TAP 216- 3: The high jump – energy changes

Note: g = 9.8 N kg^{-1} = 9.8 m s^{-2}

1 A jumper of mass 75 kg jumps a height of 1.9 m

(a) Calculate the gravitational potential energy of the jumper at his highest point.

(b) Calculate the vertical velocity of the jumper just before impact with the crash mat. (HINT: what was the vertical velocity of the jumper at the top of his jump?)

(c) Show that the kinetic energy associated with his vertical velocity is equal to the gravitational potential energy at the top of his jump.

(d) The jumper is stopped over a distance of 0.3 m when he lands on the crash mat.

Calculate the average force on the jumper as he comes to rest.

Answers and worked solutions

1)

(a) Gravitational potential energy = mgh = 70 x 9.8 x 1.9 = =1303.4 J = 1300 J to 2sf as required by the data

(b) $v^2 = u^2 + 2as$ u = 0 so $v = \sqrt{2gh}$. v = $(2x\ 9.8\ x\ 1.9)^{0.5}$ so v = 6.1 m s^{-1}

(c) ½ m v^2 = 1302 J = 1300 J to 2sf (a circular argument, of course) which emphasises that the suvat equation used in part (b) is derived from conservation of energy

(d) Fs = 1304 J so F = 1304/0.3 =4345 N = 4300N to 2sf

External references

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