T8 Energy - Forces Doing Work HIGHER and T9 Forces and their Effects HIGHER

combined sciences text book pages 371-373

combined sciences text book pages 374-378

Section A

1) What is the unit that energy is measured in?
- ☐ **A:** Joules (J)
- ☐ **B:** Newtons (N)
- ☐ **C:** Watts (W)
- ☐ **D:** Volts (V)

2) What form of energy is stored in batteries and fuel?
- ☐ **A:** Electrical
- ☐ **B:** Kinetic Energy
- ☐ **C:** Chemical
- ☐ **D:** Gravitational Potential Energy

3) All of the energy supplied to another device is transferred into other forms. This is an example of
- ☐ **A:** renewable energy
- ☐ **B:** non-renewable energy
- ☐ **C:** conservation of energy
- ☐ **D:** catalysis

4) How is power calculated from energy and time?
- ☐ **A:** power = energy + time
- ☐ **B:** power = energy × time
- ☐ **C:** power = time ÷ time
- ☐ **D:** power = energy ÷ time

5) Which of the following quantities is a vector?
- ☐ **A:** force
- ☐ **B:** speed
- ☐ **C:** distance
- ☐ **D:** mass

6) Which of these values **cannot possibly** be an accurate measure of efficiency?
- ☐ **A:** 120 %
- ☐ **B:** 50 %
- ☐ **C:** 0.5
- ☐ **D:** 0.05

Sort the forms of energies into the table.

Stores	Transfers

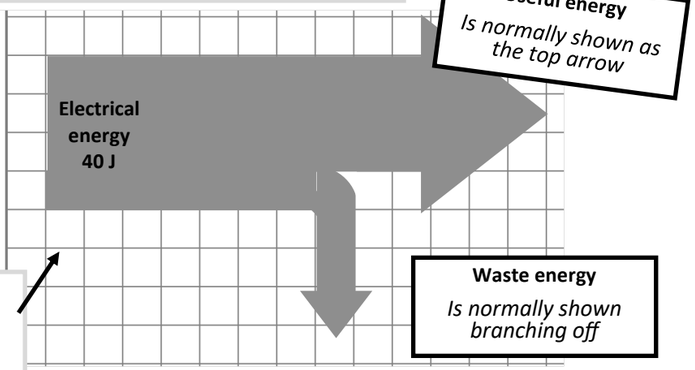
kinetic energy
thermal
light
gravitational potential energy
chemical
sound
electrical
elastic potential energy
nuclear

Pick energy names from the list to create energy transfers for these situations without using any energy more than once

Situation	Input		Output(s)
The ceiling lights in a room are turned on at the wall.		→	
A football is kicked high into the air.		→	
A battery operated radio is turned on.		→	

Section B

The diagram below shows how the total electrical energy supplied to a motor is transferred.



What is the useful output energy for a motor?

How much of the 40 J input energy is transferred to useful energy?

$$\text{efficiency} = \frac{(\text{useful energy transferred by the device})}{(\text{total energy supplied to the device})}$$

What is the efficiency of the motor?

What form is the waste energy in and how could it be reduced?

Top tip

Any time it seems like energy has disappeared it has most likely been transferred to waste thermal energy which is dissipated to the surroundings.

Reducing friction makes this happen less.

Circle the non-contact forces in this list ↓

weight/gravity
normal reaction
tension
friction
air resistance
water resistance
upthrust/buoyancy
thrust/engine force
magnetism
electrostatic force

Use some of the names of the forces in the list to help you draw free-body force diagrams for the following...

A car accelerating away from some traffic lights.

A skier is slowing down before reaching the bottom of a slope.

Link to BBC Bitesize

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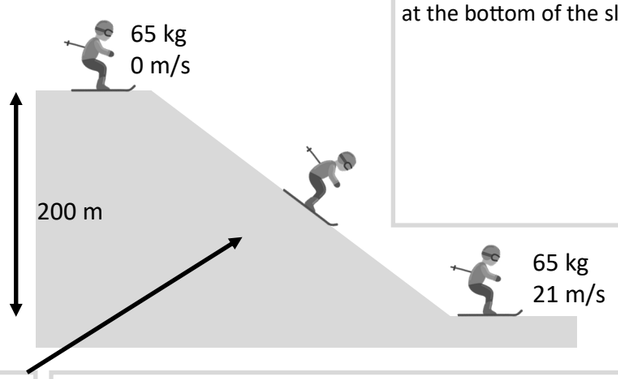
Section C

change in gravitational potential energy = mass × gravitational field strength × change in vertical height	$\Delta GPE = m \times g \times \Delta h$
kinetic energy = 1/2 × mass × (speed)^2	$KE = \frac{1}{2} \times m \times v^2$

gravitational field strength, g
is roughly 10 N/kg on Earth

Show that the skier gained more than 100 kJ of gravitational potential energy when they climbed to the top of the slope



Show that the kinetic energy of the skier at the bottom of the slope is roughly 14 kJ.

Suggest how much gravitational potential energy the skier has when they are halfway down the slope.

Suggest why the kinetic energy stored in the skier at the bottom of the slope is not equal to the gravitational potential energy stored in the skier at the top of the slope.
(hint: their skis are rubbing against the snow on the way down)

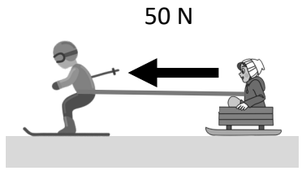
work done = force × distance moved in the direction of the force	$E = F \times d$
power = work done ÷ time taken	$P = \frac{E}{t}$

The skier pulls their niece along by pulling on a rope. The tension in the rope if 50 N.
Calculate the work done when the sledge is pulled 1.2 km.

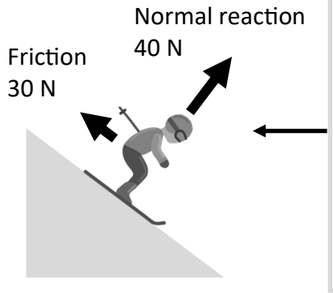
..... J

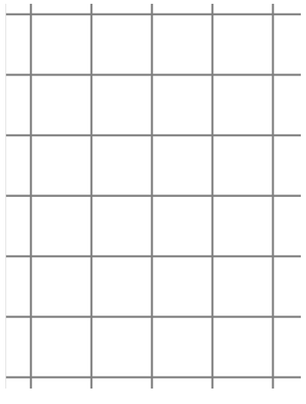
What is the power of the skier if it takes them 12 minutes to do pull the sledge that far?

..... W



Use a **scale diagram** to work out the magnitude of the resultant force of the normal reaction and friction force acting on the skier





Section D - give all answers in standard units

How much energy is required to lift a 1.5 kg bag of sugar from a worktop to a shelf 0.8 m higher up?	How much kinetic energy is stored in a 1.5 kg bag of sugar falling at a speed of 4 m/s?	A person pushes a wheelbarrow 30 m down a garden path by applying a constant force of 50 N. How much work was done moving the wheelbarrow?
What is the efficiency of a lightbulb that emits 10 J of light energy for every 150 J of electrical energy that it is supplied with? Give your answer as a decimal.	What is the power of a device that takes 120 s to do 24 J of work?	What distance was a brick moved if a force of 50 N was applied to it and a total of 20 000 J of work was done on it?
A motor in an elevator transfers 480 kJ of energy into gravitational potential energy. If it takes 30 s to do this, what is the power of the motor?	A motor is 20 % efficient. If it is supplied with 80 kJ of energy, how much kinetic energy does it output?	How much work is done by a device with a power of 20 W in 2 minutes?
If an object gains 500 J of energy when it is lifted 0.6 m upwards, what must the mass of the object be?	What force must be applied to a boulder to do 20 kJ of work moving it 110 m?	State the velocity of a 20 g bullet that possesses 37.5 kJ of kinetic energy.

Answers						
	400	16000	12	182	150	2400
	12	1936	0.2	16000	83	7