Unit 15 Oscillation

Simple Harmonic Motion:

Acceleration is directly proportional to displacement from equilibrium position. Acceleration is in the opposite direction to displacement.

Resonance:

The second object is forced to vibrate at the frequency of the first object.

Because they have similar natural frequency.

Driver/forcing frequency Matches natural frequency.

Maximum Energy is transferred from the first object to the second object.

Larger rate of transfer of energy means that the vibration persists for a shorter time.

Damped Oscillation:

Energy of the system is dissipated or energy is removed from the system,

Hence the amplitude reduces.

Unit 9 Nucleus Decay

Radioactive Isotope:

Unstable nucleus and emits α/β/γ radiation.

Radioactive Decay:

We can’t know when an individual nucleus will decay

We can’t know which nucleus will decay next.

Identification of particles

1. Record the background count
2. Fix one source close to the GM-tube
3. Introduce a sheet of paper or Aluminium between the source and the GM-tube.
4. If the paper or Aluminium reduces the count rate to

background levels then it is the objects emits alpha particles only.

1. If the paper or Aluminium cause changes but the rate is still above the background rate, then the objects emits beta and gamma particles only.
2. If the paper or Aluminium cause no change or little changes then it is the objects emits gamma particles only.

Unit 14 Nucleus Binding and Cosmology

Fusion:

Process: Small nuclei fuse together to produce a larger nucleus

Mass of the fused nucleus < total mass of initial nuclei

Energy is released as ∆E = mc2

Conditions:

A very high temperature and pressure

To overcome the electrostatic repulsion between nuclei

To maintain a high/sufficient collision rate

Difficulty:

Contact with container causes temperature to fall.

Very strong magnetic field required,

The B.E. per nucleon for He4 is greater/higher/larger (than other small nuclei) which means He4 nucleus is the most stable (of the small nuclei).

Fission:

Some heavy nuclei can undergo induced fission

Or massive nuclei can be made to split into smaller nuclei.

Massive nuclei have less B.E. per nucleon than the less massive nuclei produced in the fission

hence energy is released in the fission.

Mass of reactant > Mass of products

Energy is released according to E=mc^2

Collision

Fixed target

There is momentum before the collision so there must be momentum after the collision.

So particle(s) created must have some kinetic energy

So not all KE converted to mass.

Colliding beams

(If particles have the same mass and speed), total initial momentum is zero, momentum after collision will be zero.

If one stationary particle is created,

All of the kinetic energy of the particle is converted to mass.

Explosion:

Under explosion, the momentum is still the same as the momentum before collision,

So in order to conserve momentum, the products must be travelling different directions.

Unit 10,11,12 Heat, Internal Energy and gas model

Internal Energy:

Internal energy is (sum of) molecular kinetic and potential energies.

In an ideal gas the molecules have only kinetic energy

Ek ∝ T above 0 K, the air molecules are in continual

random motion,

If the gas reached absolute zero, then the K.E. of the molecules would be zero.

Lower Temperature, then lower collision rate

And the change of momentum is decreased.

Unit 13 Astrophysics

Methods determine the distance of the stars

Parallax method:

Angles are measured using the fixed background of more distant stars.

Find angular displacement of the star

as Earth moves around the Sun over a 6 month period.

The diameter/radius of the Earth’s orbit about the Sun must be known and trigonometry is used.

Standard candle:

Flux/brightness/intensity of standard candle is measured

Luminosity of standard candle is known.

Inverse square law is used.

Dark Matter

It cannot be detected via the em-interaction.

But it has mass

And exerts a gravitational force.

The density of the universe may be greater than the critical density.

Hence the universe is more likely to reach a maximum size and more likely to be closed.

If the density is approximately equal to the critical density,

The expansion will slow down and the size will keep constant.

If the density is far less than the critical density,

The universe will keep expanding forever.

The Death of the Sun

The Sun is fusing/burning hydrogen (into helium in its core)

When (hydrogen) fusion/burning ceases the core of the Sun cools

The core collapses/contracts

(under gravitational forces)

The Sun expands and becomes a red giant

The core becomes hot enough for helium fusion/burning to begin (in the core)

Helium begins to run out and the core collapses again

(Under gravitational forces)

Outer layers of Sun are ejected into space

The temperature doesn’t rise enough for further fusion to begin.

White Dwarfs

They are the core remnant of a red giant star.

There is no fusion in the white dwarf.

They have a relatively small surface area so they are not very luminous by black body equation.

They are very hot and appear white because they emits all visible wavelengths.

Originate of the Microwaves:

Originates from the Big Bang, Microwave radiation comes from the universe itself,

Microwave wavelength shows the temperature of universe, which indicates a temperature of space of about 3 K by Wien’s Law.

Temperature decreases as the universe expands,

Wavelength has been increased.

Start of the Universe

The universe started from a small initial point

Idea that universe has a finite age

Idea that (observable universe is finite because) we can only see

As far as (speed of light) × (age of universe)

Geostationary Satellites

T smaller than 24hrs, Increase radius, and vice versa.

Because GM=rv^2 and GM is a constant.