Topic 1

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- Astronomical objects are so distant that their light is effectively parallel.

· Converging (convex) lenses and concave mirrors can be used to focus parallel rays of light.

· Power of a lens (in D) = 1 ÷ focal length (in m)

· A converging lens forms a real image of a distant source of light.

· A simple telescope uses two converging lenses. The eyepiece is more powerful than the objective.

· Magnification = focal length of objective ÷ focal length of eyepiece.

· When an observatory is planned, non-astronomical factors such as cost, environmental impact, and working conditions must be taken into account.

Topic 1

· Most astronomical telescopes have concave mirrors as their objectives.

· A large telescope is needed to collect the weak radiation from a faint or distant source.

· The aperture of a telescope must be larger than the wavelength of the radiation it detects.

· Many telescopes are sited on mountains or in space to reduce the effects of the atmosphere, which refracts and absorbs electromagnetic radiation.

· International collaboration can share the cost of an astronomical project, and allows expertise to be shared.

Topic 2

· The apparent movements of the Sun, Moon and stars across the sky can be explained in terms of the rotation of the Earth, and the orbits of the Earth around the Sun.

· Seen from the Earth, the planets move in irregular patterns relative to the fixed stars.

· The apparent motions of the planets can be explained in terms of their orbits around the Sun.

· The phases of the moon, and eclipses of the Sun and Moon, can be explained in the terms of the relative positions of the Sun, Moon and Earth.

· Solar eclipses are rare because the orbit of the Moon is tilted relative to the Earth's orbit plane.

· Different stars are seen in the night sky through a year, as the Earth travels around its orbit.

· A sidereal day is 4 minutes less than a solar day.

- Light from distant galaxies is red-shifted. This shows that they are moving away: Speed of recession = Hubble constant × distance.

Topic 2

· Nearby stars show parallax: they appear to move relative to more distant stars over the course of a year.

· A parsec is a measure of distance, similar in magnitude to a light-year. Neighbouring stars are typically separated by a few parsecs, galaxies by megaparsecs.

· The luminosity of star depends on its temperature and size. Observed brightness also depends on distance from Earth.

· Cepheid variables are stars whose brightness varies regularly. The most luminous have the longest periods.

· The changing luminosity of Cepheid's allows astronomers to measure their distances to the galaxies they are in.

· In 1920 two American astronomers took part in a public debate about the scale of the Universe. Within a few years, new evidence conclusively showed that there are galaxies beyond the Milky Way.

Topic 3

- The electrons in an atom can only exist in certain allowed energy levels. They emit one photon with exactly the right amount of energy - exactly the right frequency.
- Frequencies show a series of spectral lines called an emmision spectrum - colours show up for different elements. Where there is no colour the element has been absorbed - this is called the absorbtion spectrum. Spectrums can be used to identify elements in stars.
- **Star Formation:**
- Gravity pulls a cloud of dust and gas together to form a protostar.
- The gas cloud contracts and the gas is compressed until the force of gravity is equal with the force form colliding particles.
- As pressure increases, the temperature increases, this causes more particles to collide.
- The centre is eventually hot enough to start nuclear fusion - this makes a star.

gas (H_2) cloud - protostar - main sequence - red giant - planetary nebula - white dwarf

Topic 3

- **Star Endings:**
- Fusion takes place in the core (hydrogen is fused to helium). When all the hydrogen is fused the star begins to cool. It stops being a main sequence star.
- The core contracts (gravity) because there is less pressure and outer layers fall inwards, heating up.
- The hydrogen left in outer layers fuse and they expand and cool and the star becomes a red giant.
- The core still contracts and heats up until helium nuclei fuse into carbon nuclei.
- The more mass the star has, the larger the gravitational forces and the hotter the core becomes. this means electrical repulsion can be overcome and a larger nuclei is formed, releasing energy.
- Only very massive stars become red supergiants.
- **A star has:**
- A hot core where fusion takes place.
- A convection zone where energy is transported to the surface by convection currents.
- A photosphere where electromagnetic radiation is emitted into space.

Topic 4

- Lenses use refraction to change the direction of light rays.
- A converging lens makes a parallel beam of light rays converge to a point, called the focal point or focus. Converging lens are fatter in the middle.
- Focal length - distance from the centre of a lens to the point where the rays are focused.
- The lens with the most curved surface will have a shorter focal length.
- Light from a source spreads out, or diverges. This is a diverging lens.7
- A lens is used to produce images in telescopes, cameras, projectors etc. The image is a copy of the object.
- Magnification = focal length of eyepiece lens / focal length of objective lens
- Real - it can be displayed on a screen because light passes through it
- Virtual - only seen through a lens, light doesn't pass through it
- Upright - the same way up as the object
- Inverted - upside down compared to the object
- Magnified - bigger than the object

Topic 4

- **Ray diagrams:**
- Light passes though the centre of a lens.
- Light parallel to the axis is converging so it passes through the focus.
- **Drawing ray diagrams:**
- Find a suitable scale
- Draw the lens and a horizontal line for the principal axis
- Draw an upright arrow to represent the object
- Mark the focus (to scale)
- Draw a line from the top arrow straight through the centre of the lens
- Draw lines from both sides of the object through the lens so that they meet at the focal point
- Draw the image arrow from where the lines meet
- Star-light comes from so far away it is parallel