STEM SMART Phase One, 2022

Physics Week 7 – Energy

https://isaacphysics.org/gameboards#smart_p_1_7

Essential GCSE Physics 33.2

GCSE - Practice (P1)
A Level - Practice (P1)

A builder needs to drag a sack of cement $20\,\mathrm{m}$ along the floor against a friction force of $60\,\mathrm{N}$.

Part A Work Done

Calculate the work done.

Part B Power

If the builder took two minutes to do the dragging, what was their power?

Essential GCSE Physics 33.5

GCSE - Practice (P1)
A Level - Practice (P1)

A lighting bar on stage has a mass of $300\,\mathrm{kg}$ when supporting stage lights.

Part A Weight

What is its weight?

Part B Energy to lift

How much energy do you need to lift it by $10\,\mathrm{m}$?

Part C Time to lift

If your power is $100\,\mathrm{W}$, how long would it take you to lift the bar by $10\,\mathrm{m}$?

Part D Gravitational potential energy

What is the increase in gravitational potential energy when the bar is lifted by $10\,\mathrm{m}$?

Essential GCSE Physics 34.2

GCSE - Practice (P1)

Calculate the kinetic energy of an $800\,\mathrm{kg}$ car when it is going at

Part A Kinetic energy at 30 mph

$30\,\mathrm{mph}$ (which is $13.4\,\mathrm{m/s}$);

Part B Kinetic energy at 40 mph

$40\,\mathrm{mph}$ (which is $17.9\,\mathrm{m/s}$).

Part C Road safety

Road safety campaigners are continually reminding motorists that $40\,\mathrm{mph}$ is much more dangerous than $30\,\mathrm{mph}$ even though it only seems a little bit faster. What does this question suggest about the issue?

- The kinetic energy is a lot greater, almost double.
- $40\,\mathrm{mph}$ is actually safer than $30\,\mathrm{mph}$.
- The difference between the two is actually minimal.

Essential GCSE Physics 34.3

GCSE - Practice (P1)

Part A Bus kinetic energy

Calculate the kinetic energy of a $20\,\text{tonne}$ bus travelling at $40\,\text{mph}$ $[1\,\text{tonne} = 1\,000\,\text{kg}]$.

Part B F1 kinetic energy

Calculate the kinetic energy of a $600\,\text{kg}$ Formula 1 race car going at $83\,\text{m/s}$ [about $190\,\text{mph}$], and compare it to that of the bus.

Essential Pre-Uni Physics B8.2

GCSE - Challenge (C3)
A Level - Practice (P1)

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

Part A GPE lost by the ball

An object of mass $3.5\,\mathrm{kg}$ slides all the way down a slope inclined at 40° to the horizontal, with a base of length $4.8\,\mathrm{m}$. How much GPE does the object lose?

Part B Work done by the ball against friction

If the average frictional forces are $4.0\,\mathrm{N}$, work out how much work the object does against friction.

Essential Pre-Uni Physics B8.3

GCSE - Challenge (C1)
A Level - Practice (P1)

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

$50\,\mathrm{J}$ of work is done in stretching a spring to an extension of $3.5\,\mathrm{cm}$. Work out the average force applied.

Essential Pre-Uni Physics B8.4

GCSE - Challenge (C1)
A Level - Practice (P1)

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

A boy whirls a $30\,\mathrm{g}$ conker around his head in a circle at a speed of $2.2\,\mathrm{m\,s^{-1}}$, using a taut inextensible string. How much work is done on the conker by the tension in the string?

Essential Pre-Uni Physics B8.7

GCSE - Challenge (C1)
A Level - Challenge (C1)

A child of $40\,\mathrm{kg}$ rides a $35\,\mathrm{kg}$ bike at $9.0\,\mathrm{m\,s^{-1}}$. The brakes are then applied and the bike is slowed to $3.8\,\mathrm{m\,s^{-1}}$. How much work is done by frictional forces?

Essential GCSE Physics 34.9

GCSE - Challenge (C1)

This question allows you to derive the equation for kinetic energy using a numeric example. We assume constant acceleration and no resistive forces. You can use these equations:

$\text{distance} = \text{average speed} \times \text{time}$

$\text{acceleration} = \text{change in speed} \,/\, \text{time taken}$

$\text{force} = \text{mass} \times \text{acceleration}$

$\text{energy transferred} = \text{force} \times \text{distance}$

Part A Acceleration

A $700\,\text{kg}$ car accelerates uniformly from rest to $30\,\text{m/s}$ in $10\,\text{s}$. Calculate its acceleration.

Part B Force

Calculate the force needed to give the car this acceleration.

Part C Distance

The average speed of the car is midway between the starting speed $(0.0\,\text{m/s})$ and the final speed. Use this information to work out how far the car will go while accelerating.

Part D Kinetic energy

The kinetic energy equals the work done in accelerating the car. Use this fact to calculate the kinetic energy.

Part E Symbolic

Now repeat this question for a car of mass m going from rest to speed v in time t.

The following symbols may be useful: `E, m, t, v`

Essential Pre-Uni Physics B8.9

GCSE - Challenge (C3)
A Level - Challenge (C1)

Physical constants which may be necessary to answer this problem can be found within the hint tab.

A $4.0\,\mathrm{kg}$ ball is thrown vertically up into the air with an initial velocity of $8.5\,\mathrm{m\,s^{-1}}$. By the time it is height h metres above the starting point, it has a velocity of $3.0\,\mathrm{m\,s^{-1}}$ and has done $4.0\,\mathrm{J}$ of work against air resistance. Find h.