Observing competition – night round

Instructions

1. There are 2 questions, each worth 25 points. You have **80** minutes to solve them, of which :
   (a) **25** minutes for reading the question and preparing for the observations,
   (b) **30** minutes to perform all the observations at the telescope (for both questions),
   (c) **25** minutes for calculations and finishing your work.

2. Additional time is allowed to move to and from the observing site.

3. Along with the questions you will receive a map of the sky, for use with both questions.

4. At the observing site you will find ready :
   (a) a refracting telescope with a right-angle mirror and an eyepiece with an illuminated reticle, which can be rotated about the optical axis,
   (b) a red torch, stopwatch, pencil, eraser and clipboard,
   (c) a chair.

   Note: the telscope is already aligned – do not change the position of the tripod!

   The brightness of the reticle can be adjusted by turning the on-off switch.

5. You are allowed to take only the questions, answer sheet and blank paper for additional work with you to the telescope.

6. Only the answer sheet will be assessed. The additional worksheets will not be assessed.

7. Clearly mark every page of the answer sheet with your code number.

8. If you have difficulty with the equipment (not related to the question) or disturb the alignment of the telescope, call an assistant.

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1. The Little Dolphin

An asterism known as the Little Dolphin lies near a line connecting the stars α Peg (Markab) and β Peg (Scheat). It is marked with a cicle on the large-scale map.

The map also shows the constellation of Delfinus, the Dolphin, with the brightest stars labelled with their Bayer designations (α, β, γ, δ and ε).

The coordinates of α and β Peg and the Little Dolphin (in right ascension order) are:

	Right Ascension α	Declination δ
Little Dolphin	$23^{h}\,02^{m}$	+23.0 º
β Peg	$23^{h}\,04^{m}$	+28.1 º
α Peg	$23^{h}\,05^{m}$	+15.2 º

Based on your observations, make two drawings on the answer sheet :

On Drawing 1 :

Draw the view of the constellation **Delphinus** (Del) as seen through the finder scope. Include as many stars as you can see in the field of view.

With an arrow, mark the apparent direction of motion of the stars across the field of view of the finder scope caused by the rotation of the Earth.

Label the stars with the Bayer designations given on the map (α, β, γ, δ and ε).

Also label the brightest of these 5 stars "m_{max}".

Also label the faintest of these 5 stars "m_{min}".

On Drawing 2 :

Draw the view of the **Little Dolphin** as seen through the larger telescope. Include as many stars as you can see in the field of view.

With an arrow, mark the apparent direction of motion of the stars across the field of view of the telescope caused by the rotation of the Earth.

Label the stars of the Little Dolphin α′, β′, γ′, δ′ and ε′ such that they match the labels of the stars in the constellation Delphinus as given on the map.

Label the brightest of these 5 stars "m_{max}".

2. Determining declination

The two pictures on the next page show a small asterism, as seen directly on the sky and as a mirror image. Three stars are labelled: S1, S2 and S*x*. The position of the asterism is also marked with a rectangle on the larger-scale map of the sky.

Find this asterism and point your telescope to it.

Using the illuminated reticle as a fixed reference point, and the stopwatch, measure the time taken for the stars S1, S2 and *Sx* to move across the field. You may rotate the eyepiece so that the cross-hairs of the reticle are in the most convenient position for your measurement.

Use your measurements and the known declinations of stars S1 and S2 as given below to determine the declination of star *Sx*.

On the answer sheet, give your measurements and working, and estimate the random error in your result.

For each set of measurements you make, draw the view through the eyepiece on the answer sheet. (Use the blank circular field on the answer sheet.)

Mark the drawing with the compass directions N and E. Draw the reticle and the tracks of the stars to show the motion which you timed using the stopwatch.

Mark the ends of each timed track and show which time measurement refers to which track – for example, for measurement "T1" marking the ends "Start T1" and "End T1".

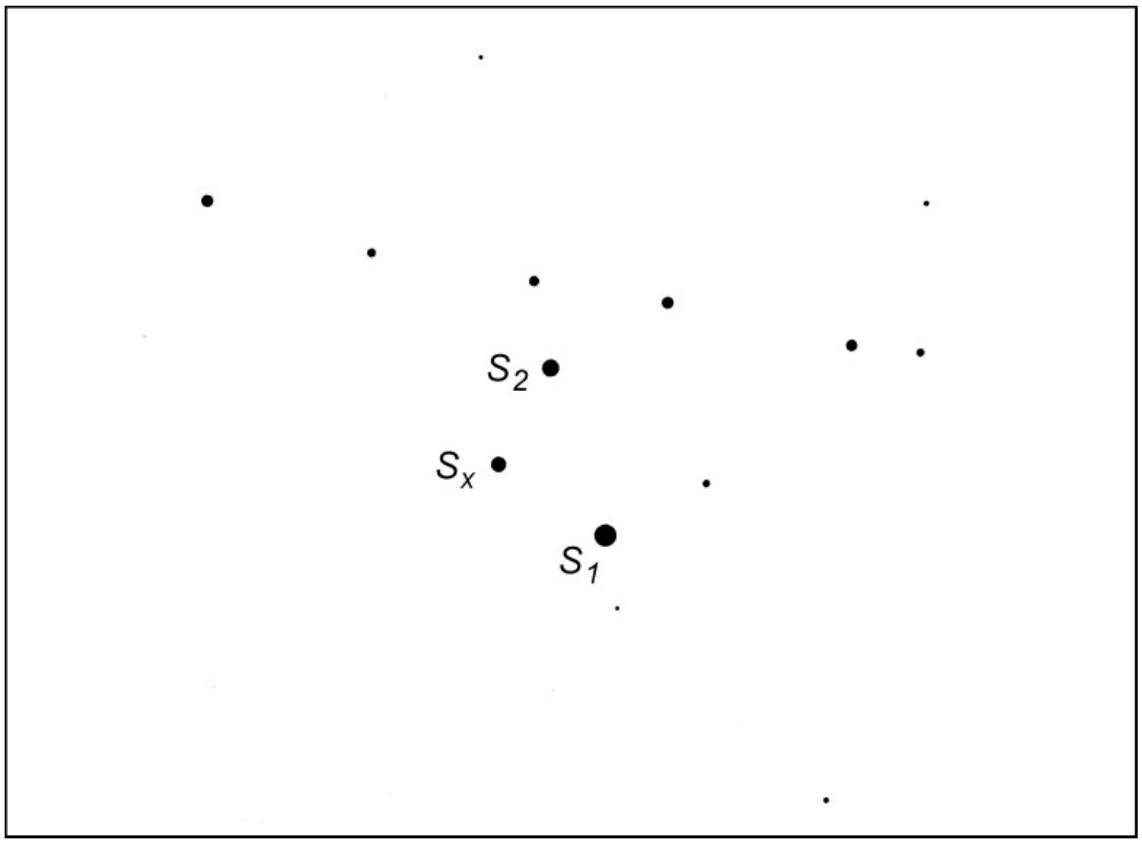
The angle of the reticle can be easily adjusted by rotating the eyepiece around its optical axis. If you change the angle of the reticle for a new measurement, draw a new diagram.

The declinations of the field stars S1 and S2 are :

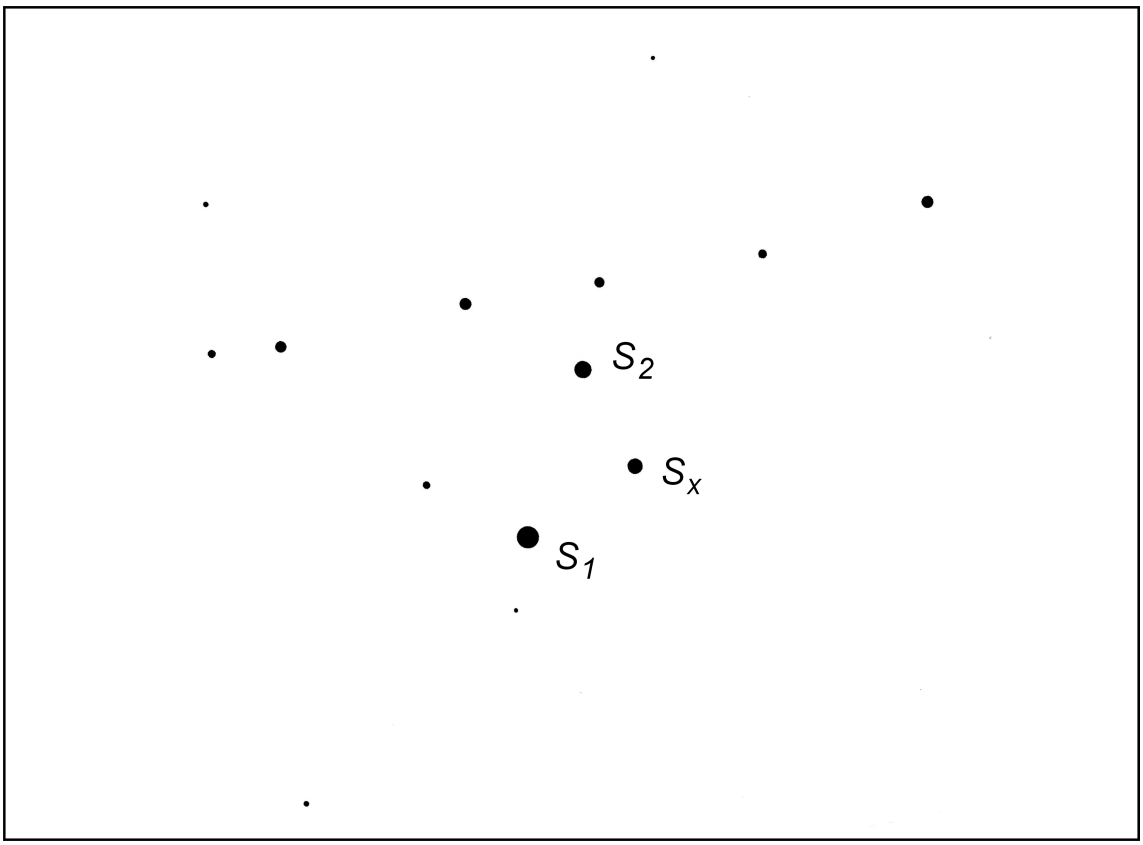
S_1 : $\delta = +19^\circ\,48'\,18''$ S_2 : $\delta = +20^\circ\,06'\,10''$

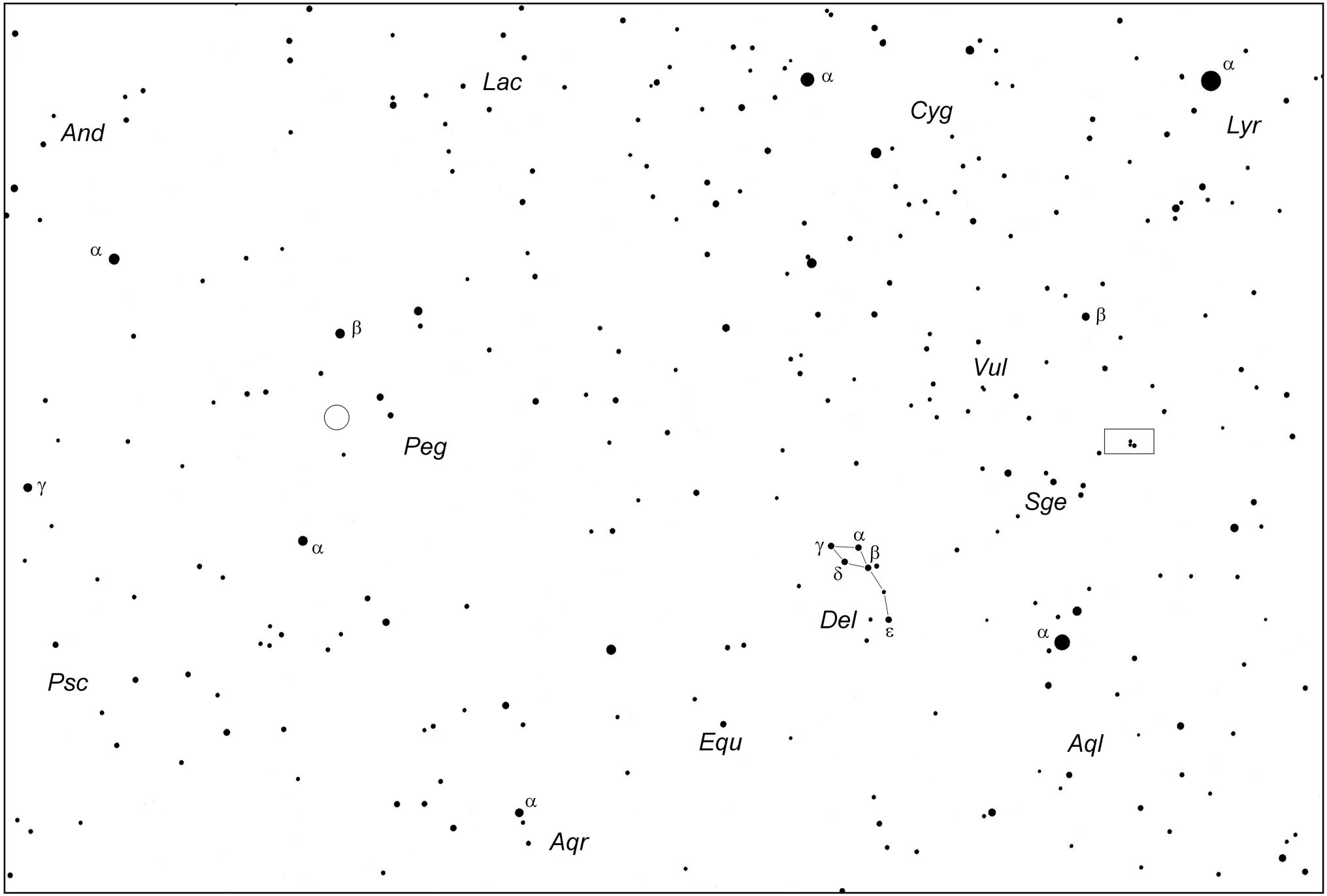
Assume that: $\delta(S_2) > \delta(Sx) > \delta(S_1)$.

Direct view:



Mirror image:




And
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Observing competition – planetarium round

General instructions

1. There are 2 questions, each worth 25 points. You have **80** minutes to solve them, of which :

   (a) **20** minutes for reading the question and preparing for the observations,

   (b) **40** minutes to perform all the observations in the planetarium (20 minutes for each questions),

   (c) **20** minutes for calculations and finishing your work.

2. Additional time is allowed to move to and from the planetarium.

3. Along with the questions you will be given a map of the sky, for use with both questions. The map is for epoch J 2000.0, using a polar projection with a linear scale in declination, and covers stars down to about 5th magnitude. You will also be given paper for working and notes, writing implements, a pencil sharpener and an eraser.

   Please take everything from the desk in the first room with you to the planetarium dome, as you will be going to a different room afterwards to finish your work.

4. At your place in the dome you will find a torch and clipboard. Please leave these two items behind for the next contestant.

5. Only answers given in the appropriate places on the question sheet and on the map of the sky will be assessed. The additional worksheets will not be assessed.

6. Clearly mark every page with your code number.

About the questions

In Question 1 :

1. The sky is stationary, the observer is on the surface of the Earth.

2. Visible on the sky are: a comet, the Moon and a nova of about 2nd magnitude.

3. From the 11th minute, a grid representing horizontal coordinates will be projected on the sky, and will remain on until the end of the question.

In Question 2 :

1. Four consecutive days on the surface of Mars will be shown.

2. There is a Martian base visible on the horizon.

3. During the Martian daytime the sky will be slightly brightened.

4. The moons of Mars and the other planets will not be displayed.

5. The local meridian will be continuously visible on the sky.

Note: Azimuth is counted from 0º to 360º starting at S through W, N, E.

Observing competition – planetarium round

1. Earth

A) On the map of the sky, mark (with a cross) and label the nova (mark it "N") and the Moon (mark it with a Moon symbol) and draw the shape and position of the comet.

B) In the table below, circle only those objects which are above the astronomical horizon. Note: you will lose 1 point for every incorrect answer.

M20 – Triffid Nebula	o Cet – Mira	δ CMa – Wezen
α Cyg – Deneb	M57 – Ring Nebula	β Per – Algol
δ Cep – Alrediph	α Boo – Arcturus	M44 – Praesepe (Beehive Cluster)

C) When the coordinate grid is visible, mark on the map the northern part of the local meridian (from the zenith to the horizon) and the ecliptic north pole (with a cross and marked "P").

D) For the displayed sky, give the :

geographical latitude of the observer : $\varphi =$ . . . . . ,

Local Sidereal Time : $\theta =$ . . . . . ,

time of year, by circling the calendar month :

Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec.

E) Give the names of the objects, whose approximate horizontal coordinates are :

azimuth $A_1 = 45°$ and altitude $h_1 = 58°$: . . . . . ,

azimuth $A_2 = 278°$ and altitude $h_2 = 20°$: . . . . . .

(If you can, use Bayer designations, IAU abbreviations and Messier numbers or English or Latin names.)

F) Give the horizontal coordinates (azimuth, altitude) of :

Sirius (α CMa) : $A_3 =$ . . . . . ; $h_3 =$ . . . . . .

The Andromeda Galaxy (M 31) : $A_4 =$ . . . . . ; $h_4 =$ . . . . . .

G) Give the equatorial coordinates of the star marked on the sky with a red arrow :

$\alpha =$ . . . . . ; $\delta =$ . . . . . .

2. Mars

H) Give the areographic (Martian) latitude of the observer : φ = ...

I) Give the altitudes of upper (h_u) and lower (h_l) culmination of :

Pollux (β Gem) : h_u = ... ; h_l = ... ,

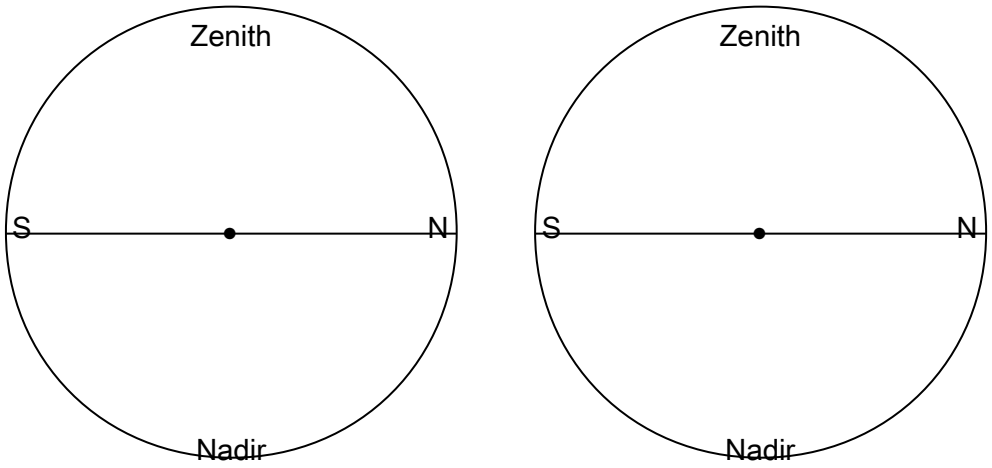
Deneb (α Cyg) h_u = ... ; h_l = ... ,

J) Give the areocentric (Martian) declination of :

Regulus (α Leo) δ = ...

Toliman (α Cen) δ = ...

K) Sketch diagrams to illustrate your working in questions (I) and (J) above :



L) on the map of the sky, mark (with a cross) and label ("M") the Martian celestial North Pole.

M) Give the azimuth of the observer as seen from the Martian base :

A = ...

N) Estimate the location of the base on Mars, and circle the appropriate description :

a. near the Equator

b. near the northern Tropic circle

c. near the northern Arctic circle

d. near the North Pole

O) The time axis below shows the Martian year and the seasons in the northern hemisphere. Mark the date represented by the planetarium display on the axis.