

SPH4U UNIVERSITY PHYSICS

ENERGY & MOMENTUM

Introduction
(P.158-161)

Energy & Momentum

For years our society has used fossil fuels to meet most of our energy needs. We now face problems as these non-renewable resources dwindle and the environmental impact of their use becomes clear. As a result, scientists and engineers have begun to study alternative energy sources more seriously to find clean, inexpensive, and renewable forms of energy.



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Energy & Momentum

For instance, new innovations in hydroelectric power allow us to harness energy from ocean tides, currents, waves, and even from the difference in temperature between deep and surface ocean water. Technology like this allows us to extract energy while having fewer negative effects on the environment.



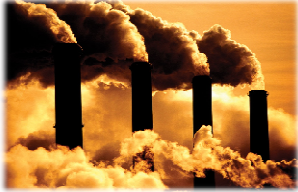
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Work, energy, and the physics of collisions are important concepts related to energy production. As such, scientists and engineers must understand these concepts in order to make innovations in energy technology.



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Overall Expectations

By the end of this unit, students will:

1. analyse and propose ways to improve, technologies or procedures that apply principles related to energy and momentum, and assess the social and environmental impact of these technologies or procedures;
2. investigate, in qualitative and quantitative terms, through laboratory inquiry or computer simulation, the relationship between the laws of conservation of energy and conservation of momentum, and solve related problems;
3. demonstrate an understanding of work, energy, momentum, and the laws of conservation of energy and conservation of momentum, in one and two dimensions.

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Big Ideas

Concepts that students should retain long after this course are:

- Energy and momentum are conserved in all interactions.
- Interactions involving the laws of conservation of energy and conservation of momentum can be analysed mathematically.
- Technological applications that involve energy and momentum can affect society and the environment in positive and negative ways.

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Getting Started: Useful Concepts & Skills

CONCEPTS REVIEW

1. Describe an energy transformation that can be used to produce electrical energy.

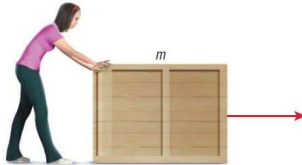
answers will vary

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Getting Started: Useful Concepts & Skills

CONCEPTS REVIEW

2. A worker moves a box with a mass m along a warehouse floor. What variables determine the amount of work done on the box by the worker? Be specific.



F (force) and d (distance)

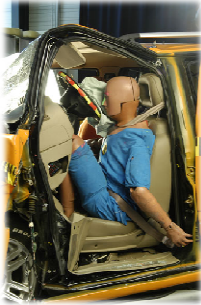
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Getting Started: Useful Concepts & Skills

CONCEPTS REVIEW

3. Airbags are a type of safety device installed in vehicles to protect passengers from injury in a collision.

(a) Explain how energy transformations are used in airbags to protect passengers from injury during a collision.



(a) answers will vary

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Getting Started: Useful Concepts & Skills

CONCEPTS REVIEW

3. Airbags are a type of safety device installed in vehicles to protect passengers from injury in a collision.

(b) What are some of the limitations of airbags as a safety device?

(b) answers will vary



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Getting Started: Useful Concepts & Skills

SKILLS REVIEW

4. Write the proportionality statement relating the variables that are defined in bold, and sketch the corresponding graph for each case.

(a) The **gravitational potential energy** of a person walking up a flight of stairs doubles when the **height** of the stairs doubles.

(b) The **kinetic energy** of a car depends on the square of its **speed**.

(c) The **acceleration** of a particle triples as the **applied force** increases by a factor of three.

(a) $E_g \propto h$ linear

(b) $E_k \propto v^2$ non-linear (increasing slope)

(c) $a \propto F_a$ linear

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Getting Started: Useful Concepts & Skills

SKILLS REVIEW

5. Compare the costs and benefits of operating a laptop computer using its battery versus using an electrical outlet. Include at least one social impact, one environmental impact, and one economic impact.

answers will vary

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Getting Started: Useful Concepts & Skills

SKILLS REVIEW

6. Calculate the x-component and y-component of each force shown.

(a)

(b)

(c)

(a) $F_x = 10 \text{ N[E]}$ $F_y = 0$
(b) $F_x = 6.4 \text{ N[W]}$ $F_y = 7.7 \text{ N[S]}$
(c) $F_x = 0$ $F_y = 10 \text{ N[S]}$


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Getting Started: Useful Concepts & Skills

SKILLS REVIEW

7. A digital balance scale is often used to measure the mass of an object. What sources of error would you minimize when attempting to determine an object's mass?

answers will vary



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