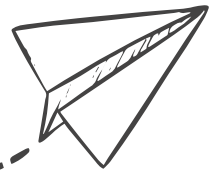


Combining equations



PHYSICS EQUATION PRACTICE

USEFUL Equations

GRAVITATIONAL POTENTIAL ENERGY = MASS $\times$ g $\times$ HEIGHT

WORK DONE = FORCE $\times$ DISTANCE

KINETIC ENERGY = $\frac{1}{2} \times$ MASS $\times$ VELOCITY²

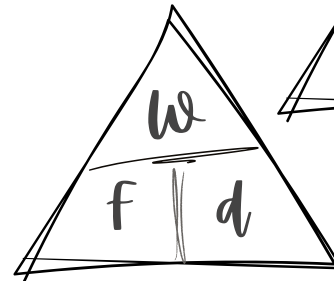
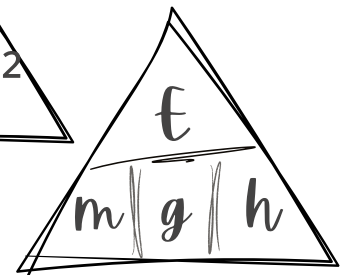
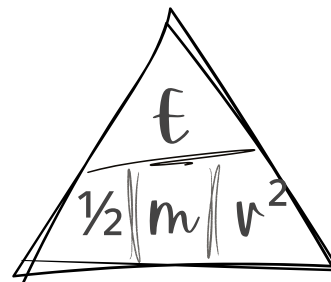
Understand

UNDERSTAND, DON'T MEMORISE

These questions involve two equations. You'll need to identify which are involved to answer the question.

Make a list of variables you have on the left of the answer space, so you can figure out which equations you need.

Equation TRIANGLES



Example QUESTION

QUESTION:

A 2000 kg rocket engine applies a constant thrust of 5000 N over 300 m along the launchpad. Find the rocket's speed at the end.

ANSWER:

$m = 2000 \text{ kg}$
 $v = ?$

$d = 300 \text{ m}$
 $F = 5000 \text{ N}$

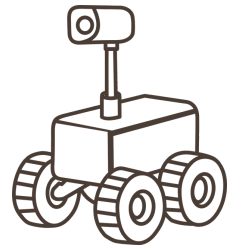
$$W = F \times d$$
$$= 5000 \times 300 =$$
$$1,500,000 \text{ J;}$$

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

$$1,500,000 = \frac{1}{2} \times 2000 \times v^2$$
$$v = \sqrt{(2 \times 1,500,000 / 2000)}$$
$$\approx 38.7 \text{ m/s}$$

Challenge QUESTIONS

1. Space Rover Push: A 350 kg Mars rover is pushed 6 m with a 400 N force along flat ground. Find its final speed from rest.

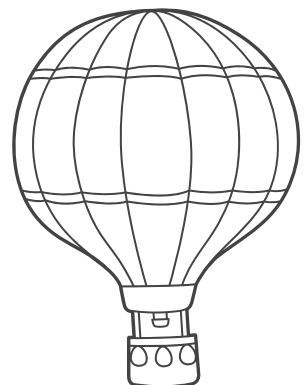


2. Diving Platform: A 60 kg diver jumps from a 10 m high platform. Find the speed just before hitting the water.

3. Skateboard Ramp: A 50 kg skateboarder descends a 5 m ramp from rest. Find the speed at the bottom.

4. Hot Air Balloon: A 200 kg basket is lifted 15 m by a balloon. Find the minimum work done.

5. Space Capsule Landing: A 1000 kg capsule falls 120 m onto a moon base. Find its impact speed ignoring air resistance.



Challenge QUESTIONS

6. Alien Sled Push: An alien pushes a 80 kg sled 12 m on flat ground with 150 N. Find the sled's final speed.

7. Wizard's Lift Spell: A 5 kg magical stone is lifted 20 m using a spell. Find the work done.



8. Catapult Launch: A 10 kg pumpkin is hurled 15 m horizontally by a catapult applying a constant force of 600 N. Find its speed.

9. Mountain Biker Drop: A 70 kg biker drops from a cliff 12 m high. Find the speed just before landing.

10. Roller Coaster Lift Hill: A 400 kg roller coaster car is lifted 25 m. Find the work done.



Combining Equations - Wd. GPE, KE

Challenge QUESTIONS

Worked Answers

1. Space Rover Push: A 350 kg Mars rover is pushed 6 m with a 400 N force along flat ground. Find its final speed from rest.

$$d = 6 \text{ m}$$

$$F = 400 \text{ N}$$

$$W = Fd = 400 \times 6 = 2400 \text{ J};$$

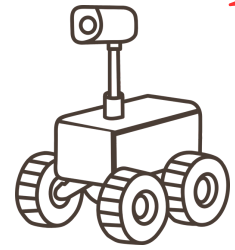
$$KE = \frac{1}{2} \times m \times v^2$$

$$v = ?$$

$$m = 350 \text{ kg}$$

$$2400 = \frac{1}{2} \times 350 \times v^2$$

$$v = \sqrt{(2 \times 2400 / 350)} \approx 3.7 \text{ m/s}$$



2. Diving Platform: A 60 kg diver jumps from a 10 m high platform. Find the speed just before hitting the water.

$$h = 10 \text{ m}$$

$$m = 60 \text{ kg}$$

$$v = ?$$

$$GPE = mgh = 60 \times 10 \times 10 = 6000 \text{ J};$$

$$KE = \frac{1}{2} \times m \times v^2$$

$$6000 = \frac{1}{2} \times 60 \times v^2$$

$$v = \sqrt{(2 \times 6000 / 60)} \approx 14.1 \text{ m/s}$$

$$g = 10 \text{ m/s}^2$$

3. Skateboard Ramp: A 50 kg skateboarder descends a 5 m ramp from rest. Find the speed at the bottom.

$$h = 5 \text{ m}$$

$$m = 50 \text{ kg}$$

$$v = ?$$

$$GPE = mgh = 50 \times 10 \times 5 = 2500 \text{ J};$$

$$KE = \frac{1}{2} \times m \times v^2$$

$$2500 = \frac{1}{2} \times 50 \times v^2$$

$$v = \sqrt{(2 \times 2500 / 50)} = 10 \text{ m/s}$$

$$g = 10 \text{ m/s}^2$$

4. Hot Air Balloon: A 200 kg basket is lifted 15 m by a balloon. Find the minimum work done.

$$m = 200 \text{ kg}$$

$$h = 15 \text{ m}$$

$$\text{Work done} = GPE \text{ gained by balloon.}$$

$$W = mgh = 200 \times 10 \times 15 = 30,000 \text{ J}$$

$$g = 10 \text{ m/s}^2$$

5. Space Capsule Landing: A 1000 kg capsule falls 120 m onto a moon base. Find its impact speed ignoring air resistance.

$$h = 120 \text{ m}$$

$$m = 1000 \text{ kg}$$

$$v = ?$$

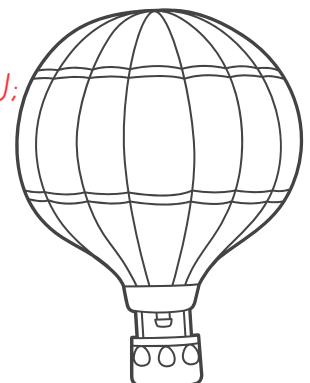
$$GPE = mgh = 1000 \times 1.62 \times 120 = 194,400 \text{ J};$$

$$KE = \frac{1}{2} \times m \times v^2$$

$$194,400 = \frac{1}{2} \times 1000 \times v^2$$

$$v = \sqrt{(2 \times 194,400 / 1000)} \approx 19.7 \text{ m/s}$$

$$g = 10 \text{ m/s}^2$$



Challenge QUESTIONS

Worked Answers

6. Alien Sled Push: An alien pushes a 80 kg sled 12 m on flat ground with 150 N. Find the sled's final speed.

$$\begin{aligned} d &= 12 \text{ m} \\ F &= 150 \text{ N} \\ m &= 80 \text{ kg} \\ v &= ? \end{aligned}$$

$$W = Fd = 150 \times 12 = 1800 \text{ J};$$

$$KE = \frac{1}{2} \times m \times v^2$$

$$1800 = \frac{1}{2} \times 80 \times v^2$$

$$v = \sqrt{(2 \times 1800 / 80)} \approx 6.7 \text{ m/s}$$

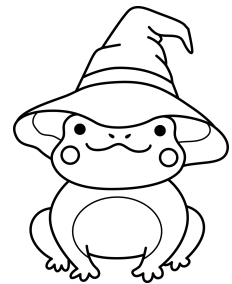
7. Wizard's Lift Spell: A 5 kg magical stone is lifted 20 m using a spell. Find the work done.

$$\begin{aligned} m &= 5 \text{ kg} \\ h &= 20 \text{ m} \end{aligned}$$

Work done = GPE gained by stone

$$W = mgh = 5 \times 10 \times 20 = 1000 \text{ J}$$

$$g = 10 \text{ m/s}^2$$



8. Catapult Launch: A 10 kg pumpkin is hurled 15 m horizontally by a catapult applying a constant force of 600 N. Find its speed.

$$\begin{aligned} d &= 15 \text{ m} \\ F &= 600 \text{ N} \\ m &= 10 \text{ kg} \\ v &= ? \end{aligned}$$

$$W = Fd = 600 \times 15 = 9000 \text{ J};$$

$$KE = \frac{1}{2} \times m \times v^2$$

$$9000 = \frac{1}{2} \times 10 \times v^2$$

$$v = \sqrt{(2 \times 9000 / 10)} \approx 42.4 \text{ m/s}$$

9. Mountain Biker Drop: A 70 kg biker drops from a cliff 12 m high. Find the speed just before landing.

$$\begin{aligned} h &= 12 \text{ m} \\ g &= 10 \text{ m/s}^2 \\ m &= 70 \text{ kg} \\ v &= ? \end{aligned}$$

$$GPE = mgh = 70 \times 10 \times 12 = 8400 \text{ J};$$

$$KE = \frac{1}{2} \times m \times v^2$$

$$8400 = \frac{1}{2} \times 70 \times v^2$$

$$v = \sqrt{(2 \times 8400 / 70)} \approx 15.5 \text{ m/s}$$

10. Roller Coaster Lift Hill: A 400 kg roller coaster car is lifted 25 m. Find the work done.

$$\begin{aligned} m &= 400 \text{ kg} \\ h &= 25 \text{ m} \\ g &= 10 \text{ m/s}^2 \end{aligned}$$

Work done = GPE gained by roller coaster

$$W = mgh = 400 \times 10 \times 25 = 100,000 \text{ J}$$

