[1]

13 A puck of mass 0.16 kg is sliding on ice with a constant velocity of $11.0\,m\,s^{-1}$. A hockey stick exerts a force on the puck, for a short period of time, in the **opposite** direction to the velocity of the puck. The momentum of the puck changes by $2.0\,kg\,m\,s^{-1}$.

Ignore friction.

What is the speed of the puck when it leaves the hockey stick?

A $1.5\,m\,s^{-1}$

B $3.8\,m\,s^{-1}$

C $12.5\,m\,s^{-1}$

D $23.5\,m\,s^{-1}$

Your answer ☐ **[1]**

22 (a) A helium atom **X** travelling at 610 m s^{-1} makes an elastic collision with a stationary helium atom **Y**. The magnitude of the velocity of **X** after the collision is 258 m s^{-1}. The directions of the velocities of **X** and **Y** are as shown in Fig. 22.

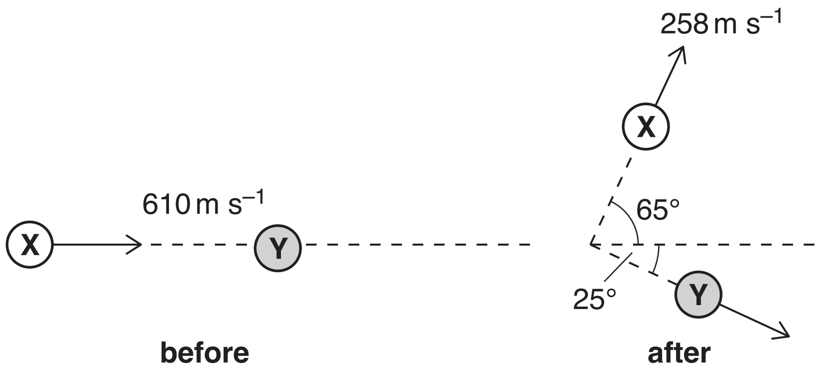

Fig. 22

(i) Explain what is meant by an *elastic collision*.

....

.... **[1]**

(ii) The mass of a helium atom is 6.64 × 10^{-27} kg.
Calculate the magnitude of the momentum p of **Y** after the collision.

p = ... kg m s^{-1} **[3]**

(b)* There is a lot of helium in the Universe. This was also true of the Earth when it was formed billions of years ago. However, only small traces of helium are now found in the atmosphere of the Earth.

Use the kinetic theory of gases to explain why only small amounts of helium are found in the Earth's atmosphere. Use the information below to do suitable calculations to support your answer.

- typical atmospheric temperature = 10 °C
- mass of helium atom = 6.64 × 10^{-27} kg
- escape velocity from the Earth = 11 km s^{-1}

[6]

11 An electron moves in a circle of radius 2.0 cm in a uniform magnetic field of flux density 170 mT.

What is the momentum of this electron?

A $3.4 \times 10^{-3}\,\text{kg}\,\text{m}\,\text{s}^{-1}$

B $5.4 \times 10^{-17}\,\text{kg}\,\text{m}\,\text{s}^{-1}$

C $1.4 \times 10^{-18}\,\text{kg}\,\text{m}\,\text{s}^{-1}$

D $5.4 \times 10^{-22}\,\text{kg}\,\text{m}\,\text{s}^{-1}$

Your answer [ ] **[1]**

3 An electron has a de Broglie wavelength equal to the wavelength of X-rays.

What is the **best** estimate of the momentum of this electron?

A $10^{-30}\,kg\,m\,s^{-1}$

B $10^{-27}\,kg\,m\,s^{-1}$

C $10^{-23}\,kg\,m\,s^{-1}$

D $10^{-18}\,kg\,m\,s^{-1}$

Your answer ☐ **[1]**