Year: 11

Topic: 6.3 Work and energy

Knowledge and Understanding to be developed:

This topic explores the relationship between work and energy. The equations for kinetic energy and change in gravitational potential energy are developed. The principles of force, energy and motion are used to analyse such safety features of cars as air bags and crumple zones.
There are a number of opportunities for the development of mathematical skills in this topic. These include performing calculations using compatible units for energy transfers associated with energy changes in a system; recalling or selecting and applying the relevant equations for work done, kinetic energy and change in gravitational potential energy; calculating the energy stored in a stretched spring. These topics afford learners the opportunity to recognise and use expressions in decimal form; to recognise expressions in standard form; to use ratios, fractions and percentages; to change the subject of an equation; to substitute numerical values into algebraic equations using appropriate units for physical quantities; to solve simple algebraic equations; to understand the physical significance of the area between a curve and the x-axis and to measure it by counting squares as appropriate.

Key Terms to be learned this topic:

work	Potential energy
efficiency	aerodynamic
Force extension	force
	mass
deformation	Gravitational potential

Learning Objectives and Outcomes: Students should be able to :

(a) the fact that, when a force acts on a moving body, energy is transferred although the total amount of energy remains constant
(b) the equation: work = force x distance moved in the direction of the force;
W = Fd
(c) the fact that work is a measure of the energy transfer, i.e. that work = energy transfer (in the absence of thermal transfer)
(d) the fact that an object can possess energy because of its motion (kinetic energy) and position (gravitational potential energy) and deformation (elastic energy)
(e) the equations for kinetic energy and changes in gravitational potential energy:
kinetic energy =

change in potential energy = mass × gravitational field strength × change in height ; PE = mgh
(f) the relationship between force and extension for a spring and other simple systems;
force = spring constant × extension; F = kx
(g) the work done in stretching by finding the area under the forceextension (F-x) graph;
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(h) how energy efficiency of vehicles can be improved (e.g. by reducing aerodynamic losses/air resistance and rolling resistance, idling losses and inertial losses)
(i) the principles of forces and motion to an analysis of safety features of cars e.g. air bags and crumple zones
SPECIFIED PRACTICAL WORK
• Investigation of the force-extension graph for a spring