1 Using a handheld catapult, a student projected a stone of mass 130 g, horizontally from a building rooftop of height 32 m, as illustrated in Fig. 1.1, aiming for it to land in an adjacent river.

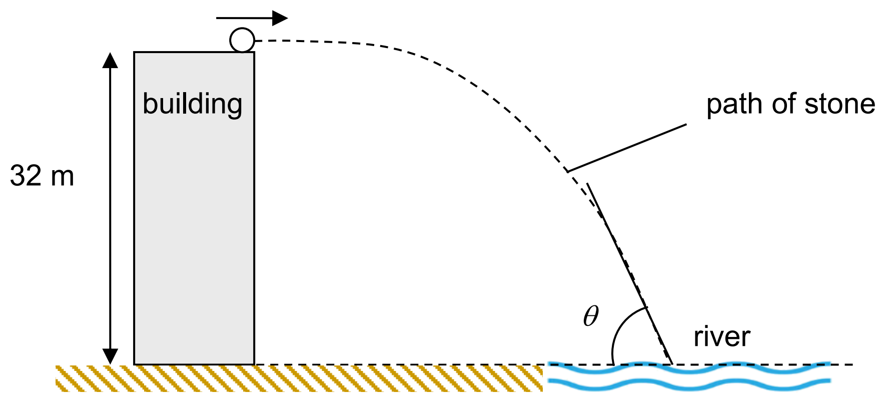

Fig. 1.1

Air resistance is negligible and the stone enters the water at a speed of 34 m s^{-1} after time t s.

(a) Determine for the stone as it hits the water,

(i) the vertical component of the velocity of the stone

vertical component of velocity = ... m s^{-1} [2]

(ii) the angle θ to the horizontal of the stone's plunge

θ = ... ° [2]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

[Turn over

(b) Use *energy* considerations to suggest why, if the stone causes a large splash on hitting the water surface, it decelerates in a shorter distance than when no splash is produced.

....

....

....

.... [1]

(c) (i) On Fig. 1.2, sketch the variation with time t of the potential energy E_p of the stone with respect to the water level.

Fig. 1.2

[2]

DO NOT WRITE IN THIS MARGIN

(ii) On Fig. 1.3, sketch the variation with time t of the kinetic energy E_k of the stone for the same period.

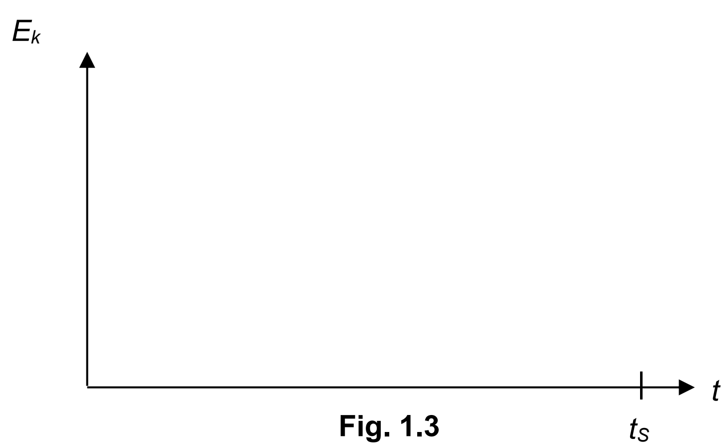

Fig. 1.3

[1]

[Total: 8]