For Examiner's Use

2 A stone is projected vertically at a velocity of *u* from the edge of a building. The stone reaches a maximum height of 27 m above the top of the building and falls down to the ground below. Take the upward direction as positive.

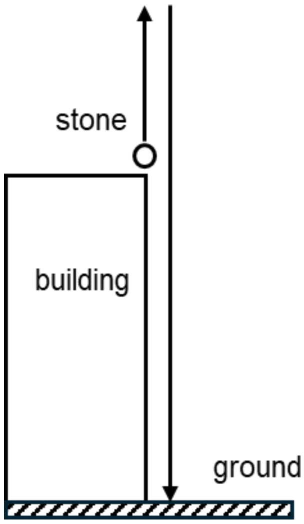

Fig. 2.1

(a) **(i)** Assume that air resistance is negligible.

1. Show that *u* is 23 m s^{-1}.

[2]

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2. The stone hits the ground after 6.0 s.

On Fig. 2.2, sketch the variation with time t of the velocity v from the time the stone is projected at t = 0 s until t = 6.0 s. Label the axes with appropriate values.

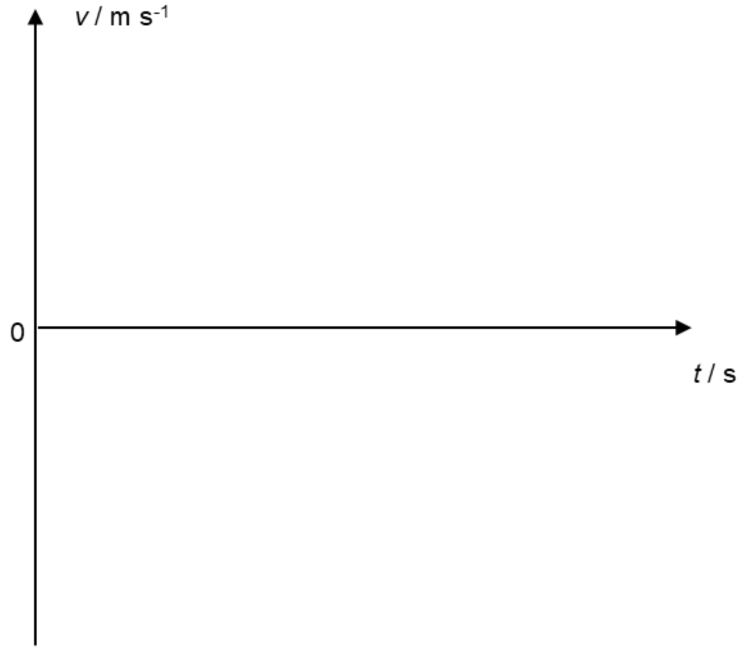

Fig. 2.2

[2]

(ii) In reality, air resistance is not negligible.

On Fig. 2.2, sketch the variation with time t of the velocity v of the stone till 6.0 s. Label the graph R. [2]

.

[Turn over

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(b) An elastic net is now placed on top of the ground to catch the stone, so that it does not hit the ground. To simplify the analysis, Fig. 2.3 shows two identical springs and a rigid container which are used to model the elastic net. Assume the masses of the springs and rigid container to be negligible. The stone hits the rigid container when the springs are at length x_0 and subsequently, the springs stretch by a maximum extension of x_s.

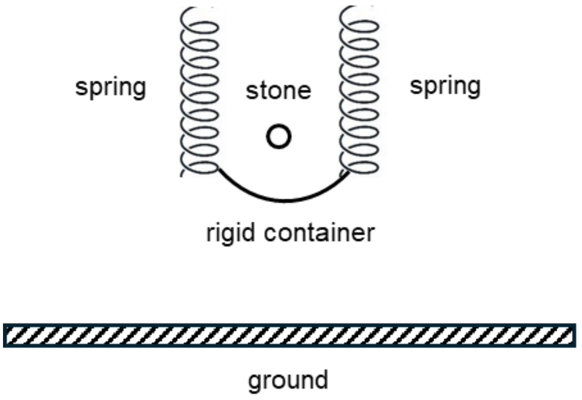

Fig. 2.3

On Fig. 2.4, sketch graphs of the following quantities to show the variation with extension x of the spring.

(i) The kinetic energy of the stone and container. Label this graph *K*.

(ii) The gravitational potential energy (GPE) of the stone and container. Take GPE to be zero at the lowest point of the motion. Label this graph *G*.

(iii) The elastic potential energy of the spring. Label this graph *E*.

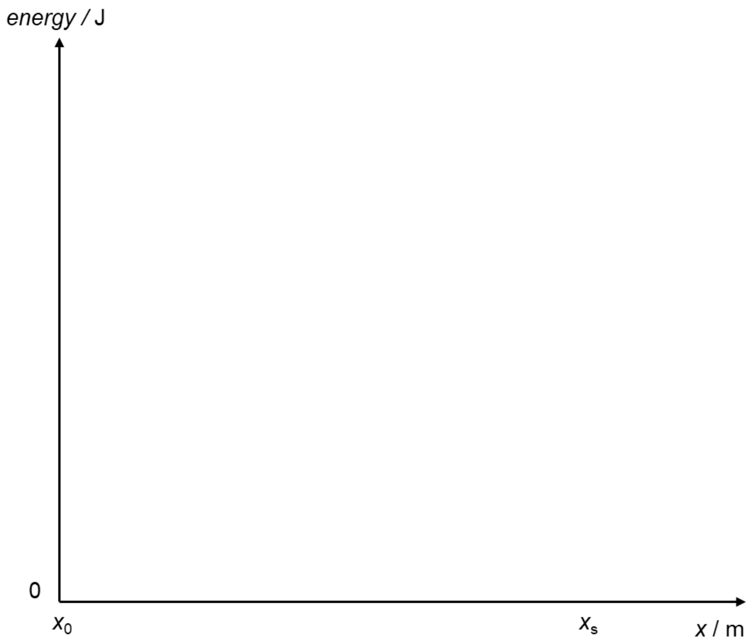

Fig. 2.4

[3]

[Total: 9]