Section B

For Examiner's Use

Answer **two** questions from this section.

6 **(a)** **(i)** Define *linear momentum.*

.....

.....[1]

(ii) State the relation between force and momentum.

.....

.....[1]

(b) Two frictionless trolleys A and B are moving horizontally in the same direction, as shown in Fig. 6.1.

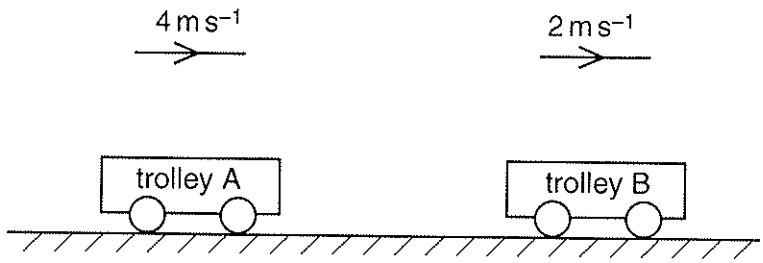

Fig. 6.1

Trolley A has speed $4\,m\,s^{-1}$ and trolley B has speed $2\,m\,s^{-1}$. The trolleys collide.

(i) State the principle of *conservation of linear momentum.*

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.....[2]

(ii) Explain whether, during the collision, it is possible for both trolleys to be at rest simultaneously.

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.....[3]

For Examiner's Use

(c) In a student's model for radioactive decay, a nucleus X decays by simultaneous emission of a β-particle of energy 0.74 MeV and a γ-ray photon of energy 0.85 MeV. A daughter nucleus Y is formed.
Before the decay, the nucleus X is stationary.

(i) Determine the magnitude of the linear momentum of the β-particle.

momentum = ... $kg\,m\,s^{-1}$ [3]

(ii) For the γ-ray photon, determine

1. its wavelength,

wavelength = ... m [2]

2. its momentum.

momentum = ... $kg\,m\,s^{-1}$ [2]

For Examiner's Use

(d) Information about the directions of the β-particle and the γ-ray photon emitted in the student's model in **(c)** may be determined using the principle of conservation of momentum and your answers in **(c)**. It is assumed that no other particle is emitted during the decay.

(i) After the decay, the daughter nucleus Y may remain stationary. Explain why this will lead to the β-particle and the γ-ray photon moving off in approximately opposite directions.

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.....[3]

(ii) The daughter nucleus Y may move after the decay. Possible directions for the β-particle, the γ-ray photon and the nucleus Y are shown in Fig. 6.2.

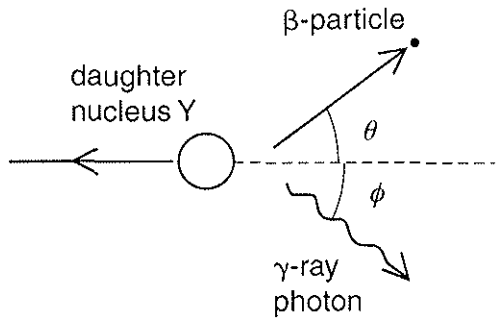

Fig. 6.2

Momentum is a vector quantity and can be resolved into perpendicular components. Suggest and explain the relation between the angle θ and the angle ϕ.

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.....[3]