9 Which of the following shows the β^- decay of a nucleon?

- ☐ **A** $n \rightarrow p + \beta^- + \nu_e$
- ☐ **B** $n \rightarrow p + \beta^- + \bar{\nu}_e$
- ☐ **C** $p \rightarrow n + \beta^- + \nu_e$
- ☐ **D** $p \rightarrow n + \beta^- + \bar{\nu}_e$

(Total for Question 9 = 1 mark)

DO NOT WR

2 A car travels along a straight horizontal road. A drag force of 150 N acts for 15 s causing the speed of the car to decrease.

Which of the following is the change in momentum of the car due to the drag force?

- ☐ **A** $10\,kg\,m\,s^{-1}$
- ☐ **B** $1125\,kg\,m\,s^{-1}$
- ☐ **C** $2250\,kg\,m\,s^{-1}$
- ☐ **D** $16875\,kg\,m\,s^{-1}$

(Total for Question 2 = 1 mark)

DO NOT WRITE IN THIS AREA

7 A moving trolley collides with a stationary trolley and they move off together.

Frictional forces are negligible and the collision is inelastic.

Which row of the table shows what happens to the total momentum and to the total kinetic energy in the collision?

	Total momentum	Total kinetic energy
☒ **A**	conserved	conserved
☒ **B**	conserved	not conserved
☒ **C**	not conserved	conserved
☒ **D**	not conserved	not conserved

(Total for Question 7 = 1 mark)

DO NOT WRITE IN THIS AREA

9: In a nuclear fission reaction, a nucleus splits into a nucleus S, a nucleus T and several neutrons.

S and T have the same kinetic energy. T has twice the mass of S.

Which of the following is the ratio $\frac{\text{momentum of T}}{\text{momentum of S}}$?

- ☒ **A** $\frac{1}{2}$
- ☒ **B** $\frac{1}{\sqrt{2}}$
- ☒ **C** $\sqrt{2}$
- ☒ **D** 2

(Total for Question 9 = 1 mark)

20 Particle physicists use the principle of conservation of momentum when analysing particle interactions.

(a) State what is meant by the principle of conservation of momentum.

(2)

.....

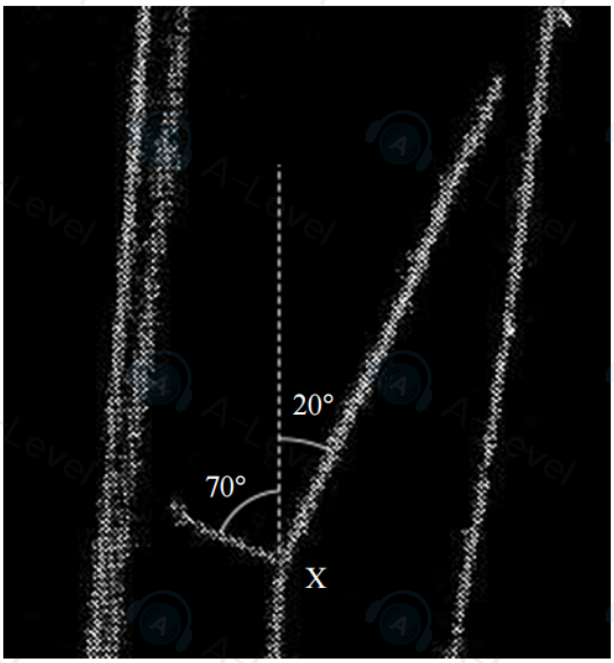
.....

.....

.....

(b) The cloud chamber photograph shows alpha particle tracks in helium.

An alpha particle collided with a helium nucleus at X. After the collision, the alpha particle moved at an angle of 20° to its initial direction, as shown.



(Source: © Institute of Physics)

DO NOT WRITE IN THIS AREA

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(i) Show that the speed of the helium nucleus immediately after the collision is about $5.6 \times 10^{6}\,m\,s^{-1}$.

mass of helium nucleus = 6.64×10^{-27} kg
speed of alpha particle after collision = $1.55 \times 10^{7}\,m\,s^{-1}$

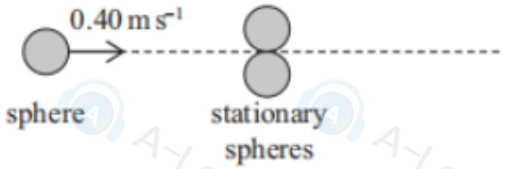
(4)

(ii) The kinetic energy of the alpha particle before the collision was 9.01×10^{-13} J.

Deduce whether the collision was elastic.

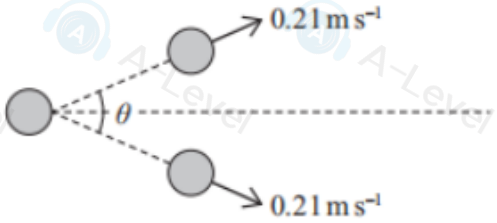
(3)

12: A student investigated collisions, using three spheres. The student rolled a sphere of mass 35 g into two stationary spheres, each of mass 37 g, as shown.



During the collision, the rolling sphere was brought to rest and the two stationary spheres began to move apart at an angle θ, as shown below.

Not to scale



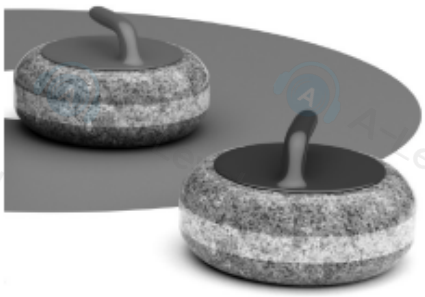
Determine the angle θ.

$\theta =$ .....

(Total for Question 12 = 3 marks)

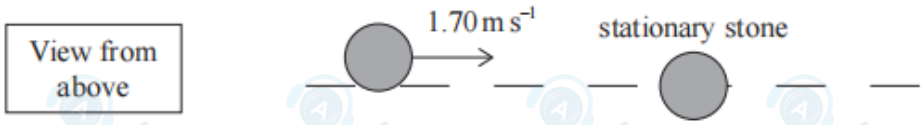
19 Curling is a sport played on ice. Players slide stones made of granite along the ice.

The photograph shows two of the stones. Each stone has a mass of 19.1 kg.



(Source: © MileA/Getty Images)

A player slides a stone at a velocity of 1.70 m s^{-1} towards a stationary stone, as shown below.



The stones collide. After the collision, both stones move off as shown below.

(a) Show that v is about 1.3 m s^{-1}.

(4)

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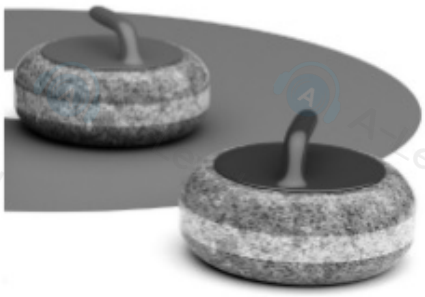
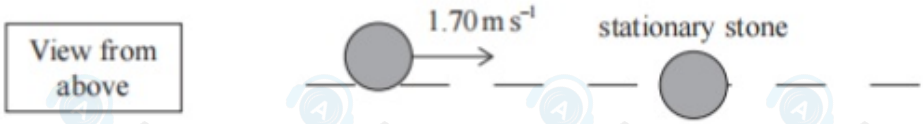
19 Curling is a sport played on ice. Players slide stones made of granite along the ice.

The photograph shows two of the stones. Each stone has a mass of 19.1 kg.



(Source: © MileA/Getty Images)

A player slides a stone at a velocity of 1.70 m s^{-1} towards a stationary stone, as shown below.



The stones collide. After the collision, both stones move off as shown below.

(a) Show that v is about 1.3 m s^{-1}.

(4)

(b) Deduce whether the collision was elastic. Your answer should include a calculation.

(3)