CHURCH STRETTON SCHOOL

Triple Science - Physics

SP8-9 Knowledge organiser

P8-9: Energy and forces and their effects

Lesson sequence

1. Work and power
2. Objects affecting each other
3. Vector diagrams
4. Rotational forces

1. Work and power	
Energy	The capacity to do work.
Joules	The units of energy, symbol = J.
Kilojoules	1000 J, symbol = kJ.
Work done	The energy transferred by a force.
Calculating work done	Work done = force x distance E = F x d Work done = joules Force = newtons Distance = metres
Power	The rate of energy transfer.
Watts, W	The unit of power: 1 W = 1 joule per second
Calculating power	Power = work done / time P = E / t Power = watts Work done = joules Time = seconds

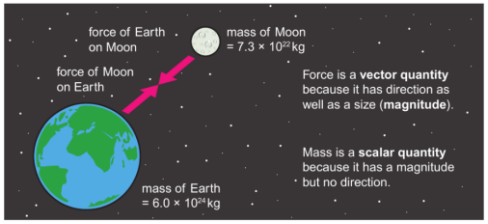
Worked example

Danny is moving a box weighing 300 N. He pulls it 3 m along a sloping ramp using a force of 200 N. Calculate the work Danny does.

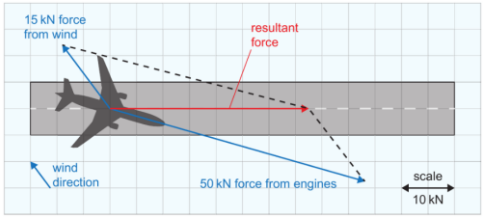
$E = F \times d$
$= 200\,N \times 3\,m$
$= 600\,J$

The force must be in the direction of the movement.

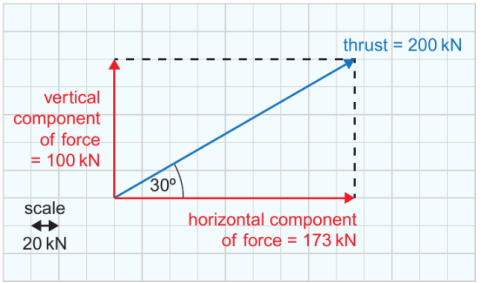
2. Objects affecting each other	
Contact force	A force that acts when two objects touch.
Contact force examples	Normal force, normal reaction force, friction, upthrust, air resistance.
Non-contact force	A force that acts at a distance.
Non-contact force examples	Gravity, magnetism, electrostatic force.
Action-reaction forces	If, A applies an action force to B, B applies a reaction force of same size and opposite direction to A.
Force field	The area around an object where its force can affect other objects.
Magnetic field	The area of magnetic force around a magnet.
Electric field	The area of electrostatic force around an object charged with static electricity.
Vectors	Arrows that show size and direction.



3. Vector diagrams	
Free body diagram	A diagram showing all the forces on an object.
Vector diagram arrows	Arrows showing the size and direction of a force – must be drawn to scale.
Scale diagram	Diagram drawn on graph paper to find the size of forces.
Resultant force	The force left over when forces acting in opposite directions are cancelled out.
Resultant force diagram	Draw correct arrows for two forces, add lines to make a parallelogram. Resultant force = the diagonal of the parallelogram.
Resolving forces	Breaking a force up into its horizontal and vertical components.
Component forces	The vertical and horizontal forces that a diagonal force is made from.
Resolving forces diagram	Draw a correct force arrow, add arrows for vertical and horizontal component forces.



4. Rotational forces	
Moment	The turning effect of a force Moment = Force x Perpendicular distance from pivot Moment = Nm Force = N Distance = m
Pivot	the central point, pin, or shaft on which a mechanism turns or oscillates.
Normal	a line at right angles to a given line or surface.
Equilibrium	a state in which opposing forces or influences are balanced.
Lever	a rigid bar resting on a pivot, used to move a heavy or firmly fixed load with one end when pressure is applied to the other.
Gears	An alternative method for transmitting the rotational effect of a force.



Worked example

In diagram B the sacks are hanging from a point 0.1 m from the pivot. They are balanced by a weight of 300 N hanging 1 metre from the pivot and a weight of 20 N hanging 1.2 m from the pivot. Calculate the weight of the sacks.

sum of clockwise moments = 300 N × 1 m + 20 N × 1.2 m
= 300 N m + 24 N m = 324 N m

sum of clockwise moments = sum of anti-clockwise moments

324 N m = weight × 0.1 m

$\text{weight} = \frac{324\,N\,m}{0.1\,m} = 3240\,N$