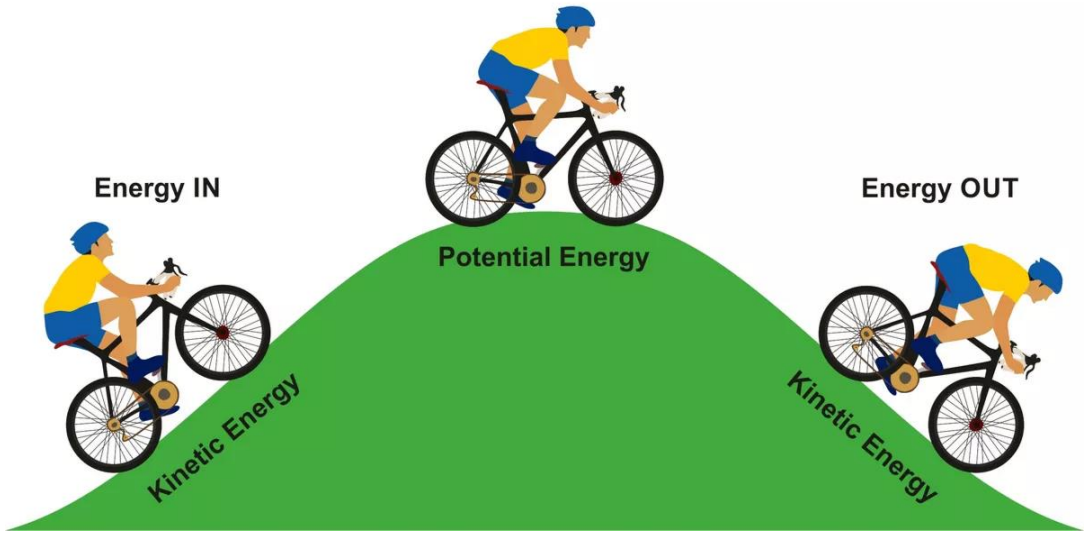
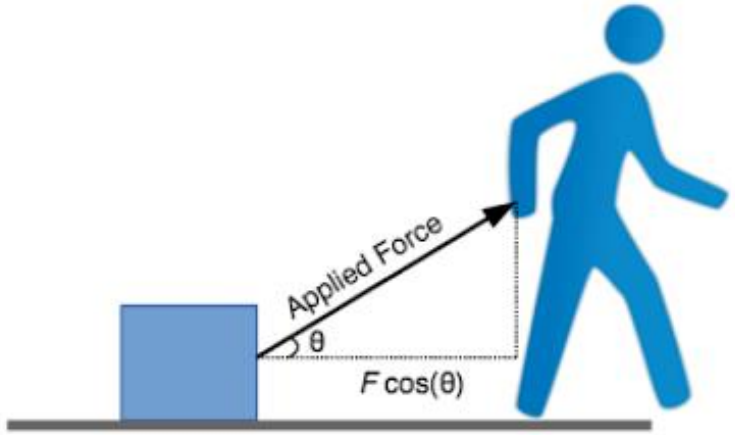
Work & Power

www.tutorfor.co

You Tube : TutorFor ExamPhysics

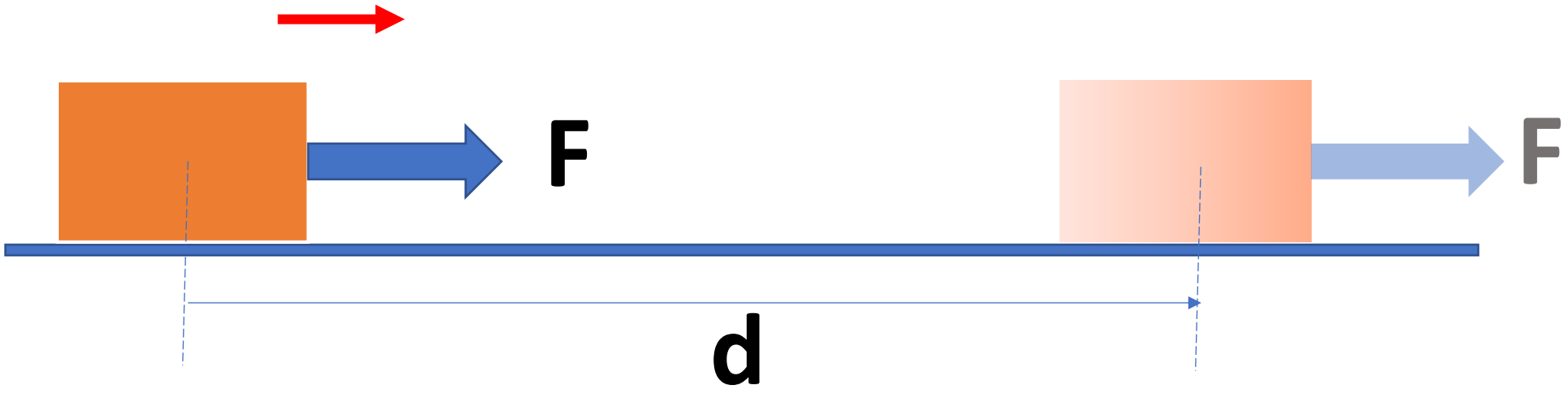




(c)	**Work and power**
Students should:	
4.11	know and use the relationship between work done, force and distance moved in the direction of the force: work done = force × distance moved $W = F \times d$
4.12	know that work done is equal to energy transferred
4.13	know and use the relationship between gravitational potential energy, mass, gravitational field strength and height: gravitational potential energy = mass × gravitational field strength × height $GPE = m \times g \times h$
4.14	know and use the relationship: kinetic energy = ½ × mass × speed^2 $KE = \frac{1}{2} \times m \times v^2$
4.15	understand how conservation of energy produces a link between gravitational potential energy, kinetic energy and work
4.16	describe power as the rate of transfer of energy or the rate of doing work
4.17	use the relationship between power, work done (energy transferred) and time taken: $\text{power} = \frac{\text{work done}}{\text{time taken}}$ $P = \frac{W}{t}$

Work done(W)

IMPORTANT



Work done = Force × distance moved in the direction of the force

$$W = F \times d$$

- Scalar quantity
- SI unit is joule(J)

Concept learning questions

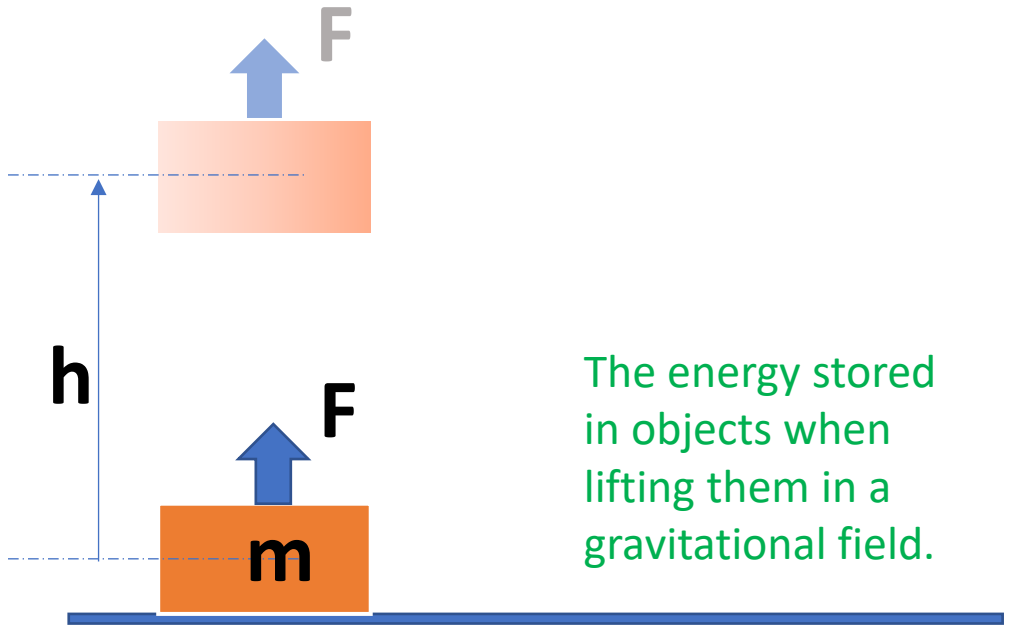
A force of 20 N is applied to move an object a distance of 12 m in the direction of the force. Calculate the work done.

Energy transfer

- Work done is equal to the amount of energy transferred.

- 1 J of work done is transferred when a force of 1 N is applied through a distance of 1 m in the direction of the force.

Gravitational Potential Energy(GPE)



The energy stored in objects when lifting them in a gravitational field.

Work done = F × d

= mg × h

= mgh

= GPE

Gravitational Potential Energy = mass × gravitational field strength × height

GPE = m × g × h

Concept learning questions

An object of mass of 2 kg is raised to a height of 4 m from ground. Find the gravitational potential energy stored in the object. (g=10 N/kg)

Concept learning question.

An object of mass 5 kg at 4 m height from the ground is raised to a height of 10 m from the ground. Find the increase in gravitational potential energy stored in the object. (g=10 N/kg)

Kinetic Energy(KE)

- The energy stored in moving object is called kinetic energy.

$$\text{Kinetic energy} = \frac{1}{2} \times mass \times (speed)^2$$

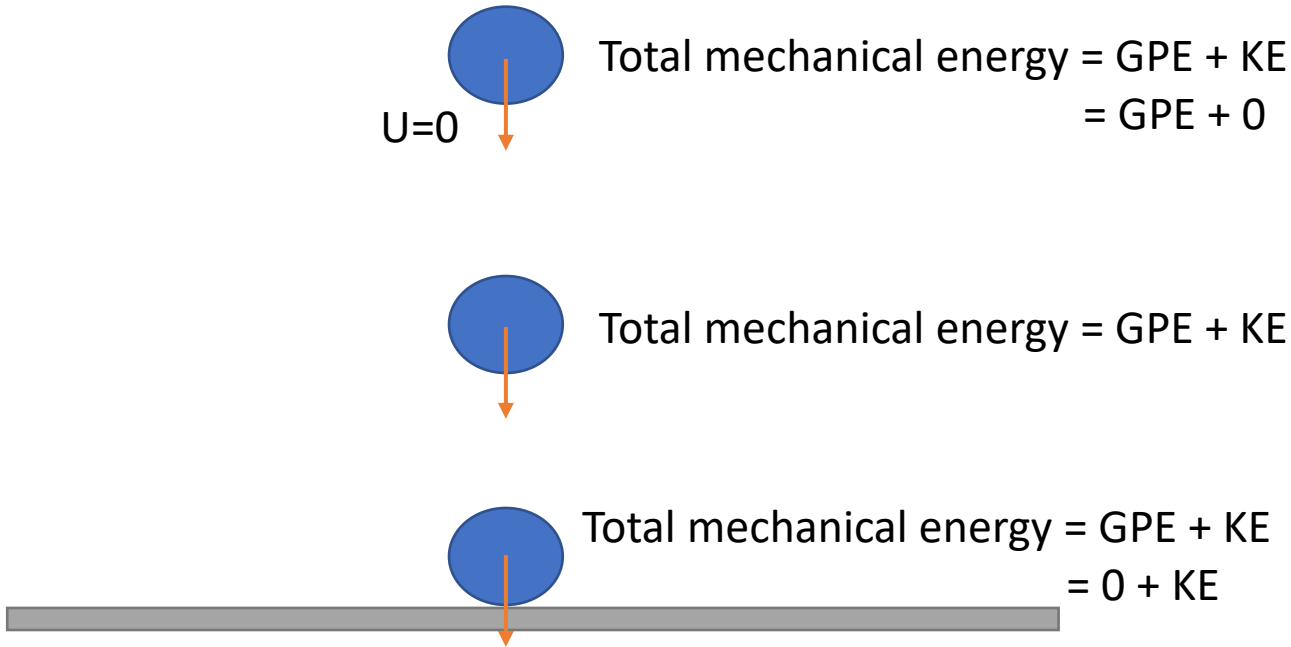
$$KE = \frac{1}{2}mv^2$$

Mechanical energy

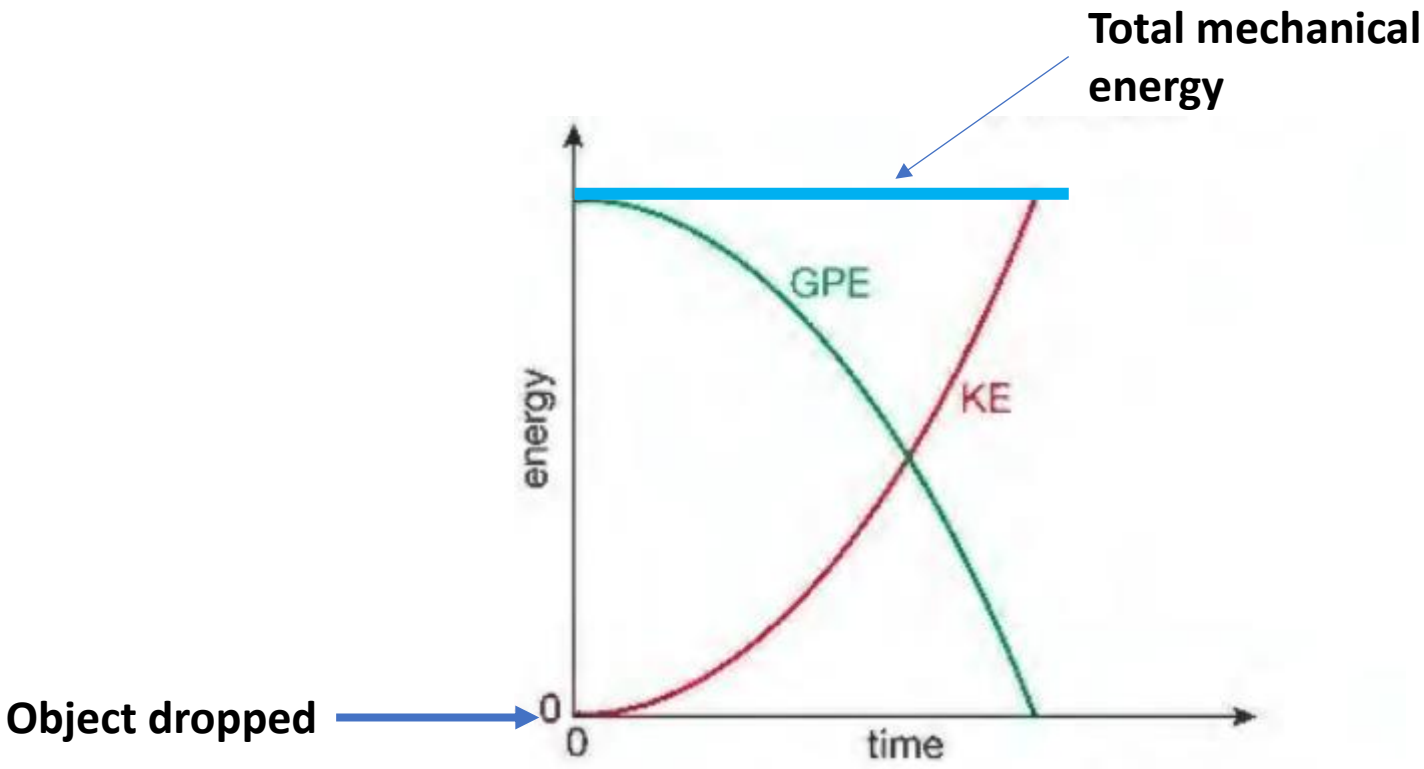
IMPORTANT

- The sum of the gravitational potential energy and the kinetic energy is called the mechanical energy.

- If an object is raised to a certain height and released the total mechanical energy remain constant(conserved) through out its journey(assume no air resistance).



Energy transfer in a dropped object



Concept learning questions.

A ball of mass 5 kg is dropped from a height of 20 m. Find the speed of the ball at 8 m above the ground and just before it hits the ground. Assume that there is no air resistance.

End Chapter questions

5 A catapult fires a stone of mass 0.04 kg vertically upwards. If the stone has an initial kinetic energy of 48 J, how high will it travel before it starts to fall back to the ground?

6 If a coin is dropped from a height of 80 m, how fast will it be travelling when it hits the ground? State any assumptions you may need to make.

Power(P)

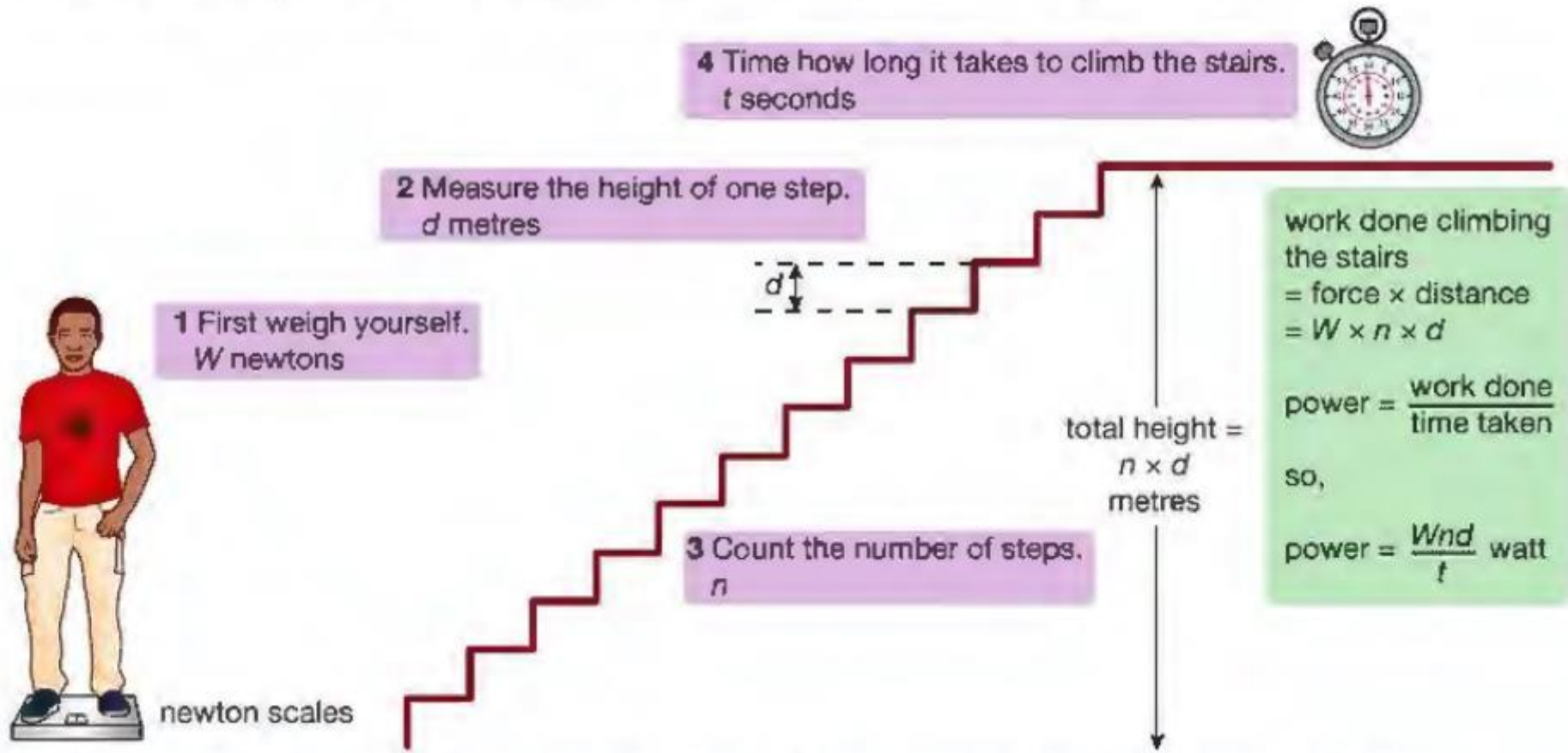
- Power is the rate of energy transfer.

$$\text{Power} = \frac{Energy}{Time} \quad \text{or} \quad \text{Power} = \frac{Work\ done}{time}$$

- The SI unit is watt(W)
- It is a scalar quantity.

▼ PRACTICAL: INVESTIGATE YOUR POWER OUTPUT

You may have done a simple experiment involving running upstairs to measure your output power. You do work as you raise your GPE, and to find your power output in watts you divide the work done by the time taken. The experiment is shown in Figure 16.11. Notice that calculating the work you do against gravity using force × distance works just as well as using the equation for *GPE* (mass × gravitational field strength × height).



▶ Figure 16.11 An experiment to measure your output power

If you don't have scales meesuring in newtons, simply multiply your mass in kg by 10 to convert to newtons.