

## Observing Our Moon

### Motivation

Today we shall discuss some ideas related to the phases of moon by writing answers to all the questions in the sheet. It's not necessary to write full sentences. At any point, if you think you should change your answer to any of the earlier questions, feel free to do so. After you have finished writing the answers, we will discuss all the questions together and try reaching to the best answer by combining all your answers.

**Materials Required:** Paper, pencil, eraser, etc.

### Task 1: Role Playing Activity

Below is the Image of Sun, Earth and Moon and the orientations of their Orbits as seen by a distant observer.

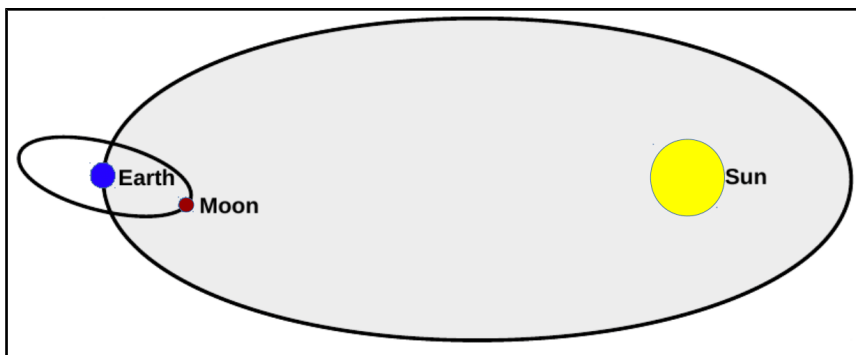


Figure 1: Illustration of Sun-earth-moon orbit

The plane of orbit of Moon is tilted to the plane of Earth's orbit around Sun at approximately  $5^\circ$  angle.

Let's play a game which help us to understand different positions of moon during different phases in between sun and earth

### Instructions

- Three students from the class will play roles of the Sun, Earth and Moon.
- Earth person's head represents planet Earth and his/her nose is an imaginary person on the Earth's surface. Other students who are not part of the role play, observe the activity from a few feet away.
- Student who is playing moon's role will draw a circle around Earth, to represent the moon's orbit around Earth (not absolutely essential but it would help).
- Keep in mind that moon moves around Earth in an anti-clockwise direction, which is also the same direction in which Earth rotates as well as revolves around sun.
- The student playing earth's role should stand stationary. Fix the position of the person playing sun's role for direction of sunlight.
- Person playing Earth's role need not to go around the sun as here we are mainly focusing on phases of moon. Now make the moon go around in its orbit. To begin with, let the moon be between Earth and Sun.

Now, guess which part of the moon's head would be illuminated, which part of the moon would be dark due to absence of sunlight.

- Now make the moon take a position such that earth is in between moon and sun and all the three become aligned.

Now lets discuss which part of the moon is illuminated, which part is not illuminated.

- Now make the moon to take various position in its path. Let students guess which part

of the moon is illuminated and which part is not illuminated.

### Full moon & New moon

At which position of the moon in orbit a person on earth (who is at position of nose of student playing earth's role) will see full moon (or new moon)?



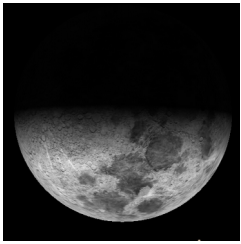





Where the moon should be so that it is full moon (or new moon) for a person at the back of the head of student playing earth's role. (What is important here is the orientation of the Moon).


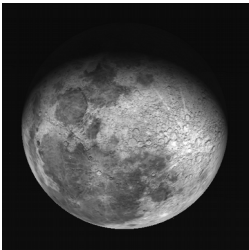


### Half moon

Guess at which position there would be a half moon and discuss it among your group.

Discuss that during motion of moon in its orbit the bright portion of moon which is seen from earth increases for sometime and then decreases for sometime. When bright portion of moon as seen from earth is increasing it is called as Waxing of moon and when it is decreasing it is called as Waning of moon. Now, guess in which half of the moon's orbit it would be waxing and in which half it would be waning. Explain by role play. Notice that when the moon is going from full moon to new moon it is waning and when it is going from new moon to full moon, it is waxing (Krishna paksha and Shukla paksha).

### Task 2: Analyzing data table

Sr. No.	01	02	03	04
Image of Moon				
Date	18/02/2018	20/02/2018	23/02/2018	24/02/2018
Rise Time	08:02	10:01	12:15	13:07
Set Time	20:00	22:39	00:31	01:31
Sr. No.	05	06	07	08
Image of Moon				
Date	26/02/2018	28/02/2018	01/03/2018	02/03/2018
Rise Time	15:04	17:10	18:12	19:12
Set Time	03:32	05:27	06:19	07:08

Sr. No.	09	10	11	12
Image of Moon				
Date	04/03/2018	05/03/2018	07/03/2018	09/03/2018
Rise Time	21:06	22:01	00:13	01:54
Set Time	08:36	09:18	12:06	13:29

1) Fill the following table by using information given above.

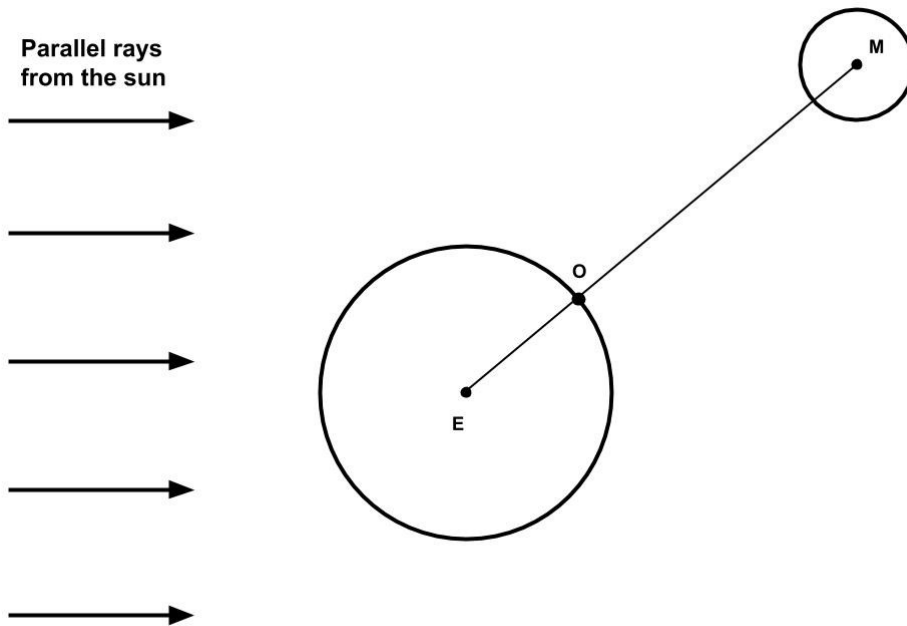
Date	Moon-rise time	Moon-set time	Moon shape (crescent / half / more than half (gibbous) / full / absent)	Boundary of Bright and Dark region of Moon is (convex / concave)
18/02/2018	08:02	20:00		
20/02/2018	10:01	22:39		
23/02/2018	12:15	00:31		
24/02/2018	13:07	01:31		
26/02/2018	15:04	03:32		
28/02/2018	17:10	05:27		
01/03/2018	18:12	06:19		
02/03/2018	19:12	07:08		
04/03/2018	21:06	08:36		
05/03/2018	22:01	09:18		
07/03/2018	00:13	12:06		
09/03/2018	01:54	13:29		

2) Observe the table and state if the following statements are true or false.

- a) The bright part of the moon is always towards the sun. \_\_\_\_\_
- b) The boundary of dark and bright part of the moon is always concave. \_\_\_\_\_
- c) Moon does not rise at same time everyday. \_\_\_\_\_
- d) Moon does not rise on a new Moon day. \_\_\_\_\_
- e) On day after the full Moon, we expect moon to rise around 1 hour after sunset. \_\_\_\_\_
- f) On day before the new Moon, we expect moon to rise around 1 hour before sunrise. \_\_\_\_\_
- g) In waxing fortnight (शुक्ल पक्ष / bright fortnight), moon is already in the sky at sunset. \_\_\_\_\_
- h) In waning fortnight (कृष्ण पक्ष / dark fortnight), moon is already in the sky at sunrise. \_\_\_\_\_

3) Let us imagine that we are astronauts and have gone in space above the plane of our

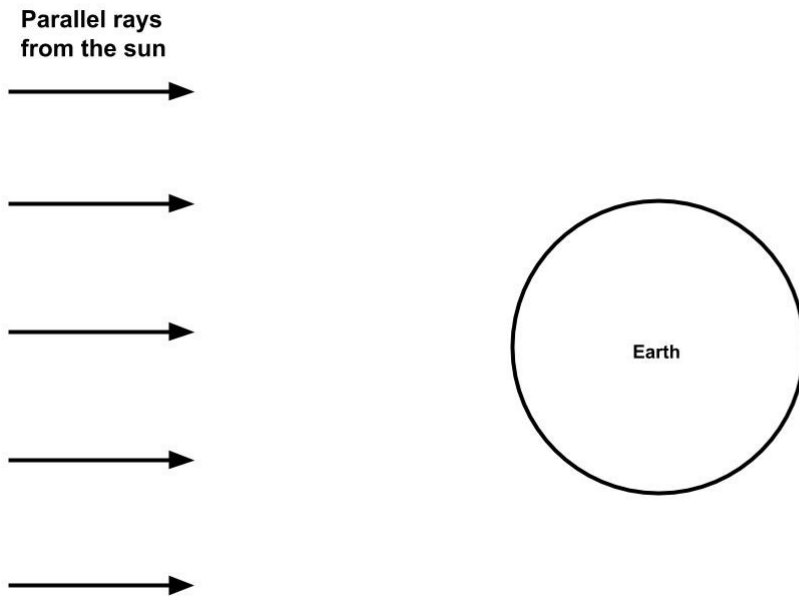
solar system and we are observing the Earth and the Moon from the top. Rays of the Sun are falling on the Earth and Moon from the left of the page and are parallel to the bottom edge. In the figure below draw appropriate diameters of earth and moon, to separate the part **receiving** sunlight and part **not** receiving sun light. Shade the dark part with your pencil. Next, you can see a tiny observer "O" on the surface of earth exactly along the line connecting the centers of earth and moon. Draw an appropriate diameter of moon to show which part of moon will be visible to this observer.



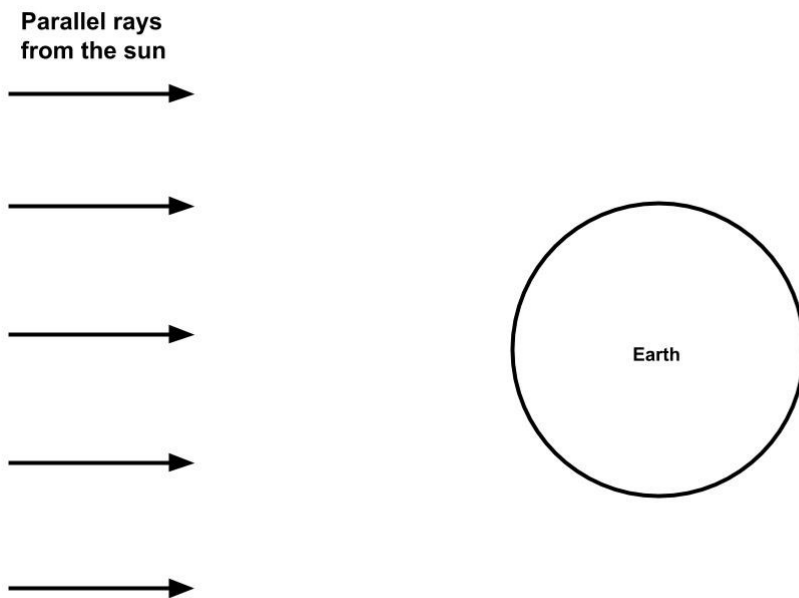
4) Based on your drawing, answer the following:

- a) Is the observer in the lighted part or dark part? \_\_\_\_\_
- b) As seen by this observer, how much part of moon's disk is bright (less than half / more than half)? \_\_\_\_\_
- c) Let's assume the diameter of moon is 2mm then diameter of the earth will be approximately 7mm. In this scale, the distance between Earth and moon will be about 23cm. Draw diagram of relative sizes and distance between earth and moon. By looking at the diagram it is possible to conclude that observers at any location on the earth will see proximately the same phase of moon. Do you agree?

d) Where will the moon be on the full Moon day? Mark the position in the diagram with a circle and mark it as F.



e) Where will the moon be on the new moon day? Mark the position in the diagram with a circle and mark it as N.



f) Will shadow of earth fall on moon on new moon day?

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g)As seen by astronauts, earth rotates anticlockwise. In question no. 3, now place second observer on surface of the earth on upper edge of the dark part. is this second observer seeing sunrise or sunset?

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h)As seen by astronauts, direction of moon's revolution is also anti-clockwise. Is this waxing fortnight or waning fortnight?

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i) Can you guess this?

(i)During a lunar eclipse, the Sun, Earth and Moon get aligned as you can see in the image you made in the answer (e) i.e. Full Moon. But we don't see lunar eclipse on every Full Moon. What do you think will be reason for this?

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(ii)Do we see solar eclipse on every New Moon day? Give reason.

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