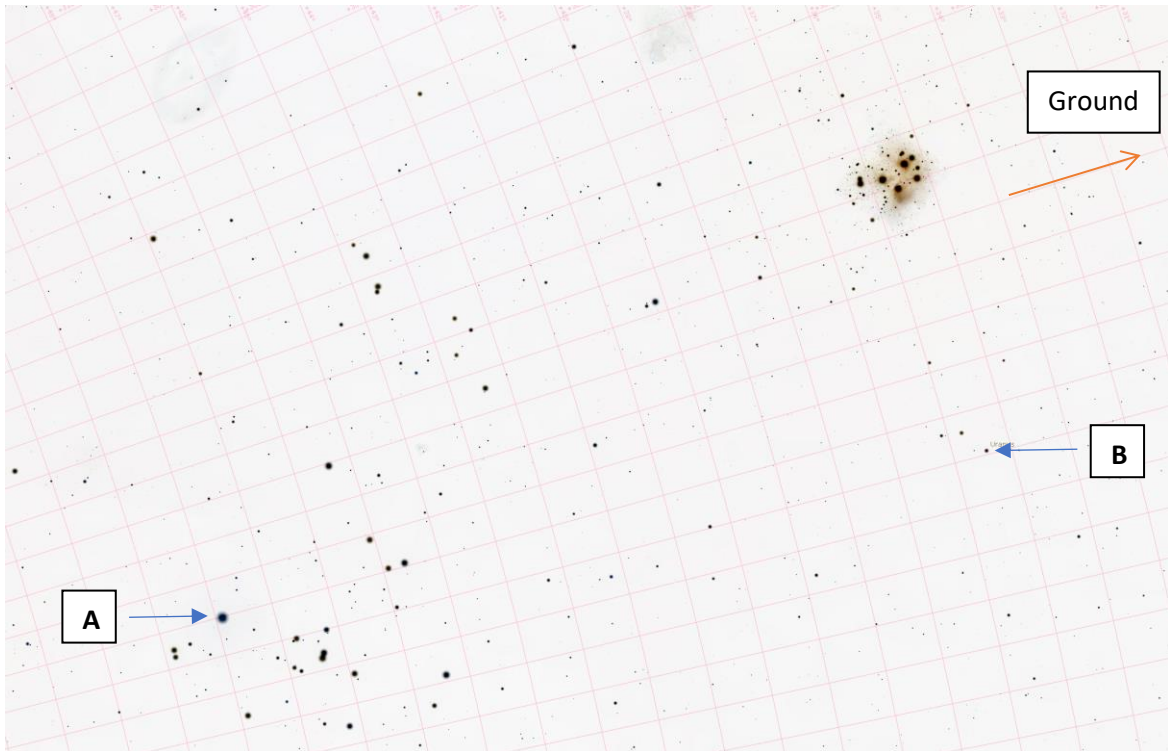

Finder Chart Question #2 (Sirius find M47)

Location: Singapore
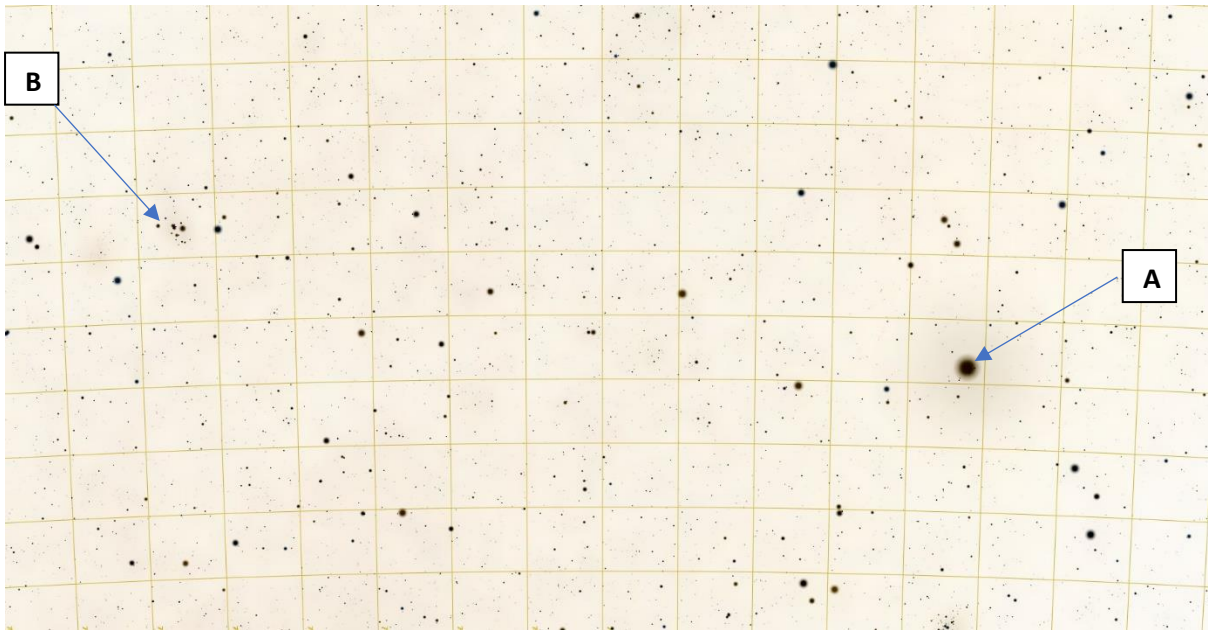
Time:11 Jan 2023, 0230hrs

Starting position: Sirius

End position: M47

Finder Chart Question #1 (Aldebaran find Uranus)

Credits: RI

Finder Chart Question #2 (Sirius find M47)

Credits: ACSI

Part C: Equipment [20]

Binoculars are often a starting point for many stargazers. They are much cheaper and affordable, especially for poor students like you and me. They are also much more portable and easier to use compared to a full telescope set up. However, they are many trashy binoculars on the market that are out there to scam our money. Let's see if you know your stuff well enough to avoid the scams.

Let's start off with the basics:

1. On the image below, label the parts of the binoculars: [2m]
   a. Objective lens
   b. Focuser
   c. Eye cup
   d. Binoculars to tripod adaptor

Eye cup

Focuser

Binoculars to tripod adaptor

Objective lens
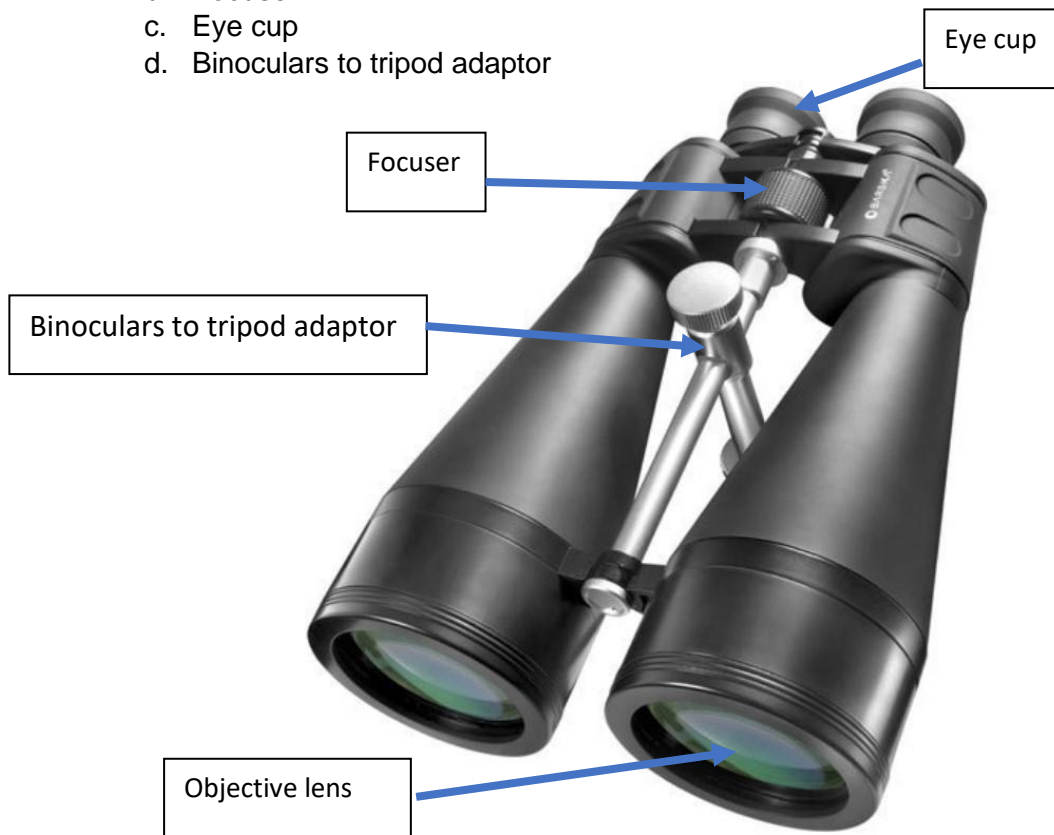
Credit: https://www.barska.com/30x80-x-trail-binoculars-w-braced-in-tripod (Not Sponsored)

Binoculars make use of lens and prisms to focus light and form an image. There are mainly two types of binoculars on the market, the porro prism and roof prism binoculars. The main difference between the two binoculars lies in how the prisms are arranged. In roof prism, the prisms are placed very closely together, making the binoculars very compact as seen in the photo below. However, this makes roof prism binoculars very expensive. Since we are all just some poor students, we will ignore all the expensive stuff and just look at porro prism binoculars.

Credit: https://birdsatfirstsight.com/roof-and-porro-prisms-in-binoculars/

2. On the image below, complete the light ray diagram of a porro prism binoculars. [2m]
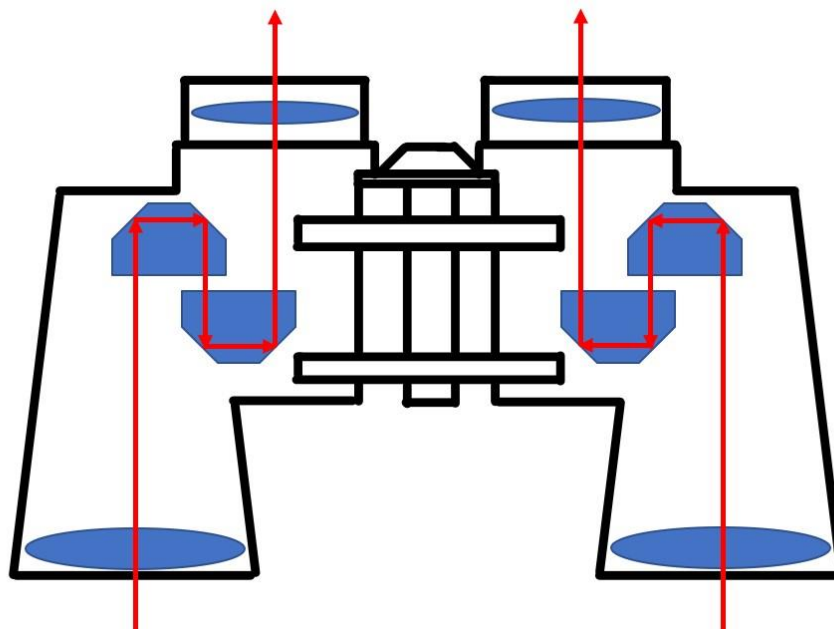
Credit: Myself (sorry for the bad drawing, hope it's not the main reason for not able to complete this question)

Now that we know roughly how binoculars work, let's take a look at some of the important specifications to look out for when buying binoculars. There are quite a few specifications that are usually given on the product information or manual. These consists of magnification, dimensions, weight, aperture of objective lens, type of coating, type of prism, FOV, exit pupil, eye relief, etc.

The two most important specification of a binoculars are usually written on the body. It is usually in the form of two numbers, AxB, as seen in the image below. This is the key specification as it determines the overall size of the binoculars and what we can see through it. One of the most common and popular specifications is 10x50.

Credit: http://www.sky-rover.com/

3. Explain what do the A and B refer to. [1m]

A: Magnification

B: Objective lens aperture/diameter

Other than the specification stated above, many specification are not printed on the binoculars but we should still know them as it will affect the view seen through. Exit pupil and eye relief two important factors in the usability and comfortability of a pair of binoculars.

4. Given a binocular that has specification of 10x50, calculate its exit pupil. [1m]

50/10 = 5mm

5. Explain the impacts of having a too large and too small exit pupil. [2m]

Too large: light loss as not all the light falls into the pupil
Too small: blurry as you are reaching the Rayleigh criterion limit. OR Need to go very close to the eyepiece lens to see the image.

(Accept any other correct answers.)

6. Explain the importance of having good (long) eye relief. [1m]

No need to go too close to the eyepiece, more comfortable especially for people wearing spectacles.

Another key specification of the binoculars is the FOV. This is important as it will affect how much we can see in the night sky. The FOV of binoculars is dependent on many factors other than the magnification. Thus, FOV (θ) is usually calculated from two values that are manually measured. It is given by the distance (D) between the FOV at (@) a certain distance away (X) as shown in the diagram below.
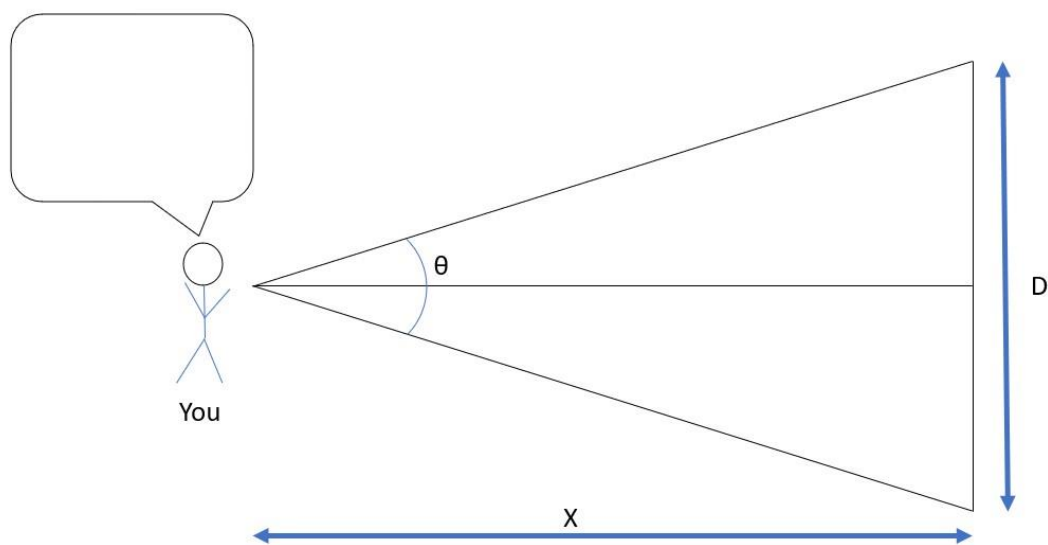
Credit: AC2023 Obs Paper Setter

7. Given that in the manual of the binoculars, it states that the FOV is given by 104m@914m. Calculate FOV of this pair of binoculars and round it off to 0.1°. [1m]

6.5°, simple trigo. Remember to times 2 if you found only half of the angle using tangent.

Finally! You have enough knowledge about binoculars! You walk into an astronomy equipment shop and the shop owner offers you two pair of binoculars. They are of the same specification and price. However, when looking at the objective lens, you are able to see your reflection clearly on the lens of binoculars A, but only a dark figure of your handsome/beautiful face on binoculars B. The shop owner tells you that binoculars A is better as it has better coating.

8. Do you think you are scammed by the shop owner? Explain your answer. [2m]

Yes, coating means allowing more light through. Reflection certainly means light are reflected.

Finderscope are common (but not necessary) for a telescope set up. However, it is still recommended in many cases. (Unless you are very good).

Credit: https://www.skyatnightmagazine.com/advice/how-set-up-finderscope-on-telescope/
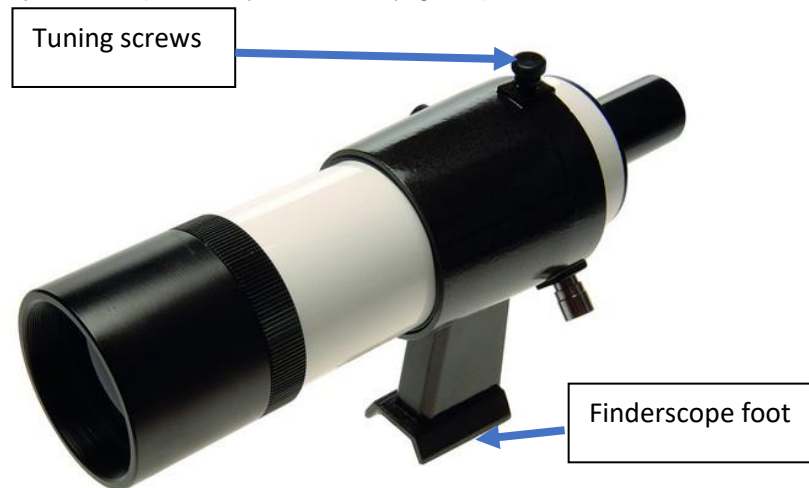
9. On the above image, label the parts of the finderscope: [1m]
    a. Finderscope foot
    b. Tuning screws

10. Explain what the purpose of a finderscope is. [1m]

Smaller FOV to locate the object.

Accept any reasonable answer.

11. Explain the steps in aligning the finderscope. [2m]

Find and centre object in eyepiece through boresight or other means, by moving the scope.

Align object in the centre of finder by adjusting the tuning screws.

12. The image below shows the FOV of what you will see in a pair of binoculars. In the empty space below, draw and explain what the same FOV will look like in a straight through finder (the one in the image above). Label the stars in your drawing. [1m]
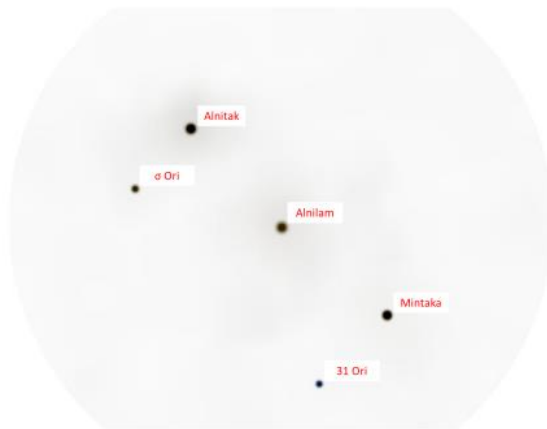
Rotate by 180°.

13. There are usually 3 screws in a finder. Explain how the 3 screws adjusts the finder. You may base your explanation on any designs. [2m]

1 screw pulls and 2 screws push. Hold the finder in place and centres the object.

Accept answers for 3 push screws also.

14. Why do most finders not come with a focuser? [1m]

Finders are focused at infinity for stars, there is no need to change the focus.

Part D: Night Sky [20]

1. On Figure 1, trace out Polaris and label it using the letter X [1]. Hence, write the cardinal points using NSEW [1].
2. On Figure 2, trace out Crux and label it using the letter C [1]. Hence, write the cardinal points using NSEW [1].
3. Draw the Local Meridian on both the Figures and label them "LM" [1].
4. On Figure 1, trace out the ecliptic, label it using the letter E [1]. Label all planets using the letter P [1]. Hint: there is at least one planet.
5. On Figure 2, trace out the ecliptic, label it using the letter E [1]. Label all planets using the letter P [1]. Hint: there is at least one planet.
6. Estimate the rough latitude coordinate that your parents are at using Figure 1 [1].

Next, we want to find out the longitude of the location.

7. Given that the Right Ascension (RA) and hour angle of the Moon in Figure 1 is 15h28m and 3h15m respectively, calculate its LST [1].
8. The LST of the Moon in Figure 2 is given, find out the local time of Figure 1. Give your answer to the closest hour [1]. Hint: Figure 1 time zone is behind Singapore and there are only 24 time zones.
9. Hence or otherwise, estimate the longitude coordinate that your parents are at. Give your answer to the closest 10° [1].
10. Identify and trace out the Summer Triangle in Figure 1, label it using "ST" [1].
11. Label the following stars on Figure 1 using the stipulated letters. [2]

| Star	Letter
Antares	AA
Albireo	AB
Arcturus	AC
Alderamin (α Cepheus)	AD

12. On Figure 1, label any 2 constellations, 2 nebulae, 2 star clusters and 2 galaxies. They cannot be any that are already identified previously [4].

For questions 1 to 5, 9 to 11, refer to the charts below.

6. Estimate the rough latitude coordinate that your parents are at using Figure 1 [1].
   Ans: Estimate the latitude using Polaris.
   Accept anything from +40° to +60°. Must indicate that it is in the northern hemisphere using either N or +.

7. Given that the Right Ascension (RA) and hour angle of the Moon in Figure 1 is 15h28m and 3h15m respectively, calculate its LST [1].
   Ans: LST = RA + HR
   15h28m + 3h15m = 18h43m

8. The LST of the Moon in Figure 2 is given, find out the local time of Figure 1. Give your answer to the closest hour [1]. Hint: Figure 1 time zone is behind Singapore and there are only 24 time zones.
   Ans: Given that Singapore is ahead of Figure 1 time zone, Figure 1 time zone will be 9h51m + (24h – 18h43m) = 9h51m + 5h17m = 15h08m.
   Since Singapore is 2000Hrs, 15h before that will be 0500hrs. The local time of Figure 1 is 0500hrs.

9. Hence or otherwise, estimate the longitude coordinate that your parents are at. Give your answer to the closest 10° [1].
   Ans: 15hours = 225°. +103°51'00" - 225° = -121°9' = -120°. Need to indicate negative sign or West (0.5 marks).

Location A: Vancouver, Canada (+49°15'00", -123°15'00")

Time: 06 May 2023, 0400Hrs local time
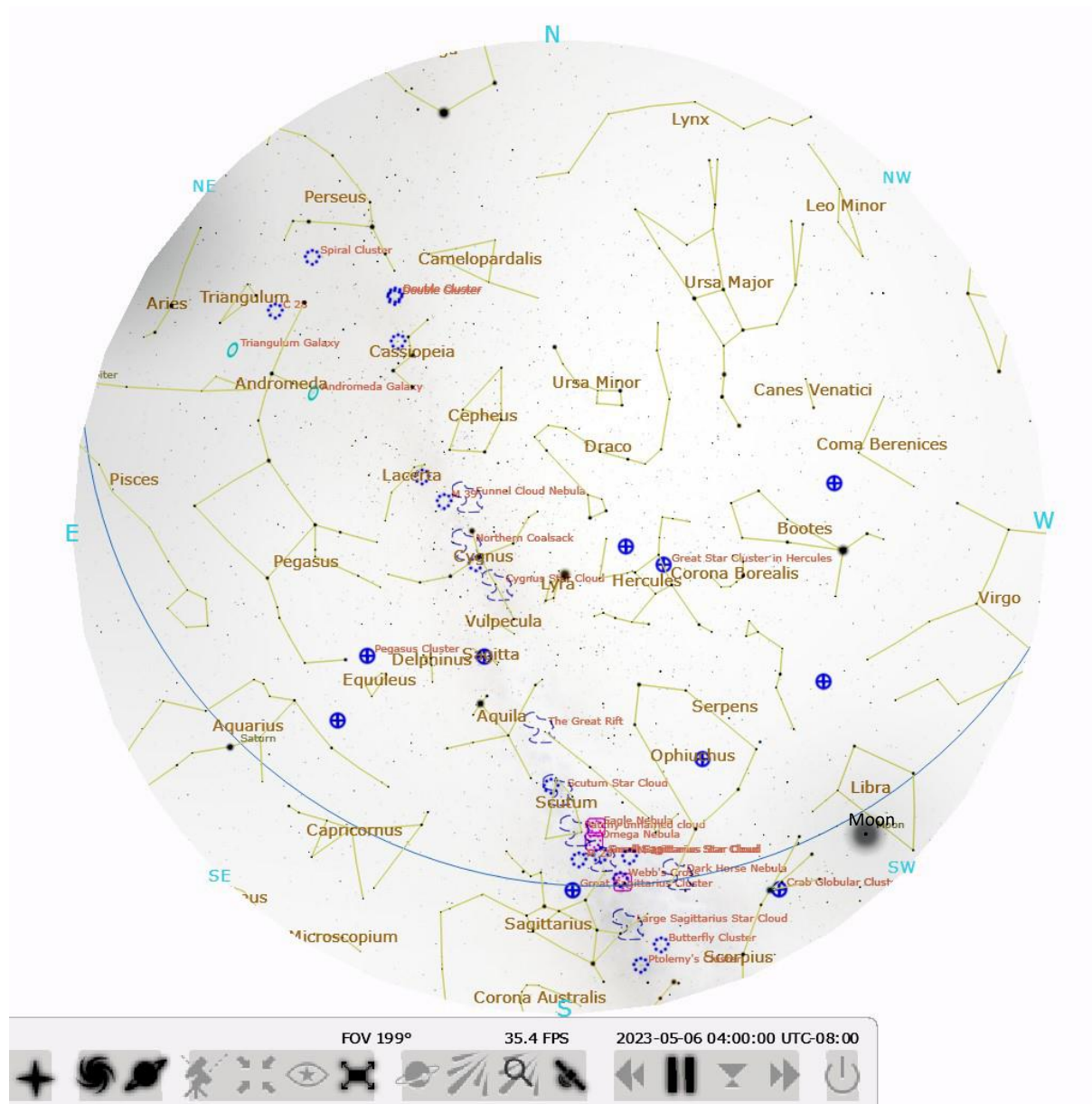
Location: Singapore (+01°17'00", +103°51'00")

Time: 06 May 2023, 2000Hrs local time