

Shadows, Moon phases and eclipses explained

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

Use the answers to check your reasoning as well as your results. For diagrams, make sure you have named the objects in the right order, and for calculations check that you have written the formula and the units.

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

Problem 1 What is a shadow?

1. A region where **light is blocked** by an object.
2. **Opaque**.
3. Light travels in **straight lines**, so it cannot bend round the object.

Problem 2 Darkest shadow

1. **Cardboard** (opaque).
2. **Glass** (transparent).
3. **Tracing paper** (translucent).

Problem 3 Phases in order

New, waxing crescent, first quarter, waxing gibbous, full, waning gibbous, last quarter, waning crescent.

Problem 4 Moon true or false

1. **False**: it reflects sunlight.
2. **True**.
3. **False**: phases come from our viewing angle.
4. **True**.

Problem 5 Moving the card

1. The **shadow** behind the card.
2. **Bigger**.
3. A card near the lamp blocks a wider set of rays, which spread further before they hit the screen.

Problem 6 Next new Moon

1. 1 March + 29.5 days $\approx$ **30 March**.

2. A full Moon is half a cycle later: 14.8 days, so about **16 March**.

Problem 7 Height of a building

1. $2.0 \div 1.5 = h \div 30$.
2. $h = 2.0 \times 30 \div 1.5 = \mathbf{40\ m}$.

Problem 8 Shadow through the day

1. At **12:00**.
2. The shortest shadow means the Sun's rays are closest to vertical.
3. $3.1 - 0.9 = \mathbf{2.2\ m\ longer}$.

Problem 9 Lamp and card

1. $8 \times 75 \div 25 = \mathbf{24\ cm}$.
2. $8 \times 75 \div 50 = \mathbf{12\ cm}$.
3. The farther the card is from the lamp, the **smaller** the shadow.

Problem 10 Four Moons

1. P: **waxing crescent**; Q: **first quarter**; R: **full Moon**; S: **last quarter**.
2. P and Q (lit on the right and growing).
3. **P, Q, R, S**.
4. **R**, the full Moon.

Problem 11 Line-ups

1. A: **solar eclipse**; B: **lunar eclipse**.
2. A: **new Moon**; B: **full Moon**.
3. The **lunar eclipse**, because the Moon is above the horizon for everyone on the night side.

Problem 12 Lit half

The Sun lights the half of the Moon that faces it. From Earth we look at this lit half from a changing angle, so **we see different amounts of the lit half**.

Problem 13 Waxing to full

1. $14.8 - 4 = \mathbf{10.8\ days}$.
2. The **first quarter** (day 7.4) and then the waxing gibbous.

Problem 14 Eclipse comparison

- (a) **solar**. (b) **lunar**. (c) **lunar**. (d) **total solar**.

Problem 15 Two torches

1. At the edge, light from one torch still reaches the wall.
2. **Umbra** (dark centre) and **penumbra** (lighter edge).

Problem 16 Eclipse frequency

1. $365 \div 29.5 = \mathbf{12.4}$.
2. The Moon's orbit is tilted by about 5° , so at most new Moons its shadow misses Earth.

Problem 17 Apparent sizes

1. $1.4 \times 10^6 \div 1.5 \times 10^8 = \mathbf{9.3 \times 10^{-3}}$.
2. $3.5 \times 10^3 \div 3.8 \times 10^5 = \mathbf{9.2 \times 10^{-3}}$.
3. The two ratios are almost equal, so the Moon appears the **same size as the Sun** and can just cover it.

Problem 18 Length of totality

1. $t = d \div v$.
2. $120 \div 0.6 = \mathbf{200 \text{ s}}$.
3. $200 \text{ s} = \mathbf{3 \text{ min } 20 \text{ s}}$.

Problem 19 Calendar forecast

1. Last quarter: $10 + 7 = \mathbf{17 \text{ September}}$; new Moon: $10 + 15 = \mathbf{25 \text{ September}}$; first quarter: $10 + 22 = \mathbf{2 \text{ October}}$.
2. $10 + 29.5 = 39.5$, so about **9 or 10 October** ($39.5 - 30 = 9.5$).

Problem 20 Who sees the eclipse?

1. The Moon is the object in shadow, and it is above the horizon for the whole night side.
2. The Moon is small, so its umbra is only about 100 to 200 km wide on Earth.
3. The **penumbra**.