**B4.** This question is in **two** parts. **Part 1** is about collisions. **Part 2** is about the gravitational field of Mars.

**Part 1** Collisions

(a) State the principle of conservation of momentum. *[2]*

. . . . . .

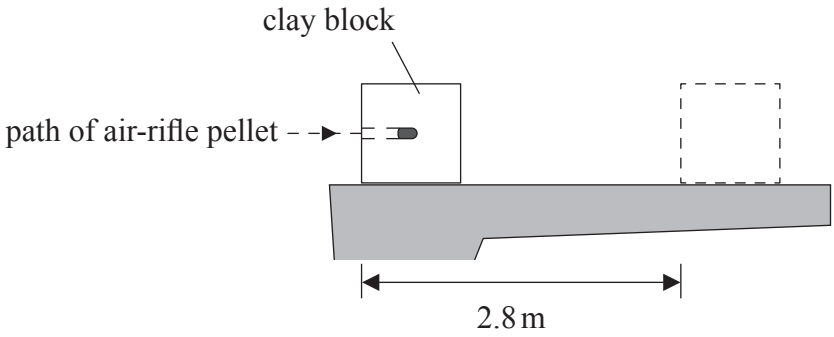
. . . . . .

. . . . . .

*(This question continues on the following page)*

*(Question B4, part 1 continued)*

(b) In an experiment, an air-rifle pellet is fired into a block of modelling clay that rests on a table.




(not to scale)

The air-rifle pellet remains inside the clay block after the impact.

As a result of the collision, the clay block slides along the table in a straight line and comes to rest. Further data relating to the experiment are given below.

| | |
|---|---|
| Mass of air-rifle pellet | $= 2.0\,\text{g}$ |
| Mass of clay block | $= 56\,\text{g}$ |
| Velocity of impact of air-rifle pellet | $= 140\,\text{m s}^{-1}$ |
| Stopping distance of clay block | $= 2.8\,\text{m}$ |

(i) Show that the initial speed of the clay block after the air-rifle pellet strikes it is $4.8\,\text{m s}^{-1}$. *[2]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(ii) Calculate the average frictional force that the surface of the table exerts on the clay block whilst the clay block is moving. *[4]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

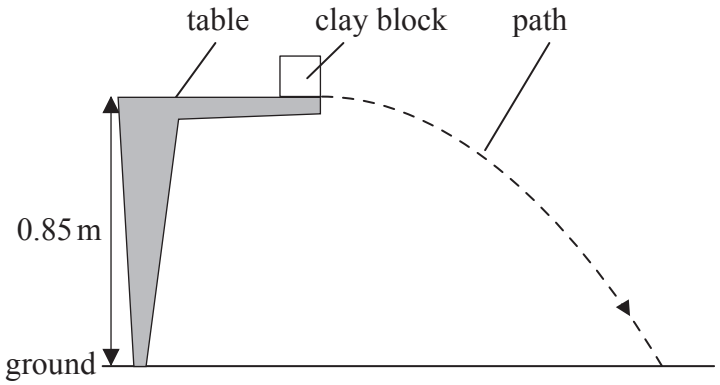
. . . . . .

. . . . . .

*(This question continues on the following page)*

*(Question B4, part 1 continued)*

(c) The experiment is repeated with the clay block placed at the edge of the table so that it is fired away from the table. The initial speed of the clay block is $4.3\,m\,s^{-1}$ horizontally. The table surface is 0.85 m above the ground.




(not to scale)

(i) Ignoring air resistance, calculate the horizontal distance travelled by the clay block before it strikes the ground. *[4]*

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(ii) The diagram in (c) shows the path of the clay block neglecting air resistance. On the diagram, draw the approximate shape of the path that the clay block will take assuming that air resistance acts on the clay block. *[3]*

*(This question continues on the following page)*