SOLUTION TO M/J/18/21

QUICK ACCESS GRID

The solution to a particular question can be accessed instantly by clicking on the desired question number in the QUICK ACCESS GRID.

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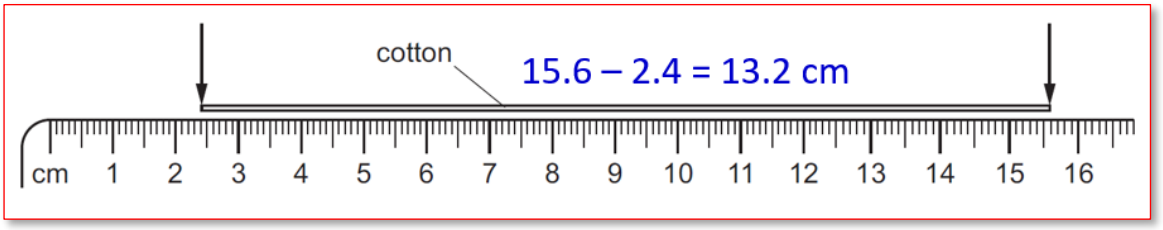
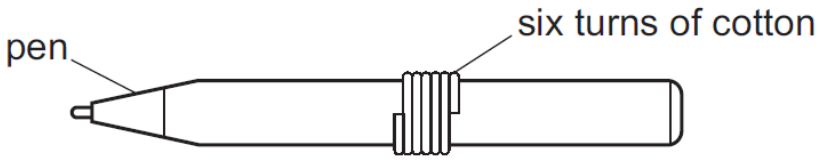
S1

A





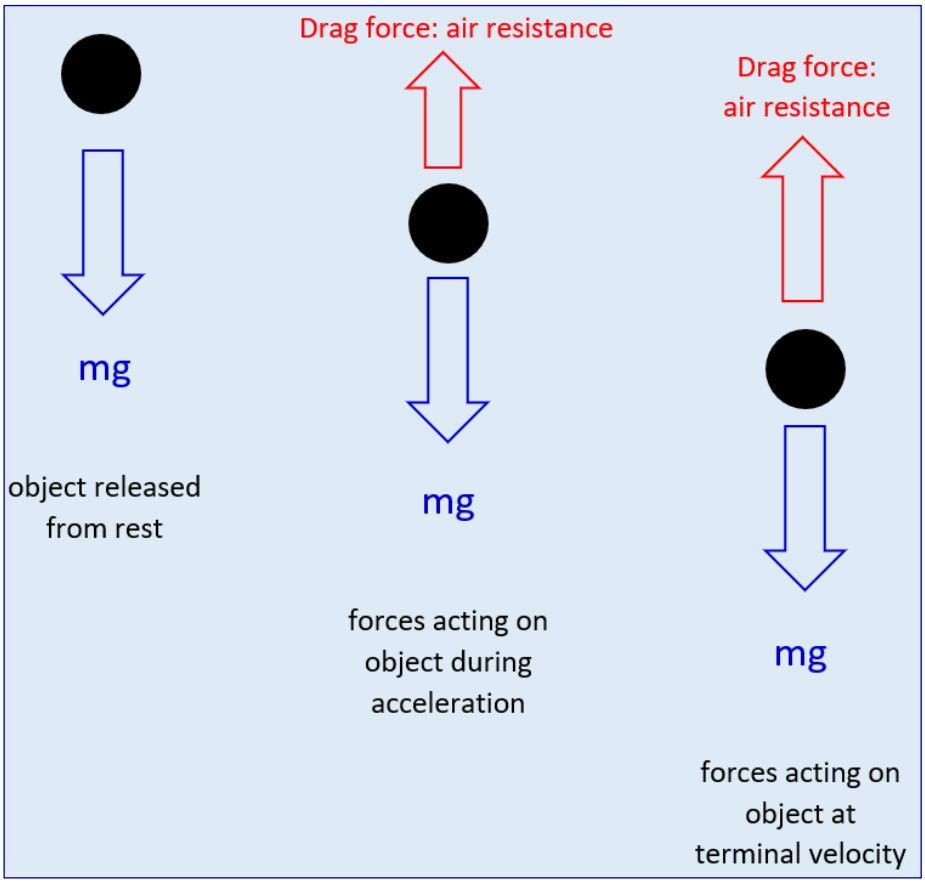
Distance around the pen = $\frac{13.2}{6}$ = **2.2 cm**

S2

C?

Terminal velocity is the constant speed that a freely falling object eventually reaches when the resistance of the medium through which it is falling prevents further acceleration.

An object falling vertically through air is accelerated due to gravity (acting downwards). The motion of the object is opposed by the air resistance acting upwards.
When the air resistance becomes equal to the force of gravity, the object attains terminal velocity – constant speed, no further acceleration!

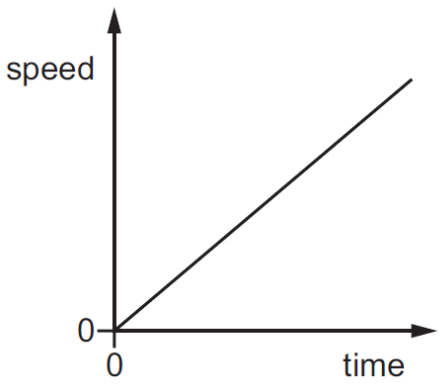


BACK TO QUICK ACCESS GRID

S3

D

D



Acceleration = $\frac{\text{speed}}{\text{time}}$ = gradient of speed-time graph → options C or D could be correct

Constant acceleration → constant gradient → **graph D**

Graph C → gradient = 0 → acceleration = 0 → car moves along the road at a constant speed

BACK TO QUICK ACCESS GRID

S4

B

Mass = amount of matter contained in an object

Mass is independent of acceleration of free fall.
The mass of the standard masses as well as that of the beaker with the attached loop remains unchanged on the moon.
The beam balance is therefore balanced on the moon.

Weight = mass × acceleration of free fall

Weight changes with change in acceleration of free fall.
On the Moon, where the acceleration of free fall is less than on Earth, the weight of the beaker with the attached loop decreases.
The spring by less than 5.0 cm on the moon.

BACK TO QUICK ACCESS GRID

S5

A

Weight = mass × gravitational field strength

A **gravitational field** must be present and acting on the mass for it to have weight.

S6

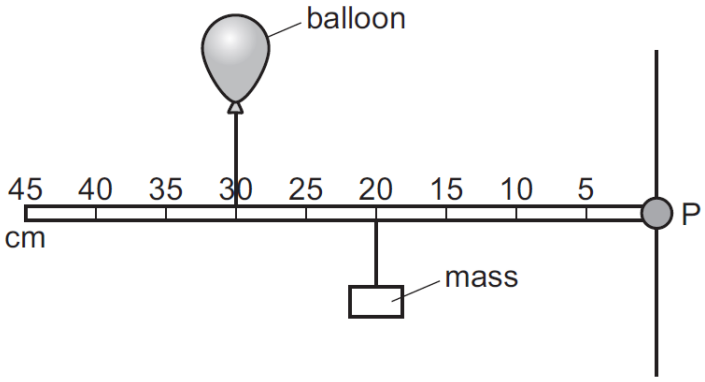
A?

Force = mass × acceleration

Since the force stays constant, a greater change in the motion of the ball can be brought about by decreasing the mass of the ball.

S7

B?



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S8

B

According to Newton's First Law of motion, an object remains in the same state of motion unless a resultant force acts on it.

When the driving force (forward force) from the engine is balanced by resistive forces (such as air resistance and friction in the car's moving parts), the resultant force acting on the car is zero and **the car moves at a constant speed** in the same direction.

BACK TO QUICK ACCESS GRID

S9

C

Momentum = Mass × Velocity

S10

C

Dissipation of energy is the spreading out or distribution of energy among the objects and their surroundings.

The total amount of energy remains unchanged in accordance with the law of conservation of energy.

BACK TO QUICK ACCESS GRID

S11

C

Initial gravitational energy of the ball = mgh = 1.2 kg × 10 m/s^2 × 30 m = 360 J

As the ball falls, 25% of its initial gravitational potential energy is transferred to thermal energy.

The remaining 75% of its initial gravitational potential energy is therefore transferred to kinetic energy.

Kinetic energy of the ball just before it hits the ground = $\frac{75}{100}$ × 360 = **270 J**

*g = gravitational field strength on Earth = 10m/s^2 approximately

BACK TO QUICK ACCESS GRID

S12

C

Useful power = $\frac{\text{Work done}}{\text{Time}} = \frac{48 \times 10 \times 0.25}{2.0}$ = **60 W**

*Work done = force × displacement

In this case, force = weight of the girl = mass of the girl × gravitational field strength

Gravitational field strength on Earth = 10m/s^2 approximately

BACK TO QUICK ACCESS GRID

S13

D

The pressure on an object **submerged in a fluid** is given by the equation –

$$\text{Pressure} = \rho \times g \times h$$

where

- ρ **(rho)** is the density of the fluid
- **g** is acceleration due to gravity
- **h** is the height of the fluid above the object

Liquid P is more dense than liquid Q → pressure in liquid Q is lower, hence options A or B are not correct

h for point C > h for point D

Least pressure is therefore experienced at **point D**.

BACK TO QUICK ACCESS GRID

S14

D

Density of the oil = 800 kg / m^3

Volume of Oil

= base area of oil tank × depth

= 2.5 × 1.2 = 3 m^3

Mass of oil = Density of oil × Volume of oil = 800 × 3 = 2400 kg

Force exerted on the base of the tank due to the oil

= m × g = 2400 × 10 = 24000 kg m/s^2 = **24000 N**

NOTE: The value of g used here is 10 m/s^2.

BACK TO QUICK ACCESS GRID

S15

B?

The pressure exerted by the gas is due to the bombardment of the gas molecules on the walls of the container which leads to the reversal of the velocity of a molecule with a certain change in its momentum.

According to Newton's third law of motion, every action has an equal and opposite reaction.

Hence during the collisions of the molecules with the walls of the container, the container too exerts a force which is due to the **change in momentum** of the molecules.

BACK TO QUICK ACCESS GRID

S16

B

For a mercury-in-glass thermometer with a °C scale, the lower fixed point is the **melting point of ice, that is 0**℃ and the upper fixed point is the **boiling point of water, that is 100**℃.

S17

C

Boiling is a bulk phenomenon – takes place throughout the liquid.

Evaporation is a surface phenomenon – takes place only at the surface of the liquid

S18

B

A metal is a better thermal conductor than plastic.

The metal front-door knob therefore feels cooler to touch.

*Plastics are thermal insulators – poor conductors of thermal energy

BACK TO QUICK ACCESS GRID

S19

D

Frequency of light = $\frac{\text{speed of light}}{\text{wavelength of light}}$

= $\frac{2 \times 10^{8}}{4 \times 10^{-7}}$

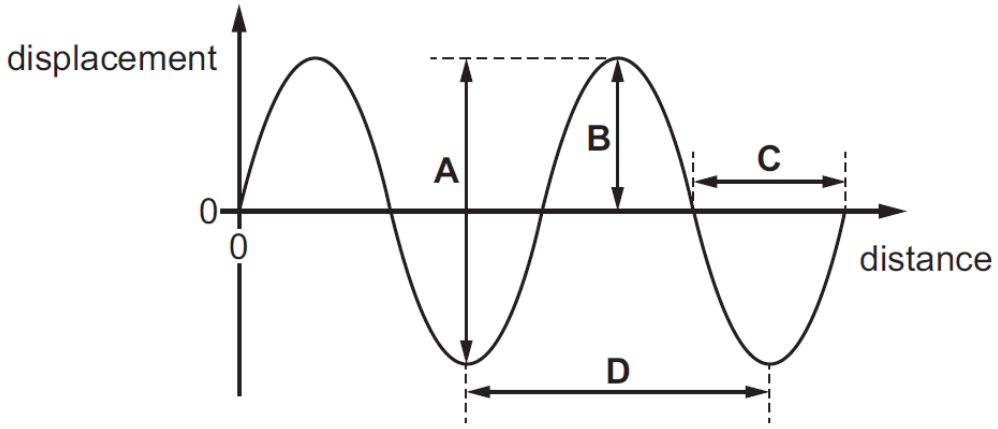
= 0.5×10^{15}

= **5.0×10^{14} Hz**

BACK TO QUICK ACCESS GRID

S20

B?



A =

B = amplitude of the wave

C =

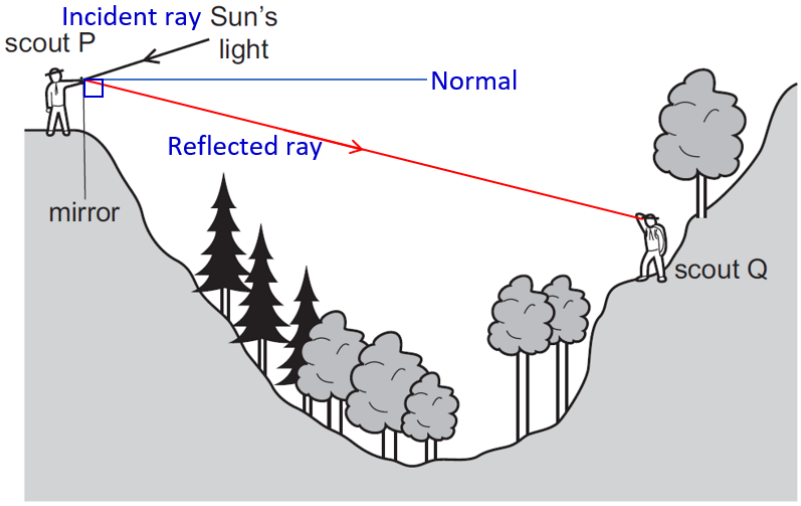
D = wavelength

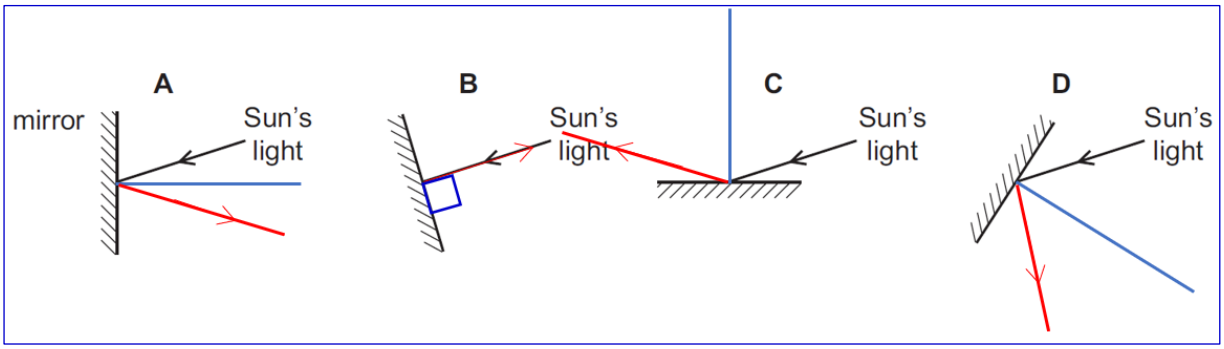
BACK TO QUICK ACCESS GRID

S21

A

Law of reflection: angle of incidence = angle of reflection





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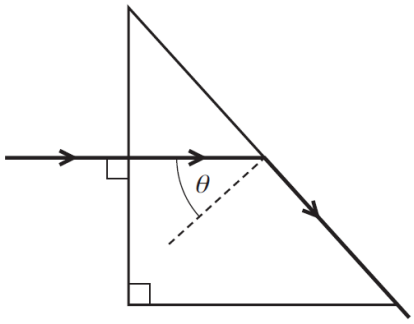
S22

D?



NOT TO SCALE

$$\eta = \frac{\text{speed of light in plastic}}{\text{speed of light in air}} = \frac{0.8c}{c} = 0.8$$

$$\eta = \frac{\sin i}{\sin r}$$

$$0.8 = \frac{\sin i}{\sin 90}$$

$\sin i = 0.8 \times \sin 90 = 0.8 \times 1 = 0.8$

$i = \sin^{-1} 0.8 = 53.13° \approx \mathbf{53}°$

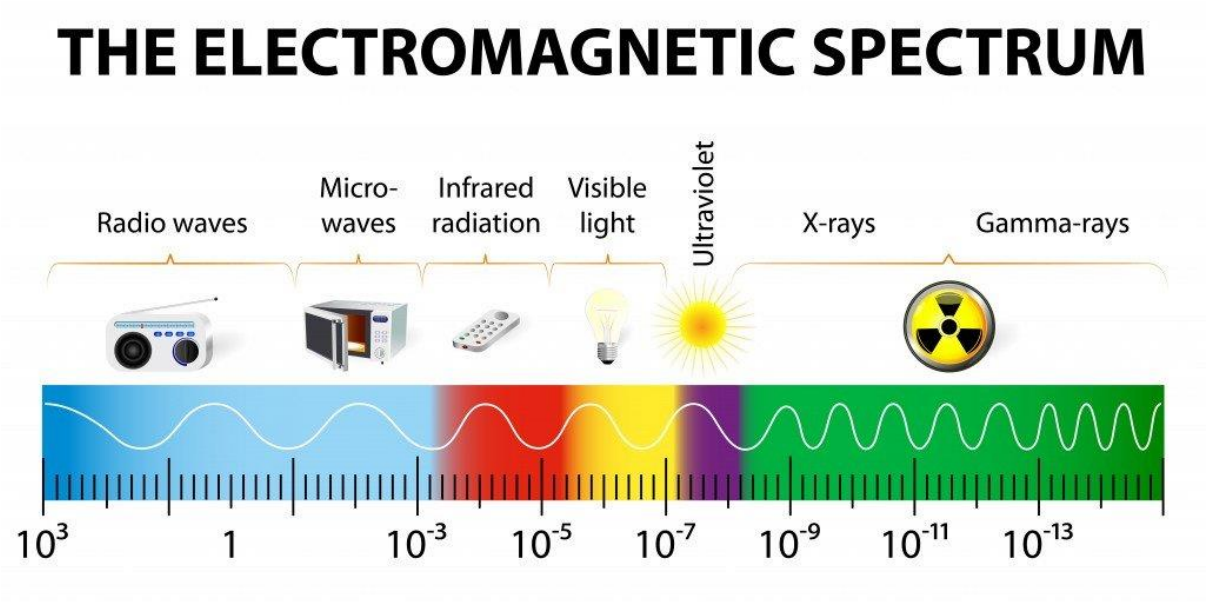
BACK TO QUICK ACCESS GRID

S23

A

The wavelength of IR radiation is longer than the wavelength of visible light.

All electromagnetic radiation (including IR and UV) travels at the same speed through vacuum which is about 3.0×10^8 m/s, regardless of wavelength.



S24

D

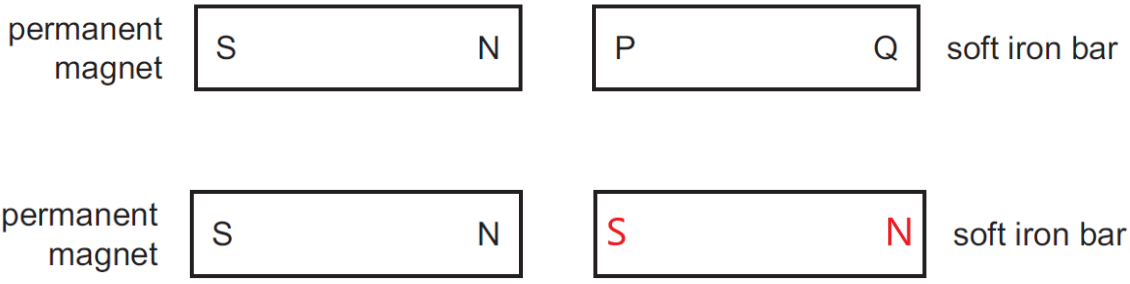
Range of audible frequencies of humans with normal hearing = 20 Hz – 20 kHz

Range of audible frequencies of dolphins = 150 Hz – 150 kHz

Range of frequencies that can be heard both by humans and by dolphins = 150 Hz – 20 kHz

S25

C



Like poles repel, unlike poles attract!

BACK TO QUICK ACCESS GRID

S26

B

Methods of demagnetising a bar magnet:

- **heating with a Bunsen burner** and then letting the magnet cool in the east-west direction
- hammering the magnet in the east-west direction
- slowly moving a magnet through a solenoid with an AC current

All of these methods randomize the orientation of magnetic dipoles.

S27

C

The electromotive force (e.m.f.) is the energy gained per unit charge as charge passes through the cell.

The electromotive force (e.m.f.) of a rechargeable battery is 6.0 V → this means that 6.0 J of energy is provided by the battery to drive a charge of 1.0 C around a complete circuit

BACK TO QUICK ACCESS GRID

S28

C

Resistance = $\frac{\textbf{Potential difference}}{\textbf{Current}}$

$R = \frac{V}{I}$

(V = IR)

S29

D

Energy = Voltage × Charge

Energy supplied by the heater = 230 × 26 × 20 × 60 = 7176000 = 7.176×10^6 J ≈ **7.2×10^6 J**

*Charge = Current (in A) × Time (in s)

1 minute = 60 seconds

BACK TO QUICK ACCESS GRID

S30

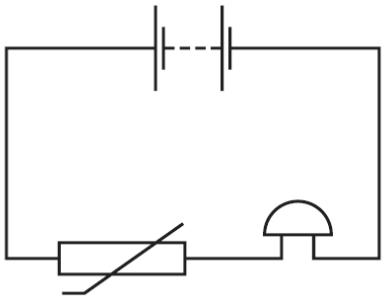
B

A diode allows the flow of current in one direction only and is represented by the symbol B.

B

S31

D?



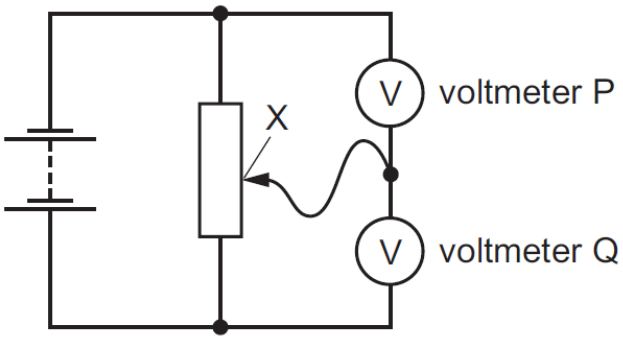
The circuit set up by the student has a battery, thermistor and a bell.

As the temperature rises, resistance of the thermistor decreases.

BACK TO QUICK ACCESS GRID

S32

B



A potential divider divides the voltage of the supply source.

S33

B?

B

X	Y	Z	output
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

Truth table for NOR gate:

X	Y	OUTPUT
0	0	1
0	1	0
1	0	0
1	1	0

Truth table for AND gate:

X	Y	OUTPUT
0	0	0
0	1	0
1	0	0
1	1	1

BACK TO QUICK ACCESS GRID

S34

C?

Electromagnetic induction occurs whenever a magnetic field and an electric conductor move relative to one another such that the conductor crosses the lines of force in the magnetic field.

Option C is therefore correct.

Option D would have been correct if the term ‘only’ would not have been used.

BACK TO QUICK ACCESS GRID

S35 ?

A

S36

A?

Power = Voltage × Current

For a given power transfer, the higher the transmission voltage used, the lower the current needed.

Heat energy wastage through electrical resistance is proportional to the square of the current, as given by the equation:

Power = Current^2 × Resistance

Reducing the current can create huge reductions in heat energy lost to the surroundings through resistance.

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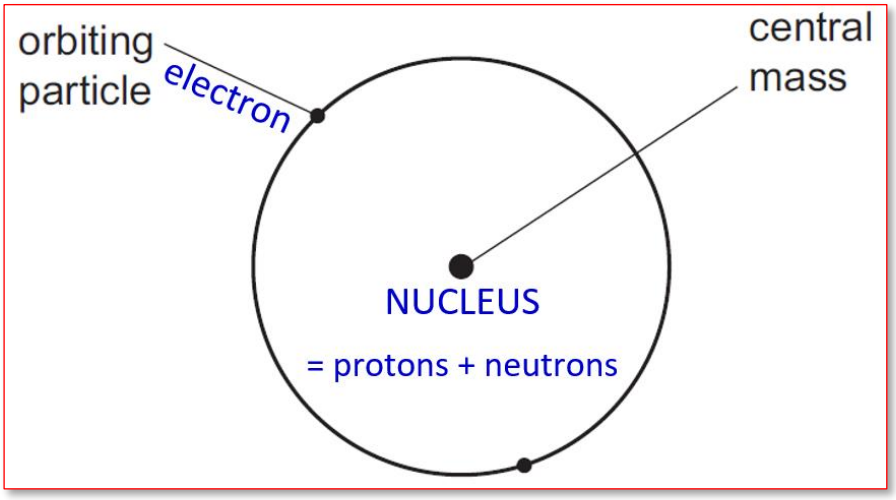
S37

D



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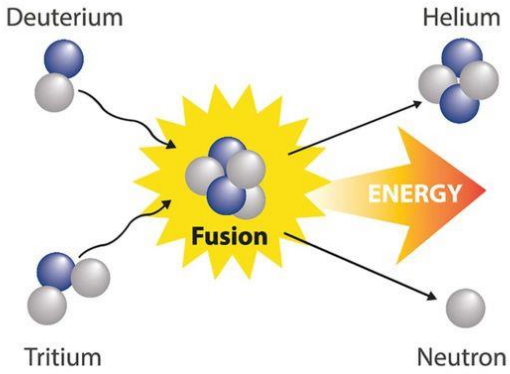
S38

D

Nuclear fusion is a reaction in which two or more atomic nuclei are combined to form a larger nucleus and subatomic particles (neutrons or protons) with the release of energy.



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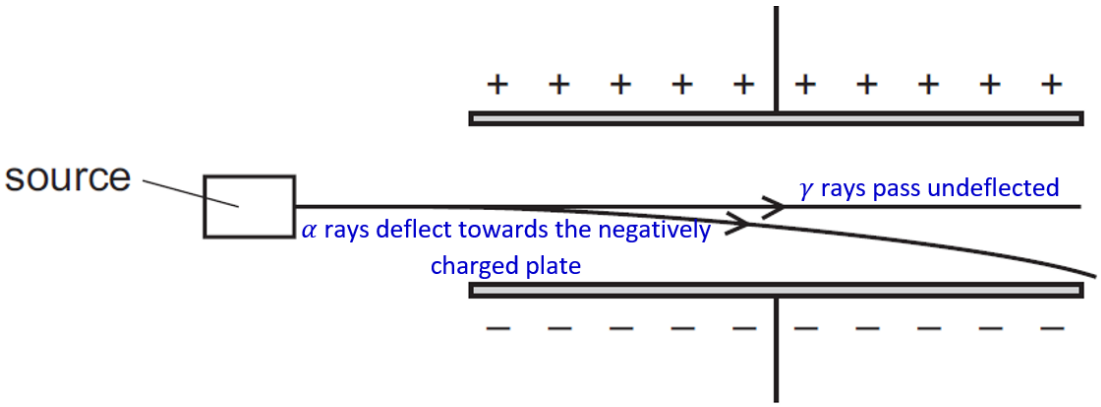
S39

C



α rays are (positively charged) nuclei of He–4 and are therefore deflected towards the negative end of the field.

Gamma rays are a form of electromagnetic radiation and carry no charge. They pass undeflected through an electrical field.

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S40

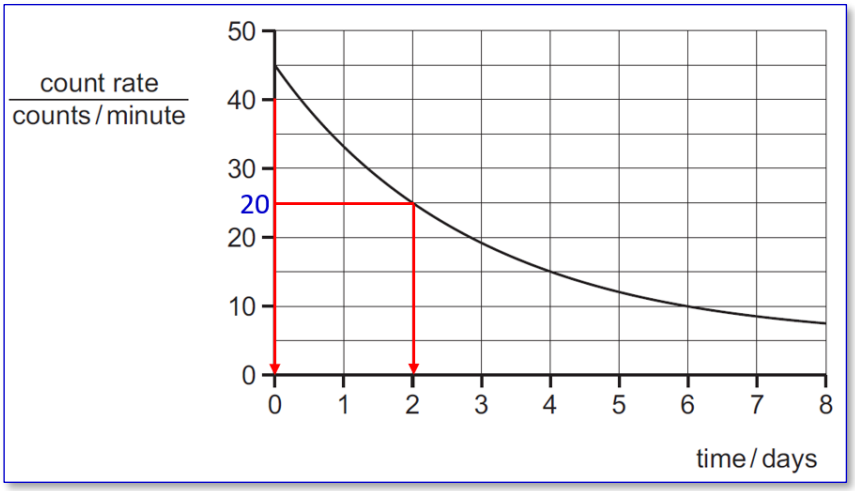
A

Half-life: the time taken for radioctivity (measured in terms of counts) of a radioactive source to fall to half of its initial value (radioactive decay).

The initial count rate of 45 counts per minute includes a background count of 5.
∴ the actual initial count = 45 – 5 = 40 counts per minute.

The half-life would be the time taken for the count rate to drop to 20 counts per minute. When this happens, the counter would display 25 (20 + 5 background counts).

The half-life is 2 days as shown on the graph that follows.



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