Autumn Term 2

P1 Conservation and dissipation of energy

Aiming for Grade 4

Extended Homework Assignment

Name: _____

Set: _____

Instructions

A printed copy should be handed into your teacher.

The knowledge required to complete this assignment will be supported in class in lessons of the half term.

worked example 1

Calculate the change in gravitational potential energy of a mountaineer who has climbed a mountain that is 3000 m high. The mass of the mountaineer is 70 kg. $g = 10$ N/kg.

Step 1: Write down what you know.

change in height $h = 3000$ m

mass $m = 70$ kg

$g = 10$ N/kg

Step 2: Use the equation for E_p to find gravitational potential energy.

$E_p = m \times g \times h$

$\quad = 70 \text{ kg} \times 10 \text{ N/kg} \times 3000 \text{ m}$

$\quad = 2\,100\,000$ J

Worked example 2

Calculate the kinetic energy of a sprinter of mass 70 kg who is running at 10 m/s.

Step 1: Write down what you know.

mass $m = 70$ kg

speed $v = 10$ m/s

Step 2: Use the equation for E_k to find kinetic energy.

$E_k = \dfrac{1}{2} \times m \times v^2$

$\quad = \dfrac{1}{2} \times 70 \times (10)^2$

$\quad = 3500$ J

Tasks

Power and efficiency

A Here are some electrical items with the energy that they transfer per second. Complete the table, and add the unit of power.

Item	Job it does	Energy transferred	Time	Power in ___
kettle		3000 J	2 seconds	
light bulb		6000 J	1 minute	
radio		600 J	30 seconds	
oven		10 kJ	1 second	

Questions

1 **a** List the different types of energy store.

....

.... (*2 marks*)

b Circle the correct answer to complete these sentences for the modelling in Part 1 of the Task:

   i In the torch the energy is transferred by **an electric current / a force**.   (*1 mark*)

   ii When the cyclist moves downhill energy is transferred by **an electric current / a force**.   (*1 mark*)

Calculating energy

2 You do work when you lift a ball.

   a Describe what we mean by 'work' in science.

     ....   (*1 mark*)

   b Calculate the work you did lifting the ball 1 m. You need to calculate the weight of the ball from the mass. $g = 10$ N/kg. Mass of ball = 0.25kg   Weight = mass $\times$ g.

     ....

     ....   (*2 marks*)

   c Suggest and explain what happens when you drop a ball into sand instead of onto the floor.

     ....

     ....   (*2 marks*)

   d A ball with a mass of 0.05 kg is dropped by a student and reaches a speed of 4 m/s just before it hits the ground. Calculate the kinetic energy.

     ....

     ....   (*2 marks*)

3 A student drops a spring onto the ground and the spring compresses. The spring constant of the spring is 100 N/m. You will need to use the equation:

elastic potential energy E_e (J) $= \dfrac{1}{2} \times$ spring constant k (N/m) $\times$ extension^2 e^2 (m^2).

Remember that the extension should be in metres.

Complete the table.   (*2 marks*)

Height dropped from in m	Compression of spring in cm	E_e (J)
1.00	2.0	
0.50	1.3	
0.25	1.0	

Power and efficiency

4 Write down two equations that you can use to calculate power.

   ....

   ....   (*2 marks*)

5 In each of the following situations write down and explain which student is more powerful. You do not need to do any calculations.

a Student A takes 25 seconds to lift 10 books onto a shelf. Student B takes 15 seconds to lift the same books onto the shelf.

....

.... (*2 marks*)

b Student A transfers 10 kJ swimming for 5 minutes, and Student B transfers 8 kJ swimming for the same amount of time.

....

.... (*2 marks*)

6 Explain the difference between an efficient and an inefficient appliance.

.... (*1 mark*)

7 For every 100 J of energy contained in the chemical store of petrol used by a car, only 20 J is transferred to a kinetic store. About 50 J is transferred by heating to the surroundings, and the remainder is transferred by sound.

a Calculate how much energy is transferred as sound.

.... (*1 mark*)

b Calculate how much energy is wasted in total.

.... (*1 mark*)

c Calculate the efficiency of the car.

....

....

.... (*3 marks*)

d A different car engine transfers 750 J to a kinetic store from the 1000 J supplied in fuel. Is this car more or less efficient? State your answer and explain why.

....

....

.... (*3 marks*)