Name: MODEL ANSWERS Form: _____

GCSE

Astronomy

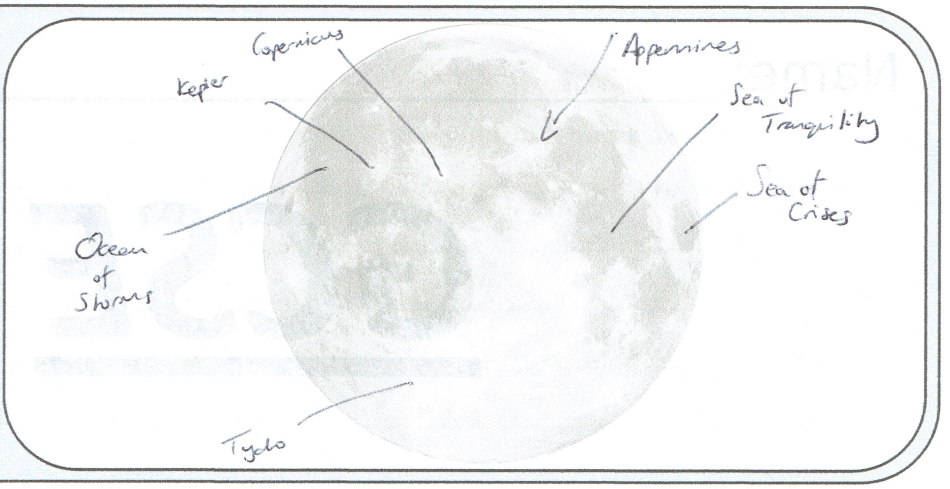
Club

1.2 Earth, Moon, Sun

The Moon

a) dentify the Moon's principal features, including the Sea of Tranquility,Ocean of Storms, Sea of Crises, the craters Tycho, Copernicus and Kepler, and the Apennine mountain range (Latin names are acceptable)

Label the principle features on this diagram of the moon.



b) recall the Moon's diameter and its approximate distance from Earth.

The diameter of the moon: 3475 km. The distance from the Earth to the Moon: 384400 km.

c) Recall the Moon's rotational period and orbital period.

The rotational period of the Moon: 27.3 days. The orbital period of the Moon: 29.5 days.

d) Demonstrate an understanding of why the far side of the Moon is not visible from Earth

Explain the reason for your answer to c) and how this leads to us not being able to see the far side of the moon:

The rotational period is the time taken for the moon to rotate once on its axis / with respect to the stars. The orbital period is the time it takes the moon to the same position relative to the Sun as observed from Earth (or to go through a full phase cycle). The earth and moon are tidally locked - it takes the same time for the moon to orbit + rotate once so we only see one face (and also explains Earth's tides).

e) Describe how astronomers know the appearance of the Moon's far side and how it differs from the near side

Mission	Mission details
Luna 3	Soviet Union space probe photographed the far side in 1959. Atlas produced 1960.
Apollo 8	US astronauts the first to view this region directly over Christmas 1968.
	The near side has many large maria (seas) while the far side is more densely cratered. The far side also has more visible craters, ~~and~~ and a generally thicker crust.

f) Distinguish between the lunar seas (maria) and highlands (terrae)

Terrae = lighter regions, highlands
Maria = darker areas, cooled molten rock post-impact

g) Demonstrate an understanding of the origin of lunar seas and craters

Describe how lunar craters are formed: Due to the impact of meteorites. The moon has no atmospheric protection. The moon also has no means of erasing the evidence of impacts - neither erosion nor tectonics / volcanism.

Explain how maria are formed and how they differ from tarrae:

Maria are where impacts took place resulting in molten rock rising to the surface. When the rock cooled, it left dark patches. The fewer, smaller craters in the maria suggest the surface is younger. Terrae are highland or mountainous regions with high albedo. They are also older and more heavily cratered, and may be a remnant of the original molten lunar ocean.

h) Demonstrate an understanding that the relative numbers of craters in the seas and highlands implies different ages of these features

Using researched examples to describe the difference in ages of the seas and highlands and explain how the relative numbers of craters provides evidence for this.

Highlands ≈ 4bn yrs old (Apollo 16, Cayley Plains)

Seas ≈ 3.5bn yrs old (Apollo 11, Mare Imbrium; Apollo 12, Ocean of Storms)

The terrae are older and have more craters. The fact that the maria have less craters suggests they are younger, or that the surface here cooled/formed later.

i) Describe the nature of rilles and wrinkle ridges

Explain how these frilles and wringle ridges are caused:

Rilles are grooves or trenches, likely caused by collapsed lava channels.

Wrinkle ridges are ridges found in maria. They are tectonic features from when the moon was tectonically active, and formed when lava cooled and contracted.

j) Relate the lack of atmosphere to the Moon's low gravity

Using the idea of escape velocity, explain how the Moon's low gravity leads to a lack of atmosphere:

As the moon is smaller (less mass) than the Earth, the kinetic energy needed to escape is less (as the gravitational attraction is smaller). This allowed the lunar gases to break free more easily (and prevents the moon from hanging on to any gases that may arrive).

k) Describe the nature and purposes of the Apollo space programme and its experimental packages (ALSEPs) Compare Project Apollo with Project Gemini and Project Mercury in terms of aims and achievements. Project Mercury was the first human spaceflight programme of the US from 1959-63, with the aim of putting the first human into space (and back). Gemini was the second US programme (1961-66) designed to develop space travel techniques ahead of Apollo. Apollo's aim was to achieve JFK's goal of a manned lunar landing before the end of the 1960s. Apollo ran from 1961-72.

Major achievements of Project Apollo: Allowed the US to beat the USSR at something! Only missions beyond low Earth orbit. First orbit of another celestial body (8). Six moon landings. Return of moonrock for study. Spin-off technology - avionics, telecommunications + computing.

ALSEP Instrument	Role of instrument & reason for its inclusion in ALSEP.
Seismic (Passive) Experiment	To detect moonquakes, either natural or artificial, to help study the subsurface.
Magnetometer	To measure the lunar magnetic field. To understand the electrical properties of the subsurface and the interaction of solar plasma and the lunar surface.
Medium Energy Solar Wind	To measure and sample the solar wind outside the Earth's magnetosphere. First isotopic measurements of solar material.
Suprathermal Ion Detection	To measure various properties of positive ions in the lunar environment. Provide data on the plasma interaction between the moon + solar wind + electrical potential at surface.
Heat Flow Management	Placed in a drilled hole, to make thermal measurements of the subsurface to determine heat flow from the interior. Data on radioisotopes and evolution of the Moon.
Low Energy Solar Wind	As above (3).
Active Seismic Experiment	Using mortars + geophones to determine the internal structure of the Moon to several hundred feet underground.

l) Describe the likely origin of the Moon (the giant impact hypothesis) Collision of 2 protoplanetary bodies during early solar system

m) Describe the evidence that allowed astronomers to develop the giant impact hypothesis.

Compare the giant impact theory with other theories of the origin of the Moon. Provide evidence and draw a clear conclusion: The giant impact hypothesis ~~best~~ explains the orbital relationship between the earth and moon and the relatively small lunar metallic core. That said, this hypothesis does not explain everything, such as the moon being able to hang on to some of its more volatile elements and identical isotopic rock signatures to the Earth. The capture hypothesis argues that the moon was captured by the Earth and explains well the moon's size, orbit and tidal locking, but no satisfactory explanation of the capture mechanism has been put forward. Other less established hypotheses include: fission (where the early Earth lost a big piece of mass); accretion (where the earth and moon formed together from the early solar system accretion disk); collision with an ancient second earth moon; and the earth took the moon from Venus! Though it has its problems, the GIH is the leading current theory as it explains most features and has the least flaws. More evidence is needed.