Summary of Space

THE SOLAR SYSTEM
Candidates should:

(a) know the theory of the origin of the Solar System in terms of the gravitational collapse of a cloud of gas (largely hydrogen and helium) and dust.

KEY POINTS

- Cloud of gas and dust, spins, flattens, centre collapses to form Sun, matter further out collapses into planets
- Evidence comes from planets orbiting in same direction and plane
- Rocky planets form closer to Sun where it is too warm for gases to solidify (rock solidifies at higher temps)
- Gas planets form further out where it is cold enough for gases to freeze/solidify

(b) describe the main features of the Solar System, including the Sun, the rocky and gas planets, moons, asteroids and comets, relating these features to the origin of the Solar System.

KEY POINTS

- Asteroids orbit between Mars and Jupiter
- Asteroids would have formed a planet but for Jupiter's pull of gravity opposing Sun's pull of gravity like a tug of war keeping the rocks apart
- Comets (made of dust and ice) have highly elliptical orbits
- Comets orbit close to Sun where some of the frozen gas vapourises

(c) interpret data on the orbits of planets and other bodies in the Solar System.

KEY POINTS

- be able to interpret tables of data and make predictions

(d) understand the effect of gravity on the orbital motion of planets, comets, moons and artificial satellites and use a model of radiation pressure to account for cometary tails.

KEY POINTS

- Sun's gravity makes comets travel faster as they get closer to the Sun and slow down as they move further away
- Comets tails always point away from the Sun, this is because of the Sun's radiation pressure

(e) know how new discoveries of solar system objects are made by the use of ICT to detect movement.

KEY POINTS

- Astronomers use ICT to monitor skies for stray asteroids which may collide with Earth
- They compare images taken of same part of sky over a period of days, looking for any object that moves against the background of stars. These objects could be asteroids, comets or minor planets

STARS

Candidates should:

(a) know that, in the 19th and early 20th centuries, the source of the Sun's energy became a problem as Geologists discovered that the Earth was millions of years old, and the model of the Sun's being powered by Chemical energy could not account for its shining for more than a few thousand years.

KEY POINTS

- if Sun uses chemical reactions like combustion to generate energy then there is not enough fuel for it to burn for millions of years
- Geologists and palaeontologists needed the Earth to be millions of years old

(b) know that studies of the light from stars, including our Sun, show that they are composed mainly of hydrogen and helium and that their energy is supplied by the fusion of hydrogen into helium, which is able to supply energy at the current rate for about 10 000 million years.

KEY POINTS

- hydrogen atoms fuse together to make heliuim
- this process is known as nuclear fusion
- the energy released is vast
- large stars make elements all the way up to iron

(c) appreciate the role of previous generations of stars in the existence of elements heavier than helium in the Solar System and that the fraction of heavier elements in the universe is gradually increasing as a result of the processes in stars.

KEY POINTS

- stars create elements heavier than hydrogen all the way up to iron by nuclear fusion
- outer layers of dying stars cool and drift off sending these newly formed elements into space
- elements heavier than iron are made when large dying stars explode in supernova
- the amount of heavier elements I space is increasing with time and the amount of hydrogen is decreasing

(d) **model the stability of stars in terms of the balance between gravitational force and gas/radiation pressure and describe the stages in the evolution of low and high mass stars.**

KEY POINTS

- clouds of gas and dust (nebulae) collapse due to pull of gravity
- clumped material heats up
- if there is enough material then temperature becomes high enough to start nuclear fusion reactions
- main sequence star remains constant in size, this is due to inward force of gravity being balanced by outward pressure due to high temperature

- as fuel (hydrogen) runs out, small stars expand (outward force greater than inward force) to become red giant
- outer layer cools drifts off and inner contracts (inward force greater than outward force) to become a white dwarf, which eventually cools and dims
- large stars run out of fuel, expand to become super-massive red giant
- they then explode – called a supernova
- left behind is a very dense neutron star, if really massive then a black hole is formed instead

10. THE UNIVERSE

Candidates should:

(a) know how studies of the electromagnetic radiation from distant galaxies lead to a model of an expanding universe and that the further they are away, the bigger their speed.

KEY POINTS

- the spectrum from a galaxy shows the wavelengths have been shifted to the red end of the spectrum
- this shifting is called red shift
- red shift happens because the galaxy is moving away from us
- the further away a galaxy is , the greater is its red shift and the faster it must be moving away from us
- all the galaxies are moving away from each other so the universe must be expanding

(b) know that Red Shift measurements provide evidence that the universe started with a hot Big Bang which, according to current measurements, occurred 12-15 thousand million years ago.

KEY POINTS

- tracing back the paths of all the galaxies shows that they all started off at the same very small point in space
- the universe must have been created in a rapid, hot, expansion (explosion) called the Big Bang
- it was created 12-15 thousand million years ago