FORCES – WORK DONE

OBJECTIVES

- Know how to calculate work done and re-arrange the formula (all)
- Understand the applications of work done to car brakes (most)

SUCCESS CRITERIA

- Successfully carry out work done practical and complete calculations
- Correctly answer 9 work sheet questions

STARTER – IN PAIRS

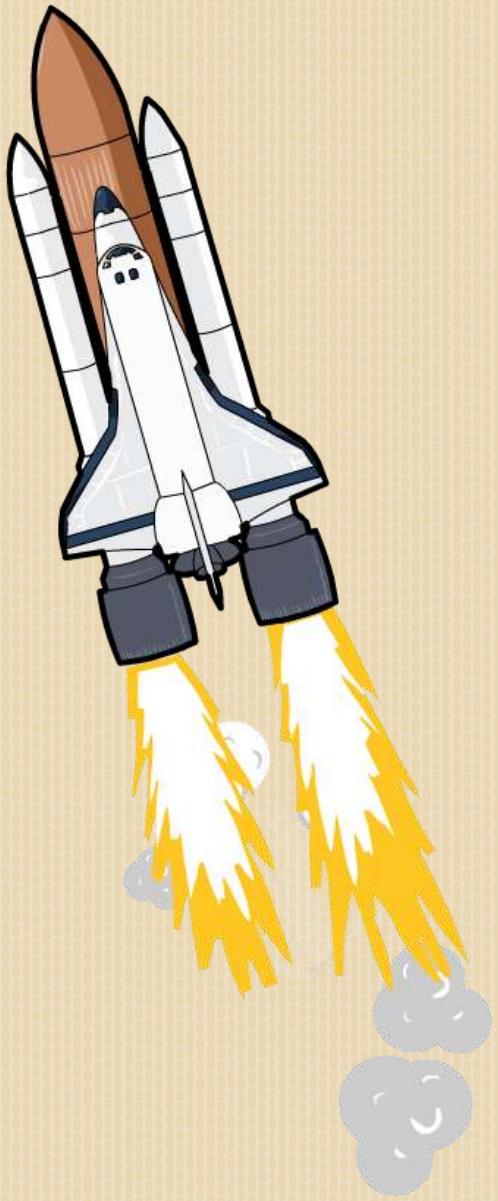
- Explain why a person weighs something different in space
- What is mass?

WHAT IS WORK?

What happens when a rocket is launched into space?

When the rocket's engines are fired, chemical energy in the fuel is **transferred** to kinetic energy in the rocket.

This transfer of energy is called **work**.



WORK AND ENERGY

What is the link between work and energy?

work done = energy transferred

This means the units for work are the same as the units for energy – **joules**.

For example, if a person does 500 J of work, then 500 J of energy is transferred.

In the same way, if a person transfers 250 J of energy, then 250 J of work is done.

What factors affect the amount of work done?

Work is done when energy is transferred, but what factors affect the amount of work done?

Click "**start**" to find out.

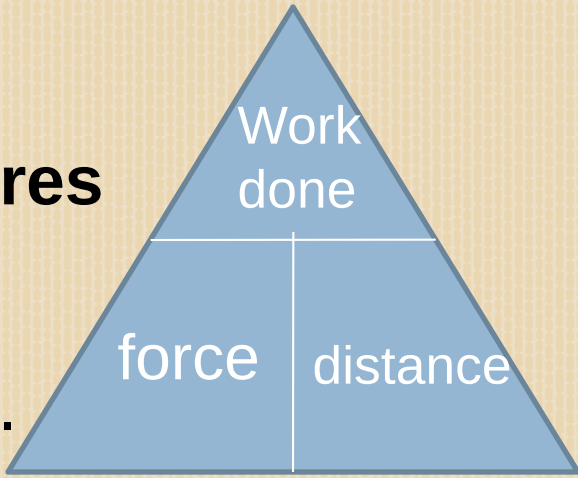
start

HOW IS WORK CALCULATED?

The work done on an object can be calculated using this equation:

work done = force x distance moved

- Force is measured in **newtons** (**N**).
- Distance moved is measured in **metres** (**m**).
- Work done is measured in **joules** (**j**).



CALCULATING WORK DONE QUESTION 1

A cyclist peddles a bicycle with a force of 1,000 N moving it 250 m.

How much work has been done by the cyclist?

work done = force x distance

= 1,000 x 250

= **250,000 J = 250 kJ**

A crane lifts a load with a force of 10 kN and does 500 kJ of work. How far has the car travelled?

work done = force x distance

$$\textbf{distance} = \frac{\textbf{work done}}{\textbf{force}}$$

= 500,000 / 10,000

= **50 m**

WORK DONE BY A MASS

If you are calculating the work done by an object being lifted (or a person jumping)– you will need to calculate the force of the mass

The force is equal to their weight (in N) (remember the definition of weight from Monday)

Weight = mass (kg) X Gravitational force
= mass (kg) X 10

WORK DONE AND CAR BRAKES

A car loses kinetic energy when it stops.

The kinetic energy is transferred mainly into heat by the brakes.

Kinetic energy lost = work done by the brakes

You can calculate braking distance

$$\text{Braking distance} = \frac{\text{work done by the brakes}}{\text{Braking force}}$$

QUESTION

The brakes in a car produce a force of 5000N and the car has to lose 200,000 J of kinetic energy. What is it's breaking distance.

Work done by brakes = 200,000J

$$\text{Braking distance} = \frac{\text{work done by the brakes}}{\text{Braking force}}$$

= 200,000 / 5000 = 40m

ACTIVITY: MEASURING WORK DONE

Method

1. Attach a newton-meter to a toy car.
2. Pull the car across the bench or floor at a steady rate keeping the pulling force constant.
3. Note the steady reading on the newton meter.
4. Measure the distance moved by the car.
5. Record your results in the table (shown on next slide)
6. Calculate the work done in moving the car.
7. Repeat for the other situations listed in the table.

COPY TABLE AND RECORD YOUR RESULTS

task	force in N	distance moved in m	work done in J
pulling toy car across bench or floor			
lifting ball into the air			
pulling toy car up a raised runway			
jumping up in the air			

NOTES – read carefully:

- For jumping you will need to measure the person's weight in newtons = mass in kg X 10 = weight (N)
- For lifting a ball – you will need to measure the ball's weight on the newton-meter

NEXT: Complete the questions on your worksheet (make sure you complete the last one if you are aiming for an A)

ANSWERS

Worksheet P3d 2 – Working hard

1) 1 000 000 J

2) None; lamppost does not move

3)a 22.5 J

b Sam (Pete only does 18 J of work on ball)

4)a 480 000 J

b Dan will have to do work: for example, to overcome friction between tyres and road

c Second route – Dan will do less work

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1) 40 000 N

2)a 300 m

b 150 000 J

3)a 25m

b It does not change, as Calum moves the same force through the same vertical height

4)a 66.7m

b Thinking distance should be added

PLENARY: TRUE OR FALSE?

Are these statements about work and energy true or false?

1.	The amount of work done only depends on the force applied.	
2.	A object has to move for work to be done.	
3.	The further an object moves, the more work is done.	
4.	Work done is measured in newtons.	
5.	Work done is equal to the energy transferred.	
6.	Energy transfer is measured in joules.	

true false

? solve