Q1. Act out in groups how the seasons work on Earth. You may wish to plan your approach first in the box below.

Plan to demonstrate how the seasons work on Earth:

Q2. a) You are a scientist investigating if the Sun could have seasons. Astrophysicists, who study the Sun at DIAS Dunsink Observatory, have gathered the following images of the Sun. In these images, there are regions with black dots visible on the Sun's surface, which are called Active Regions. The dots are called **sunspots**. Examine the **Sunspots** on the images and complete the table below.

Images:

Image 1

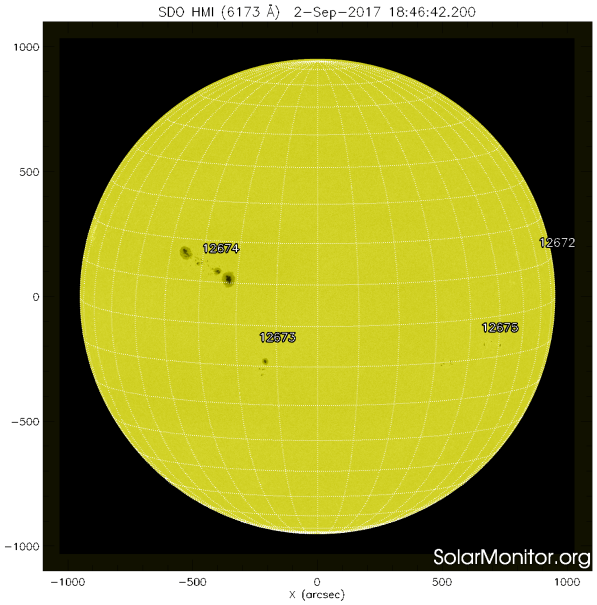


Image 2

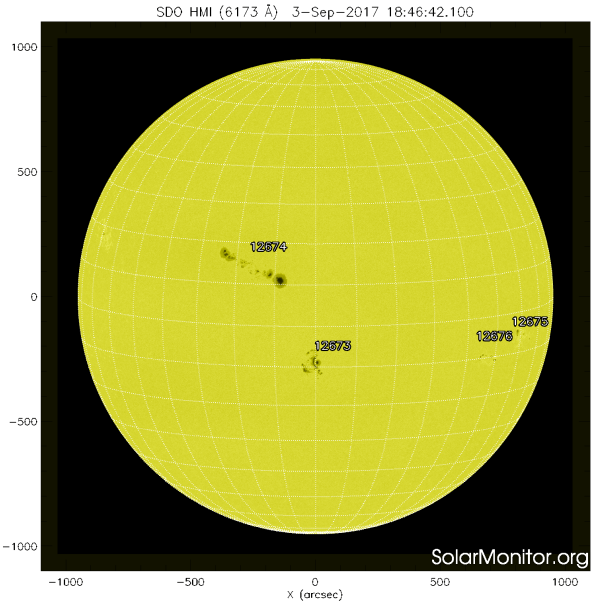
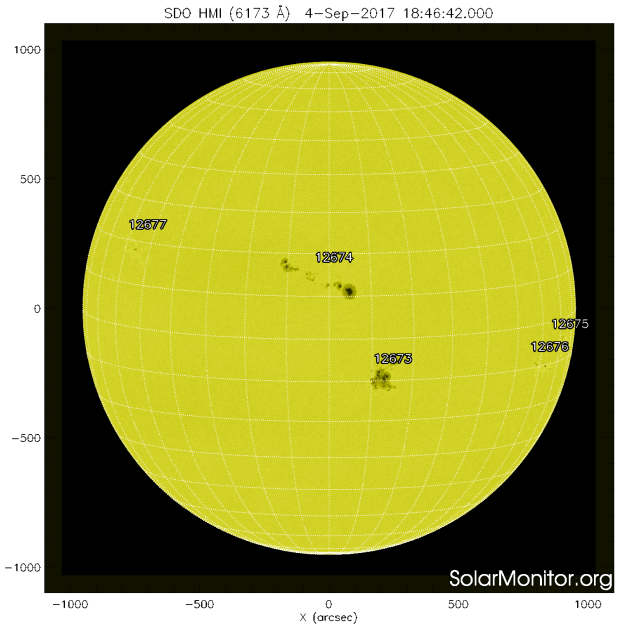


Image 3



Data:

Image number	Number of Sunspots visible
1	
2	
3	

Q2. b) What does part a) tell you about the Sun? How does the data in part a) support or oppose the hypothesis "The Sun has seasons"? Explain your thinking and include diagrams where appropriate.

Evidence to support or oppose the hypothesis :

Q2. c) Astrophysicists all around the world use a website called solarmonitor.org to look at daily images of the Sun and track sunspots. Click here to examine the images from this week and record how many sunspots are visible in the table below.

Date	Number of Sunspots visible

Q3. a) Is there a way to calculate how long it takes the Sun to rotate using the sunspots? Explain your thinking.

Q3 b) The table below contains more information about one Active Region as seen in the images from Q1. Sunspots are visible in this Active Region. The location of the sunspots is given in the table in latitude and longitude coordinates.

Latitude is the distance of the sunspot North or South from the equator of the Sun.

Longitude is the distance of the sunspot East or West from the meridian line of the Sun.

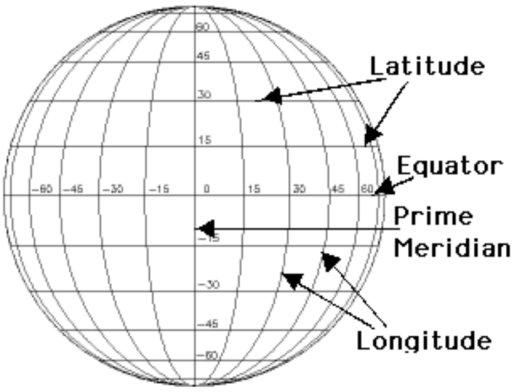
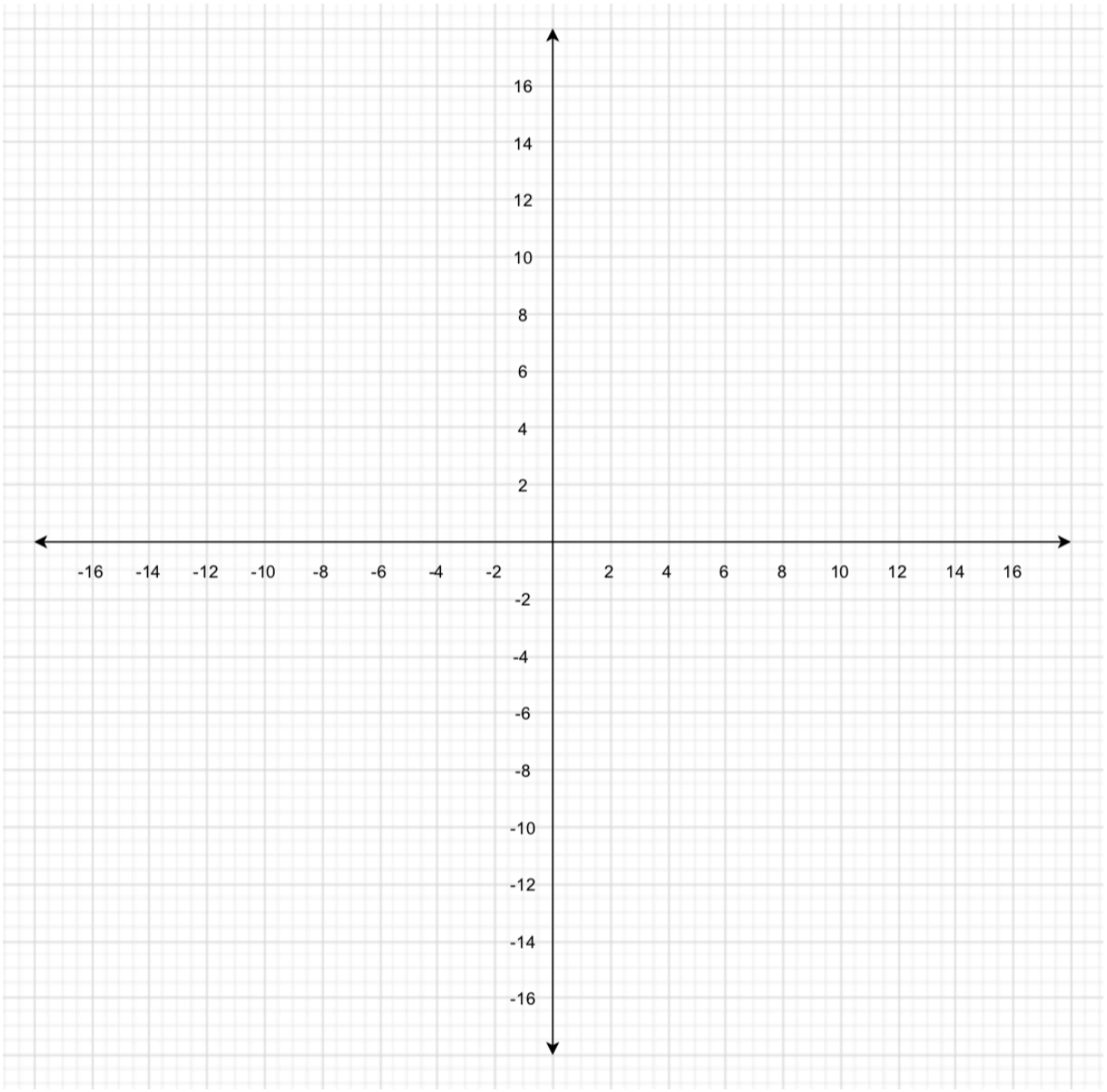


Table A.

Image number	Active Region Number	Image date and time (DD-MM-YYYY hh:mm)	Sunspot latitude (degrees)	Sunspot longitude (degrees)
1	12673	02-09-2017 18:46	-8	-11
2	12673	03-09-2017 18:46	-10	3
3	12673	04-09-2017 18:46	-10	14

Plot the latitude and longitude position of the sunspots from Table A. on the graph below.



Q3. c) What does the plot tell you about the position of the sunspots as time (in days) passes?

Q3. d) Complete Table B below using Table A. An example of the calculations has been done in the first row.

Table B.

Image Pair (image a, image b)	Time difference between images (in days)	Average latitude of sunspot from image a and image b (in degrees)	Longitude of sunspot from image b - Longitude of sunspot from image a (in degrees)
(x,y)	Date y - Date x = **w**	(Latitude x + Latitude y)/2 = **t**	Longitude y - Longitude x = **s**

Q3. e) Calculate how many days it takes for the Sun to make a single rotation using the data from Table B.

My calculations:

Q3. f) What is the average time for one rotation of the Sun according to your calculations?

Q3. g) Astrophysicists estimate that the Sun's rotation takes 27 days. How accurate were your calculations? How could you improve the accuracy of your calculations?

Q4. Table C. gives details on the time it takes different celestial bodies in our solar system to rotate. Compare the rotation periods of each to the rotation period of the Sun.

Table C.

Celestial Body	Rotation Period (days)
The Sun	27
Mercury	58.8
Venus	244 (rotates in opposite direction to Earth)
Earth	1
The Moon	27.4
Mars	1.03
Jupiter	0.415
Saturn	0.445
Uranus	0.720 (rotates in opposite direction to Earth)
Neptune	0.673
Pluto	6.41

Patterns that I notice in Table C are…