Changes in Energy

Key Stage 4 Revision Programme

Pupil Name	
Handbook Designed by	Dr Wright

Timetable and Assignment Submission

Timetable – Tutorials

Tutorial	Date	Time	Location
1 (Baseline)			
2			
3			
4			
5			
6 (Final Assignment)			
7 (Feedback)			

Timetable – Homework Assignments

Tutorial 1		
Tutorial 2		
Tutorial 3		
Tutorial 4		
Tutorial 5		

Contents

Course Rationale 4

Glossary of Keywords 5

Tutorial 1 – Gravitational Potential Energy 8

Objective A: Defining gravitational potential energy 8

Objective B: Calculating gravitational potential energy 10

Objective C: Calculating change in gravitational potential energy 13

Tutorial 2 – Kinetic Energy 15

Objective A: Defining kinetic energy 15

Objective B: Calculating kinetic energy 17

Objective C: Calculating change in kinetic energy 20

Tutorial 3 – Elastic Potential Energy 22

Objective A: Defining elastic potential energy 22

Objective B: Calculating elastic potential energy 24

Objective C: Calculating change in elastic potential energy 26

Tutorial 4 – Conservation of Energy 29

Objective A: Defining gravitational potential energy 30

Objective B: Calculating gravitational potential energy 31

Revision Techniques 35

Exam Techniques 37

Tutorial 6 - Reflection 38

Reflection on feedback 39

Notes 40

Course Rationale

A lot of physics involves transferrable skills that can be used across the curriculum. This might be something as simple as putting the units at the end of a calculation or knowing how to put graph together.

In this course, we will delve into the conservation of energy in great detail. Doing this will enable you to gain a deeper understanding of the nuts and bolts of not only energy but basic rules of maths and physics, and the way we choose to represent things the way we do.

'Practice makes perfect', are words often mentioned but rarely taken to heart. We are constantly looking for a quick fix, a shortcut, some kind of way to save time. However, when it comes to the true mastery of something, there really is no substitute for doing it over and over. In as many ways as you can think of. Much as you cannot hope to pick up a guitar and play a tune, you cannot pick up a mathematical or science problem and expect to be able to solve it.

The framework of deliberate practice relies on this concept. By creating detailed worked examples, covering every eventuality, and then allowing the student (you) time to practice many similar but contrasting examples like these, the hope is that you will eventually master the concept.

I hope that this workbook will provide this for you. It will strengthen your knowledge of energy conservation and tighten up your mathematical skills in physics, enabling you to add an extra mark here and there that may add up to the difference between the grade you expect and the one above.

Subject Vocabulary

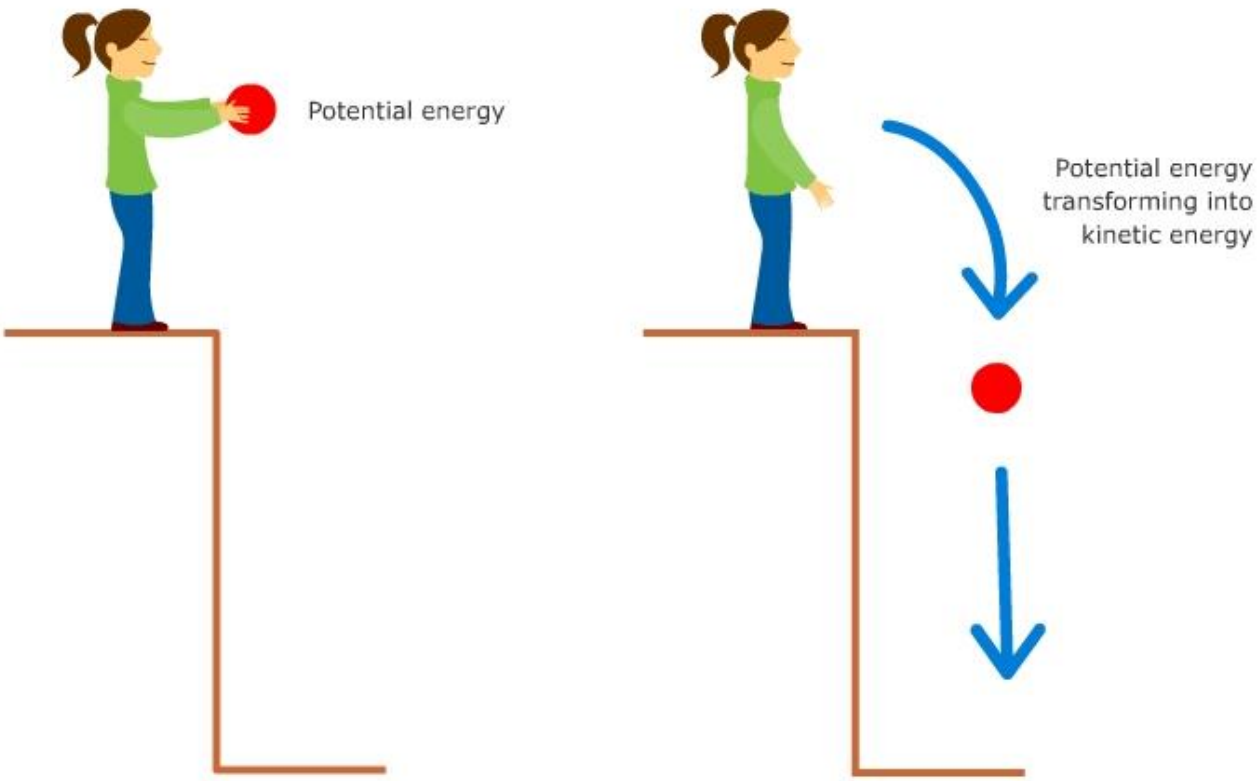
Word	Definition	In a sentence
Average Speed	Speed calculated from total distance travelled divided by total time taken.	
Doing Work	Transferring energy by means of a force.	
Efficiency	The proportion of input energy transfer which is usefully transferred. Also the proportion of input power which is usefully output.	
Elastic Deformation	An object undergoing elastic deformation will return to its original shape once any forces being applied to it are removed	
Elastic Energy	Energy of an object due to its having been stretched or compressed.	
Elastic Object	An object which can be elastically deformed	
Energy	The capacity to do work.	
Energy Store	A means by which an object stores energy. There are 8 different types of energy store: thermal, kinetic, gravitational potential, elastic potential, chemical, magnetic, electrostatic and nuclear	
Equilibrium	When no net force wand no net moment act on a body.	
Extension	The increase in length of a spring when a load is attached.	
Gravitational Potential Energy (GPE)	The energy of an object raised up against the force of gravity.	

Gravity	The force that exists between any two objects with mass	
Hooke's Law	The extension of an object is proportional to the load producing it, provided that the limit of proportionality is not exceeded	
Joule (J)	The SI unit of work or energy	
Internal Energy	The total energy that a system's particles have in their kinetic and potential energy store	
Kinetic Energy (KE)	The energy of a moving object	
Mass	The property of an object that causes it to have a gravitational attraction for other objects, and that causes it to resist changes in motion	
Mean (average)	A measure of average found by adding up all the data and dividing by the number of values there are	
Scalar	A quantity that has a magnitude (size) but no direction	
S.I. Unit	A unit recognised as standard by scientists all over the world	
Speed	The distance travelled by an object in unit time	
Spring Constant	The ratio of force to extension for a spring which obeys Hooke's Law	
Standard Form	A number written in the form $A \times 10^{a}$, where A is a number between 1 and 10	
Strain Energy	Energy of an object due to its having been stretched or compressed	

Vector	A quantity that has both magnitude (size) and direction	
Velocity	The speed of an object in a stated direction	

Tutorial 1 – Gravitational Potential Energy

Keywords: gravity, potential, mass, height



Objectives of Tutorial 1:

A. Defining gravitational potential energy
B. Calculating gravitational potential energy
C. Calculating change in gravitational potential energy

Starter: Complete the sentences below.

When a bungee jumper falls, he _____ gravitational potential energy.

When the bungee cord pulls him back up, he _____ gravitational potential energy.

If he were to forget his cord and hit the floor, he would have _____ gravitational potential energy.

Objective A: Defining gravitational potential energy

Gravitational potential energy is the amount of energy an object has because of its position about the ground, i.e. its height.

- Can be shortened to 'GPE' or E_p.

GPE is defined by the equation $GPE = mgh$, where:

- GPE is gravitational potential energy (in J)
- m is mass (in kg)
- g is gravitational field strength (gravity) (in N/kg)
- h is height (in m)

Note that gravitational field strength is usually taken as 10 N/kg on Earth (unless the question states otherwise).

Don't forget! You can convert units (e.g. km to m) to make sure you have the right units for the equation.

Practice A: Defining gravitation potential energy

1) State the equation for gravitational potential energy, defining the terms used.

2) Explain why the units for GPE could be written as newton metres instead of Joules.

3) Write a sentence defining GPE in your own words.

4) Rank the following from low to high GPE: a bird sat in a tree, a person laying on the beach, a plane in flight, a frisbee mid-flight.

5) A plane takes off on a runway. Explain whether the GPE of the plane changes.

6) A plane flies at a constant altitude for an hour. Explain whether the GPE changes during this hour.

Assessment A: Defining gravitational potential energy

Which statement is incorrect?

A	*GPE = mgh*
B	Gravitational field strength has units of N/kg.
C	An adult and child stood on a bridge have the same GPE.
D	To convert from km to m times by 1000.

Objective B: Calculating gravitational potential energy

Worked example 1

An osprey has a mass of 2 kg and is flying at a height of 200 m. What is it's GPE?

$E_p = m \times g \times h$

$E_p = 2\ kg \times 10\ N/kg \times 200\ m$

$E_p = \underline{4{,}000\ J}$ ← units

Worked example 2

A man of mass 80,000 g standing at the top of a tall building has 96,000 J of GPE. How tall is the building?

$m = 80{,}000\ g = 80\ kg$ ← conversion

$E_p = 96{,}000\ J$

$E_p = m \times g \times h$

$h = E_p / (m \times g)$ ← transformation

$h = 96{,}000 / (80 \times 10)$

$h = \underline{120\ m}$

> **Study tip**
> Don't forget to convert non-standard units into standard units!

> **Study tip**
> Don't forget *g* is 10 N/kg on Earth unless the question states otherwise.

Worked example 3

A plane takes off and climbs to a height of 12,000 m about it's take off point leading to 2940 MJ of energy being transferred to gravitational potential energy. What is the mass of the plane?

$E_p = 2940\ MJ = 2{,}940{,}000{,}000\ J$ ← conversion

$h = 12{,}000\ m$

> **Study tip**
> To convert Megajoules (MJ) into Joules (J) you need to multiply it by 1×10^6 (1,000,000).

$E_p = m \times g \times h$

$m = E_p / (h \times g)$ ← transformation

$m = 2{,}940{,}000{,}000 / (12{,}000 \times 10)$

$m = \underline{25{,}000\ kg}$

Practice B: Calculating gravitational potential energy

1) If Sophie climbs a ladder 3.4 m tall, and Sophie has a mass of 48 kg, how much GPE has she gained?

2) A girl (on the Earth) drops a ball of mass 0.5 kg from a height of 2 m. a) How much GPE does the ball have before it has dropped? b) How much GPE does it have once it hits the ground?

3) How much GPE is lost when a rock of mass 0.3 kg falls to the foot on a 250 m cliff on the Moon where '*g*' is 1.6 N/kg?

4) A lighting bar on stage has a mass of 300 kg when supporting stage lights. a) What is its weight? b) How much energy do you need to lift it by 15 m?

5) In a hydroelectric power station, how much GPE is lost by 100 tonnes of water flowing down through the pipes and falls a vertical distance of 200 m? (hint: 1 tonne = 1000 kg).

6) The International Space Station has a mass of 419,600 kg and a GPE of 1,049,000 MJ. How high above the Earth is it?

Assessment B: Calculating gravitational potential energy

Zaf has a mass of 85.0 kg. He runs up some stairs carrying a 10.0 kg box. The staircase is 10.0 m high and it takes Zaf 7.0 seconds to reach the top. How much energy has been transferred to the gravitational potential energy store of Zaf and the box when reaches the top of the stairs? (Gravity on Earth is 9.8 N/kg).

A	65,170 J
B	1,330 J
C	9,310 J
D	8,500 J

Objective C: Calculating change in gravitational potential energy

Worked example 1

An athlete of mass 50 kg runs up a hill. The foot of the hill is 400 m above sea-level. The summit is 1,200 m above sea-level. a) What is his GPE at the start and end of the run? b) What is his increase in GPE? Write the answer in kJ.

a)

GPE at 400 m

$E_p = m \times g \times h$

$E_p = 50 \times 10 \times 400$

$E_p = 200{,}000\ J = \underline{200\ kJ}$

GPE at 1,200 m

$E_p = m \times g \times h$

$E_p = 50 \times 10 \times 1{,}200$

$E_p = 600{,}000\ J = \underline{600\ kJ}$ ← conversion

b) *Increase in GPE*

E_p *at the 1200 m* – E_p *at 400 m* ← Calculate the difference by taking the smallest number away from the largest

$600{,}000 - 200{,}000 = 400{,}000\ J = \underline{400\ kJ}$

Practice C: Calculating change in gravitational potential energy

1) A parachutist has a mass of 70 kg. He goes up in a plane to 12 km above the ground. a) How much GPE does the parachutist have? b) He decides to take his dog with him which has a mass of 15,000 g. How much does the GPE change?

2) A rocket fully loaded with fuel has a mass of 100,000 kg takes off. When the rocket reaches a height of 30,000 feet it has burned 50,000 kg. What is the change of GPE for the rocket?

3) One day the International Space Station will fall out of orbit. Explain what will happen to all of the GPE it is currently storing.

Assessment C: Calculating change in gravitational potential energy

Which of these sentences describes the change in gravitational potential energy of a bungee jumper?

A	As the bungee jumper is falling his GPE increases and reaches its maximum when the cord is stretched out.
B	As the bungee jumper is fall his GPE decreases. When he bounces back up his GPE increases.
C	There is no change in GPE during the bungee jump.
D	GPE is zero when the bungee cord is stretched.

Tutorial 2 – Kinetic Energy

Keywords: kinetic, joule, mass, velocity

Objectives of Tutorial 2:

A. Defining kinetic energy
B. Calculating kinetic energy
C. Calculating change in kinetic energy

Starter:

Statement	True	False	Comment
1 Energy is a kind of stuff that is transferred from place to place when something happens.			
2 Energy causes events to happen.			
3 Heat and temperature are the same thing.			
4 Heat is a form of energy.			
5 Heating is a process of energy transfer.			
6 Electricity is an energy source.			

Objective A: Defining kinetic energy

Kinetic energy is the energy an object has because it is moving. All moving things have kinetic energy, but the amount of energy they have is not just dependent on how fast they are moving.

Kinetic energy is defined as $E_k = ½ m v^2$, *where:*

- E_k is kinetic energy (in J)
- m is mass (in kg)
- v^2 is velocity squared (in m/s)

Note that velocity is a vector – it has both magnitude and direction.

Don't forget! You can convert units (e.g. g to kg) to make sure you have the right units for the equation.

Practice A: Defining kinetic energy

1) State the equation for kinetic energy, defining the terms used.

2) Write a sentence defining kinetic energy in your own words.

3) Rank the following from low to high kinetic energy: a person lying in bed, a space rocket launching, a car driving down a motorway, a car driving past a school.

4) A lorry driving up a hill. Explain whether the kinetic energy of the lorry changes.

5) A bus picks up 20 people on its route. Explain whether it's kinetic energy changes.

6) A body is thrown vertically upwards. Its velocity keeps on decreasing. What happens to its kinetic energy when its velocity becomes zero?

Assessment A: Defining kinetic energy

Which statement is incorrect?

A	The units for mass are kg.
B	$E_k = ½ m v^2$
C	Kinetic energy increases as mass increases.
D	$E_k = ½ m v$

Objective B: Calculating gravitational potential energy

Worked example 1

Determine the kinetic energy of a 625 kg roller coaster car that is moving with a speed of 18.3 m/s.

$E_k = ½ \times m \times v^2$

$E_k = 0.5 \times 625\ kg \times (18.3\ m/s)^2$

$E_k = \underline{105000\ J}$ ← units

$E_k = \underline{1{,}05 \times 10^5 J}$ ← In standard form

Worked example 2

Phil Matis, the former platform diver for the Ringling Brother's Circus, has a kinetic energy of 12 000 J just prior to hitting the bucket of water. If Phil's mass is 40 000 g, then what is his speed?

$m = 40{,}000\ g = 40\ kg$ ← conversion

$E_k = 12{,}000\ J$

> **Study tip**
> Don't forget to convert non-standard units into standard units!

$E_k = ½ \times m \times v^2$

$v^2 = (2 \times E_k) / m$ ← transform

$v^2 = (2 \times 12{,}000) / 40$

$v^2 = 600$

$v = \sqrt{600}$

$v = \underline{24.5\ m/s}$

> **Study tip**
> Don't forget to square root the answer to get *v*.

Worked example 3

How much force will it take if you wish to stop a 930kg car going at 14.5 m/s in a distance of 23.0 m?

$E_k = ½ \times m \times v^2$

$E_k = 0.5 \times 930\ kg \times (14.5\ m/s)^2$

$E_k = 97\ 800\ J$

Study tip
Energy transferred = Force x distance

$E_k = F \times s$

$F = E_k / s$ ← transform

$F = 97\ 800\ J / 23.0\ m$

$F = \underline{4\ 250\ N}$ ← units

Practice B: Calculating kinetic energy

1) Object "P" has a mass of 60 kg and velocity of 120 m/s. What is the kinetic energy of object "P"?

2) An athlete has a mass of 70 000 g and is running at a speed of 10 m/s. What is their kinetic energy?

3) What is the mass of a ball which has 2.5 J of energy and is travelling at 5 m/s?

4) What is the speed of a bird of mass 3 kg which has a kinetic energy of 400 J?

5) A rifle can shoot a 4.20 g bullet at a speed of 965 m/s. What is the kinetic energy of the bullet as it leaves the rifle? Write your answer in standard form.

6) A stroppy teenager throws their PS4 controller at the wall after losing at FIFA. It has 78.125 J of kinetic energy and moves at 25 m/s before it hits the wall. How much mass does it have?

Assessment B: Calculating kinetic energy

A van of mass 2450 kg is travelling at 40.0 m/s. Calculate the energy in its kinetic energy store.

A	1 960 MJ
B	1 960 000 J
C	49 000 J
D	49 kJ

Objective C: Calculating change in kinetic energy

Worked example 1

A 900 kg compact car moving at 60 mph has approximately 320 000 J of kinetic energy. Estimate its new kinetic energy if it is moving at 30 mph.

E_k = *<u>80 000 J</u>*

> **Study tip**
> Use the kinetic energy equation as a "guide to thinking".

The kinetic energy is directly related to the square of the speed. If the speed is reduce by a factor of 2 (as in from 60 mph to 30 mph) then the kinetic energy will ve reduced by a factor of 4. Thus, the new kinetic energy is 320 000 / 4 = 80 000 J.

Practice C: Calculating change in kinetic energy

1) A car of mass 1 200 kg slows down from a speed of 20 m/s to 10 m/s. How much kinetic energy does the car lose?

2) How fast was a 1 400 kg car travelling if it lost 280kJ of kinetic energy in coming to a stop?

3) A car and its passengers have a total mass of 1 200 kg. The car is travelling at 8 m/s. Calculate the increase in kinetic energy when the car increases its speed to 14 m/s.

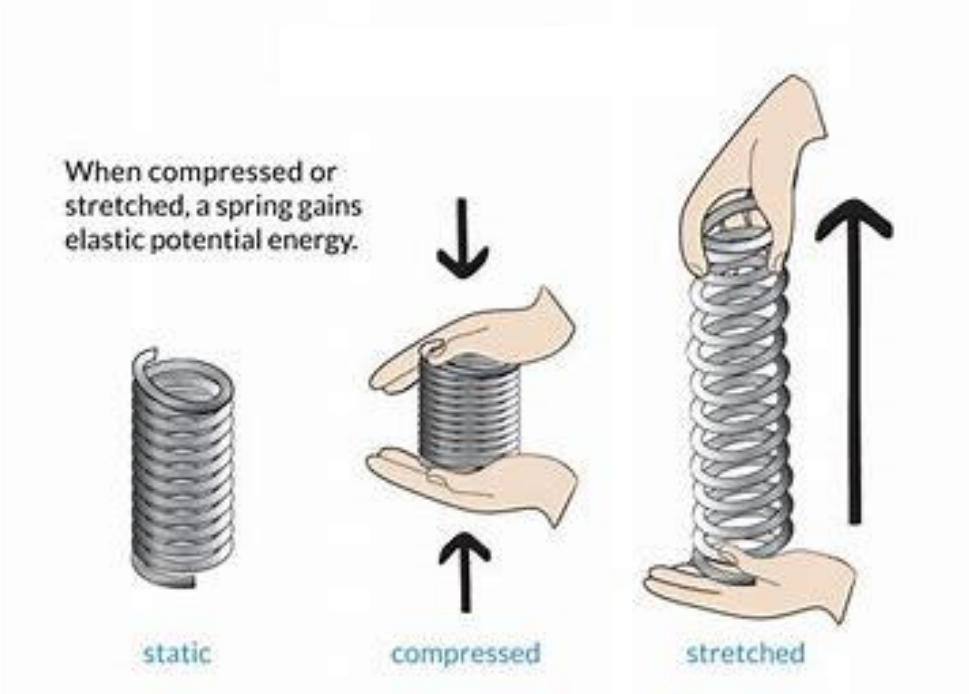
Assessment C: Calculating change in kinetic energy

What would happen to the kinetic energy of an object if you doubled the mass?

A	The kinetic energy would be cut in half
B	The kinetic energy would double
C	The kinetic energy would triple
D	The kinetic energy would stay the same

Tutorial 3 – Elastic Potential Energy

Keywords: elastic, joule



Objectives of Tutorial 3:

A. Defining elastic potential energy
B. Calculating elastic potential energy
C. Calculating change in elastic potential energy

Starter:

Elastic potential energy is the energy _____ in anything that is _____ or _____. The amount of energy depends on how much the thing is stretched or squashed by, we call this the _____. To work out the _____ you do: Extension = new length - original length. The extension is measured in _____. The elastic potential energy also depends on _____ _____, which tells us how easy or difficult it is to stretch the thing.

Objective A: Defining elastic potential energy

Elastic potential energy called "EPE" is a measure of the restoring force when an object changes its shape. Elastic means that an object will return to its original shape when the force is removed.

Elastic potential energy is defined as $E_E = ½ k x^2$, *where:*

- E_E is elastic potential energy (in J)
- k is spring constant (in N/m)
- x^2 is extension squared (in m)

Don't forget! You can convert units (e.g. cm to m) to make sure you have the right units for the equation.

Practice A: Defining elastic potential energy

1) State the equation for elastic potential energy, defining the terms used.

2) Write a sentence defining elastic potential energy in your own words.

3) Which object has elastic potential energy? Plastic, rock, bone, stretched spring.

4) Write down three more examples of objects that have elastic potential energy.

5) What is the equation linking spring constant, force and extension? How does this link with the equation for elastic potential energy?

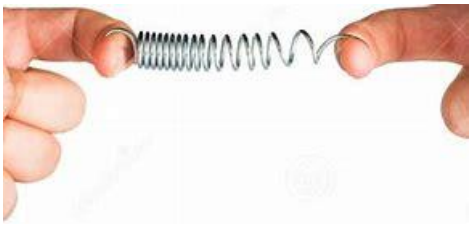
Assessment A: Defining elastic potential energy

Which statement is incorrect?

A	The units for extension are m.
B	The units for spring constant are Nm.
C	Elastic potential energy is stored in an object when it is compressed.
D	$E_E = ½ k x^2$

Objective B: Calculating elastic potential energy

Worked example 1



A spring, which has a spring constant k = 7.50 N/m, has been stretched 0.40 m from its equilibrium position. What is the potential energy now stored in the spring?

$E_E = ½ \times k \times x^2$

$E_E = 0.5 \times 7.50\ N/m \times (0.40\ m)^2$

$E_E = \underline{0.60\ J}$ ← units

Worked example 2

A spring with a spring constant k = 800 N/m has been compressed, and 196 J of potential energy is stored. What distance from equilibrium has the spring been compressed?

$E_E = ½ \times k \times x^2$

$x^2 = (2 \times E_E) / k$ ← transformation

$x^2 = (2 \times 196) / 800$

$x^2 = 0.49$

$x = \sqrt{0.49}$

$x = \underline{0.70\ m}$

Study tip
Don't forget to square root the answer to get *v*.

Practice B: Calculating elastic potential energy

1) Calculate the elastic potential energy stored when a 1 000 N/m spring is stretched by 6.0 cm from its original length.

2) Calculate the elastic potential energy stored when a 1 000 N/m spring is stretched by a 20 N force.

3) Calculate the extension of a 500 N/m spring when storing 3.0 J of elastic potential energy.

4) Calculate the elastic potential energy when a 40 N force stretches a spring by 0.50 cm.

5) A spring is stretched by 60 cm, which transfers 18 J of energy to its elastic potential energy store. What is its spring constant?

6) An elastic rope is suspended from a beam so that it is hanging vertically down. Macie hangs vertically down on the elastic rope. The rope is stretched 0.60 m below its normal position when Macie hangs from it. Calculate the elastic potential energy stored in the elastic rope. (Macie has a mass of 55 kg.)

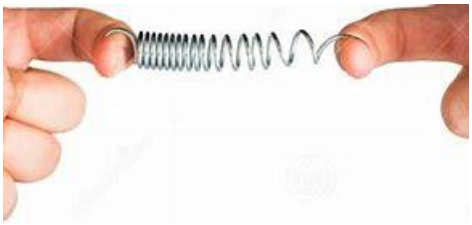
Assessment B: Calculating elastic potential energy

A remote control car is attached to a spring, and does 4 J of work to stretch the spring 40 cm over 5 s. Calculate the spring constant of the spring.

A	20 N/m
B	50 N/m
C	100 N/m
D	250 N/m

Objective C: Calculating change in elastic potential energy

Worked example 1



A spring, which has a spring constant k = 7.50 N/m, has been stretched 0.40 m from its equilibrium position. What is the potential energy now stored in the spring?

$E_E = ½ \times k \times x^2$

$E_E = 0.5 \times 7.50\ N/m \times (0.40\ m)^2$

$E_E = \underline{0.60\ J}$ ← units

Now two springs are added to the previous spring in a parallel system. They all have the same spring constant as before. Calculate the elastic potential energy now stored in the spring.

Spring constant of the 3 springs in parallel = 22.5 N/m

$E_E = ½ \times k \times x^2$

$E_E = 0.5 \times 22.50\ N/m \times (0.40\ m)^2$

$E_E = \underline{1.8\ J}$ ← units

Study tip
When springs are attached in parallel you multiply the spring constant by the number of springs.
When springs are attached in series you divided the spring constant by the number of springs

Practice C: Calculating change in elastic potential energy

1) How much strain energy is
    a. Stored in a 40 kN/m spring when it is stretched by 3.0 cm?

    b. Released when relaxing to a stretch of 1.5 cm?

2) A spring stretches 10 m under a load of 20N.
    a. Determine the spring constant

    b. How much energy is stored when stretching it the first 5 m?

    c. How much energy is stored when stretching it the whole 10 m?

3) To compress spring 1 by 0.20 m takes 150 J of work. Stretching spring 2 by 0.30 m requires 210 J of work. Which spring has the greater spring constant?

4) Ethan jumps into the middle of a car and his force is evenly spread across the 4 suspension springs attached to each wheel. He hits the car with a force of 100 N.
   a. How far does each spring compress by?

   b. How much elastic potential energy is stored in one of the four springs?

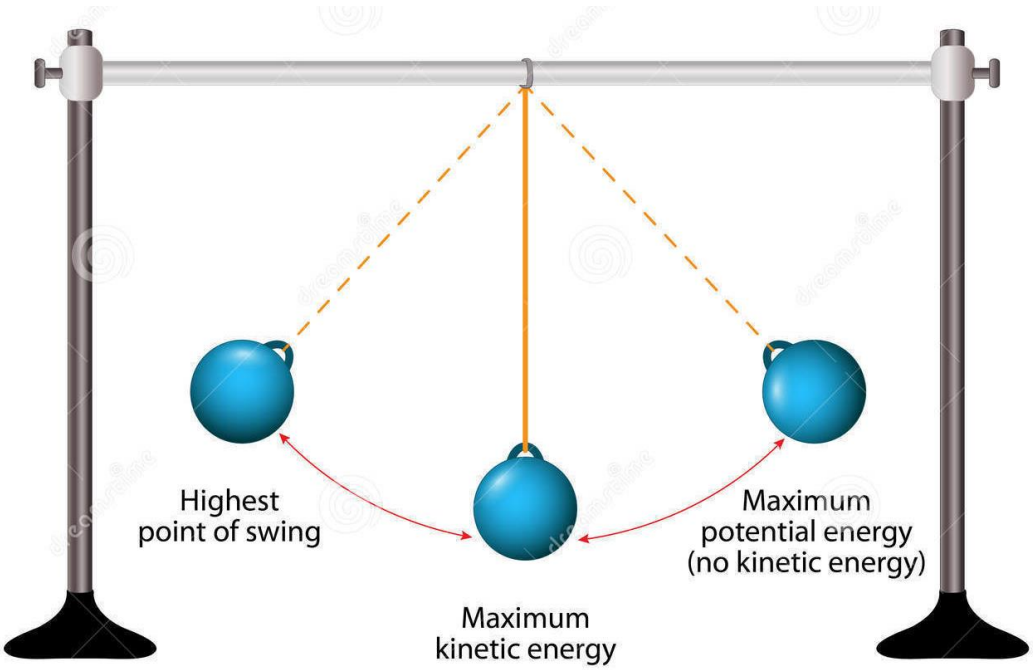
Assessment C: Calculating change in elastic potential energy

Which of these sentences are correct for describing the change in elastic potential energy of a toy car?

A	As the toy car is wound up the elastic potential energy increases and reaches its maximum when the car is released.
B	When the toy car is released the elastic potential energy decreases with distance travelled.
C	As the toy car is wound up the elastic potential energy increases and reaches its maximum when the car wont wind up any more.
D	When the toy car is released the elastic potential energy increases with distance travelled.

Tutorial 4 – Conservation of Energy

Keywords: conservation, joule



Objectives of Tutorial 4:

A. Defining conservation of energy
B. Calculating conservation of energy

Starter:

Write out the energy transformations that take place in:

a) TV

b) Car

c) Torch

Objective A: Defining conservation of energy

The principle of conservation of energy states that energy can never be created or destroyed – only transferred, stored or dissipated.

Practice A: Defining conservation of energy

1) State the law of conservation of energy in your own words.

2) Explain the law by taking oscillating simple pendulum as an example.

3) A brick is lifted to a given height and then dropped to the ground. A second identical brick is lifted half as high as the first and also dropped to the ground. How does the amount of kinetic energy change between the two bricks?

4) A ball is dropped from the top of a tall building and reaches terminal velocity as it falls. (At terminal velocity drag equal weight and a falling object stops accelerating.) Will the potential energy of the ball upon release equal the kinetic energy it has when striking the ground? Explain your reasoning.

5) A nail becomes warm when it is hammered into a plank. Explain why

Assessment A: Defining conservation of energy

Which of the following can be converted into kinetic energy?

A	Gravitational potential energy
B	Chemical energy
C	Elastic potential energy
D	All of the above

Objective B: Calculating conservation of energy

Worked example 1

A lump of ice falls from an aeroplane as it comes in to land. If the ice hits the ground with a vertical speed of 85 m/s, what was the height of the plane when the ice fell off?
(Assume that fiction can be ignored.)

Kinetic energy of the ice as it hits the ground is equal to the initial potential energy when it fell off the plane.

So $E_p = E_k$

But $E_p = m \times g \times h$ *and* $E_k = ½ \times m \times v^2$

So $m \times g \times h = ½ \times m \times v^2$ ← This is the same as $E_p = E_k$

$g \times h = ½ \times v^2$ ← *m* is on both sides of the equation so we can remove it

$2 \times g \times h = v^2$

$h = v^2 / (2 \times g)$ ← transform

$h = 85^2 / (2 \times 10)$

$h = 7225 / 20$

$h = \underline{362.25\ m}$

Study tip
Don't forget *g* is 10 N/kg on Earth unless the question states otherwise.

Practice B: Calculating conservation of energy

1) A 500 g pumpkin is dropped 15 m on top of a school bus.
   a. How much gravitational potential energy is gained when it is winch up 15 m?

   b. Assuming all of this GPE is turned into kinetic energy as the pumpkin drops, work out its speed as it hits the school bus.

   c. Would the speed be any different for a 5.0 kg pumpkin?

2) A 300 000 kg airliner is flying at 250 m/s at an altitude of 11 000 m. how large is its kinetic energy when expressed as a percentage of the total of the kinetic energy and gravitational potential energy?

3) In order to jump over the bar, a high jumper must raise his mass above the ground by 1.25 m. the high jumper has a mass of 65 kg. The high jumper just clearers the bar.
   a. Calculate the gain in his gravitational potential energy.

b. Calculate the minimum vertical speed the high jumper must reach in order to jump over the bar.

4) Hannah is playing on a swing. At the top of her swing, 2 meters from the ground, she has a potential energy of 500 Joules. When she is 1 m from the ground what is her kinetic energy?

5) A mass of 4 kg is dropped from a tower of height 45 m. Calculate

a. the potential energy possessed by the body when it is at the top of the tower

b. the kinetic energy possessed by the body when it is at a height of 35 m

c. the kinetic energy just before hitting the ground

d. the velocity of the body just before hitting the ground

6) A 1 kg potato falls to the ground and loses 450 J of energy from its gravitational potential energy store. Assuming no air resistance, what is the speed of the potato as it hits the ground?

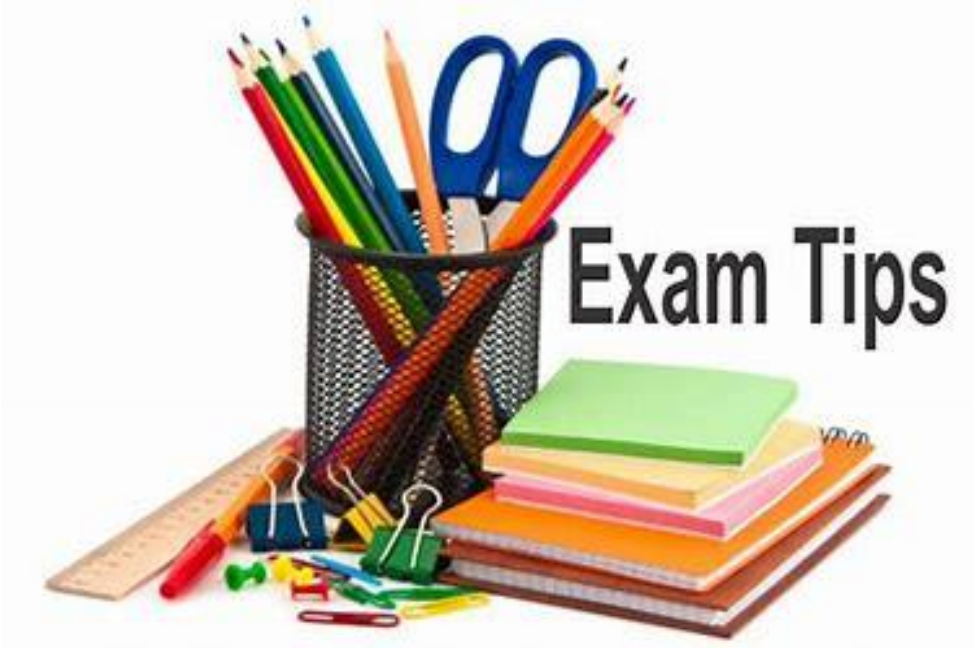
Assessment B: Calculating conservation of energy

Zaf has a mass of 85.0 kg. He runs up some stairs carrying a 10.0 kg box. The staircase is 10.0 m high and it takes Zaf 7.0 seconds to reach the top. How much energy has been transferred to the gravitational potential energy store of Zaf and the box when reaches the top of the stairs? (Gravity on Earth is 9.8 N/kg).

Zaf stops and then drops the box from a height of 1.25 m. Calculate the speed at which it hits the ground.

A	86.3 m/s
B	61.02 m/s
C	24.01 m/s
D	4.9 m/s

Revision Techniques



What is the Purpose of this page?

People in all walks of life often struggle with where to start. This is especially true of what we do when we start revising. We often think that reading or copying notes out is a good idea but this is NOT true.

The number one tip I can give you when you get down to it is it needs to be active. Your notes are a great start but it really is what you do with them that counts.

Below are Dr Stackhouse's top-tips for getting the most out of revision...

Revision guide

1. Know where to start: you need to know what you're revising for. When it's an end of unit test it's really easy, you just look back a few lessons, but what about for those final exams?

   I would always suggest starting with something broad and low-stakes learning is a great resource for jogging your memory on a topic, and its easily split up into each unit you need to tackle! So if you want to revise energy, look at Physics Unit 1 in our class.

2. Check exactly what you need to know: use your AQA spec and tick off which bits you think you have!

3. Use your notes, textbooks, revision guides, to make some dedicated revision resources: flashcards are a great way to test yourself or others on definitions or the many many equations you need to know in science!

4. Deliberate practice: work in rich and varied examples. You need to think of every way you could be asked a question on a particular topic. Think about how I've set up this book! Examples from your textbook and revision guides are a good start here (THIS IS THE MOST IMPORTANT PART).

5. Apply it: exam questions, exam questions, exam questions, you can never do too many! The more you do, the more you PRACTICE, the better you get at answering the style of question AQA is going to throw at you!

6. Work in rest: If you feel yourself flagging, make a cuppa!

Exam Technique

What is the Purpose of this page?

EXAMS!!!! Arrrrggghhhhhh, right? Here's my top tips!

Exam guide

1. Questions have a common theme: in other words, question 1 is all about question 1, that's why it's a single question. It might have (a), (b), (c), etc but they're probably all about 1 unit or part of a unit.

2. If you're stuck on something, move on: just because you can't do one bit, doesn't mean you can't do the next. Try it, what's the worst that can happen?

3. If you're unsure of context, think what it's similar to: instead of thinking, 'hmm, I've never done that before,' think, 'aha, I've done this thing that's very close to it.' See also, OSMOSIS HAPPENS IN CARROTS AS WELL.

4. Look at the marks: if you've spent 5 minutes on a 1 mark question it's waaaaaaayyyy too long. 1 mark = 1 minute, stick to it.

5. Stop and think before you start to write: make sure you take the information you've just read in, like, all the way. If you need to make some rough notes before answering an extended question, do it, it's better than waffling on like a monologuing supervillian!

6. Use graphs, diagrams, and tables: no, really, they don't put them in for giggles.

7. Look at bold print: it's important...if it says **one** answer, give one, any more will probably lose you marks.

8. Highlight key terminology, words, and command words: if that's your gig, I mean, I never did it but it might help you focus on what's needed. This neatly leads me onto...

9. KNOW YOUR COMMAND WORDS: there's a list, online, download it. I've always found it helps to know what a question is actually asking you to do...and finally,

10. Breathe: when it feels like all is lost, take yourself a nice deep breath, we don't want you passing out in an exam do we?..No, but seriously, sometimes taking a minute not looking at a question you're struggling on can make all the difference. The answer may just come to you in a vision!

Tutorial 6 – Reflections

What is the Purpose of Tutorial 6?

A. To receive feedback on final assignments.
B. To share examples of best practice with the other pupils in your group.
C. To write targets for improvement in school lessons.
D. To reflect on the programme including what was enjoyed and what was challenging.

Final assignment feedback

What I did well…	What I could have improved on…
•	•
•	•
•	•

My target for future work is…

Reflecting on Uni Pathways

What did you most enjoy about Uni Pathways?
• • •

What did you find challenging about the programme?	How did you overcome these challenges?
• • •	• • •

Notes

Notes

Notes

Changes in Energy

Key Stage 4 Programme

researchersinschools.org