

- 2 (a) State the principle of *conservation of linear momentum*.

[1]

- (b) In a nuclear reactor, carbon atoms are used to slow down neutrons. A fast neutron collides head-on with a stationary carbon atom.
- (i) Show that the impulse acted on the neutron is proportional to the final velocity of the carbon atom in such a collision.

[2]

- (ii) In the collision between a neutron and a carbon atom, a neutron of mass $1.0\ m$ with initial velocity u collides elastically head-on with a stationary carbon atom of mass $12\ m$. The final velocities of the neutron and the carbon atom are v and V respectively.

By considering the relative speeds between the neutron and carbon atom before and after their collision, show that the fraction of the kinetic energy that is retained by the neutron after such a collision is 0.72.

[3]

- (iii) Explain why nuclei which are much more massive than carbon atoms are ineffective in slowing down neutrons in the nuclear reactor.
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[2]

- (iv) Explain why particles of similar mass to neutrons such as hydrogen nuclei are unsuitable for slowing down neutrons in the nuclear reactor.
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[1]

[Total: 9]

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