astro challenge 2022

Observation Round – Theory Paper

Time – 1hr 40 mins

Format Overview

Section	Marks	Recommended Time
I: Finder Chart Drawing	10	10 mins
II: Starlore Cloze	20	20 mins
III: When Stars Align	25	30 mins
IV: In Time Passed	25	40 mins
Total:	80	1hr 40 mins

Instructions (reminder)

- Backwards navigation is permitted. Total time for the paper is 1hr 40 mins.
- It is the participants' responsibility to collate their answers and submit to their invigilator in a single word document.
- Some questions require drawing on-screen with the use of zoom annotation tools. Please remember to screenshot your answers and insert the images into your answer document.
- Participants are to ensure that their answers are collated and submitted to the invigilator <u>before</u> the time ends.

Your time starts after this slide.

You have a total of 1hr 40 mins to complete and submit your answers.

I: Finder Chart Drawing

10 marks, recommended 10 mins

Instructions

- Start at point A (Denebola Alpha Leonis). Your destination is point B (Earth). Note carefully where B is referring to.
- Draw a finder chart that shows how to get from point A to B.
- You are given that each square is 1 degree
- You are given the following equipment:
  - 50mm finder (5° FOV, 3x magnification)
  - 60mm Diameter, 1000mm Focal Length telescope on a fork mount
  - Eyepieces 30mm (43 °), 26mm (45 °), 10mm (50 °).

A
B

End of Part I

Remember to collate your answers for submission.

II: Starlore Cloze

20 marks, recommended 20 mins

Instructions

- You will be given two cloze passages with 10 blanks each labelled (A – J) and (K – T). Each blank is worth 1 mark.
- Collate your answers in a word document.

Cloze Passage 1 [10m]

(A) is arguably the most iconic asterism in the summer night sky. The asterism spans three different constellations lying near the milky way, which are (B), (C) and (D) respectively. To an observer on the ground, (C) and (D) appear to be 'swimming' through the milky way. On the other hand, (B) lies a bit further away from the milky way and is a fairly small constellation. Within (B) lies a double star (E) that, when resolved at a high magnification, splits into two pairs of two double stars each. Nearby, within (B) and between the stars Sulafat and Sheliak lies (F), which is easily visible in small telescopes.

There are other celestial wonders to be found within the boundaries of (A). (G) is a double star notable for its amber and sapphire component stars, which contrast beautifully against each other, and can be found at the very 'tail' of (C). Close to (G) and sandwiched in between (C) and (D), lies (H), which is the first planetary nebula discovered by Charles Messier in 1764. (G) lies within the small and dim constellation of (I), and has a fairly high surface brightness, making it a popular stargazing target for small telescopes. Lastly, near (A) lies the highly dense open cluster (J). Even though (J) is part of the constellation of Scutum, we can find it easily by using the stars of (D) as a guide.

Cloze Passage 2 [10m]

The historical constellation of (K), which formed the shape of a ship, was previously the largest constellation in the night sky. As (K) was deemed to be too large and impractical for cataloguing stars, it was subsequently broken down into three separate constellations, (L), the Ship's keel, (M), the Ship's deck and (N), the Ship's sails. After the breakup of (K), the largest official IAU constellation is (O), which coincidentally spans the region of sky just north of (K) as well as the southern constellation of (P).

Nearby what was once the largest constellation of the night sky, lies the smallest constellation of the night sky, (Q). Despite its small size, it is bright and easily visible even in light-polluted skies. Near the beta star of (Q) lies (R), a small and compact open cluster easily identifiable by its A-shaped pattern. (Q) itself is nearly entirely enveloped by the constellation (P), which is much larger in comparison.

When looking for (Q), one might be misled by (S) or (T), which are nearby asterisms similar in shape and size to (Q). However, they are not merely distractions from (Q) and offer hidden jewels of their own. At the top vertex of (S) lies the Theta Carinae cluster, better known as the Southern Pleiades. From (T), we can easily find the bright open clusters Caldwell 96 and the Omicron Velorum cluster.

End of Part II

Remember to collate your answers for submission.

III: When Stars Align

25 marks, recommended 30 mins

Instructions

- There are 5 questions in total.
- Some questions require you to label a diagram on-screen. Remember to screenshot your answers.
- Collate all your answers in a word document.

Q1. The following is an image of a Newtonian Telescope.

Label the following telescope parts in the image given above.

A: Dovetail

B: Secondary Mirror

C: Focuser Knob

D: Finderscope

[2m]

Q2. A Newtonian needs to be well-collimated (i.e., mirrors aligned to one another) to produce a sharp image.

If you have set-up a Newtonian Reflector outdoors, how can you quickly test if it is out of collimation?

[1m]

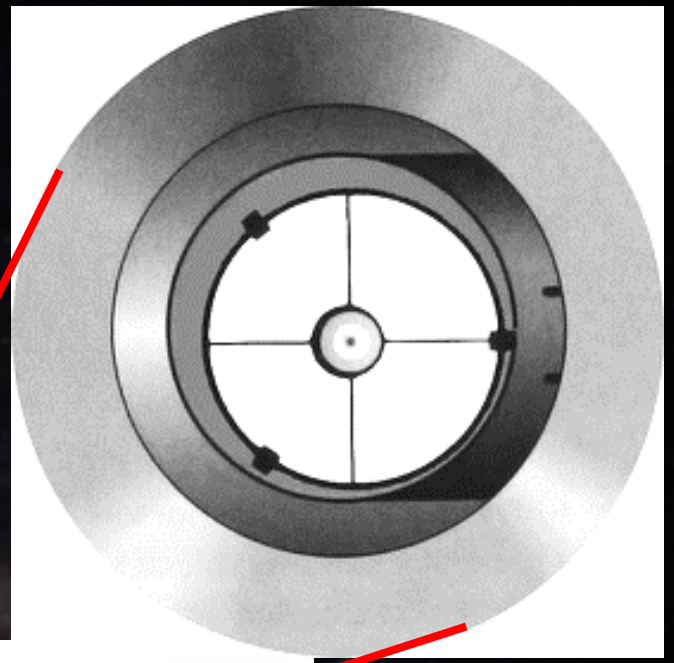
Picture for illustrative purposes only

Q3. To collimate a Newtonian, one can check if the optical elements are aligned by looking through the focuser.

The following diagram is that of the expected view through the focuser of a Newtonian reflector without an eyepiece inserted.

Label the following parts [next slide] with the corresponding letters in the diagram.

[4m]



Label the following parts:

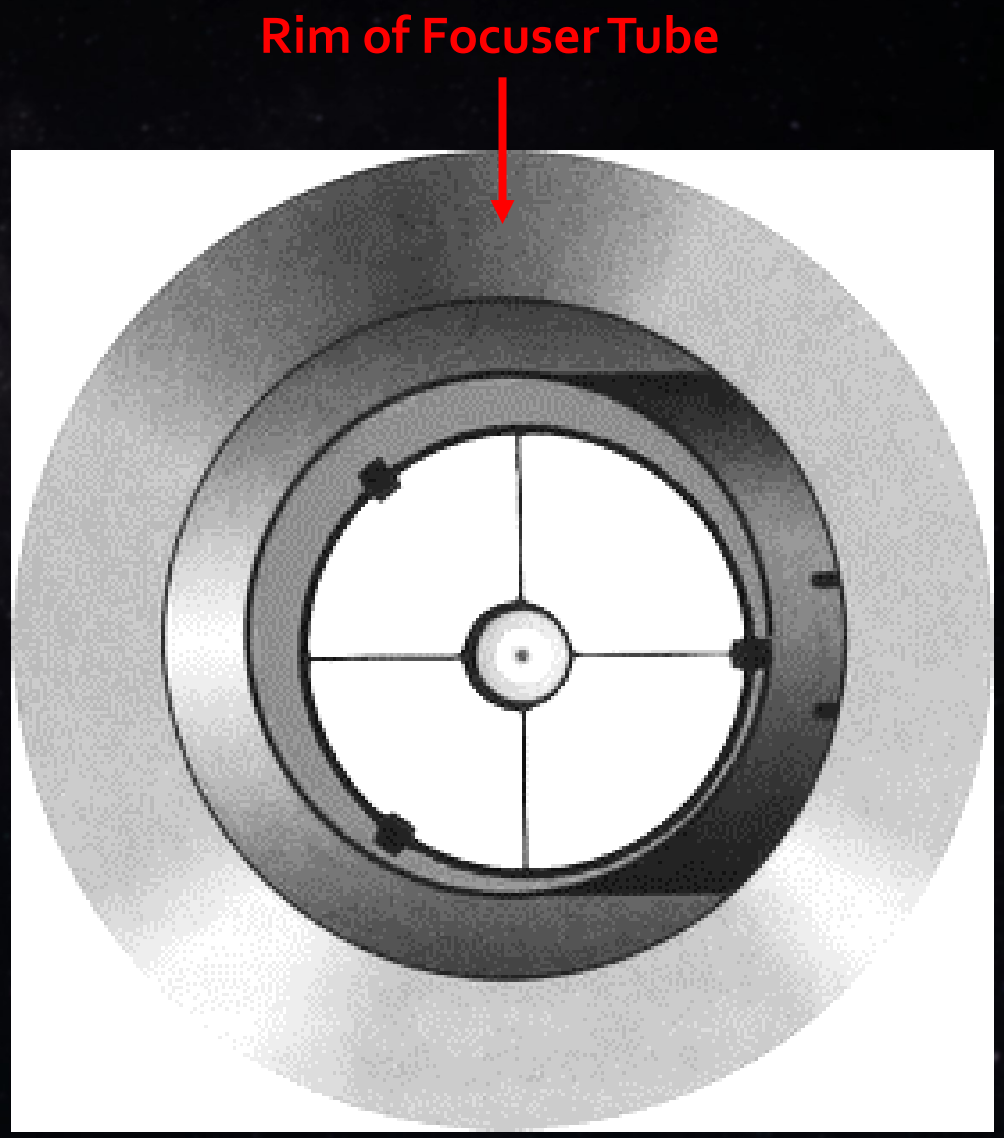
A: Edge of the Secondary Mirror

B: Reflection of the Primary Mirror in the Secondary

C: Reflection of the Spider Vanes in the Primary

D: Reflection of the Secondary Mirror in the Primary

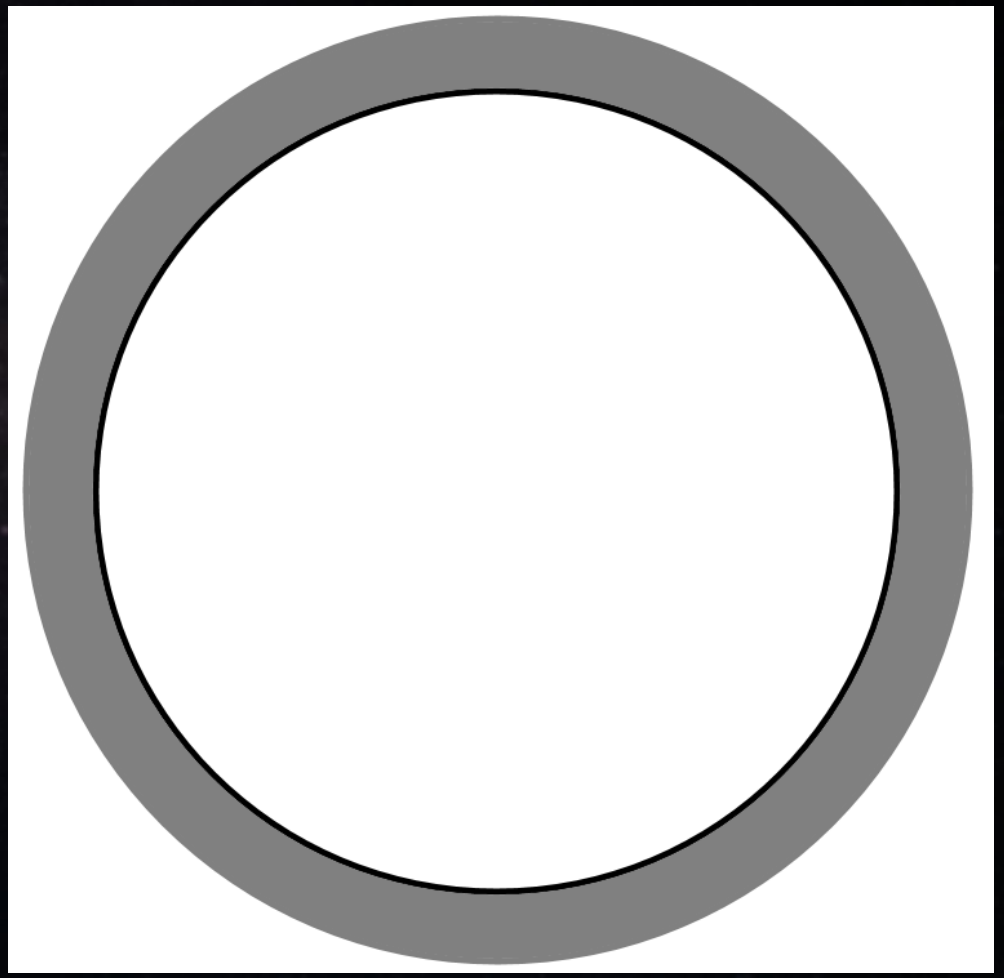
[Note: the rim of the focuser tube has been labelled for you]



Q4. Reflector Designs can be affected by optical aberrations.

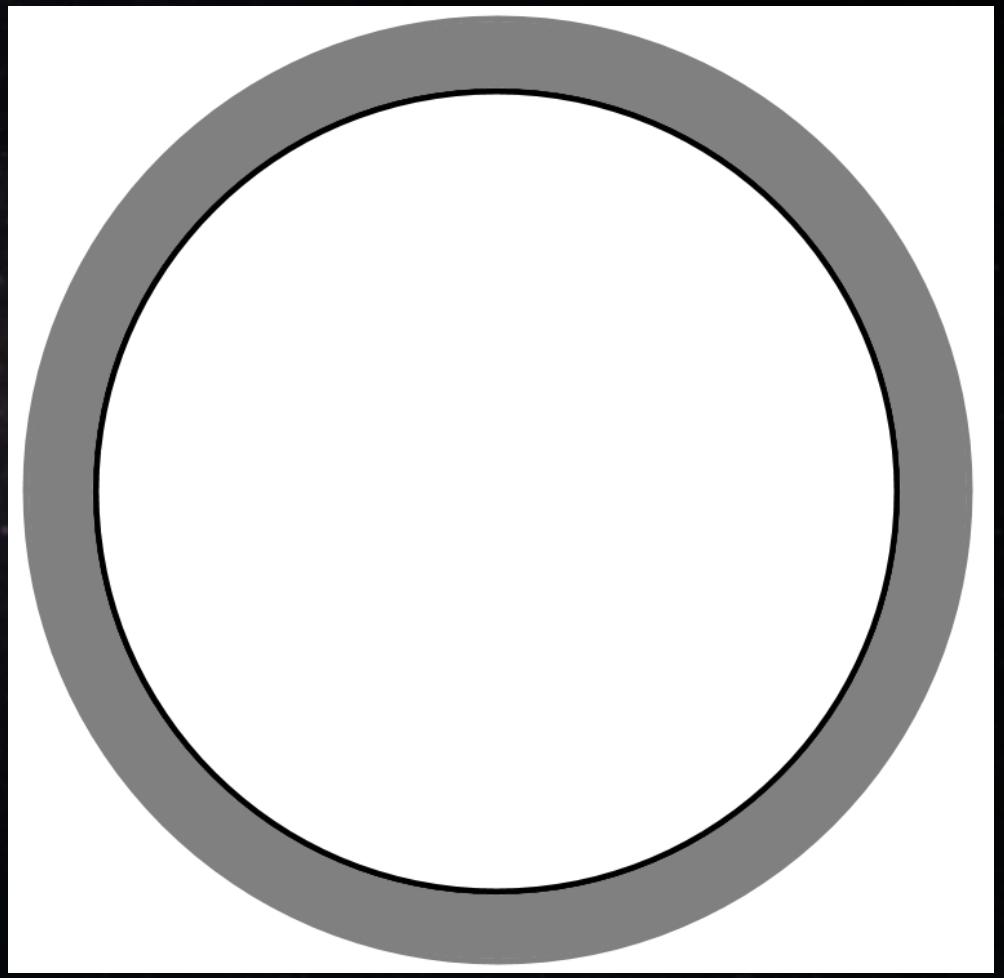
For each of the following aberrations [next 3 slides], briefly explain how the appearance of a star field would be affected by the aberration.

You may draw a diagram to supplement your explanation (on-screen or physical), if necessary.



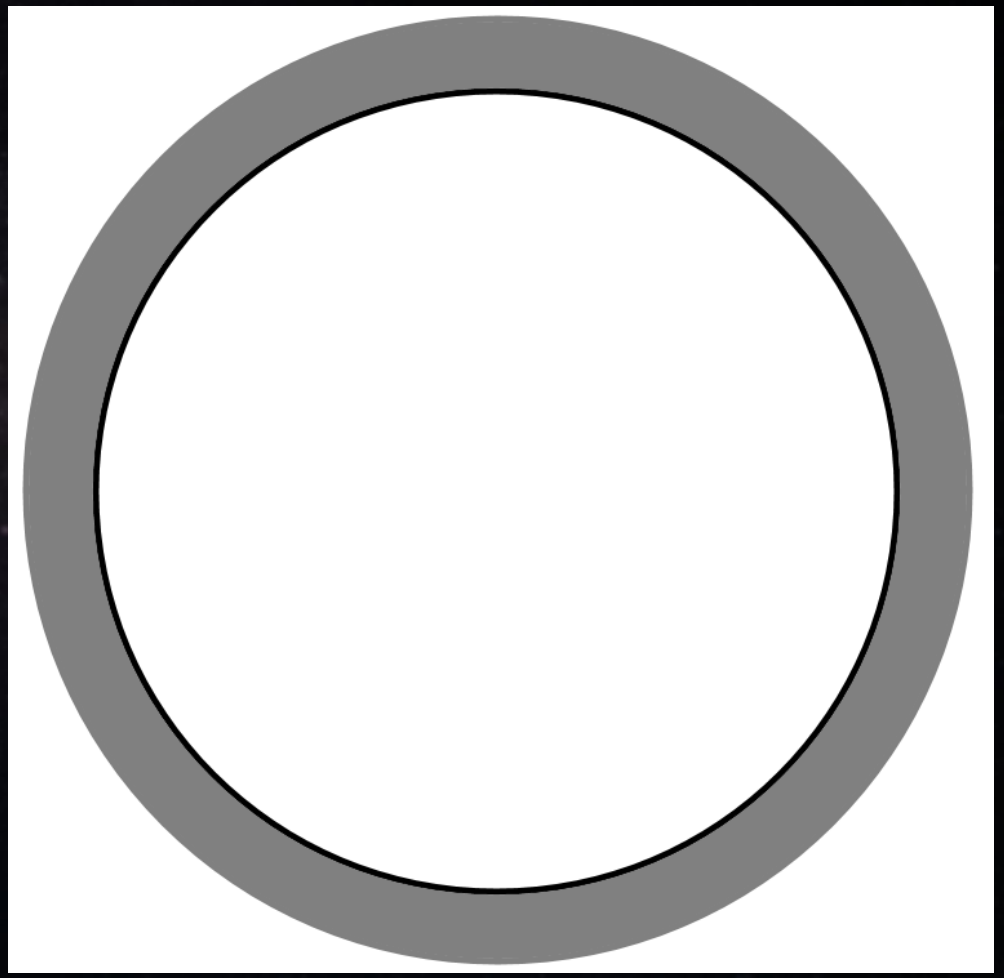
Q4. a) Comatic Aberration

[2m]



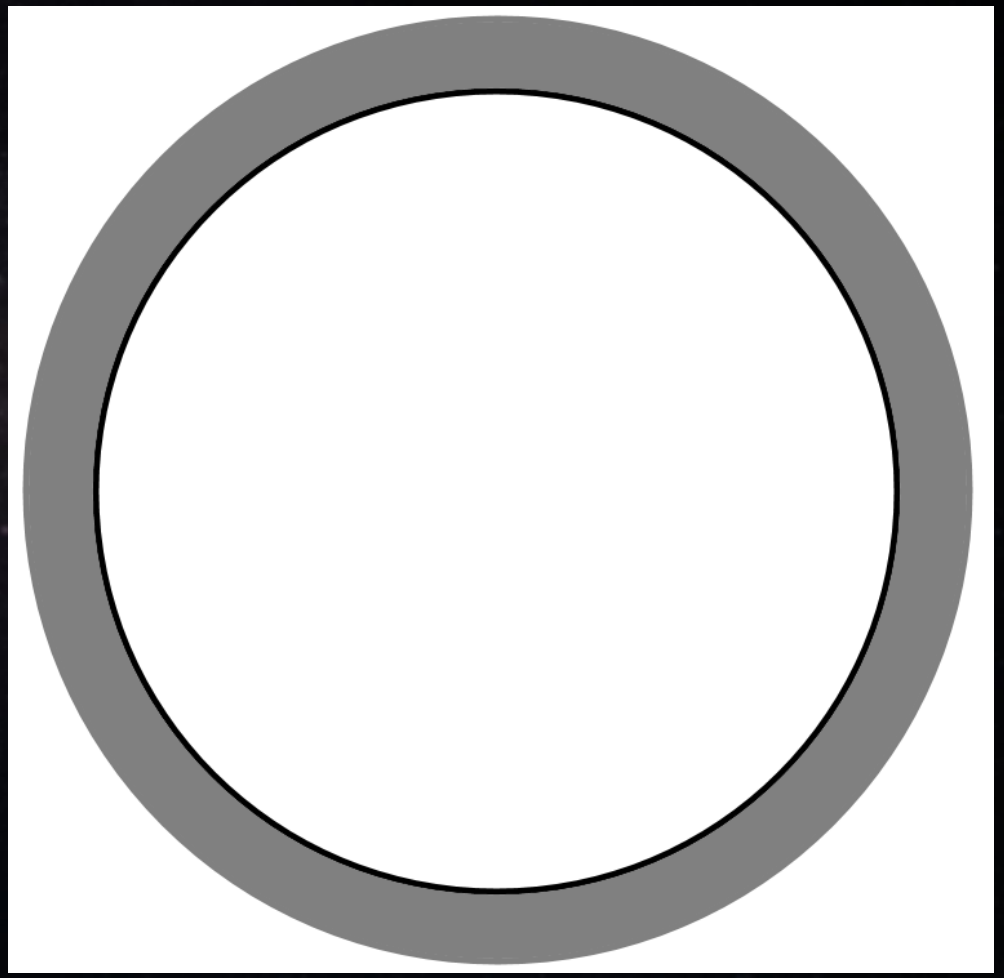
Q4. b) Spherical Aberration

[2m]



Q4. c) Field Curvature

[2m]



Q5.

You will be given a table of 10 statements labelled from A to J. Determine if they are true or false respectively.

[10m]

Statement (T/F)
A. A Bahtinov mask is used to check the collimation of a telescope by creating a distinct diffraction spike pattern.
B. If an emission nebula is too faint to be detected through an eyepiece, a H-alpha filter will increase its visibility by improving the contrast of the nebula.
C. The true field-of-view of a telescope can be increased indefinitely by using an eyepiece with a longer focal length.
D. A pair of binoculars with a larger exit pupil will always produce a brighter image.
E. A lightweight and flexible tripod is better at damping telescope vibrations than a heavy and stiff tripod.

Statement (T/F)
F. Monochrome CCD cameras are more light-sensitive than colour CCDs but cannot be used to take color images.
G. An equatorial mount can track the rotation of a sky without an onboard computer.
H. It is possible to polar-align an equatorial mount without a polarscope.
I. Field rotation in long-exposure deep-sky images can be corrected for in post-processing with field de-rotators.
J. Temperature differences between a telescope primary and the environment can produce internal air currents which degrade image quality.

End of Part III

Remember to collate your answers for submission.

IV: In Time Passed

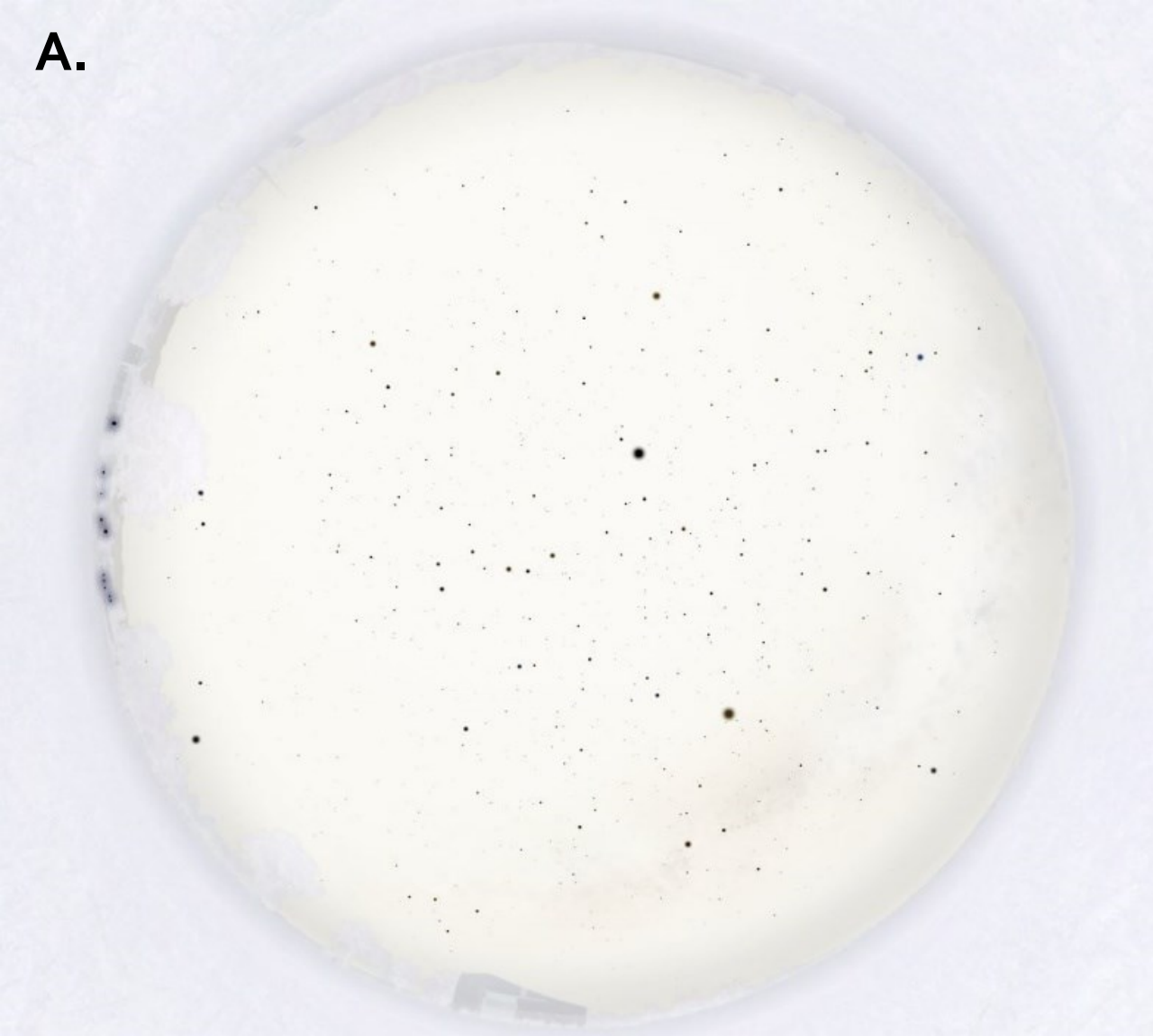
25 marks, recommended 40 mins

Instructions

- You will be given two sky charts (labelled A. and B.) in standard stereographic projection (Stellarium default) covering a full 180-degree FOV.
- Both sky charts were taken from the <u>same night</u> and <u>same location</u> at <u>different times</u>. You do not know the location which the sky charts correspond to.
- There are 11 questions in total.
- Answers are to be drawn on sky chart(s) or typed in text depending on the question.
- The star charts remain the same on all slides.

Q1. Sketch and label the Big Dipper and Polaris on both A and B. [2m]

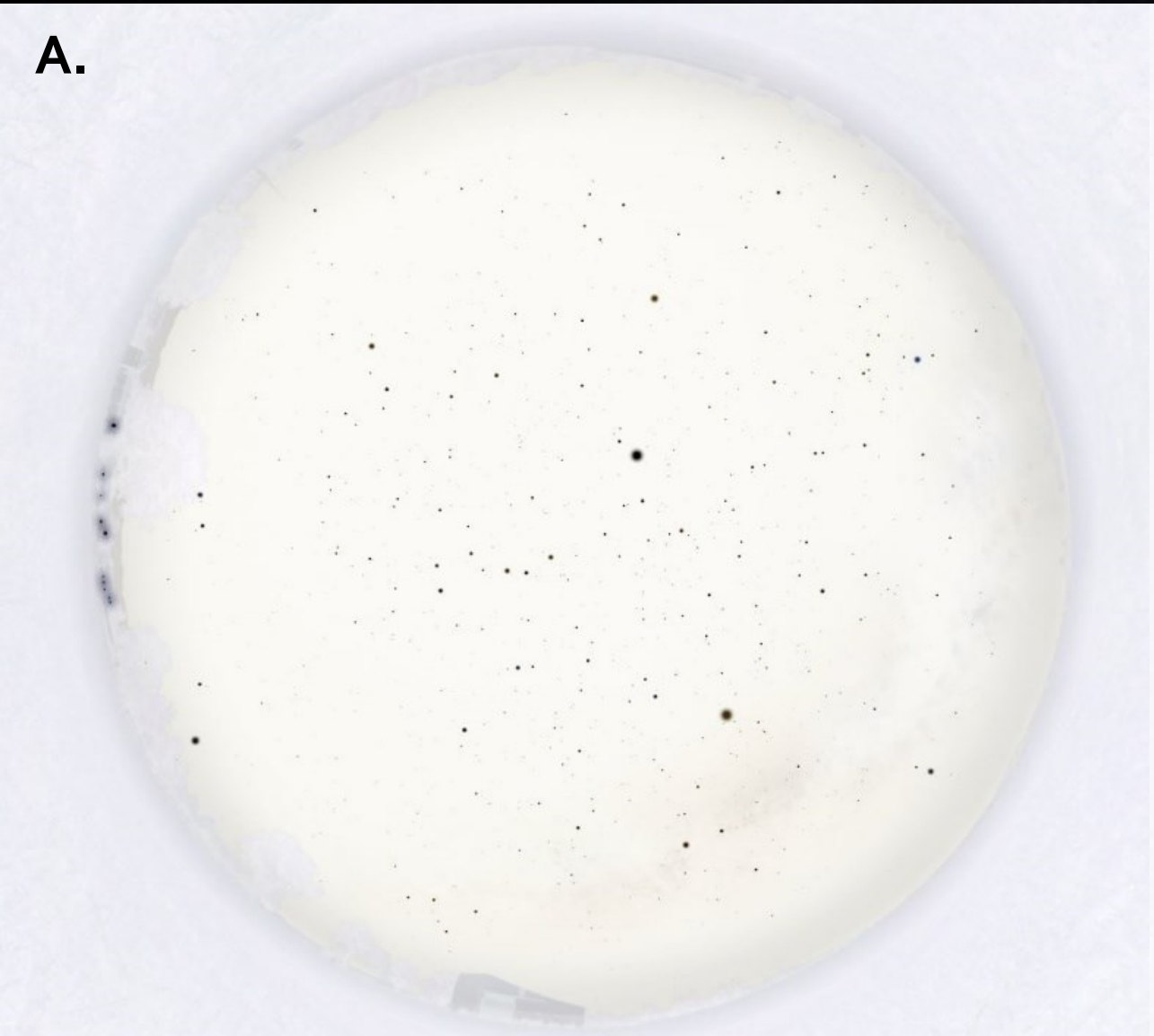
A.



B.

Q2. Sketch the rough position of the local meridian and prime vertical, labelling them with ‘LM’ and ‘PV’ respectively. [2m]

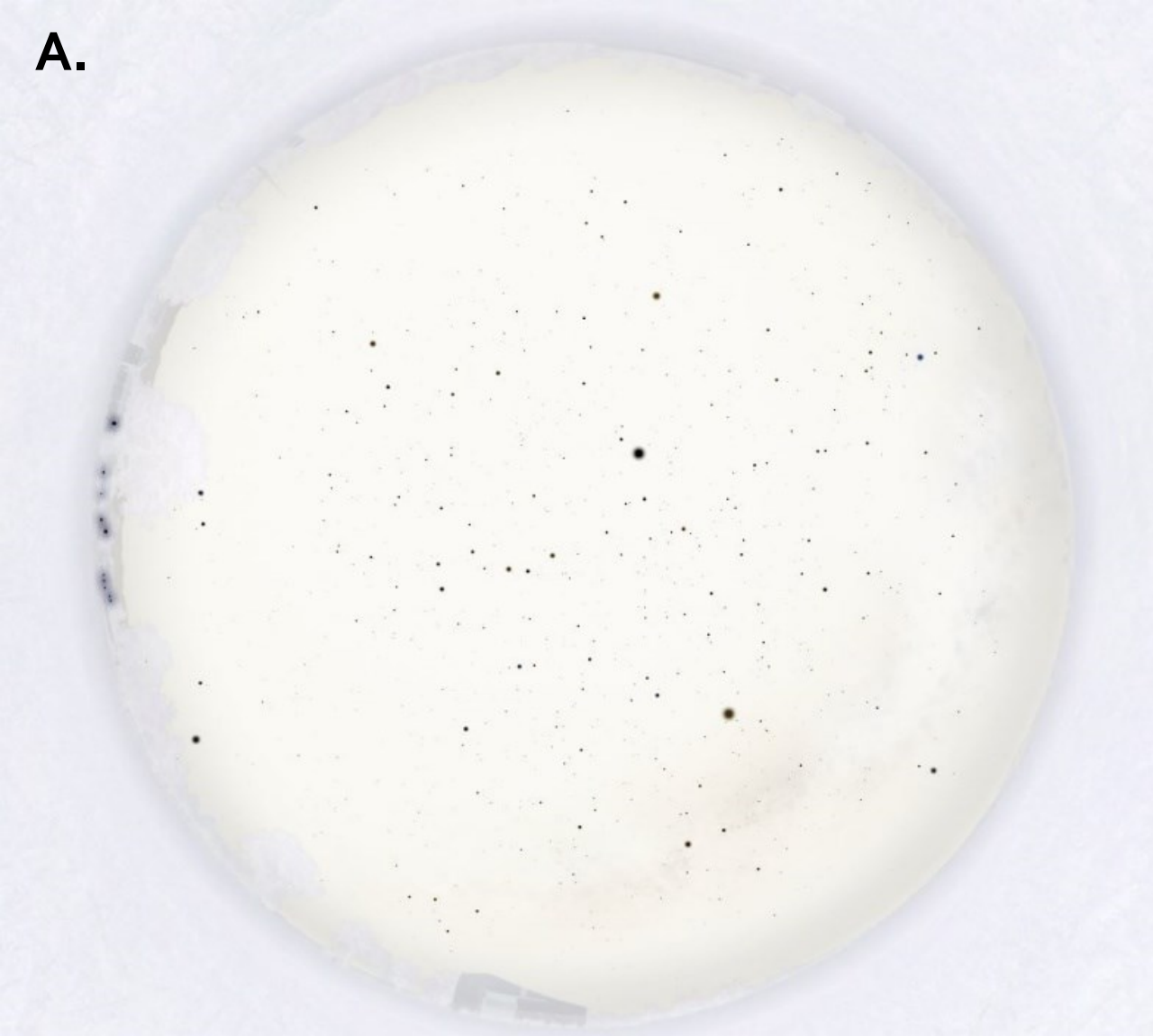
A.



B.

Q3. Determine which of the sky charts is ‘before’ and ‘after’ (within the same night) and label them accordingly. [1m]

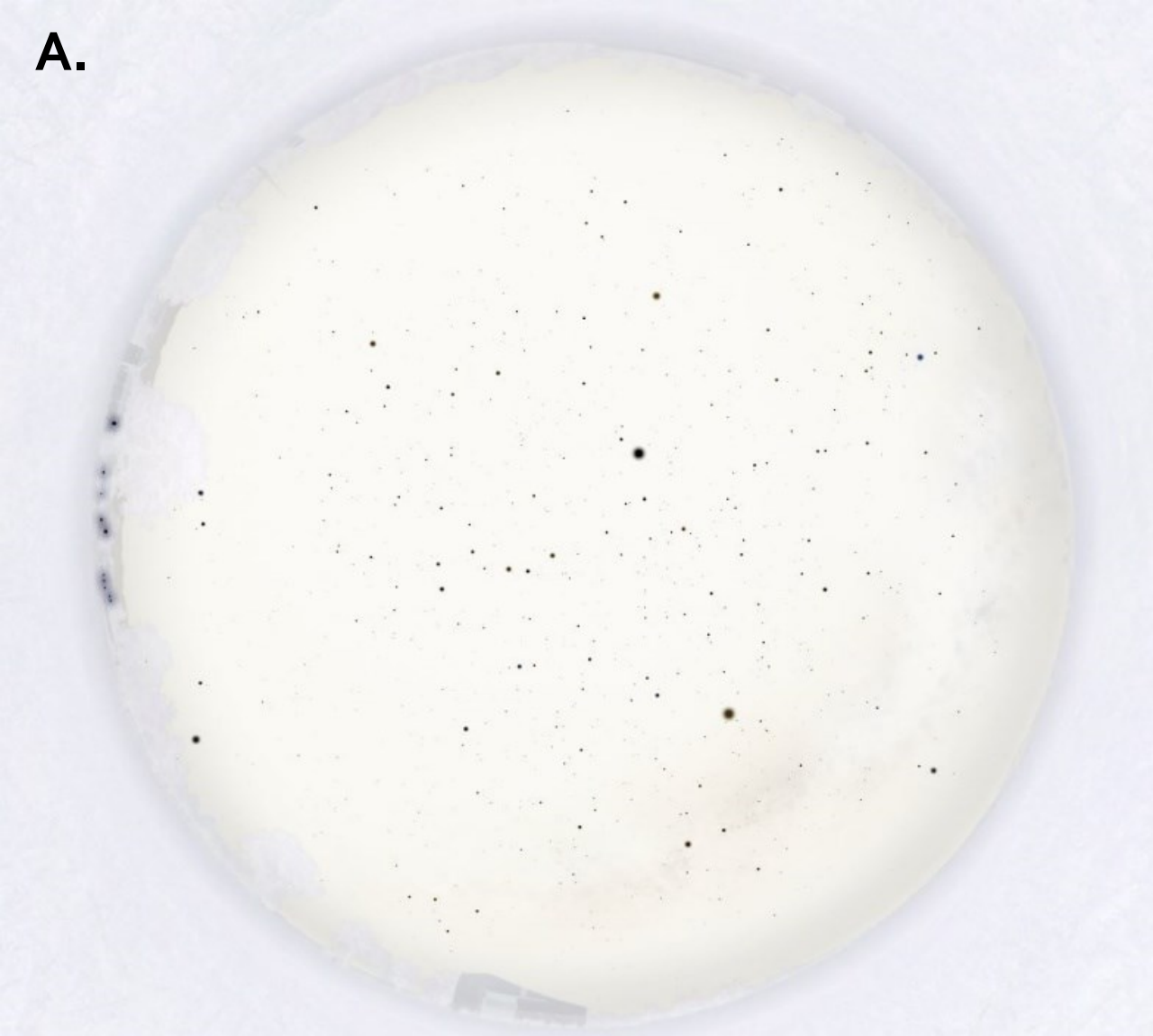
A.



B.

Q4. Estimate how much time has past between the star charts to the nearest hour. [1m]

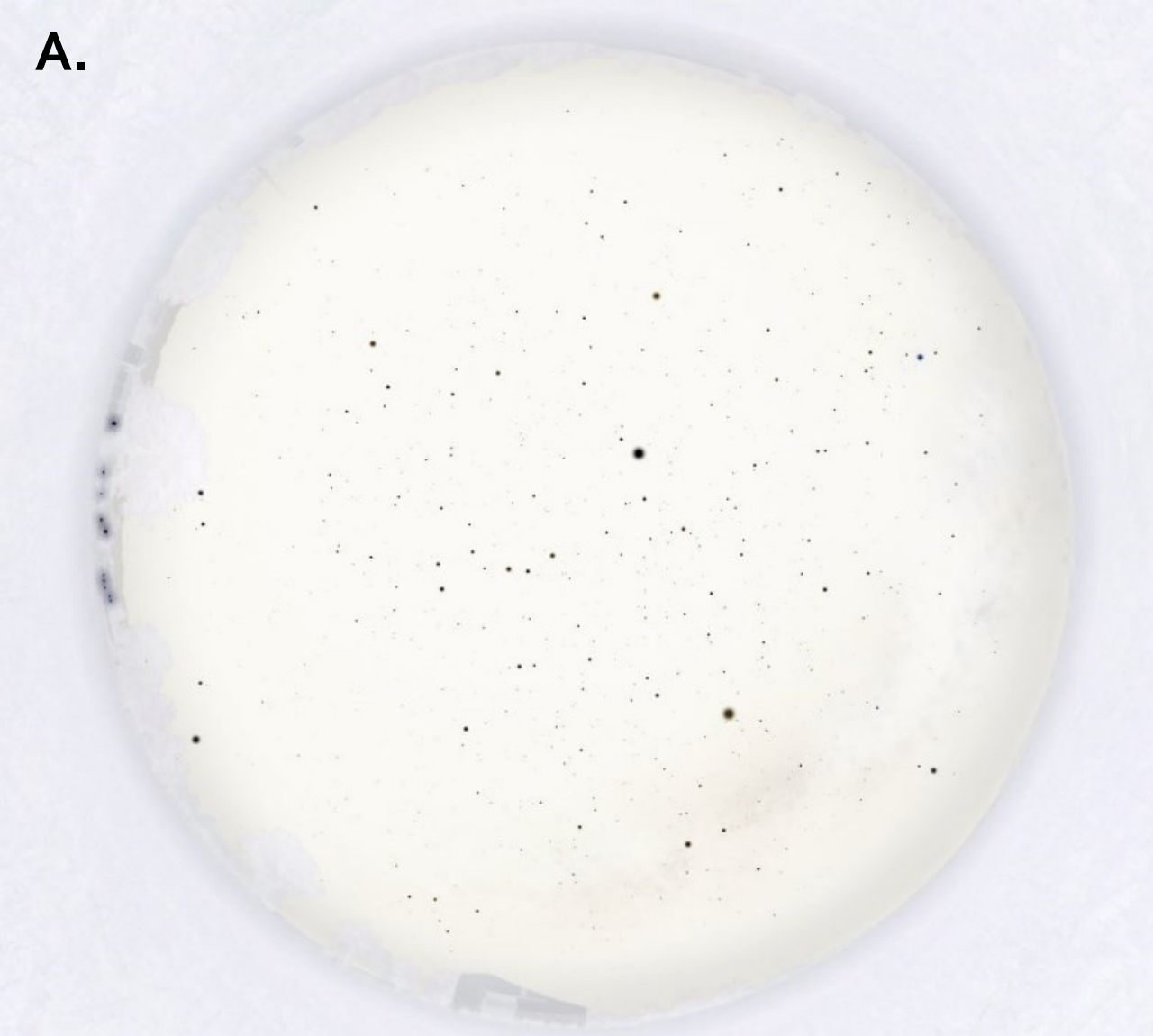
A.



B.

Q5. Name <u>any</u> 3 constellations that are circumpolar at this location. [3m]

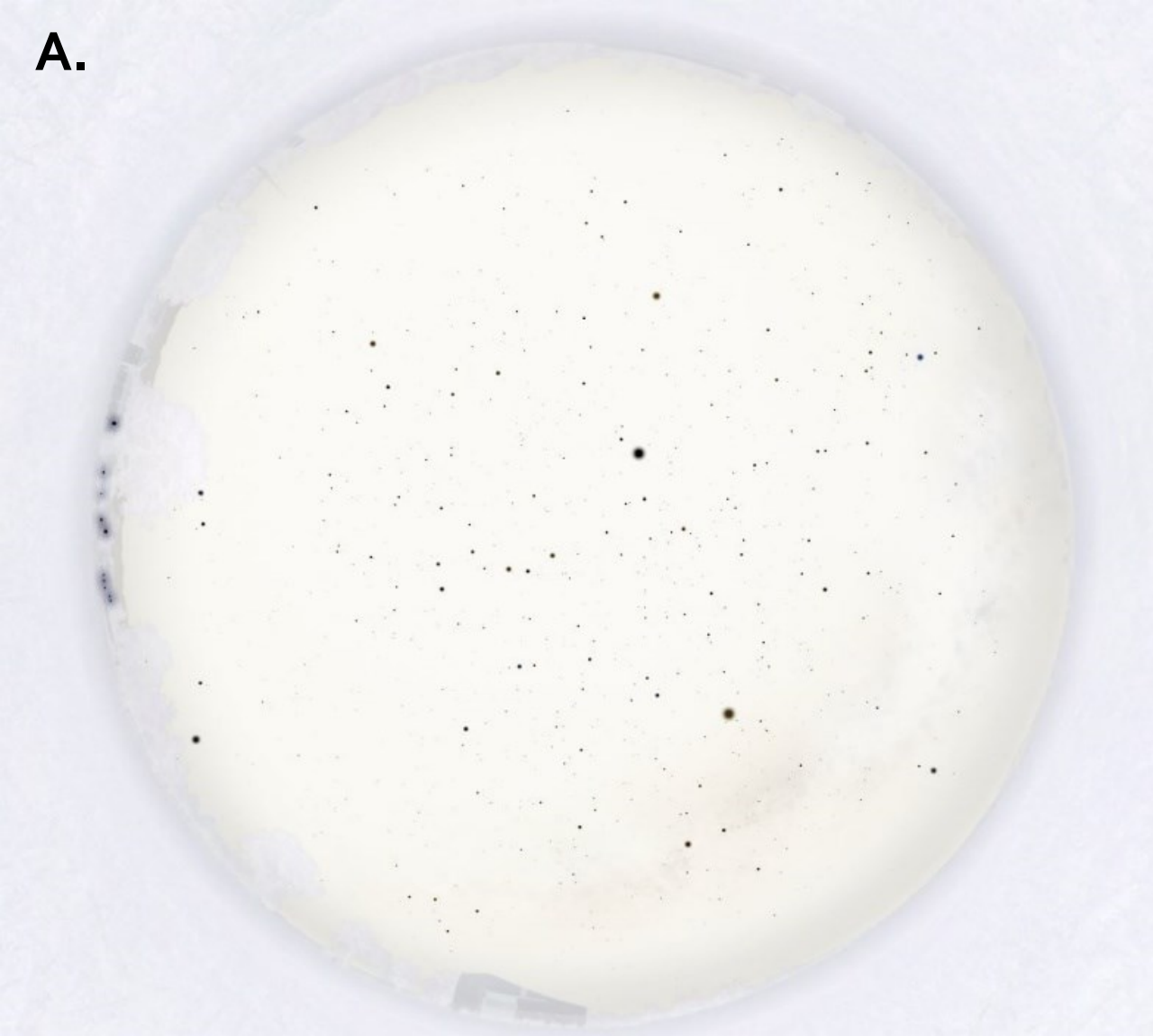
A.



B.

Q6. Sketch the rough position of the ecliptic line in both charts. [4m]

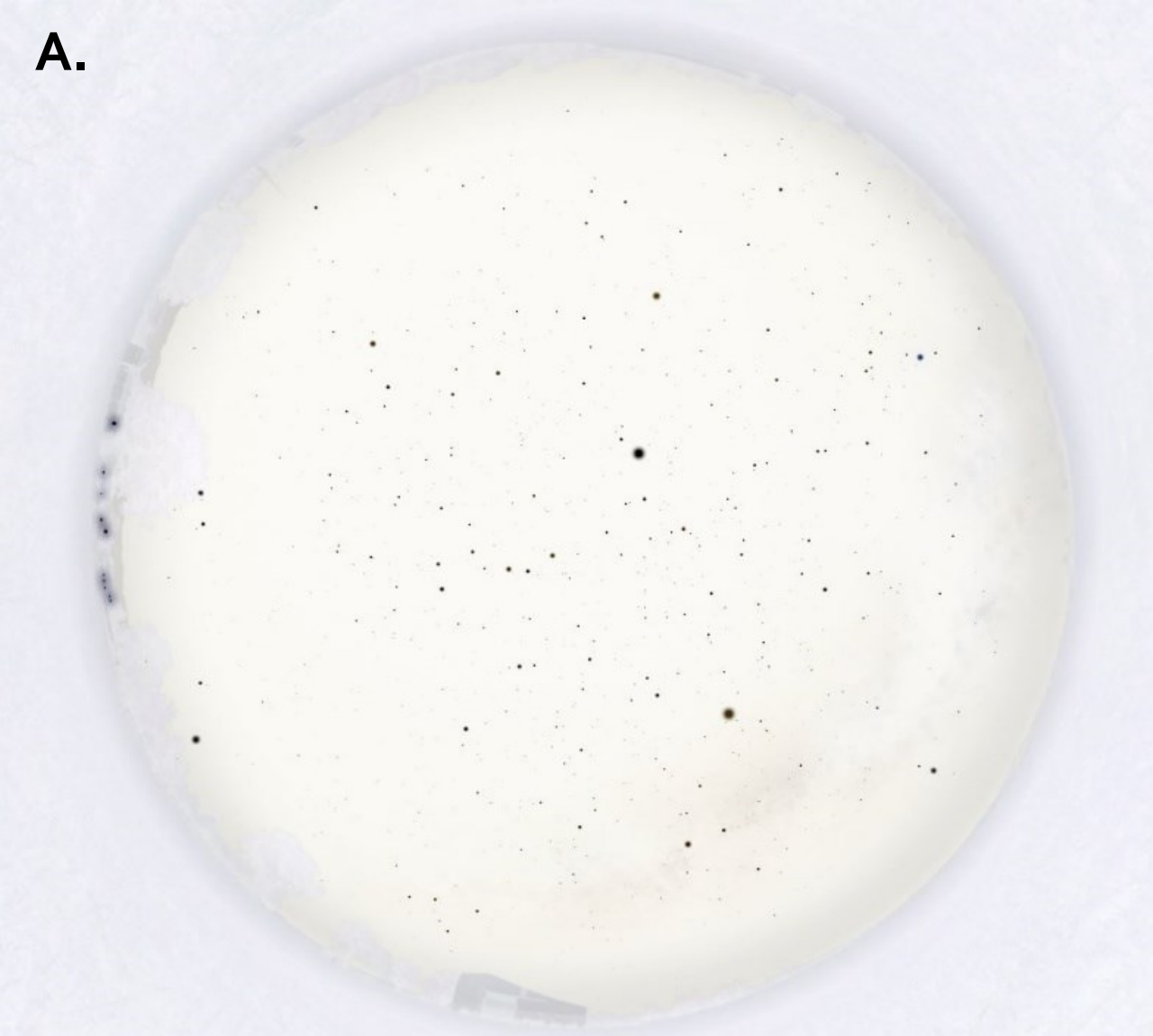
A.



B.

Q7. Circle and label any planets with ‘X’, if there are any. [2m]

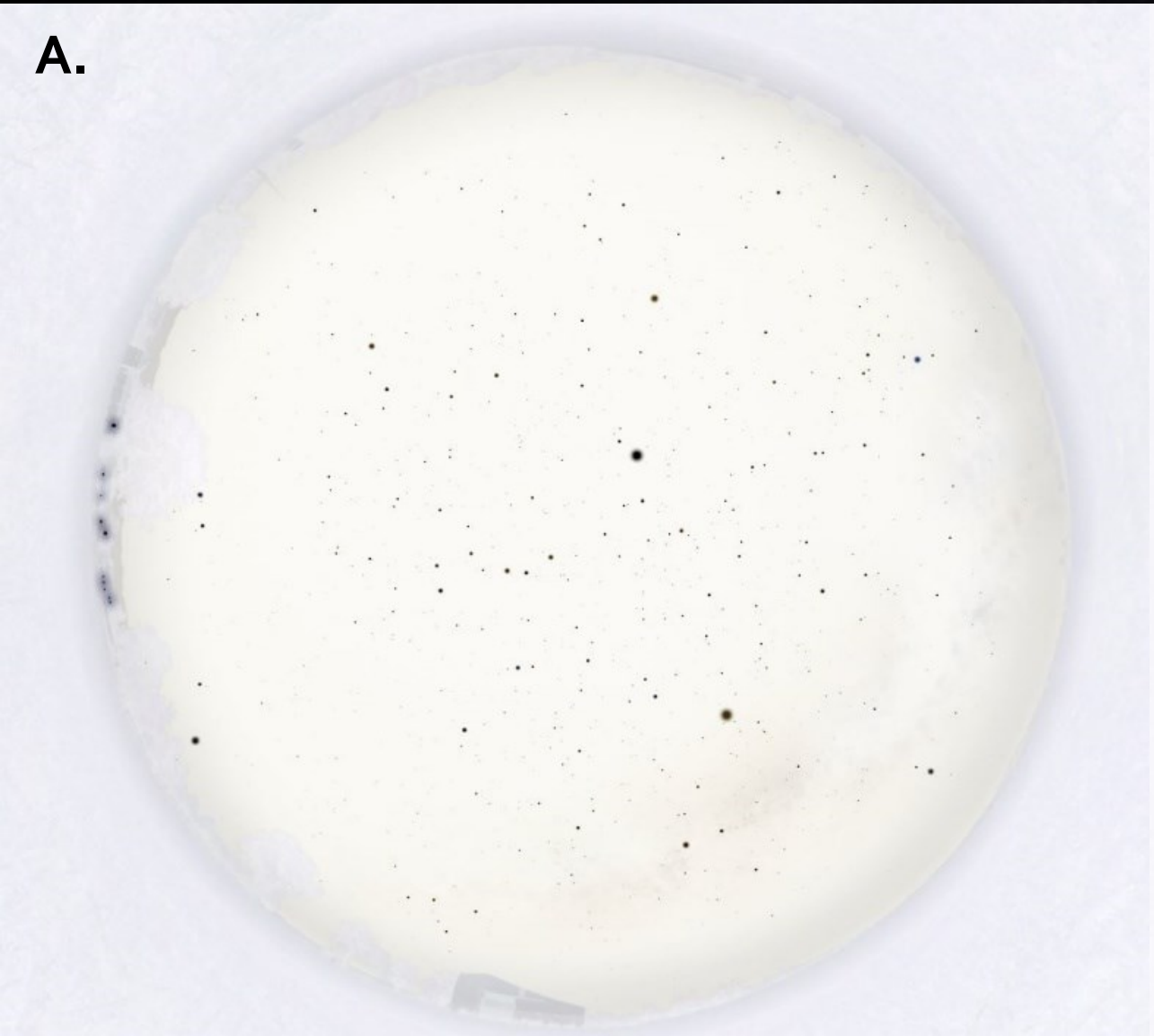
A.



B.

Q8. In the ‘before’ sky chart, mark and label the expected position of the moon if it is in the waning gibbous phase and it is currently local solar midnight. [2m]

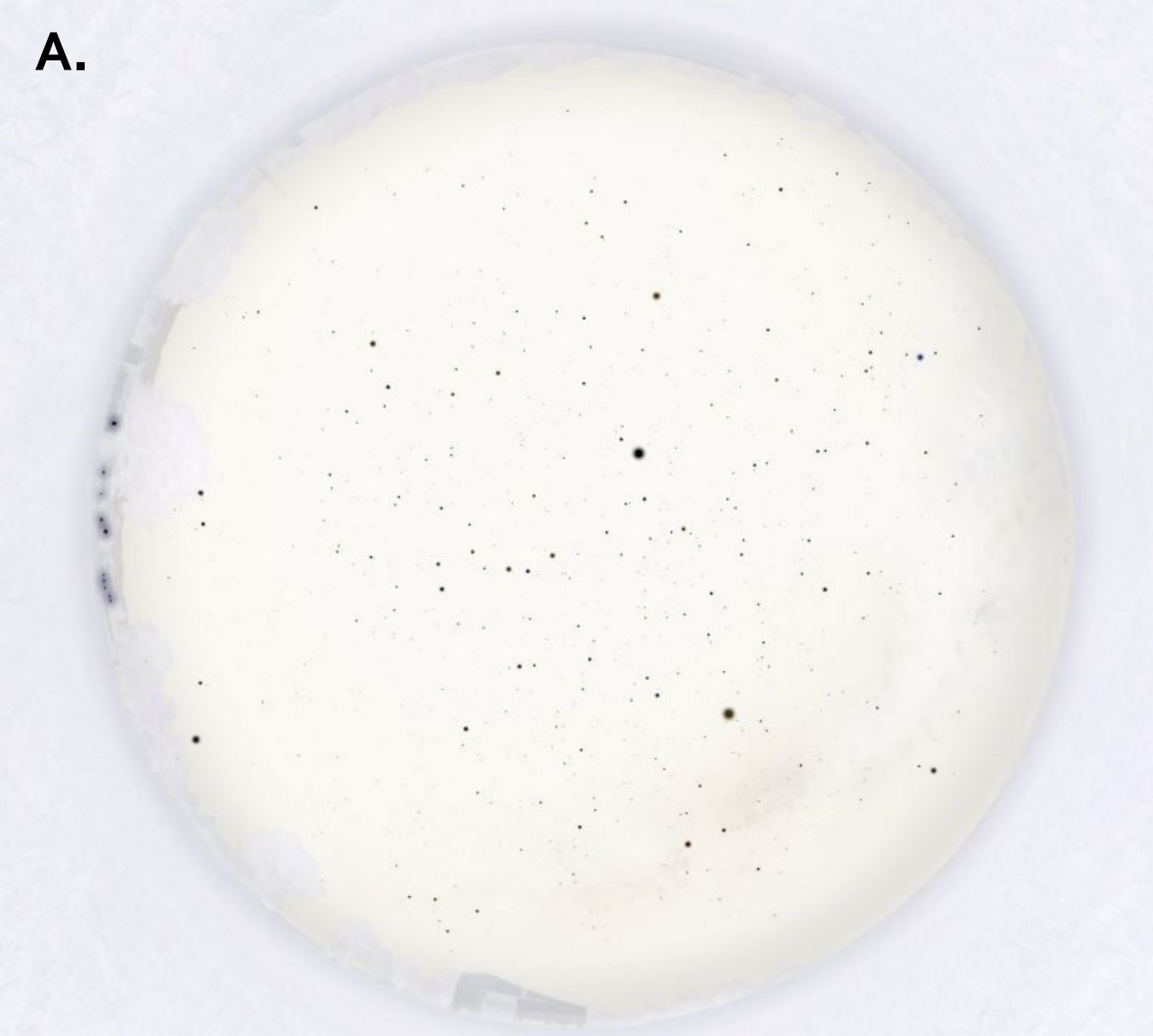
A.



B.

Q9. Hence mark and label the expected position of the moon in the ‘after’ sky chart. [2m]

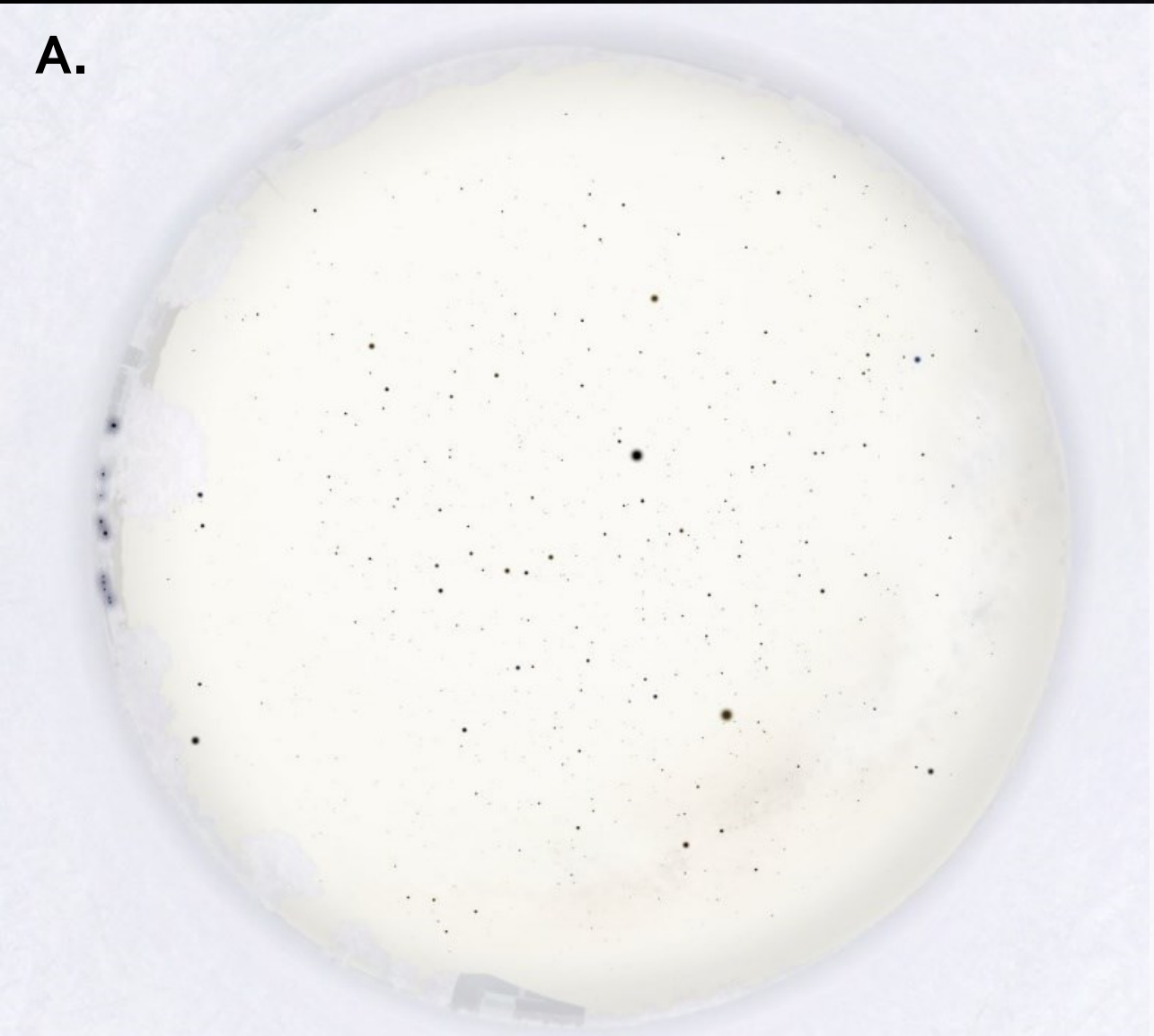
A.



B.

Q10. Circle and label the following stars in either chart with their corresponding letter: (C) Castor, (R) Regulus, (A) Arcturus, (P) Procyon. [2m]

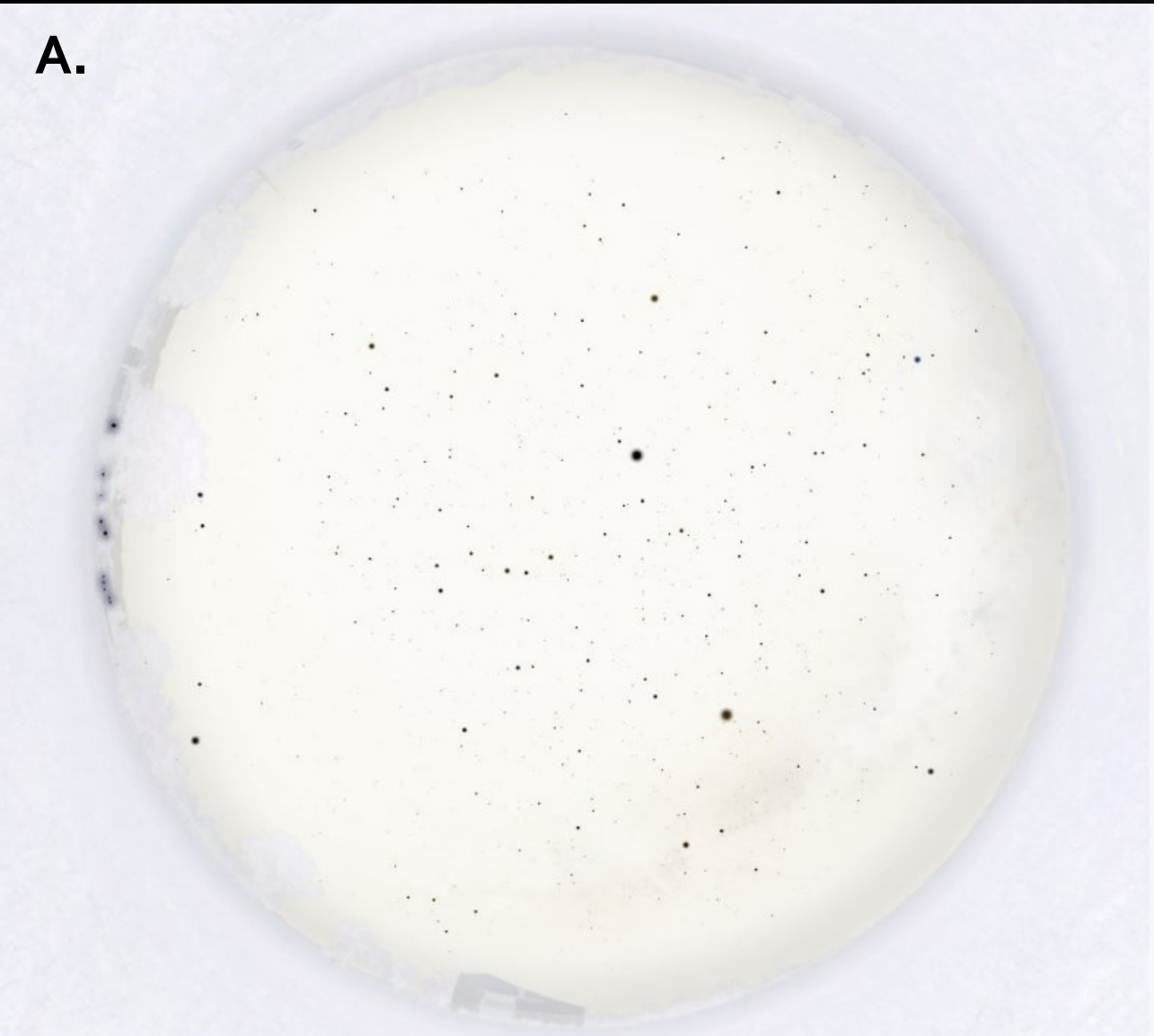
A.



B.

Q11. Circle and name 2 constellations, 2 nebulae, 2 star clusters, and 2 galaxies (not previously identified) in either chart. [2m]

A.



B.

End of Part IV

Remember to collate your answers for submission.

End of Theory Obs Paper

Please collate your answers and submit them to your invigilator.