

1.4 Gravitation

- ☐ 1 Define *Gravitational Field Strength*.
- ☐ 2 Sketch gravitation field lines for an isolated point mass e.g. planet.
- ☐ 3 Sketch gravitational field lines for 2 point masses e.g. a planet-moon system.
- ☐ 4 Carry out calculations using $F = \frac{Gm_1m_2}{r^2}$ where G is the gravitational constant.
- ☐ 6 Carry out calculations involving the period of satellites in circular orbits, orbit radius and satellite speed using equations
$$F = \frac{Gm_1m_2}{r^2} = mr\omega^2 = mr\left(\frac{2\pi}{T}\right)^2$$
- ☐ 7 State that the period of a satellite depends upon distance from the centre and the mass of the astronomical object being orbited.
- ☐ 5 Define gravitational potential.
- ☐ 6 Define the zero of gravitational potential.
- ☐ 7 Carry out calculations using $V = -\frac{Gm}{r}$.
- ☐ 8 Define gravitational potential energy.
- ☐ 9 Carry out calculations using $E_p = Vm = -\frac{GMm}{r}$.
- ☐ 10 Explain the term 'conservative field'.
- ☐ 11 Explain the term 'escape velocity'.
- ☐ 12 Derive the expression $v = \sqrt{\frac{2GM}{r}}$ and use this in calculations.
- ☐ 13 Explain the energy change when a satellite moves from one orbit to another.

1.5 General Relativity

- ❑ 1 State that special relativity deals with motion in inertial (non-accelerating) frames of reference
- ❑ 2 State that general relativity deals with motion in non-inertial (accelerating) frames of reference
- ❑ 3 State and explain what is meant by the equivalence principle
- ❑ 4 Describe what is meant by space-time
- ❑ 5 Know that light or a freely moving object follows a geodesic (the shortest distance between two points) in spacetime
- ❑ 6 Know that space-time can be curved by mass
- ❑ 7 Explain how space-time can affect the motion of mass and light
- ❑ 8 Give examples of evidence for General Relativity (the curvature of space-time) e.g. gravitational lensing and the precession of Mercury
- ❑ 9 Know that gravity arises from the curvature of spacetime
- ❑ 10 Represent the motion of objects which are stationary, moving with constant velocity and accelerating with *World lines* on a spacetime diagram
- ❑ 11 Explain what is meant by a black hole
- ❑ 12 Use the equation $r = \frac{2GM}{c^2}$ to calculate the Schwarzschild radius
- ❑ 13 Explain the terms 'Schwarzschild radius' and 'event horizon'.
- ❑ 14 Know that time appears frozen at the event horizon of a black hole

1.6 Stellar Physics

- ❑ 1 Use the following terms correctly and in context: Surface Temperature, core, photosphere and corona
- ❑ 2 State what is meant by the luminosity of a star
- ❑ 3 Carry out calculations using the equation $L = 4\pi r^2 \sigma T^4$
- ❑ 4 State what is meant by power per unit area for a star
- ❑ 5 Carry out calculations using the equation
power per unit area $P/A = \sigma T^4$
- ❑ 6 State what is meant by apparent brightness of a star
- ❑ 7 Carry out calculations using the equation $b = \frac{L}{4\pi r^2}$
- ❑ 8 Explain what is meant by apparent and absolute magnitude of a star
- ❑ 9 Explain how stars are classified - known as 'Stellar Classification'.
- ❑ 10 Know the stages in the proton-proton chain in Stellar Evolution
- ❑ 11 Explain how stars maintain gravitational equilibrium with reference to nuclear fusion reactions
- ❑ 12 Describe the process of star formation
- ❑ 13 Explain the Hertzsprung-Russell diagram and the significance of a stars position in it.
- ❑ 14 Predict the colour of a star from its position in the HR diagram
- ❑ 15 Explain what happens to a star at the end of the star's life cycle and how this depends on the mass of the star