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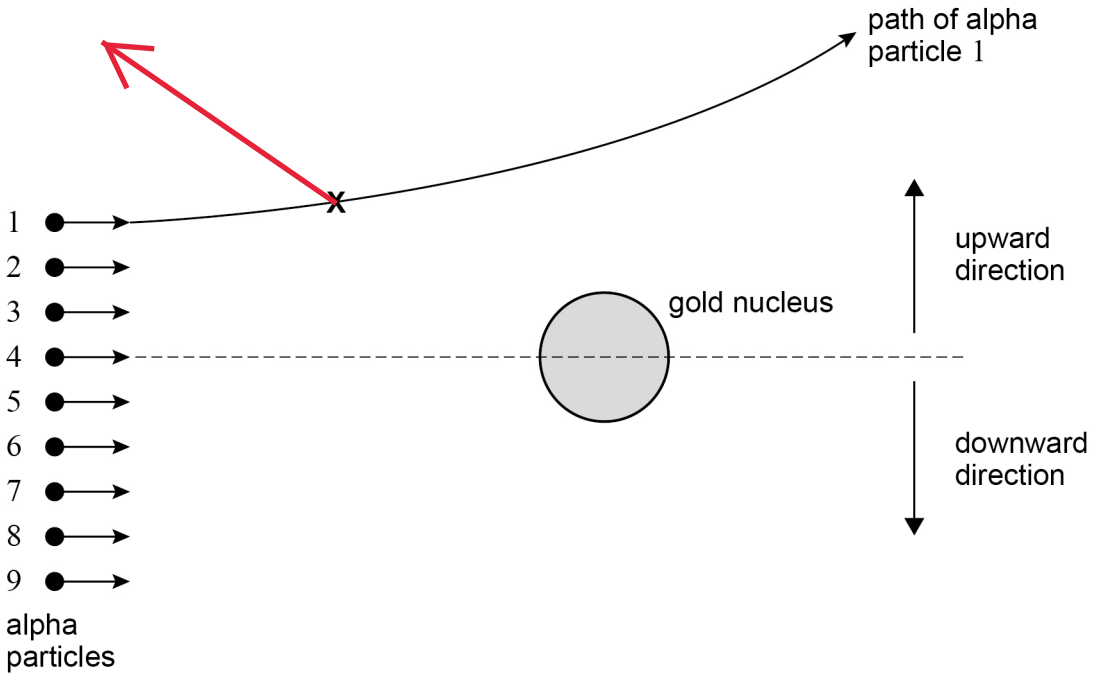
0 5 **Figure 11** shows alpha particles all travelling in the same direction at the same speed.
The alpha particles are scattered by a gold ($^{197}_{79}Au$) nucleus.
The path of alpha particle **1** is shown.

Figure 11



0 5 . 1 State the fundamental force involved when alpha particle **1** is scattered by the nucleus in **Figure 11**.

[1 mark]

electromagnetic (not just electric or electrostatic - not one of the fundamental forces)

0 5 . 2 Draw an arrow at position **X** on **Figure 11** to show the direction of the rate of change in momentum of alpha particle **1**

[1 mark]

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0 5 . 3 Suggest **one** of the alpha particles in **Figure 11** which may be deflected downwards with a scattering angle of $90°$

Justify your answer.

[2 marks]

alpha particle number = _____

5
4 is straight on so will come back. 1-3 will go up
6-9 are too far away and wont deflect enough

0 5 . 4 Alpha particle **4** comes to rest at a distance of 5.5×10^{-14} m from the centre of the $^{197}_{79}Au$ nucleus.

Calculate the speed of alpha particle **4** when it is at a large distance from the nucleus. Ignore relativistic effects.

mass of alpha particle = 6.8×10^{-27} kg

[3 marks]

initial Ek equals final electric potential energy

$k = \frac{1}{4\pi\varepsilon_0}$

$\frac{1}{2}mv^2 = \frac{kQ_1Q_2}{r} \Rightarrow v^2 = \frac{2kQ_1Q_2}{mr}$

$v^2 = \frac{2}{4\pi\varepsilon_0} \times \frac{(2\times1.6\times10^{-19}) \times (79\times1.6\times10^{-19})}{6.8\times10^{-27} \times 5.5\times10^{-14}}$

Always do these long calculations several times to get a consistent answer

speed = 1.4 × 10 7 m s^{-1}

Question 5 continues on the next page

Turn over ►

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0 5 . 5 The nuclear radius of $^{197}_{79}\text{Au}$ is 6.98×10^{-15} m.

Calculate the nuclear radius of $^{107}_{47}\text{Ag}$.

[2 marks]

$R = r_0 A^{1/3}$

$\frac{R_1}{A_1^{1/3}} = \frac{R_2}{A_2^{1/3}} \Rightarrow R_2 = \frac{R_1 A_2^{1/3}}{A_1^{1/3}}$

$= \frac{6.98 \times 10^{-15} \times 107^{1/3}}{197^{1/3}}$ =

radius = _____ m

0 5 . 6 All nuclei have approximately the same density.

State **one** conclusion about the nucleons in a nucleus that can be deduced from this fact.

[1 mark]

YOu cannot compress nucleons, p and n have same mass/size

10

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1 3 What is the angular speed of a satellite in a geostationary orbit around the Earth?

[1 mark]

A 1.2×10^{-5} rad s^{-1} ⬭

B 7.3×10^{-5} rad s^{-1} ⬭

C 4.4×10^{-3} rad s^{-1} ⬭

D 2.6×10^{-1} rad s^{-1} ⬭

2π in 24hrs

1 4 Two fixed charges of magnitude $+Q$ and $+3Q$ repel each other with a force F.
An additional charge of $-2Q$ is given to each charge.

What are the magnitude and the direction of the force between the charges?

[1 mark]

	Magnitude of force	Direction of force	
A	$\frac{F}{3}$	repulsive	⬭
B	$5F$	attractive	⬭
C	$5F$	repulsive	⬭
D	$\frac{F}{3}$	attractive	⬭

$F \propto Q_1 Q_2$

orrly: $F_2 Q \times 3Q$

$F \propto 3Q^2$

Second:

$-Q \times Q = -Q^2$

so $F/3$ & attractive

Turn over for the next question

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1 5 At a distance L from a fixed point charge, the electric field strength is E and the electric potential is V.

What are the electric field strength and the electric potential at a distance $3L$ from the charge?

[1 mark]

	Electric field strength	Electric potential	
A	$\frac{E}{3}$	$\frac{V}{9}$	○
B	$\frac{E}{3}$	$\frac{V}{3}$	○
C	$\frac{E}{9}$	$\frac{V}{3}$	○
D	$\frac{E}{9}$	$\frac{V}{9}$	○

$E \propto \frac{1}{r^2}$

$\therefore E/9$

$V \propto \frac{1}{r}$

$\therefore V/3$