



Paralympics Road Cycling

STARTER –

- Complete question 1 on the worksheet...

1 Fill in the table below, choosing from these forms of energy:
chemical strain (elastic) gravitational movement (kinetic)
heat light sound electrical
The first one has been done for you.

	Example	Energy before	Energy after
a	cooking on a gas oven	chemical	heat and light
b	shining a torch		
c	a clockwork toy		
d	eating food		
e	a falling parachute		
f	a catapult		
g	a TV set		
h	a car going uphill		
i	a growing plant		

26a

Go with energy

Extension Sheet

Name

Class

Sometimes we talk about energy being 'changed' or **transformed** from one form to another. This can happen when it is **transferred** from one object to another (or to the surroundings).

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Gravitational potential energy and Kinetic energy

2 The diagram shows a diver:
At the top, the diver has a lot of gravitational potential energy (PE).
He has 6000 joules of PE.
As he falls down, his PE changes to an **equal** amount of kinetic energy (KE).
Notice how his total amount of PE + KE is always 6000 J.

a) Where did the 6000 J come from?
b) Where does the 6000 J go to?

3 A book falls from a shelf.
On the shelf it had 20 J of gravitational potential energy.

a) What is the kinetic energy of the book just before it hits the floor?
b) What happens to this energy?

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Paralympics Road Cycling

We Are Learning To...

1. Describe the forces on a static and moving object (4)
2. Calculate GPE and KE (5/6)
3. Explain the conservation of energy but also why GPE does not fully transfer into KE (6)



Paralympics Road Cycling

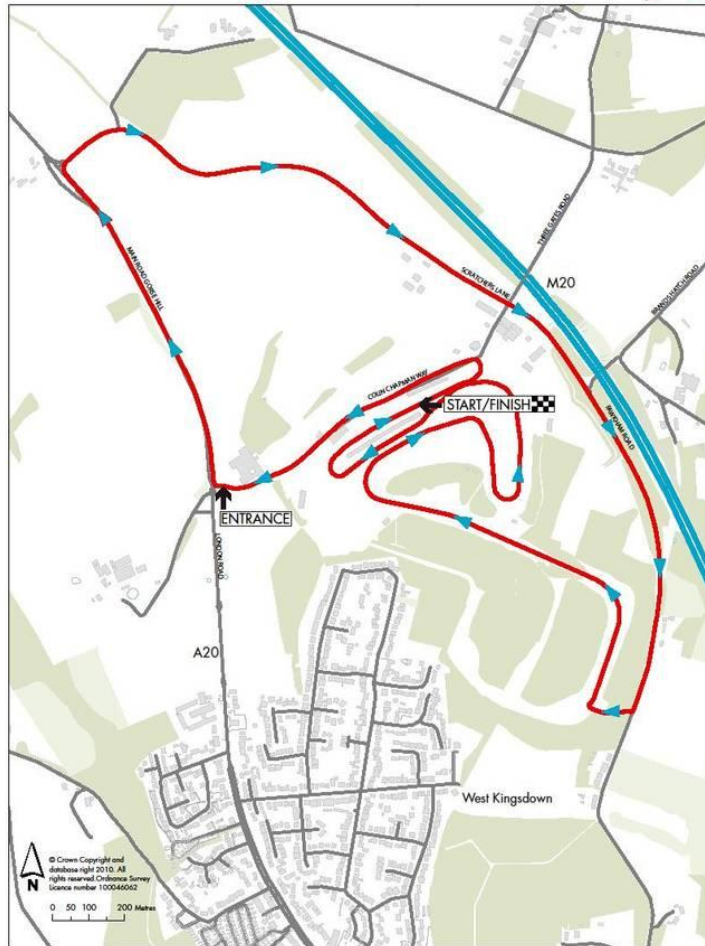


- Initially created for blind athletes through the use of tandem cycles.
- Road cycling is not the 3rd largest event.



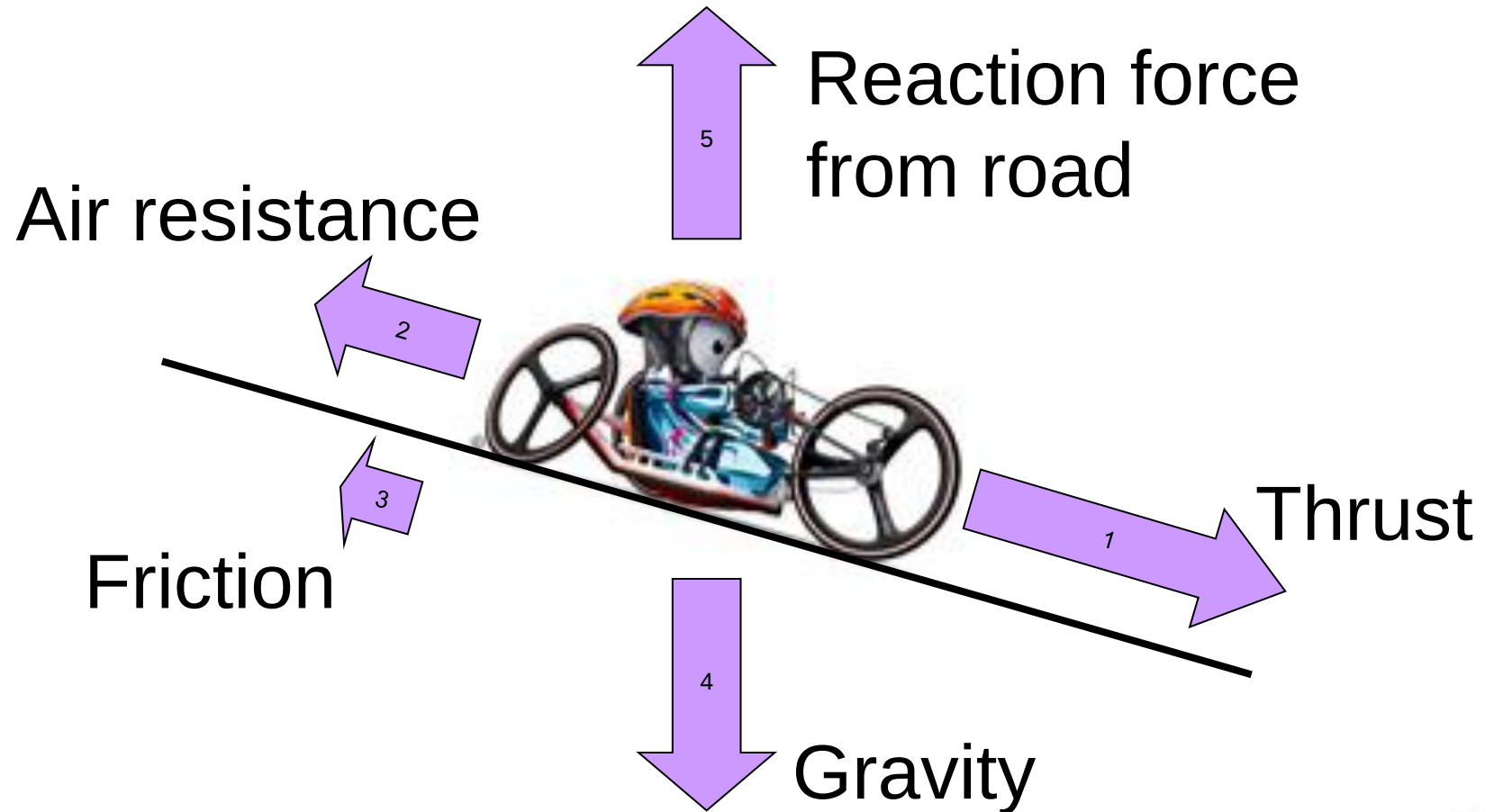
Brands Hatch

Paralympic Road Cycling - Brands Hatch





What are the forces on Mandeville?





26a Go with energy Extension Sheet

26a

Go with energy

Extension Sheet

Name

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- a) Where did the 6000 J come from?
- b) Where does the 6000 J go to?

P.E. = 6000 J
K.E. = 0

P.E. = 3000 J
K.E. = 3000 J

P.E. = 0
K.E. = 6000 J

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Energy transfer



When Mandeville is at the top of a hill what energy does he have?

Gravitational potential energy

What will all of that energy transfer into when he reaches the bottom of the hill?

Kinetic energy





Gravitational potential energy (GPE)

$$\text{GPE} = \text{mass} \times \text{gravitational field strength} \times \text{height}$$

- **Mass:** kilograms (kg)
- **Gravitational field strength:** Newton's per kilogram (N/kg) [10 N/kg on Earth]
- **Height:** metres (m)
- **GPE:** joules (J)



Kinetic energy (KE)

$$\begin{aligned} \text{KE} &= \frac{1}{2} \times \text{mass} \times \text{velocity}^2 \\ &= \frac{1}{2}mv^2 \end{aligned}$$

- **Mass:** kilograms (kg)
- **Velocity**² (speed²): (metres per second)
squared (m/s)²
- **KE:** Joules (J)



Conservation of energy

**Energy cannot be created or destroyed,
just changed in form.**

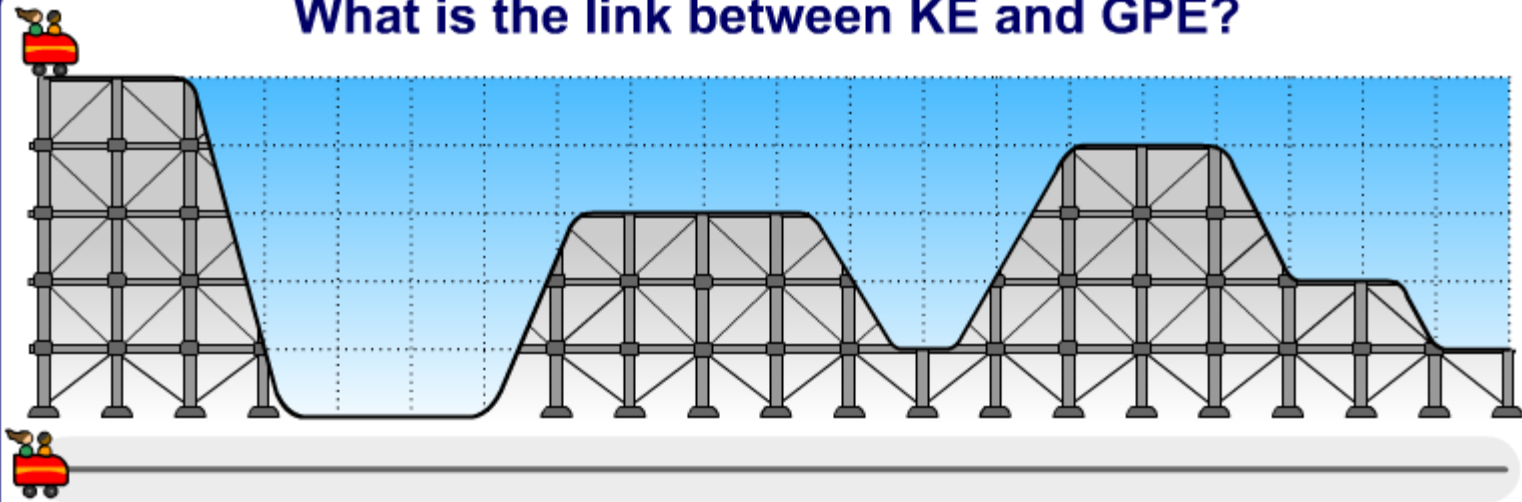
- The law of conservation means that as an objects falls, the GPE it loses must turn into a different form.

$\text{GPE lost} = \text{KE gained}$



A rollercoaster

What is the link between KE and GPE?



mass (kg) 500

height (m)

velocity (m/s)

GPE (J)

KE (J)



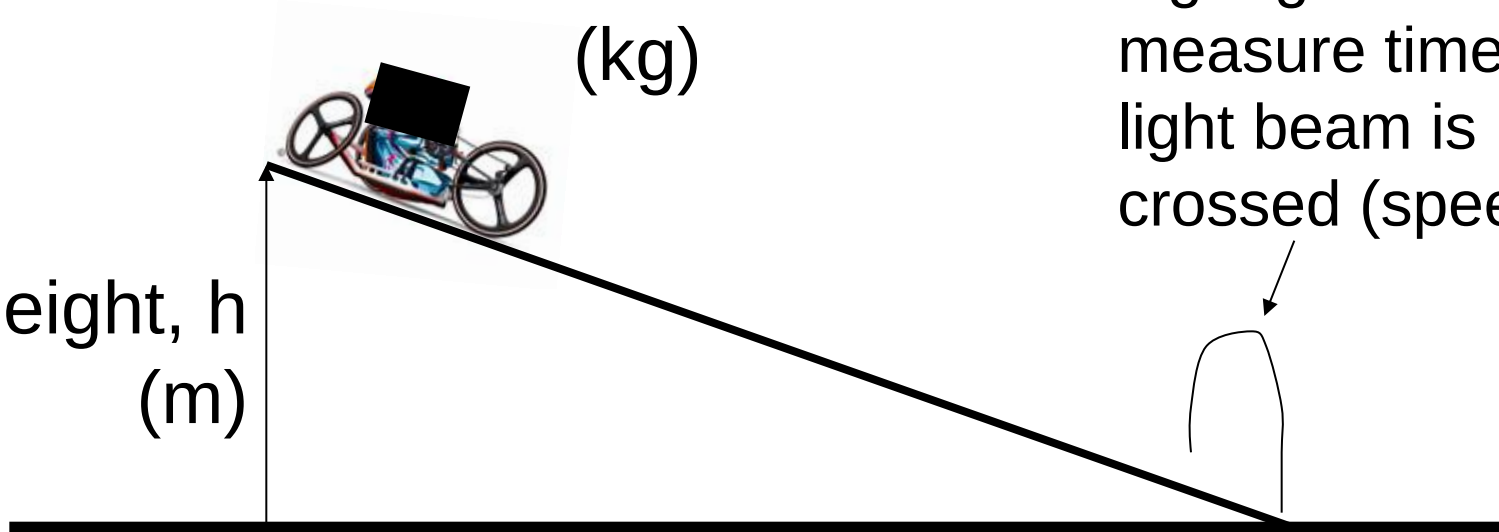


Demonstration

Mass, m
(kg)

Light gate to
measure time
light beam is
crossed (speed)

Height, h
(m)



$$\text{GPE} = mgh$$

$$\text{KE} = \frac{1}{2}mv^2$$



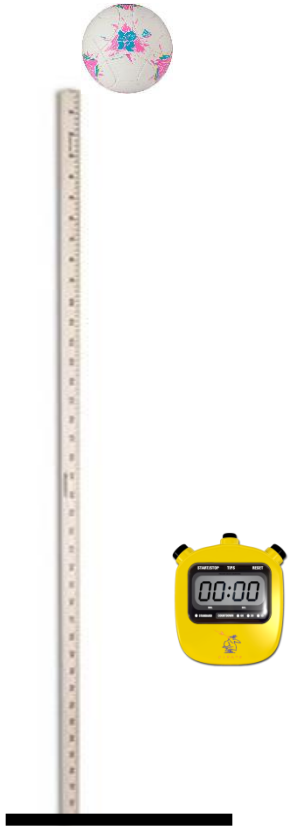
Demonstration

- $GPE = mgh$
- $KE = \frac{1}{2}mv^2$



Dropping a ball investigation (method)

1. Drop a ball from a height.
2. Time how long it takes from letting go to it hitting the floor.
3. Calculate the GPE given to the ball before the drop.
4. Calculate the KE transferred when it hit the ground.





Dropping a ball investigation (calculations)

- **$GPE = mgh$**

- m = mass of ball (kg)
- $g = 10 \text{ N/kg}$
- h = height ball dropped from (m)

- **$KE = \frac{1}{2}mv^2$**

- M = mass of ball (kg)
- v = final velocity (speed) of ball (m/s)
- **$v = u + at$**
- u = initial speed of ball (0 m/s)
- a = acceleration due to gravity (10 m/s^2)
- t = time for drop (s)



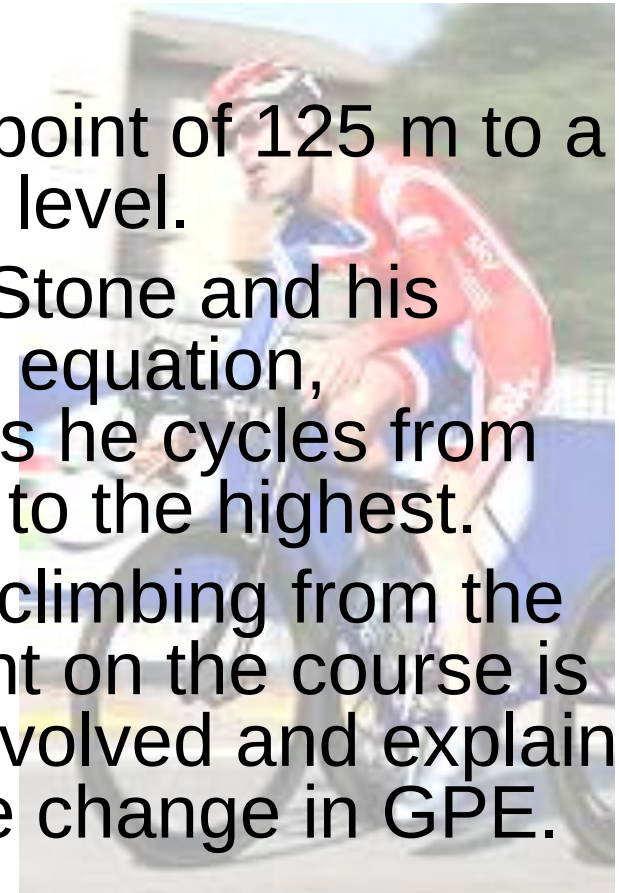
Dropping a ball investigation (conclusions)

1. In your investigation, does $GPE = KE$?
 - a. If so, explain why.
 - b. If not, say which type of energy was less and why that should be.
2. What were / could have been sources of error in the investigation.



Paralympics Road Cycling course

- The course climbs from a low point of 125 m to a high point of 170 m above sea level.
- 1. The combined mass of David Stone and his cycle is 72 kg. Using the GPE equation, calculate the change in GPE as he cycles from the lowest point on the course to the highest.
- 2. The energy David transfers in climbing from the lowest point of the highest point on the course is 45 kJ. Identify all the forces involved and explain why this is not the same as the change in GPE.





Paralympics Road Cycling course

- The combined mass of Rachel and her cycle is 67 kg. She freewheels down a hill from a height of 80 m.
- 1. Calculate Rachel's GPE at the top of the hill.
- 2. Estimate Rachel's velocity at the bottom of the hill. Assume all her potential energy has been converted into kinetic energy.
- 3. Rachel's actual velocity at the bottom of the hill was 45 km/h.
 - a. Calculate the difference in energy between your estimated velocity and the actual velocity.
 - b. Explain why all the GPE is not transferred into kinetic energy.
- 4. Identify all the energy transfers occurring as Rachel completes the Brands Hatch course.

