

Shadows, Moon phases and eclipses explained

Grade 6 science (Year 7 · Class 6) · Worksheet

Name: _____ Date: _____ Class: _____

These twenty problems train you to explain how shadows form and change size, to name and order the Moon's phases, and to describe solar and lunar eclipses. You will use ratios, dates and simple formulas as well as diagrams.

The first problems are recall and reading diagrams, and the last five need several steps of reasoning. They suit Grade 6, Year 7 and Class 6 science courses.

Level: Grade 6 science (Year 7 · Class 6) · **Curriculum:** MS-ESS1-1

Problem 1 What is a shadow? (easy)

1. Define a shadow.
2. Which type of material, transparent, translucent or opaque, gives the darkest shadow?
3. State what a shadow tells you about the way light travels.

Problem 2 Darkest shadow (easy)

Zainab holds a sheet of glass, a sheet of tracing paper and a sheet of cardboard in front of a lamp.

1. Which gives the darkest shadow?
2. Which gives almost no shadow?
3. Which gives a faint shadow?

Problem 3 Phases in order (easy)

Write the eight Moon phases in order, beginning with the new Moon.

Problem 4 Moon true or false (easy)

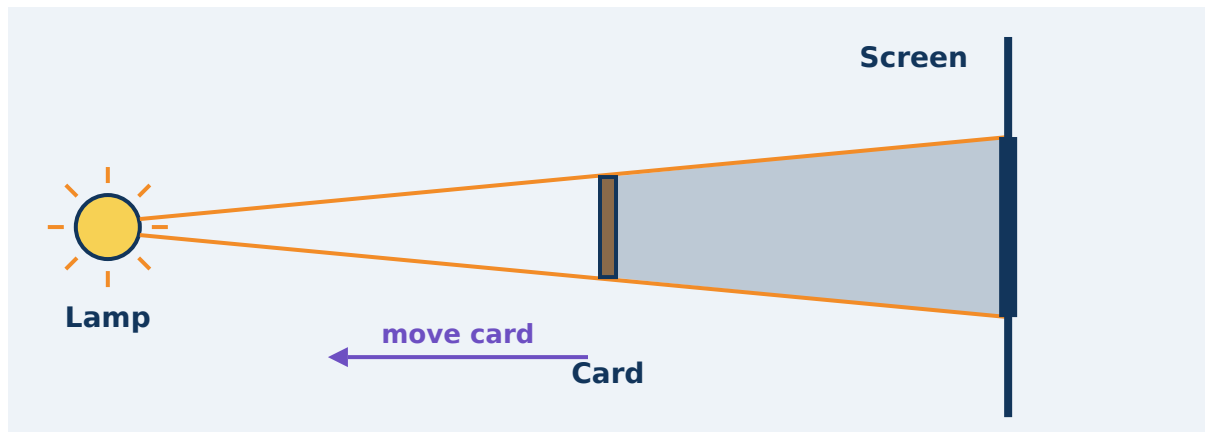
Write true or false and correct the false ones.

1. The Moon makes its own light.
2. Half of the Moon is always lit by the Sun.
3. Earth's shadow causes the phases.
4. A solar eclipse happens at new Moon.

Problem 5 Moving the card (easy)

Look at the diagram.

1. Name the part of the screen that is dark.
2. If Wanjiru moves the card closer to the lamp, does the shadow get bigger or smaller?
3. Explain why.



The set-up for Problem 5.

Problem 6 Next new Moon (easy)

A new Moon occurs on 1 March. The cycle lasts 29.5 days.

1. Estimate the date of the next new Moon.
2. Estimate the date of the next full Moon.

Problem 7 Height of a building (medium)

A pole 2.0 m high casts a shadow 1.5 m long. At the same time a building in Leeds casts a shadow 30 m long.

1. Write the equation linking the heights and shadows.
2. Calculate the building's height.

Problem 8 Shadow through the day (medium)

Mei in Singapore measures a flagpole's shadow: 08:00, 3.2 m; 10:00, 1.8 m; 12:00, 0.9 m; 14:00, 1.7 m; 16:00, 3.1 m.

1. At what time is the Sun highest?
2. Explain your answer.
3. Calculate the change in shadow length from 12:00 to 16:00.

Problem 9 Lamp and card (medium)

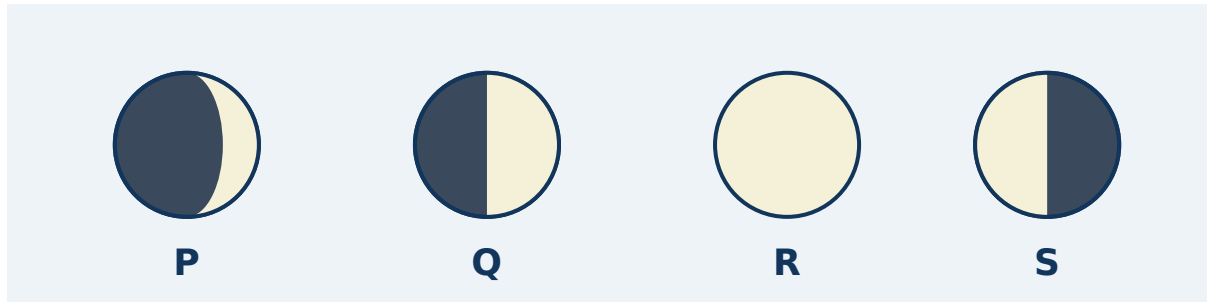
A lamp is a small source. A card 8 cm tall stands 25 cm from the lamp. The screen is 75 cm from the lamp.

1. Calculate the height of the shadow.
2. The card moves to 50 cm from the lamp. Calculate the new height.
3. Describe the trend.

Problem 10 Four Moons (medium)

Look at the four phases.

1. Name each phase.
2. Which two are waxing?
3. Put P, Q, R and S in order of day in the cycle.
4. Which one occurs when the Moon is on the far side of Earth from the Sun?



Four phases of the Moon for Problem 10.

Problem 11 Line-ups (medium)

Study the two line-ups.

1. Name the eclipse in A and the eclipse in B.
2. State the Moon phase for each.
3. Which eclipse can be seen from the whole night side of Earth?



Two Sun, Earth and Moon line-ups, not to scale.

Problem 12 Lit half (medium)

Explain why half of the Moon is always lit, but we do not always see a half Moon.

Problem 13 Waxing to full (medium)

Diego sees a waxing crescent on day 4 of the cycle. Use the table: full Moon is day 14.8.

1. Calculate how many days until the full Moon.
2. Say which phase comes between.

Problem 14 Eclipse comparison (medium)

Complete: (a) The Moon is in the middle for a ... eclipse. (b) Earth is in the middle for a ... eclipse. (c) A ... eclipse happens at full Moon. (d) A ... eclipse is seen only from a narrow strip of Earth.

Problem 15 Two torches (medium)

Aarav shines two torches side by side at a card and sees a shadow with a dark centre and a lighter edge on the wall.

1. Explain why the edge is lighter.
2. Name the two parts of such a shadow.

Problem 16 Eclipse frequency (hard)

The cycle of phases lasts 29.5 days.

1. Calculate the number of new Moons in a year of 365 days, to one decimal place.
2. Only about 2 to 5 solar eclipses occur worldwide each year. Explain why this is far fewer than your answer.

Problem 17 Apparent sizes (hard)

The Sun has a diameter of 1.4×10^6 km and is 1.5×10^8 km away. The Moon has a diameter of 3.5×10^3 km and is 3.8×10^5 km away.

1. Calculate diameter $\div$ distance for the Sun.
2. Calculate it for the Moon.
3. Explain what your answers show about total solar eclipses.

Problem 18 Length of totality (hard)

The Moon's umbra on the ground is 120 km wide and moves across the ground at 0.6 km/s.

1. Write the formula for time.
2. Calculate the time, in seconds, that the umbra takes to pass over one spot.
3. Convert to minutes and seconds.

Problem 19 Calendar forecast (hard)

A full Moon is on 10 September. A cycle lasts 29.5 days. Phases occur at: last quarter 7.4 days, new Moon 14.8 days, first quarter 22.1 days after the full Moon.

1. Give the dates, to the nearest day, of those three phases.
2. Estimate the date of the next full Moon.

Problem 20 Who sees the eclipse? (hard)

Everyone on the night side of Earth can see a lunar eclipse, but only a narrow strip of Earth

sees a total solar eclipse.

1. Explain the first statement.
2. Explain the second using the sizes of the Moon and its shadow.
3. Name the part of the shadow where a partial eclipse is seen.