Name: MODEL ANSWERS Form: _____

GCSE

Astronomy

Club

1.1 Earth, Moon, Sun

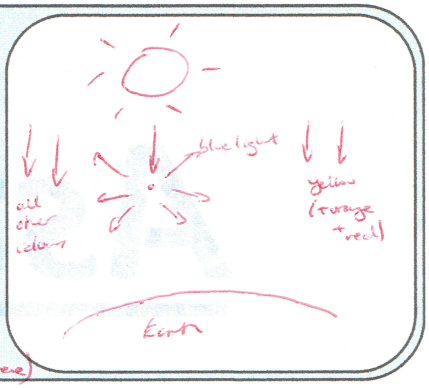
Planet Earth

a) Describe features of the Earth that distinguish it from other planets, including its water surface and atmosphere Task:

Feature of Earth	Planets without this feature	Planets with similar feature and details of the differences and similarities.
Atmosphere	—	Mercury (v. thin), Venus (CO_2, greenhouse effect, hottest, denser), Mars (thin, mainly CO_2), gas giants (H+He mainly, often ices) + Pluto (v. thin)
Water surface	All rest	Mars, Venus (x moons, dwarf + extra solar planets) may have or once had
Tectonics	All gas ones plus Mercury	Potentially Venus + Mars (+ Titan + Galilean moons + exoplanets)
Life	All rest	Potential on Mars (+ extra solar planets + Titan)

b) Relate the blue sky to the preferential scattering of light in its atmosphere

Task: Explain, with the help of a ray diagram, how white sunlight is scattered causing the sky to appear blue and the sun to appear yellow.



Also called Rayleigh Scattering

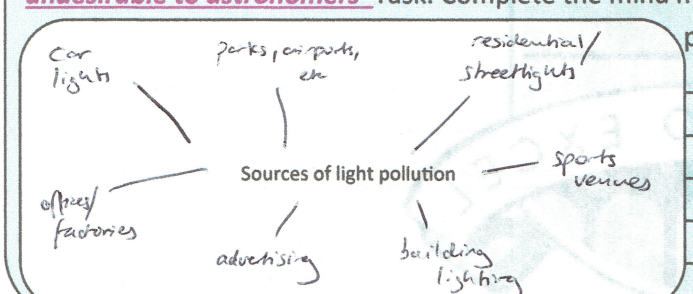
The incoming sunlight is scattered by particles in the Earth's atmosphere. This scattering is more effective at short λ and the blue end of the spectrum is therefore scattered more. The sun's light is white but if you take some blue away it'll turn yellowish (+orange +red at sunset as more light is scattered (more in sky - more atmosphere))

c) Demonstrate an understanding of the benefits of the Earth's atmosphere to humankind

Task: Explain how oxygen, ozone and other constituents of the atmosphere contribute to a habitable environment for humans on Earth. Explain how the atmosphere protects us from various forms of EM radiation.

Animal life as we know it requires an atmosphere with oxygen. To sustain plant life and to enable photosynthesis there must be sufficient CO_2 also. The sustaining of a stable habitable temperature also depends on the mixture of greenhouse gases (balance of heat in and out). Much of the radiation incident on the Earth is absorbed. Light, some IR, some UV, and microwaves reach the surface. Gamma and X-rays, most UV and some IR are absorbed, largely by the ozone layer.

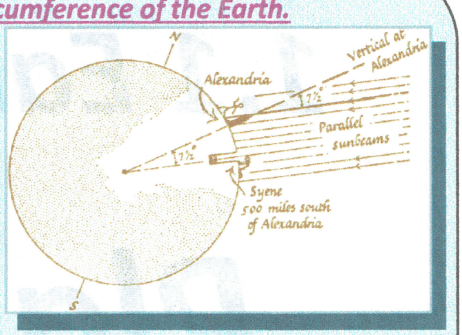
d) Describe some of the major causes of light pollution and demonstrate an understanding of why it is undesirable to astronomers Task: Complete the mind map and explain how light pollution causes astronomers problems



Light pollution is a side effect of an industrial civilisation. Particularly near towns and cities, there is a glow - sky glow. Light escapes skywards and mean only the brightest stars and planets remain visible. Artificial light can also interfere with spectroscopic data

e) Describe how Eratosthenes made the first accurate calculation of the circumference of the Earth.

Task: Draw a diagram to help you and perform the calculations which Erotosthenes made to calculate the Earth's circumference:



$7.2° = \frac{1}{50^{th}}$ of a circle

800 km × 50 = 40000 km

So now 40,008 km

f) Recall the shape and diameter of the Earth

Task: Shape of the Earth: Oblate spheroid Description of this shape: A sphere slightly flattened in the direction of Earth's axis (north - south) (around the middle) Average diameter of the Earth: 12742 km.

g) Describe the evidence that the Earth is approximately spherical

Evidence	(How does this evidence support the theory that the Earth is approximately spherical)
Picture from space	Pictures show a sphere (and satellites can orbit)
Lunar eclipse	Earth's shadow is round
Horizon	Can see elevated points first in the distance / see further by climbing higher
Sun position	Sun is lower in the sky as you travel away from the tropics (and length of day light varies)
Shadows	Change direction with hemispheres
Circumnavigation	Can return to starting point (and gain/loss of day at date line)
Sunrise/set	Would be the same time everywhere if flat
Gravity	Is vertical everywhere; wouldn't be if flat

h) Recall the rotation period of the Earth and the time to rotate through 1 degree.

Time taken for the Earth to make one full rotation: 23:56 (or 24:00) Hours. Time taken for the Earth to make one degree of rotation: 4 minutes. Explain your answers:

↳ assuming 24hrs The time elapsed for one rotation is 23:56 with respect to the stars and 24hrs with respect to the sun. 360° = one rotation = 24hrs = 1440 mins. 1° = 1440/360 = 4 mins

i) demonstrate an understanding of the terms: equator, tropics, latitude, longitude, pole, horizon, meridian and zenith

Term	Definition and explanation of the term in your own words
Equator	Intersection of a sphere's surface with the plane perpendicular to the axis of rotation + midway between the poles.
Tropics	A region surrounding the equator with latitudes defined by the Earth's axial tilt / area where sun directly overhead at least once a year.
Latitude	A geographic coordinate that specifies the north-south position of a point on the Earth's surface
Longitude	" " east-west " "
Pole	The projection of the Earth's axis of rotation onto the celestial sphere / northern + southernmost fixed points on Earth's surface
Horizon	Also called skyline - the apparent line that separates earth from sky. We may see a visible horizon as the true horizon may be obscured.
Meridian	An imaginary circle in a plane perpendicular to the planes of the celestial equator + horizon - passes through the poles, zenith + nadir
Zenith	An imaginary point directly 'above' a particular location; the 'highest' point in the celestial sphere

j) demonstrate an understanding of the drawbacks to astronomers of the Earth's atmosphere and relate these to the need for optical and infra-red observatories to be sited on high mountains or in space

Astronomers place telescopes in space because: they are above the Earth's atmosphere. The atmosphere is turbulent ∞ (twinkle twinkle...) and affects the sharpness of images. The atmosphere also absorbs much useful UV + IR light. In space, you can also see the whole sky and operate 'day and night!'

Astronomers place telescopes on top of mountains because: there is less light pollution. There is also less atmosphere to interfere with the incoming radiation so blurring is reduced.

Radio Telescopes do not need to be placed in space or on top of mountains because: radio waves are unaffected by the atmosphere and clouds (mostly).

k) Describe the features of refracting and reflecting telescopes (detailed ray diagrams not needed)

Features of Refracting Telescopes	Features of Reflecting Telescopes
Objective lens – produces an image of a distant object at its focus	Primary mirror reflects the light back to a focus
Eyepiece (lens) – magnifies this image	Secondary mirror (if present) re-reflects this light to the eyepiece.
More magnification	More light gathering power

l) Demonstrate an understanding of why the world's largest telescopes are reflectors rather than refractors

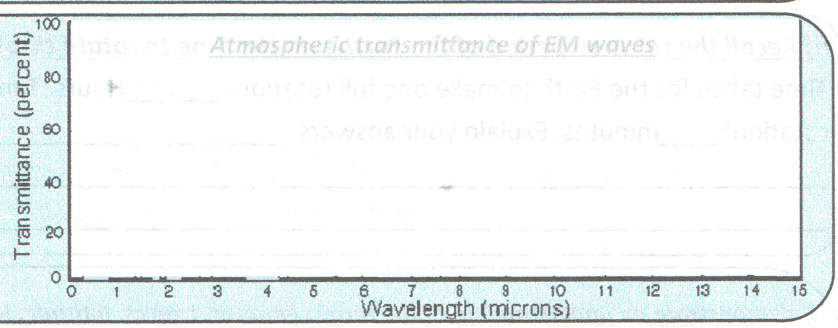
Explain the reasons why refractors can not be used for very large telescopes: Refractors use lenses + can deform under their own weight. Reflectors use mirrors that can be supported

Explain the advantages of reflecting telescopes over refracting telescopes in terms of image quality: Reflectors do not suffer from chromatic aberration and only need one ephemal surface (easier to grind). Mirrors are also easier to cast and are more tolerant. Light bent by a reflector interacts with only one surface so attenuation is less.

m) Demonstrate an understanding that the Earth's atmosphere is transparent to visible light, microwaves and some radio waves

Task: Complete the graph and label the regions of the E-M spectrum.

Right scale ?



n) Interpret data on the effect of the Earth's atmosphere on infra-red, ultra-violet and X-rays

Mostly absorbed

o) Describe where infra-red, ultra-violet and X-ray observatories are sited and explain the reasons why

Task: Using the data in the "Atmospheric transmittance of EM waves" graph above, explain where I-R, U-V and X-Ray telescopes should be positioned and why. As these types of EM waves are largely absorbed, or affected by water vapour the best place would be in space or failing that, at high + dry altitudes.

p) Describe the nature and discovery of the Van Allen Belts.

Task: Draw a diagram including the altitudes and cause of the Van Allen Belts. Describe how the Van Allen Belts were discovered and by whom.

The earth has 2 main belts of radiation held in place by its magnetic field. These belts are layers of energetic charged particles discovered by James Van Allen. Most of these particles are thought to come from the solar wind and cosmic rays. The belts are located in the earth's magnetosphere. The outer belt is largely made of electrons, with the inner belt largely electrons + protons. These belts had been theorised and were confirmed in early 1958 by the US probes Explorer 1 and Explorer 3 managed by JVA. They were mapped by later probes. Other planets have similar belts.