CIE IGCSE PHYSICS
for board 0625 and 0972
(For exam 2025+)

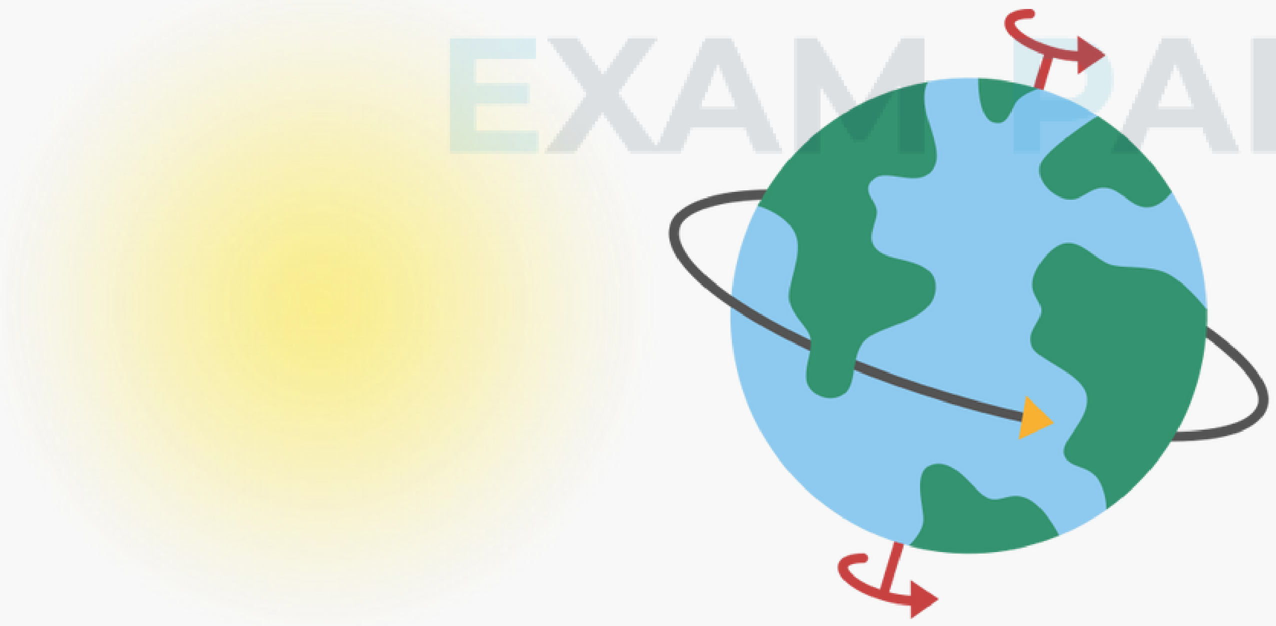
Earth and the Solar System

Day and night

1.The Sun appears to move across the sky daily, rising in the east and setting in the west.

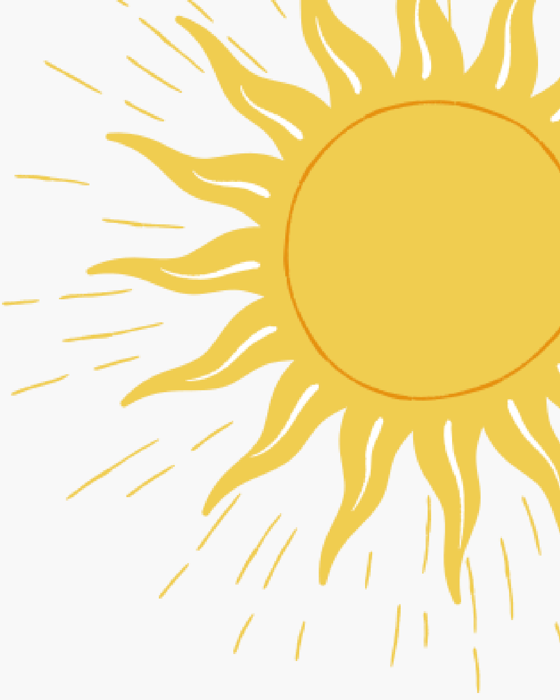
2. This phenomenon is explained by the Earth's rotation on its axis.

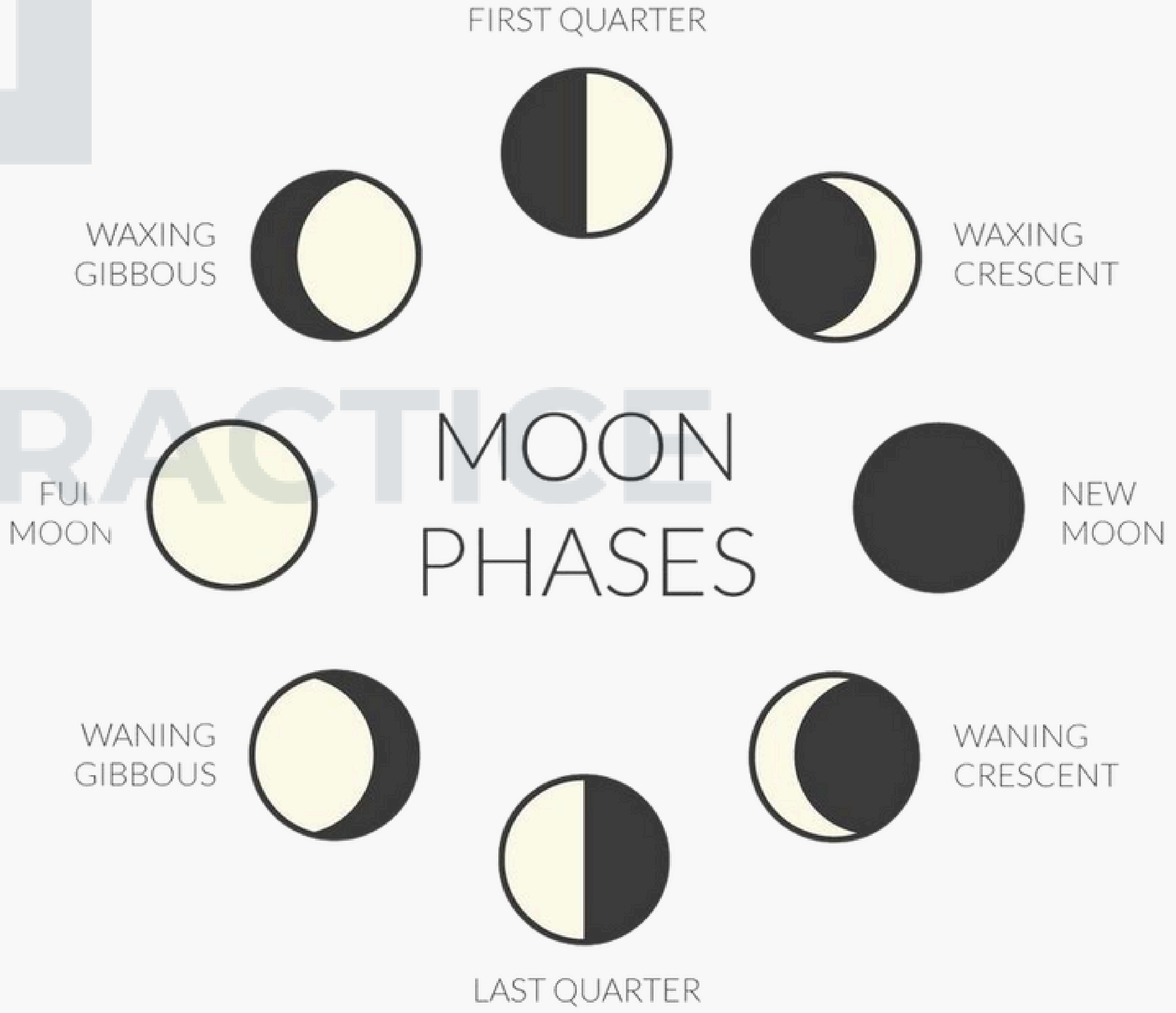
3.As the Earth rotates, one hemisphere faces the Sun, experiencing daylight, while the opposite hemisphere experiences darkness.



Months

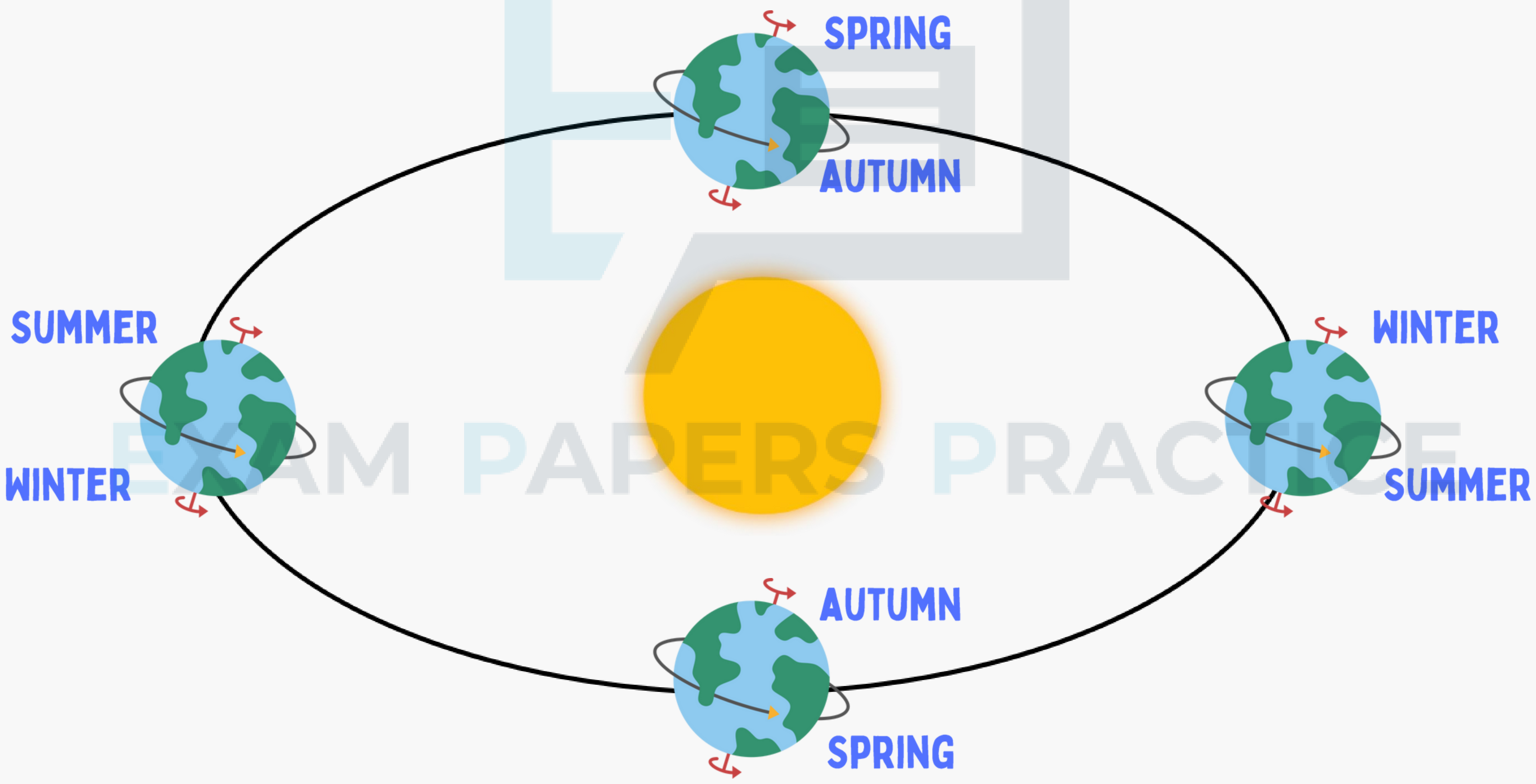
1. The Moon is the second most prominent celestial body visible in our sky, after the Sun.
2. We can observe the Moon because it reflects sunlight.
3. The Moon completes its orbit around the Earth every 27.5 days, and its position relative to the Earth changes, causing varying amounts of sunlight to illuminate different parts of its surface.
4. The illuminated portions of the Moon visible from Earth at any given time create the distinct phases of the Moon that we observe.





Years

1. The Earth travels around the Sun, completing a full orbit in slightly over 365 days.
2. Seasons are caused by the Earth's axis being tilted.



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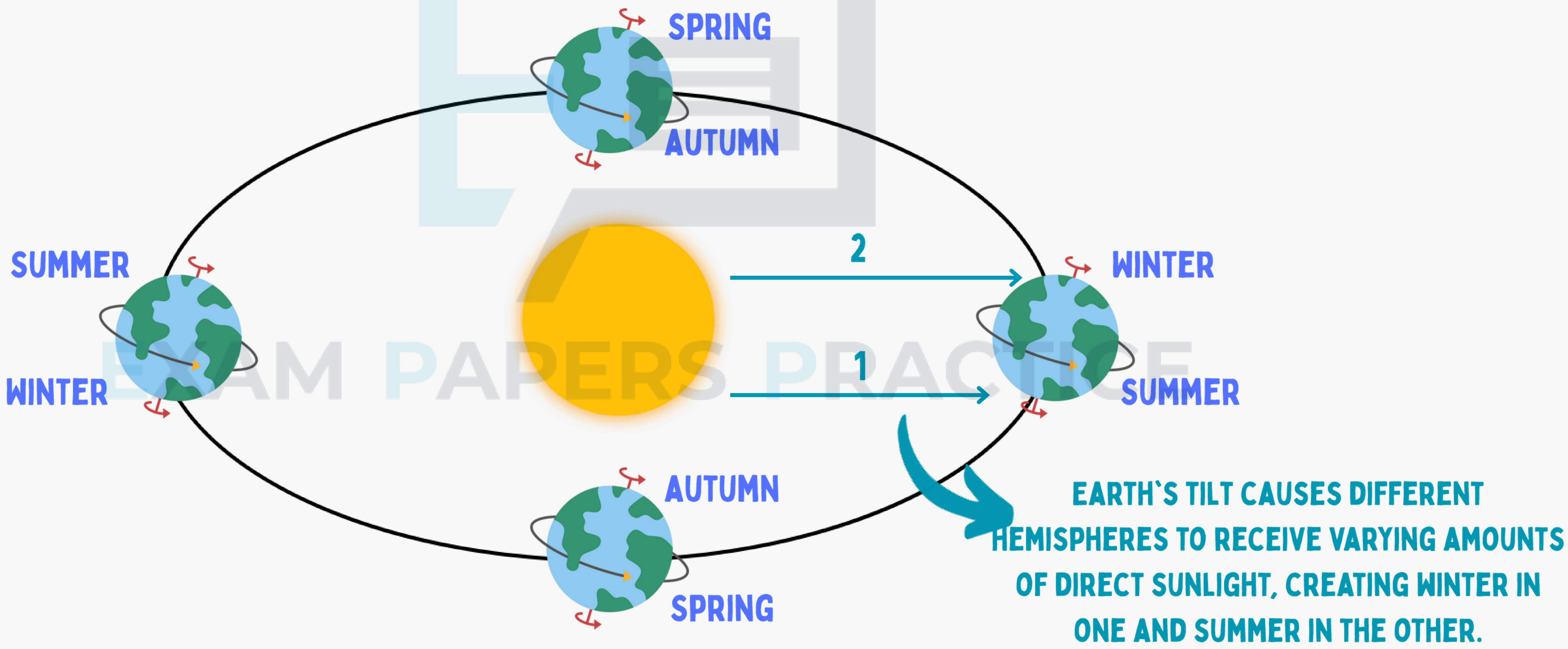

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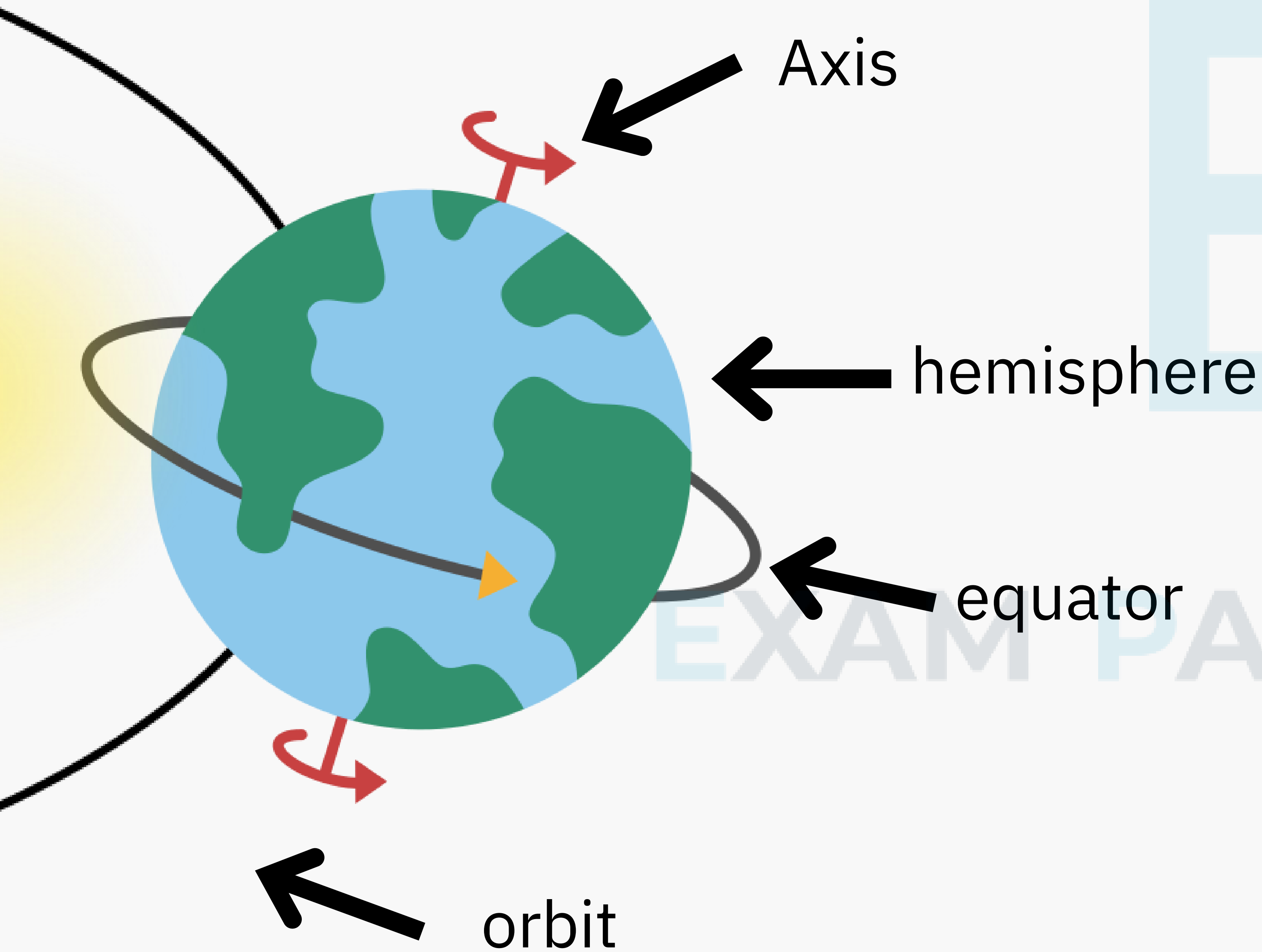

Countries located on the Equator experience minimal seasonal changes because the Sun's rays strike them at a consistent anglethroughout the year. In contrast, regions farther from the Equator experience more pronounced differences between seasons.

The Solar System

The Solar System consists of the Sun, which is our star, and all the objects which orbit it. It includes the following:

Eight planets (Mercury, Venue, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune).

Minor planets (Pluto and Eris), also known as dwarf planets

Moons that orbit planets and dwarf planets.

The Solar System

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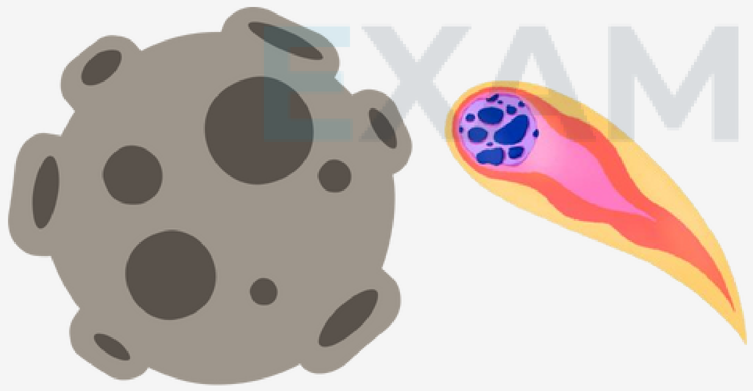
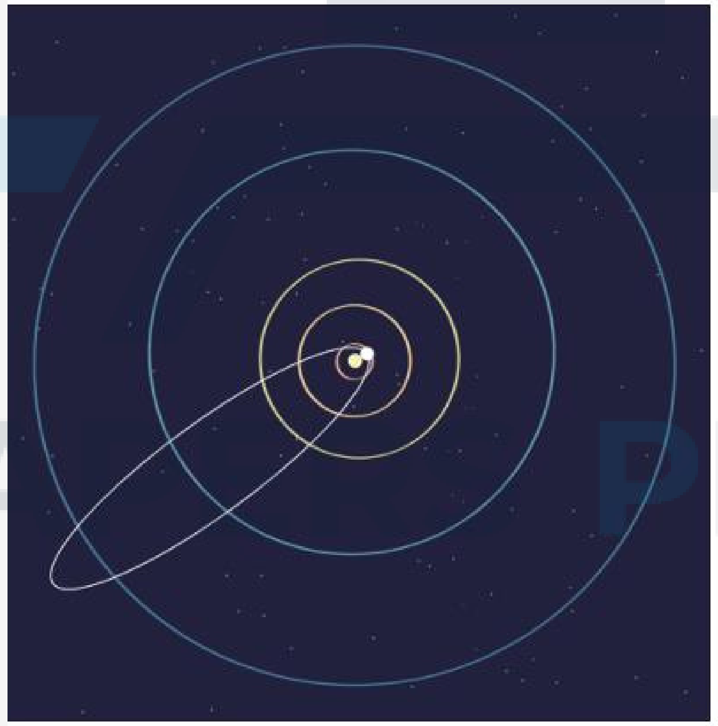
Millions of asteroids and meteoroids. They are lumps of rock which orbit the Sun.





Comets are celestial objects often described as enormous snowballs that orbit the Sun in highly irregular paths. At their farthest distance from the Sun, comets primarily consist of frozen gases, rocks, and dust. As comets approach the Sun, they warm up and begin to release a trail of gases and dust behind them.

The formation of the planets

THE SOLAR SYSTEM ORIGINATED FROM A NEBULA, A LARGE, ROTATING CLOUD OF GAS AND DUST.

The formation of the planets

PLANETS FORMED FROM THE REMNANTS OF THE NEBULAR MATERIAL THAT DID NOT FALL INTO THE SUN'S GRAVITATIONAL PULL.

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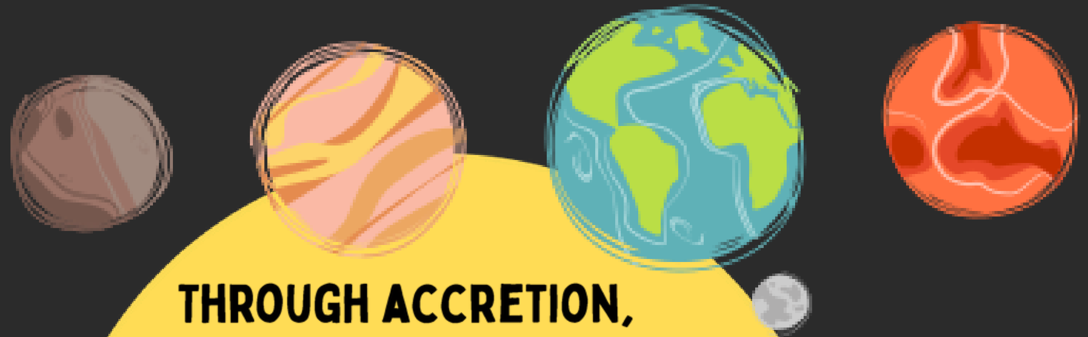

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THROUGH ACCRETION, SMALLER PARTICLES LIKE DUST AND GAS CLUMPED TOGETHER UNDER GRAVITY, FORMING LARGER ROCKS. THIS PROCESS CONTRIBUTED TO THE FORMATION OF THE INNER, ROCKY PLANETS.

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DUE TO THE INTENSE HEAT NEAR THE SUN, LIGHTER MATERIALS WERE PUSHED FARTHER AWAY, EVENTUALLY FORMING THE OUTER PLANETS, ALSO KNOWN AS GAS GIANTS.

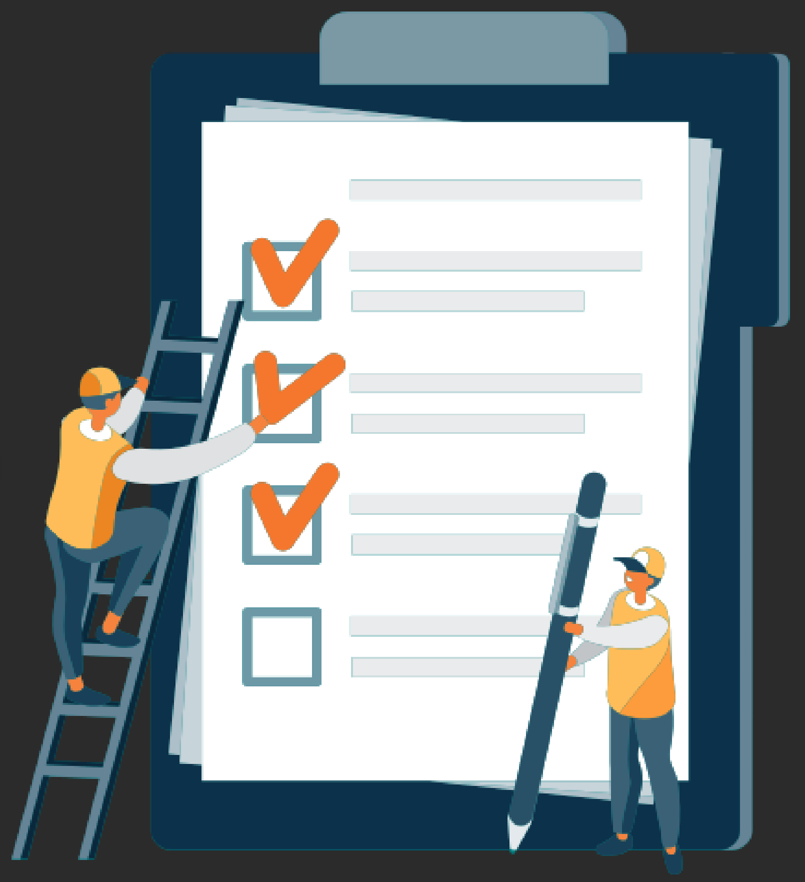
Distances and times in the Solar System

1. Distances in the Solar System are incredibly vast.
2. These distances are often measured in terms of how long it takes for light to travel.
3. One light year is the distance traveled by light in a year.

distance travelled / year

Worked Example

Determine the time it takes for light from the Sun to reach Earth, given the distance of 150,000,000 km between them.



Solution

150,000,000 km = 150,000,000,000 m

Speed of light = 300000000 m / s

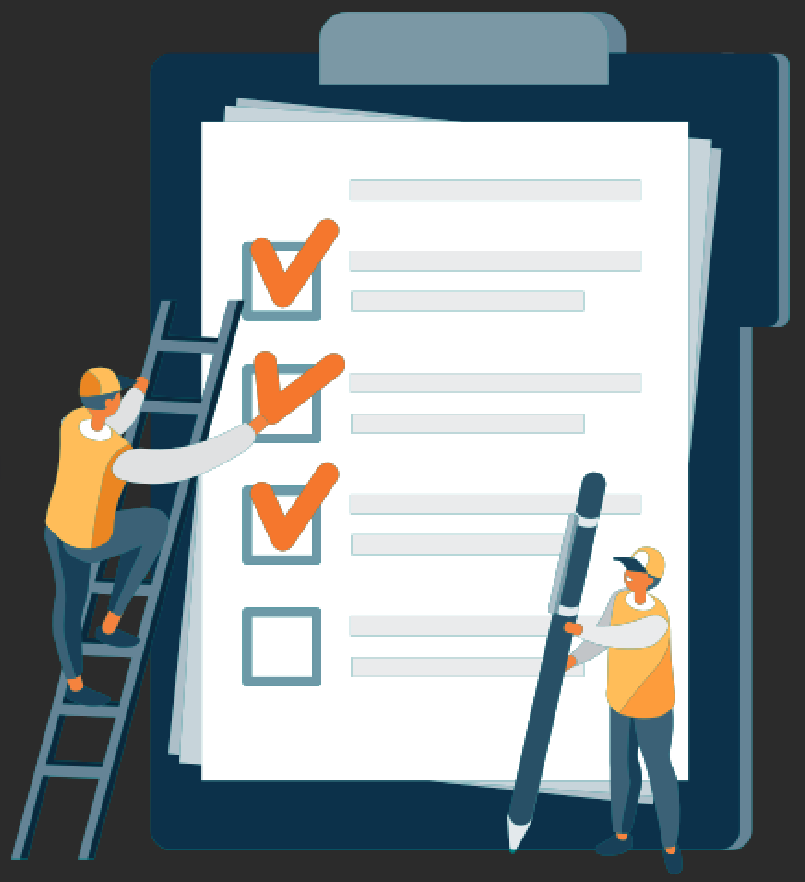
150,000,000,000m / 300000000 m/s

= 500 seconds

= 8 mins 20 second

Worked Example

Calculate the duration for light to travel from the Moon to Earth, considering the Moon is approximately 390,000 km away.



Solution

390000 km = 390, 000,000 m

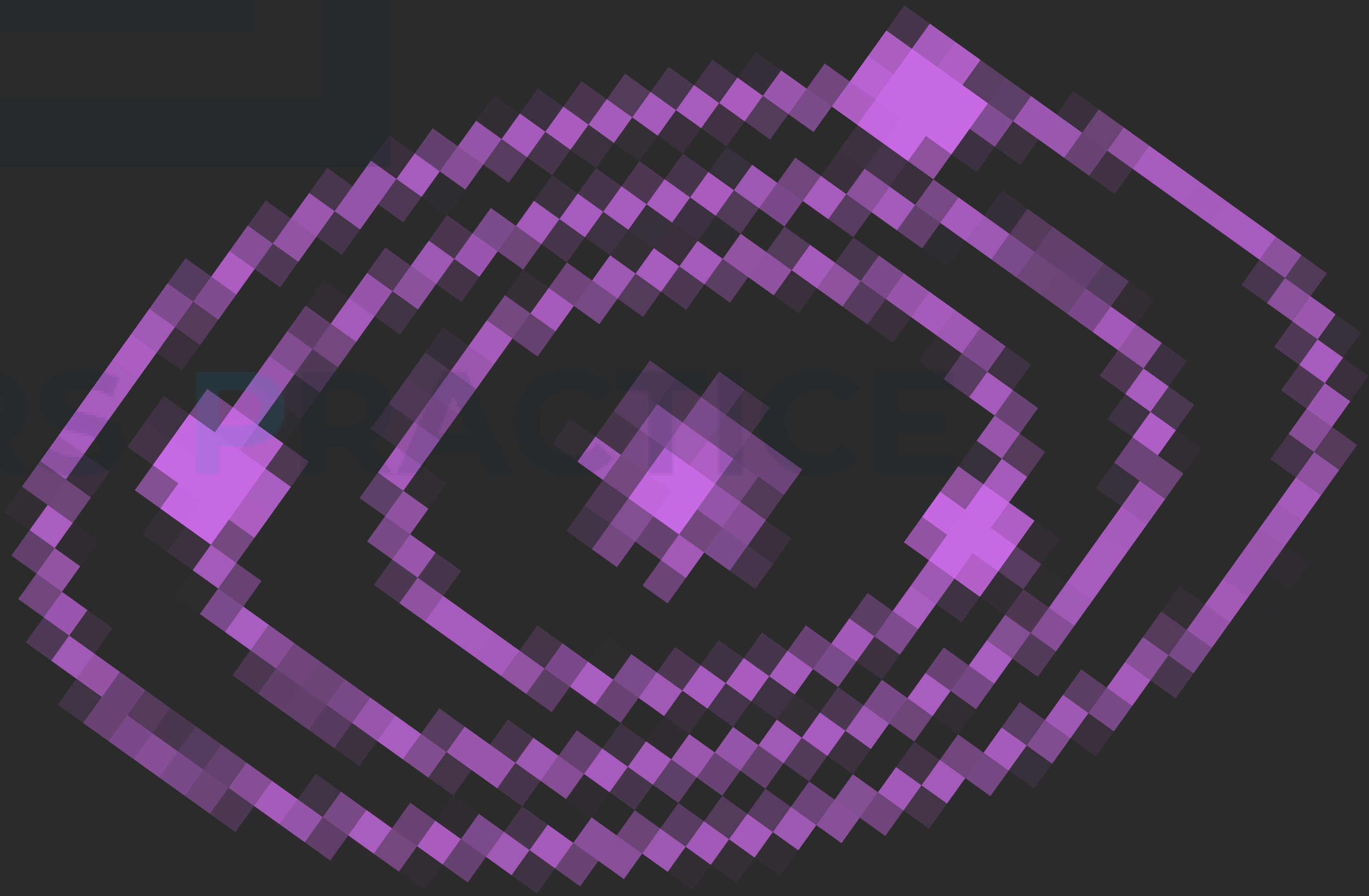
Speed of light = 300000000 m / s

Time = 390000000 m / 300000000 m / s

= 1.3 seconds

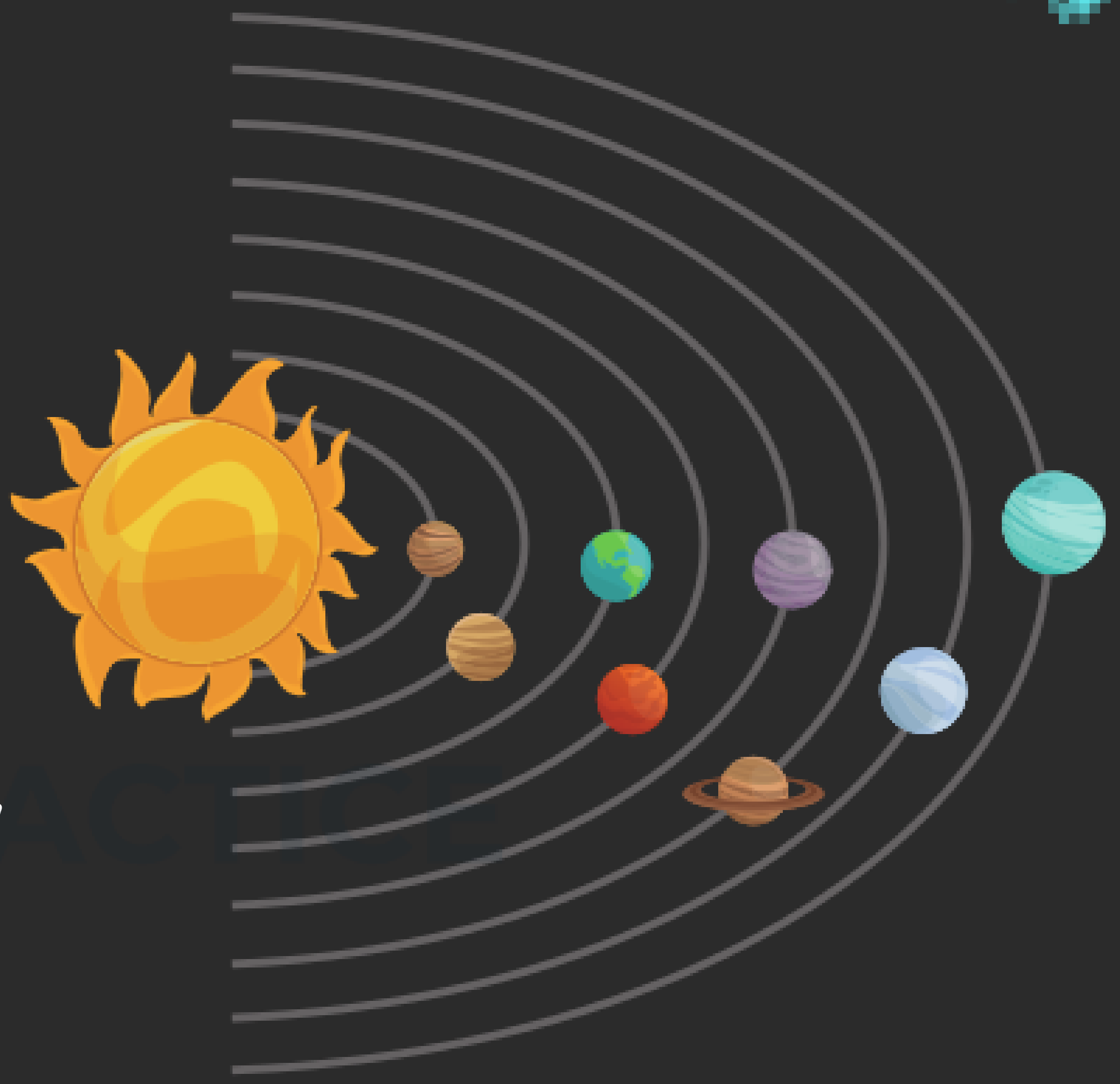
The Sun's gravitational pull

1. The paths of the planets around the Sun are nearly circular.
2. Objects traveling in circular paths require a force directed towards the center of the circle.
3. The gravitational pull exerted by the Sun is responsible for keeping the planets in orbit around it.



Forces

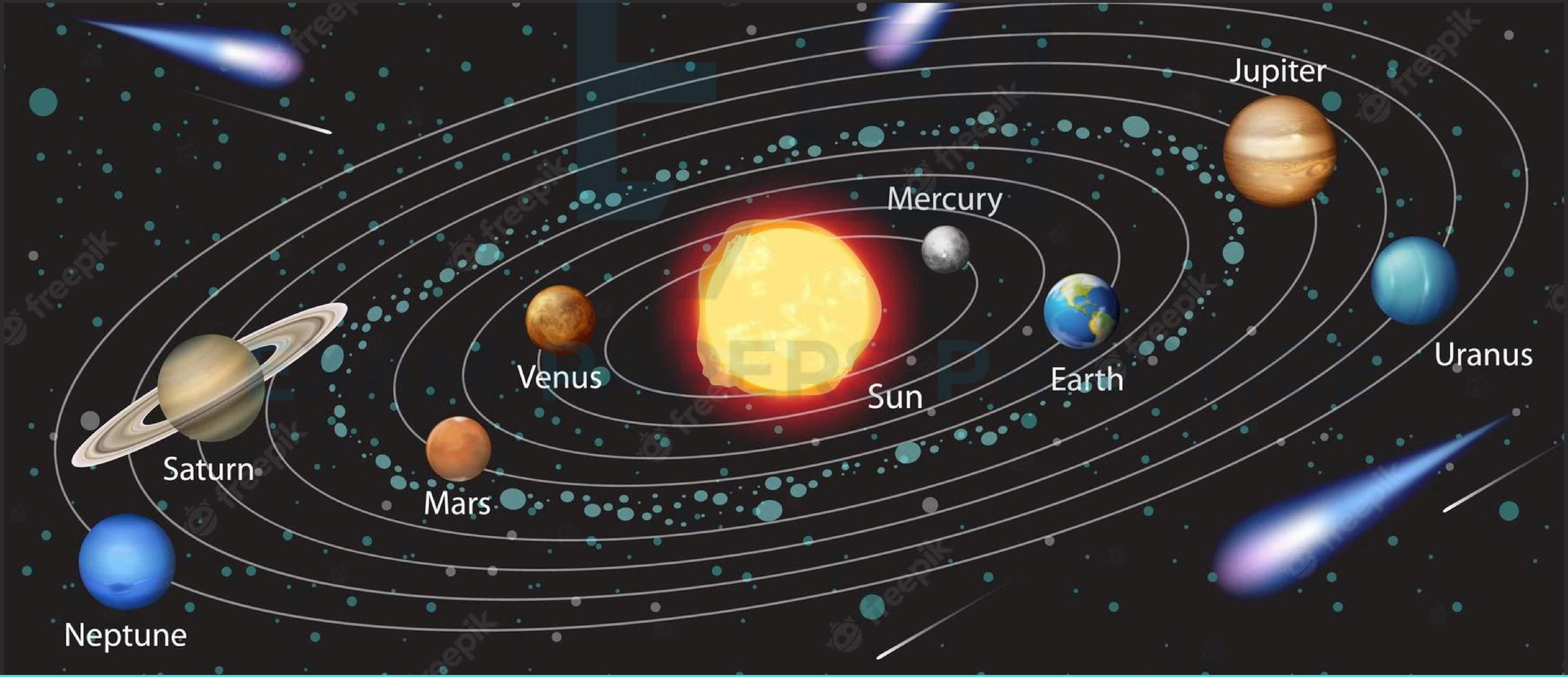
1. The Sun occupies the central position in the Solar System and accounts for approximately 99.8% of its total mass, making it the most massiveobject by a significant margin.
2. The Sun's gravitational field is substantially strongerthan any other object in the Solar System due to its immense mass, as gravitational attraction is directly related to mass.
3. The Sun's gravitational force governs the orbits of all celestial bodies, including planets, asteroids, meteoroids, and comets.
4. Gravitational attraction weakens with increasing distance, resulting in weaker gravitational forces experienced by the outer planets compared to the inner planets. Additionally, a planet's size also influences the gravitational force it encounters.



Orbits and energy

EXAM PAPERS PRACTICE

1. The orbits of planets are described as elliptical.
2. The amount the orbit is squashed is called its eccentricity.



Why are orbits elliptical

1. Initially, the object was moving rapidly past the Sun, driven by its momentumfrom the Big Bang.
2. As the object approaches the Sun, the Sun's gravitational pull starts attractingit towards itself.
3. This gravitational attraction causes the object to accelerate, with its kinetic energycarrying it to the farthest point of its orbit.
4. Eventually, the object decelerates and is pulled back towards the Sun once more.

Why are orbits elliptical

EXAM PAPERS PRACTICE

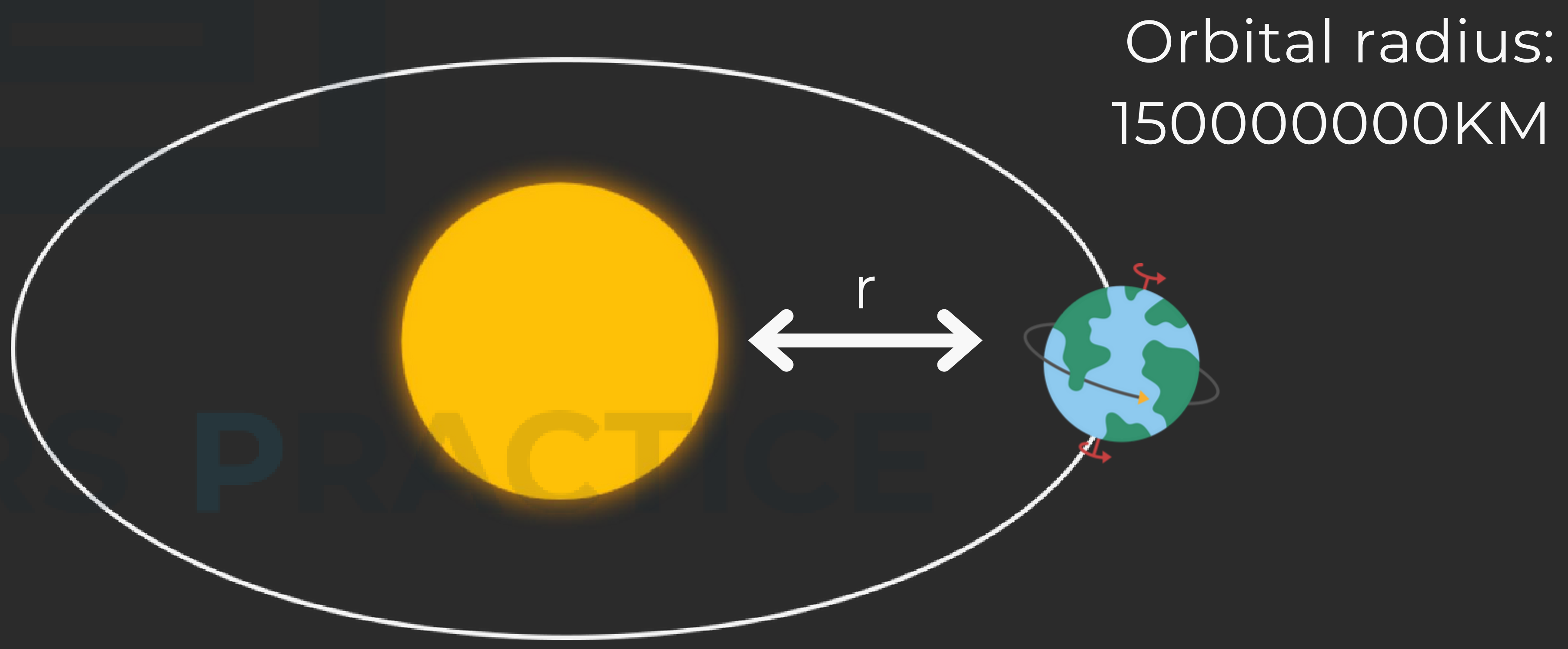
Energy involved:

1. Kinetic energy
   a. Highest when nearby the Sun, lowest when furthest away from the Sun.
2. Gravitational potential energy
   a. Lowest when nearby the Sun, highest when furthest away from the Sun.

Speeds

1. The speed of a planet in orbit around a star is called its orbital speed (v).
2. We can calculate the orbital speed if we know the orbital radius.

> Orbital radius refers to the average distance between the center of mass of an orbiting body (such as a planet, satellite, or electron) and the center of mass of the body it orbits (such as a star or nucleus).



Speeds

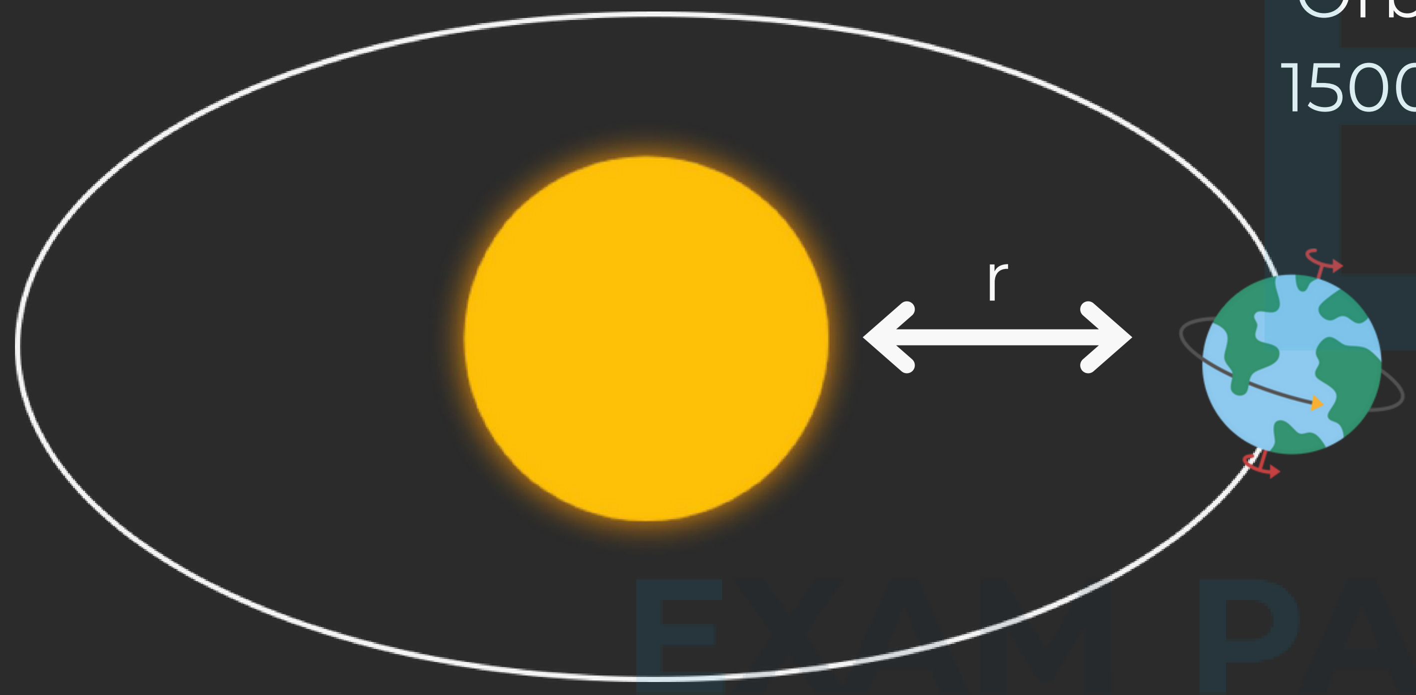
3. Formula to calculate orbital speed

$$\text{average orbital speed} = \frac{2\pi r}{T}$$

T = Orbital Period

Speeds

Calculate the orbital speed of Earth.

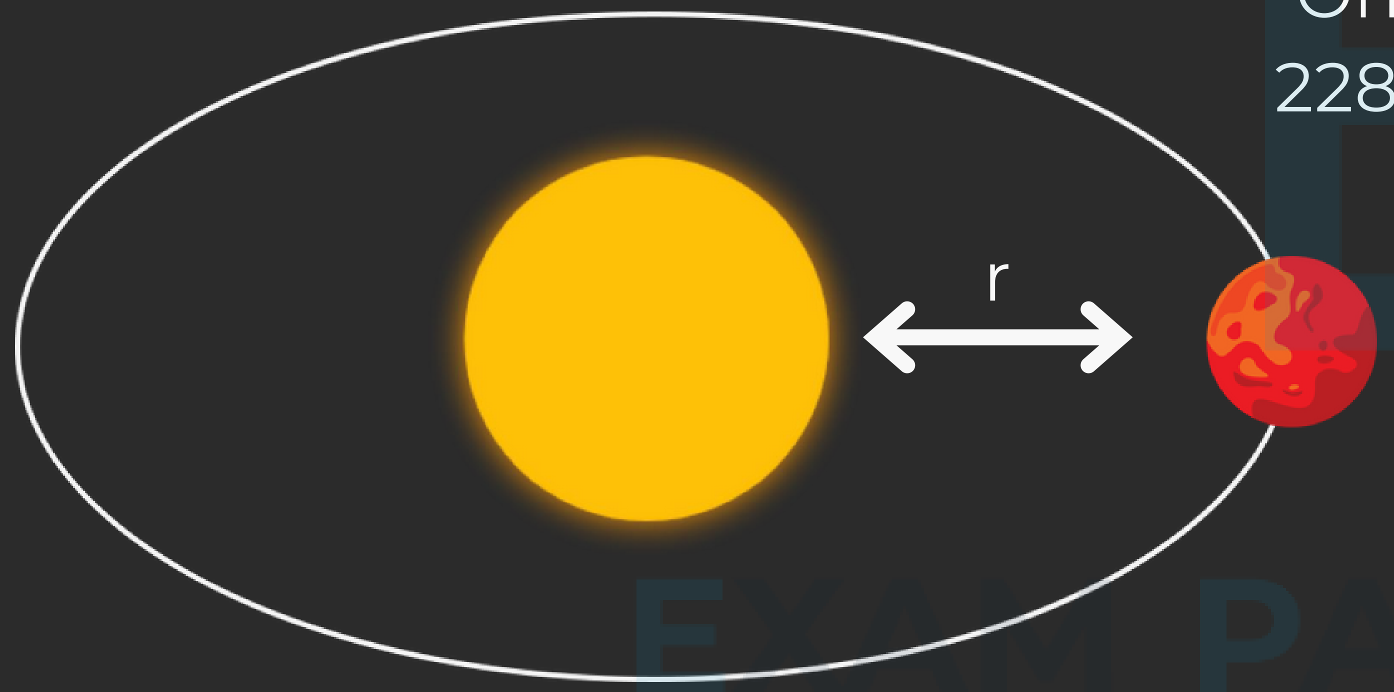


Orbital radius:
150000000KM

Speeds

Calculate the orbital speed of Mars.

Orbital radius:
228000000KM



T = 687 days

Planetary patterns

1. This table is useful for analysing and comparing properties and behaviours of planets, facilitating detailed examination across various criteria.
2. By graphing the data on a scatter plot, it is possible to determine if there is a relationship or correlation between the two sets of data being compared, visually representing potential patterns or trends.

Planet	Average orbital distance / million km	Orbital duration / years	Density / kg/m3	Surface temperature	Gravitational field strength N/kg	Number of Moons
Mercury	58 108	0.2 0.6	550	-18 to 460	4 9 10	0
Venus	150 228 778 1427	1 1.9 12 30 84	0	470	4 26 11 11 12	0
Ear th	2870 4497	165	520	-8 to 58		1
Mars			0	-8 to -5		2
Jupiter			550 0	15 to		1
Saturn			400	20 -140		6
Uranus			0	-200		2
Neptune			130	-220		0
			0			1 5

Worked Example

Using the table above, draw and comment on scatter graphs to investigate the relationship betweenthe gravitational field strength and the number of moons