Section B

Answer **one** question from this section.

7 **(a)** **(i)** Define *velocity*.

....

.... [1]

(ii) Define *acceleration*.

....

.... [1]

(b) Popcorn is produced in a shallow pan. One piece of popcorn is projected out of the pan from the base of the pan. Fig. 7.1 shows the trajectory of this piece of popcorn.
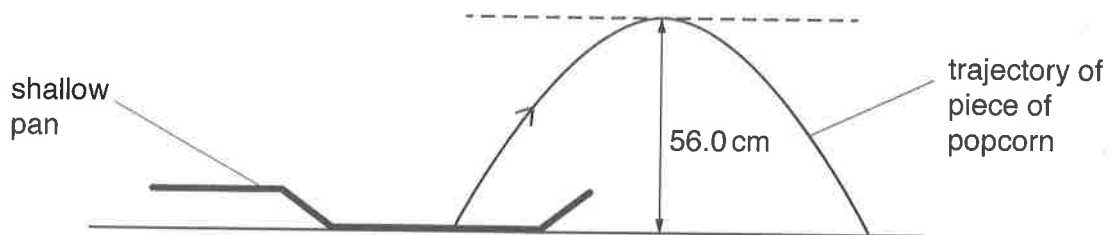

Fig. 7.1

The piece of popcorn reaches a maximum vertical height of 56.0 cm above the base of the frying pan. You can assume that air resistance is negligible.

(i) Sketch, on Fig. 7.2, a graph to show how the vertical component u_v of the initial velocity u of the piece of popcorn depends on time t.
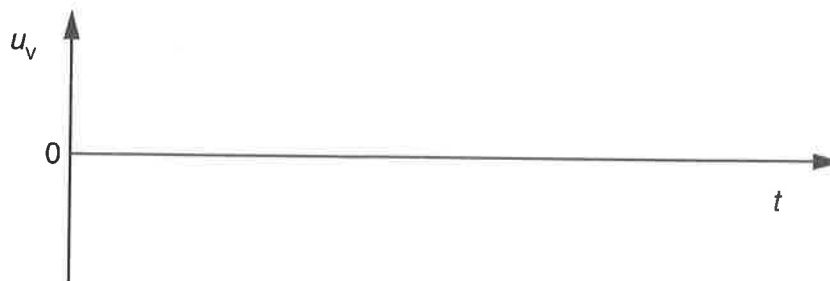
There is no need to calculate any values. [2]

Fig. 7.2

(ii) Sketch, on Fig. 7.3, a graph to show how the horizontal component u_h of the initial velocity u of the piece of popcorn depends on time t.

There is no need to calculate any values. [1]

Fig. 7.3

(iii) Show that the vertical component u_v of the initial velocity of the piece of popcorn is about $3.3\,m\,s^{-1}$.

[2]

(iv) The piece of popcorn lands, without bouncing, at the same level as its starting point in the pan at a horizontal distance of 1.20 m from its starting point.

Calculate the magnitude of the initial velocity u of the piece of popcorn.

Show all stages of your working.

$u =$ .... $m\,s^{-1}$ [5]

(c) Assume that the initial gravitational potential energy of the piece of popcorn is zero.

(i) Describe the changes in gravitational potential energy of the piece of popcorn during its flight.

....

.... [2]

(ii) The total energy of the piece of popcorn during its flight is the sum of its instantaneous kinetic and potential energies.

The total energy of the piece of popcorn is constant throughout its flight, but the maximum potential energy of the piece of popcorn during its flight is **not** equal to the maximum kinetic energy.

Explain why.

....

....

.... [2]

(d) A microphone placed near the pan recorded the sound (pop) emitted as the piece of popcorn was produced.

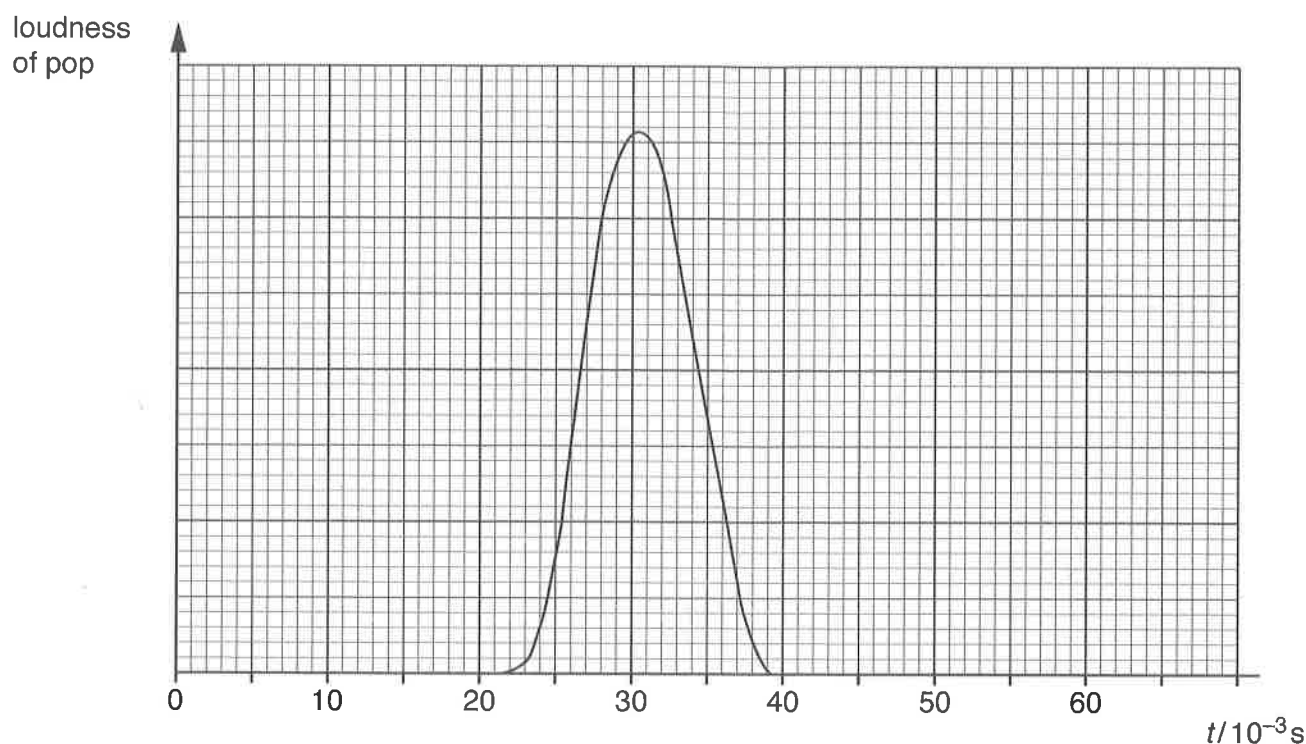Fig. 7.4. shows how the loudness of the pop varied with time.

loudness
of pop

Fig. 7.4

(i) Determine the average acceleration achieved by the piece as it pops.

acceleration = ... $m\,s^{-2}$ [3]

(ii) Comment on the value of the acceleration of the piece of popcorn.

....

.... [1]

[Total: 20]