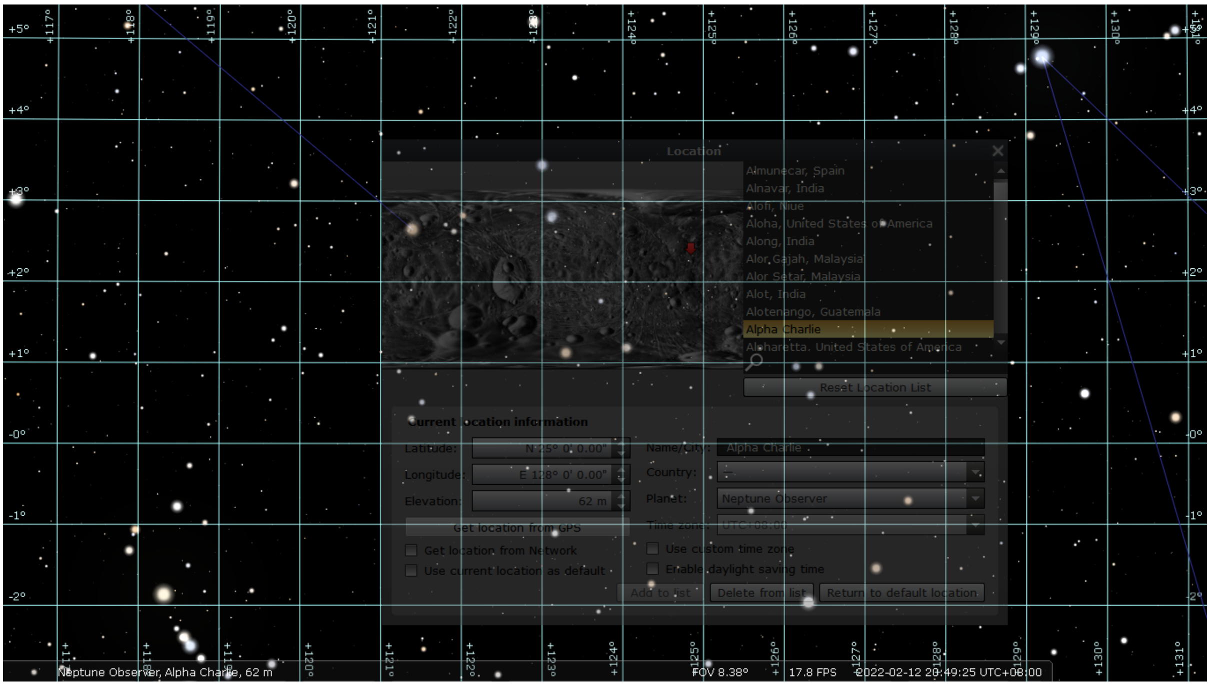
Theory Observation Round Answer Key

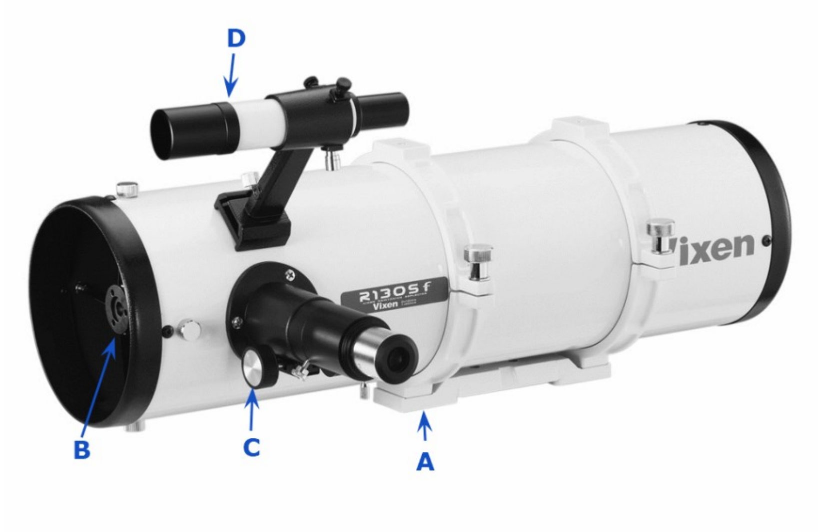
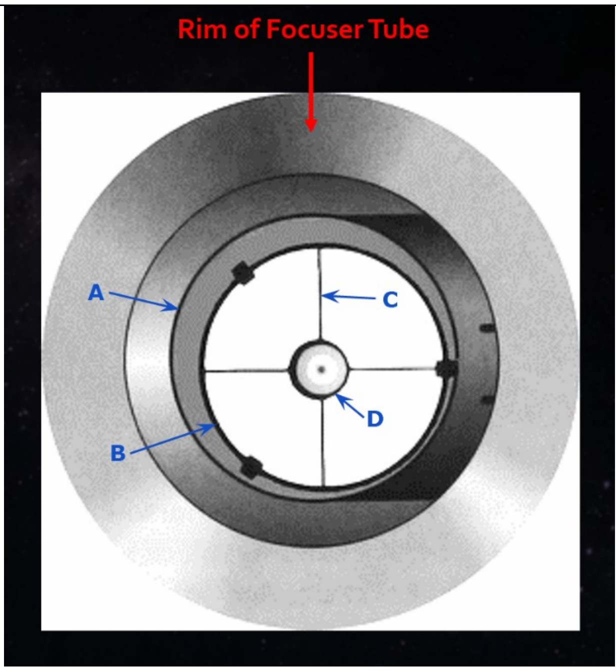
Finder Chart:



(Image is mirrored)

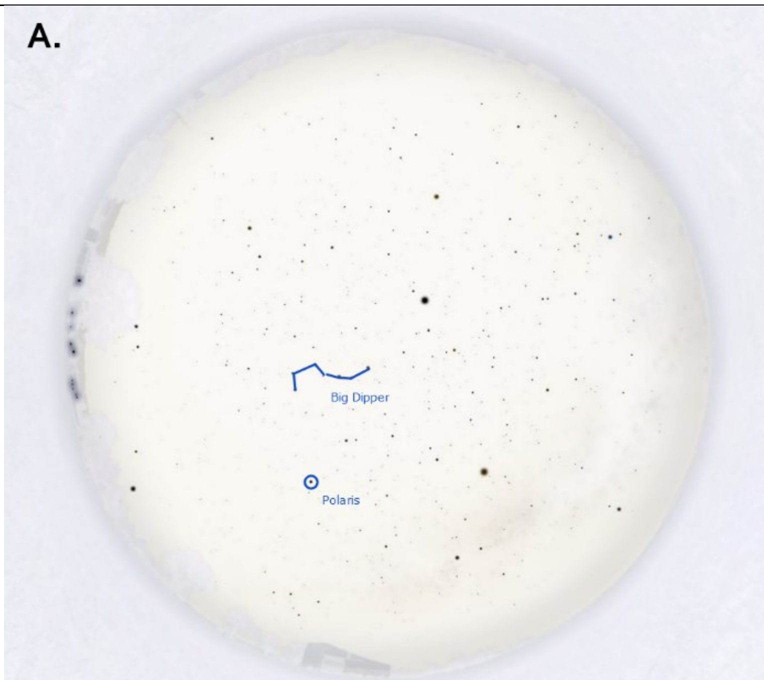
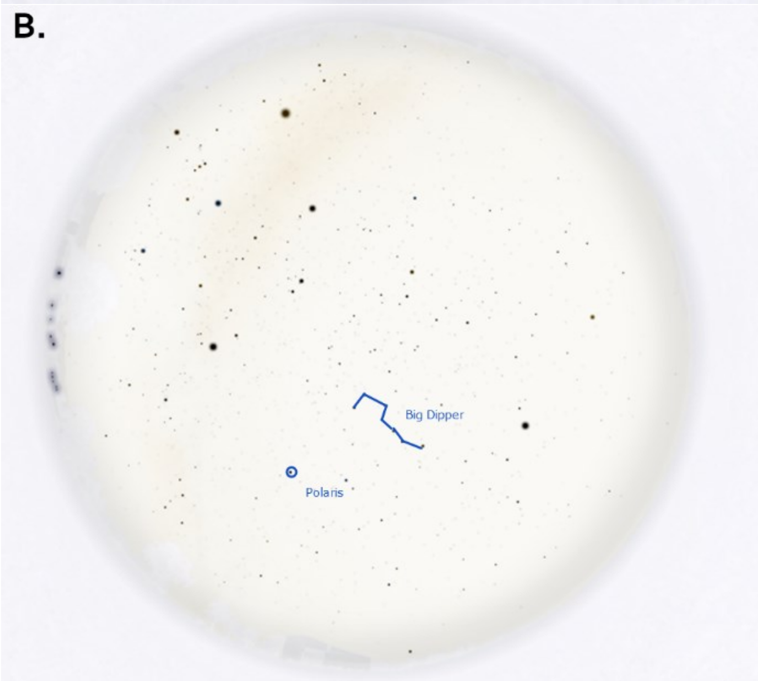
Main Section:

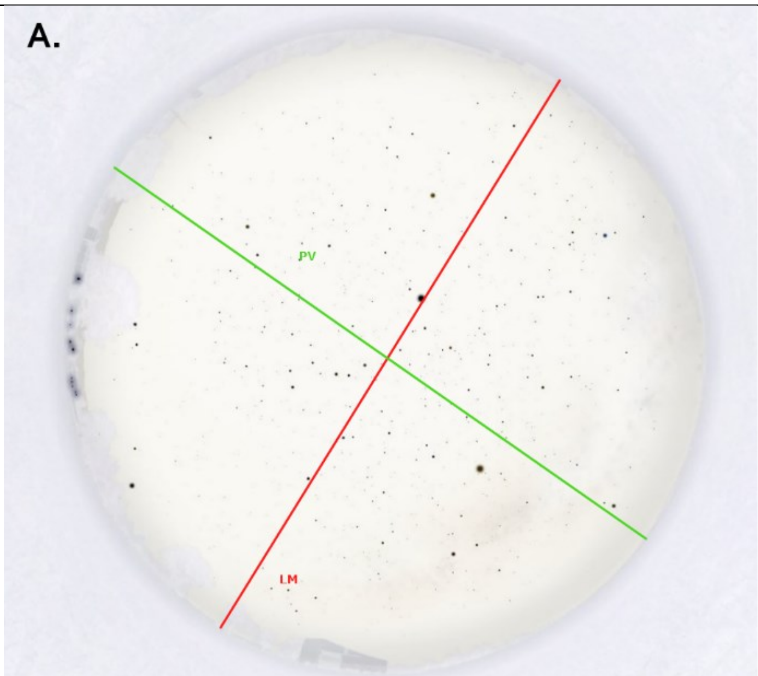
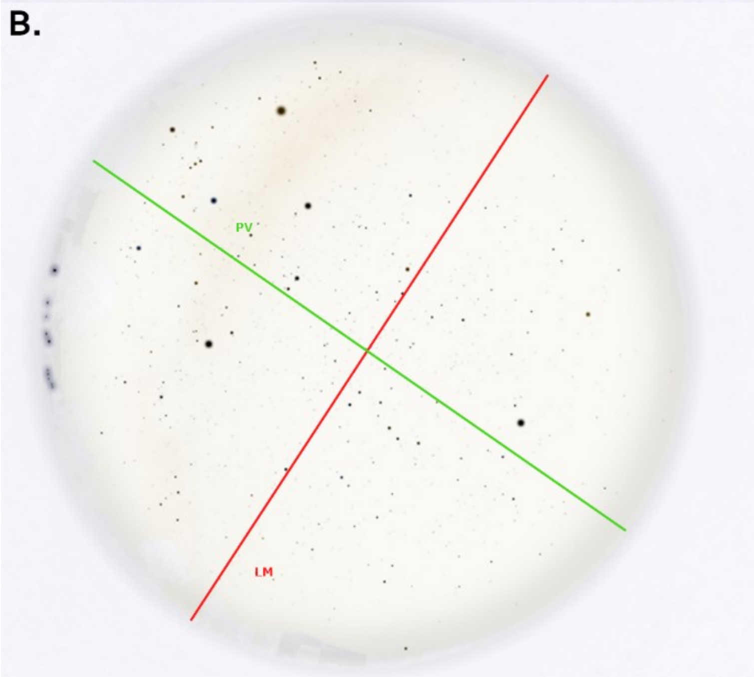
Q. No.	Answer/Explanation	Marking Criteria
Section 1		
Cloze Passage 1	A: Summer Triangle B: Lyra C: Cygnus D: Aquila E: Epsilon Lyrae/Double-Double F: Messier 57/Ring Nebula G: Albireo H: Dumbbell Nebula I: Vulpecula J: Messier 11/Wild Duck Cluster	1 mark per correct answer, 10 marks in total.
Cloze Passage 2	K: Argo Navis L: Carina M: Puppis N: Vela O: Hydra P: Centaurus Q: Crux/Southern Cross R: Jewel Box Cluster S: Diamond Cross T: False Cross	1 mark per correct answer, 10 marks in total.

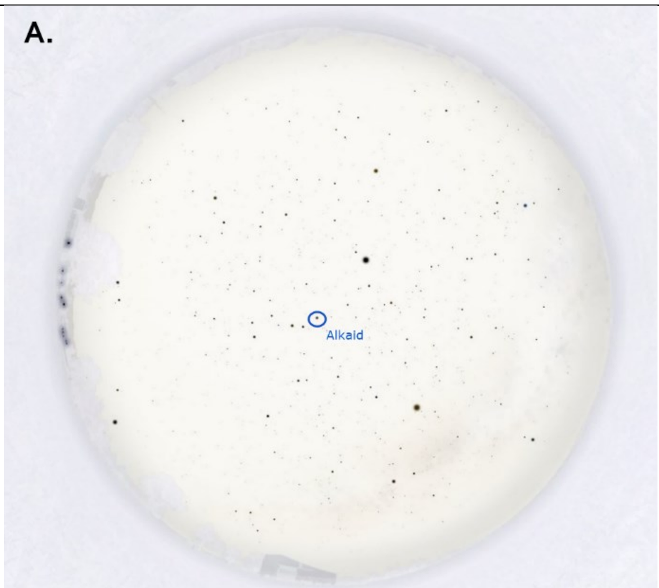
Section 3		
Q1.	 A: Dovetail B: Secondary Mirror C: Focuser Knob D: Finderscope	0.5 marks per correctly labelled part.
Q2.	Perform a star test (i.e. defocusing a star at high magnification to make the diffraction rings more visible, and then checking if the diffraction rings are aligned or off-center). Accept any other reasonable answer.	1 mark for accepted answers.
Q3.	 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	1 mark for each correctly labelled part.

	If participants label the edge of the secondary reflection (D) in the primary mirror as (A), credit was awarded for (A) only as it can be construed as a reasonable misunderstanding. Marker's comment: Participants often mislabel the white and black circles in the middle of the reflection of the secondary as the primary/secondary reflections. This is wrong as that is actually a reflection of the focuser viewport (remember that the secondary is angled at 45 degrees to the primary, so an observer at the primary mirror will not be able to see their own reflection).	
Q4.	a) Stars right in the centre of the field of view are sharp, while off-axis stars have a comet-like 'tail' that points away from the centre (m1), and the effect worsens the further the star is from the optical axis (m2). b) Stars throughout the entire field of view (m1) have a bright centre with a hazy 'halo' around it (m2). c) Different parts of the field of view come into focus at different focal distances (m1). For example, the centre of the field of view may be sharp with the edges out of focus, and by shifting the focus, we may instead get a defocused centre and a focused edge (m2).	2 marks for each part. Marking points are awarded based on information in both the written explanations and sketched diagrams.
Q5.	Spherical Aberration: • Schmidt/Maksutov Corrector Plates • Bird-Jones reflector designs • Sub-aperture correctors (e.g. Vixen's VMC system, mirror corrector built into WFPC2 for Hubble) • Increasing the focal length of the system • Parabolic/Hyperbolic mirror designs (not ideal but accepted as an answer) Field Curvature: • Field Flatteners • Curved CCD arrays (often used for large observatories with fast designs that inherently have significant field curvature) • Increasing the focal length of the system *At least two non-repeating points, each addressing one aberration for full credit to be awarded. Accept any other reasonable answers.	1 mark per accepted answer.
Q6.	A: False. A Bahtinov mask is used to achieve fine focusing especially for astrophotography.	1 mark for correct

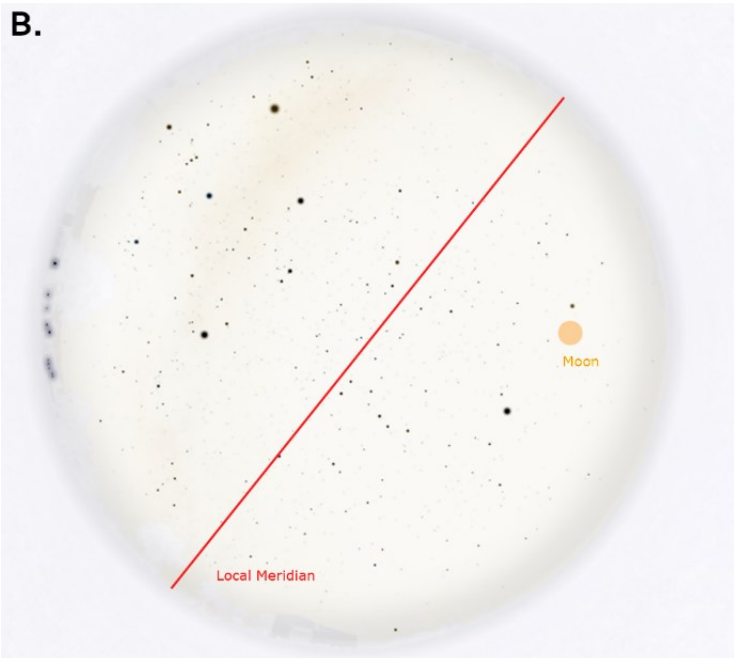
	B: False. Monochrome CCD cameras are indeed typically more light-sensitive; however we commonly use them in conjunction with filter wheels to take color images, or to image specific wavelength bands in astrophotography. C: False. Field de-rotators are physical motors which rotate the image train at the same rate as the calculated field rotation and are often used in large modern observatories. For post-processing, specialized image deconvolution algorithms may mitigate effects of field rotation in long exposure images, but their effectiveness is highly limited. D: True. The brightness of an image is limited by the pupil size of the observer. If the exit pupil is larger than the pupil of the observer, the extra light is effectively 'lost'. Marker's comment: Common misunderstanding that brightness is solely determined by the aperture of the optical system because it determines the total light entering the system. Note that not all light entering the aperture makes it to your eye. Only a fraction of it within a certain angle (aka your True FOV) will travel through the binoculars and form the exit pupil. Image brightness (and pupil size) are thus related to the magnification of the optical system; aperture mainly affects image brightness at a particular scale of magnification. E: True. A temperature differential between the primary mirror and its environment will cause convection currents in air, which distorts incoming light.	True/False, 1 mark for correct explanation.
Section 4		

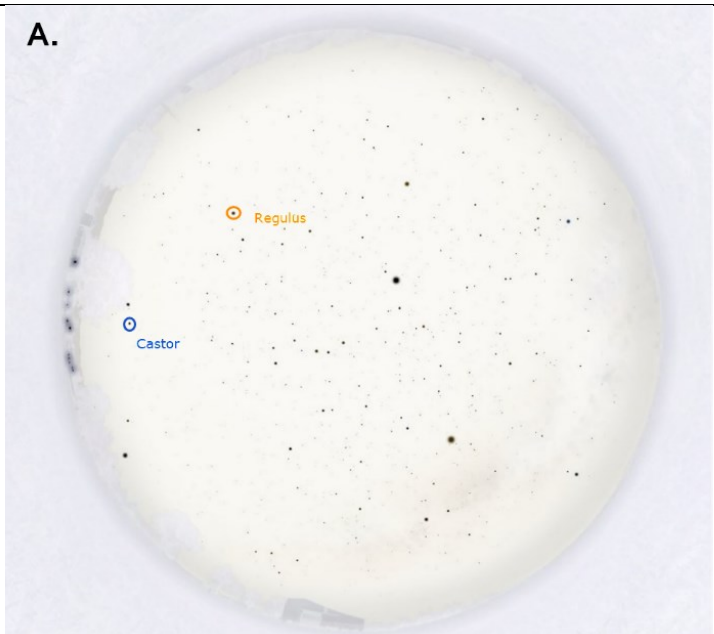
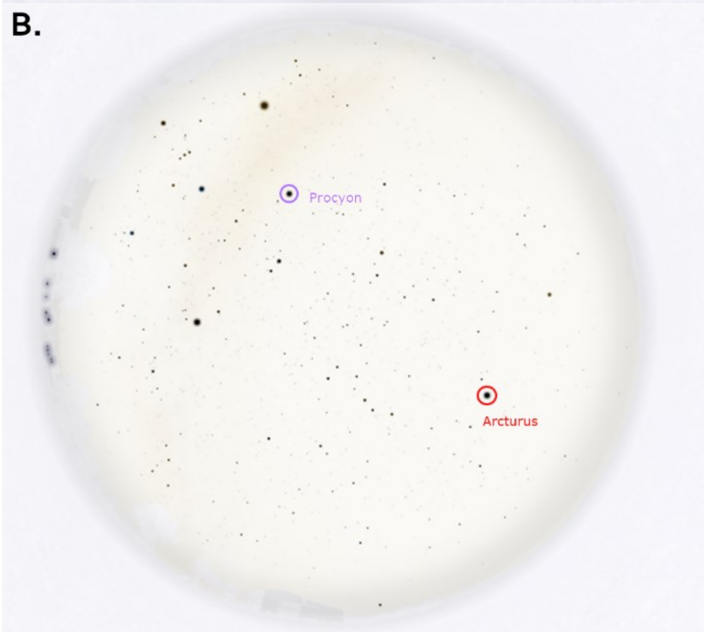
Q1.	 		0.5 marks for each correctly drawn & labelled object in each star chart.

Q2.	 	0.5m for each correct local meridian/ prime vertical in each star chart.
Q3.	B: Before, A: After. This is because the sky rotates counterclockwise around the North Celestial Pole (marked by Polaris).	1 mark for correct assignment.
Q4.	By using the Big Dipper as a ‘clock hand’ (extending a line from Merak and Dubhe towards Polaris) and eyeballing the change in angle between star charts, the angle of rotation of the sky is between 45 deg and 90 deg. Thus accepted range 3-6 hours.	1 mark for correct value.

Q5.	 Alkaid is very close to the zenith point in the chart. W may thus estimate for the declination of the zenith point to be around 50°N (or slightly less, if participants choose to correct for Alkaid being slightly north of the zenith point). This angle is exactly the local latitude.	Marks are awarded for correct reasoning rather than accurate number.
Q6.	Possible answers: Ursa Major, Ursa Minor, Cassiopeia, Cepheus, Canes Venatici, Draco, Camelopardalis.	1 mark per accepted constellation.
Q7.		1 mark per correctly annotated star chart.

	B.  The Ecliptic line should be curved, passing through the ecliptic constellations, and cutting the horizon at opposite ends.	
Q8.	The Ecliptic will never be a straight line for a sky chart at this latitude. For a great circle (ecliptic) to appear as a straight line in stereographic projection, it has to pass through the zenith (m1). This only happens when the point(s) on the ecliptic with a declination equal to your latitude are directly overhead. However, since the local latitude is estimated to be around 40°N to 50°N, the ecliptic never crosses the zenith as this location (m2).	Marking points are for correct explanations.
Q9.	There are no planets in either star charts. Note that participants should claim 'no planets' or submit a blank star chart in their answer document to count.	
Q10.	The moon is expected to be east of the local meridian, around the constellation Virgo close to the ecliptic.	

		
Q11.	The moon should be in roughly the same location with respect to the background stars. 	

Q12.	 	0.5 marks per correct star.
Q13.	Any correct answers that were not repeated in an earlier question.	0.5 marks per correct item.