EXERCISE 15

MECHANICS

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1. A crate of 890 kg is lifted to a height of 2,1 m. Calculate the crate's gravitational potential energy.

$E_P = mgh$

$= 890 \times 9,8 \times 2,1$

$= 18\ 316,2\ J$

2. Charmaine, 55 kg, jumps on a trampoline. If she jumps to a height of 47 cm, what is her gravitational potential energy?

$E_P = mgh$

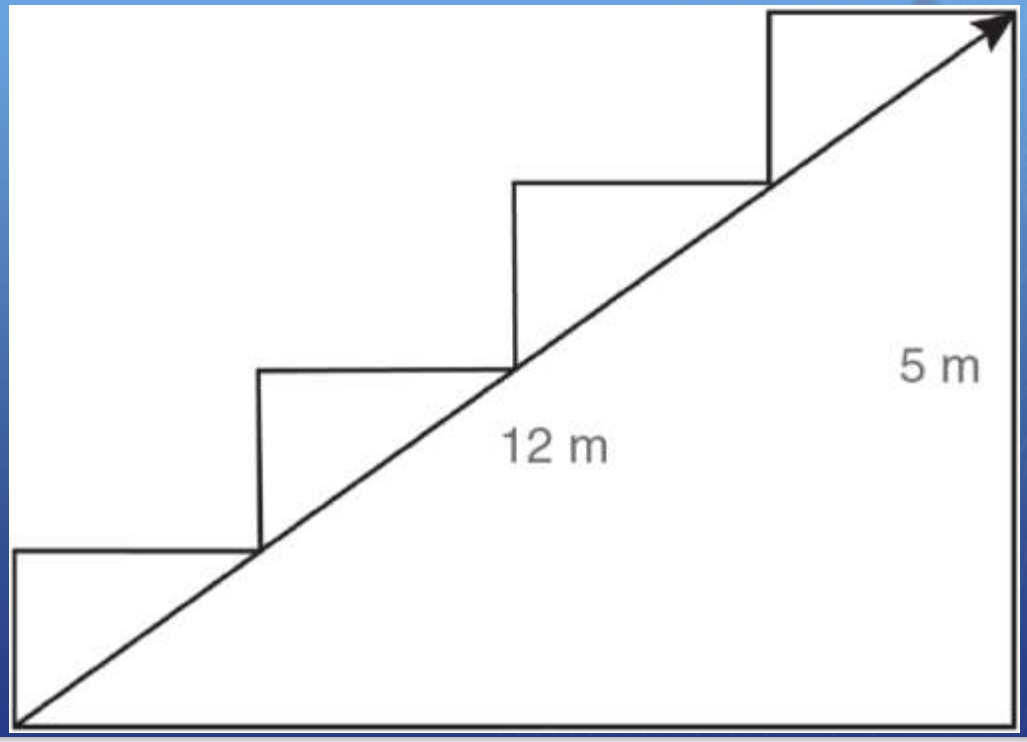
$= 55 \times 9,8 \times 0,47$

$= 253,33\ J$

3. Sifiso has a mass of 70 kg. He climbs the stairs to the science lab. Calculate his gravitational potential energy when he reaches the top.

$E_P = mgh$
$= 70 \times 9{,}8 \times 5$
$= 3\,430$ J

Note: Only the vertical height is used to calculate E_P.



4. A container has a gravitational potential energy of 1 715 J after it is raised 5 m. What is the mass of the container?

$E_P = mgh$

$1\,715 = m(9,8)(5)$

$m = 35\ kg$

5. 78 400 000 J of gravitational potential energy is transferred into various other types of energy when an aeroplane lands..

This includes kinetic energy and heat. If the mass of the plane is 40 000 kg, how high was it before it started to land? Ignore air friction.

$$E_P = mgh$$

$$78\ 400\ 000 = (40\ 000)(9,8)h$$

$$h = 200\ m$$

6.1 Calculate the kinetic energy of Caster Semenya (65 kg) when she runs at a constant speed of 4 $m \cdot s^{-1}$.

$E_K = \frac{1}{2}mv^2$

$= \frac{1}{2}(65)(4)^2$

$= 520$ J

6.2 If her speed is halved, calculate her kinetic energy..

$E_K \propto v^2$

∴ if v is halved, E_K 4 × smaller

becomes∴ 520 ÷ 4 = 130 J

OR

$E_K = \frac{1}{2}mv^2$

$= \frac{1}{2}(65)(2)^2$

$= 130$ J

7 A trailer (100 kg) is pulled with a constant force at a velocity of 8 $m \cdot s^{-1}$ across a smooth surface.

7.1 Calculate its kinetic energy.

$E_K = \frac{1}{2}mv^2$

$= \frac{1}{2}(100)(8)^2$

$= 3\ 200$ J

7.2 If the trailer has double the mass and travels at the same speed, calculate E_K.

$E_K = ½mv^2$

$= ½(200)(8)^2$

$= 6\ 400$ J

OR

$E_K \propto m$

$\therefore$ if m is doubled, E_K will double.

7.3 If the velocity of the 100 kg trailer is halved, what will the E_K be?

$E_K = ½mv^2$

$= ½(100)(4)^2$

$= 800$ J

OR

$E_K \propto v^2$

∴ if v is halved, E_K will become 4 × smaller.

∴ 3 200 ÷ 4 = 800 J

7.4 If the velocity of 8 $m \cdot s^{-1}$ and the mass of 100 kg are both doubled, what will the E_K be?

$E_K = ½mv^2$

$= ½(200)(16)^2$

$= 25\ 600$ J