Gravitation

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Gravitational Force

Fg = mg

m is mass

g = -9.8 m/s^2

Newton's Law Gravitation

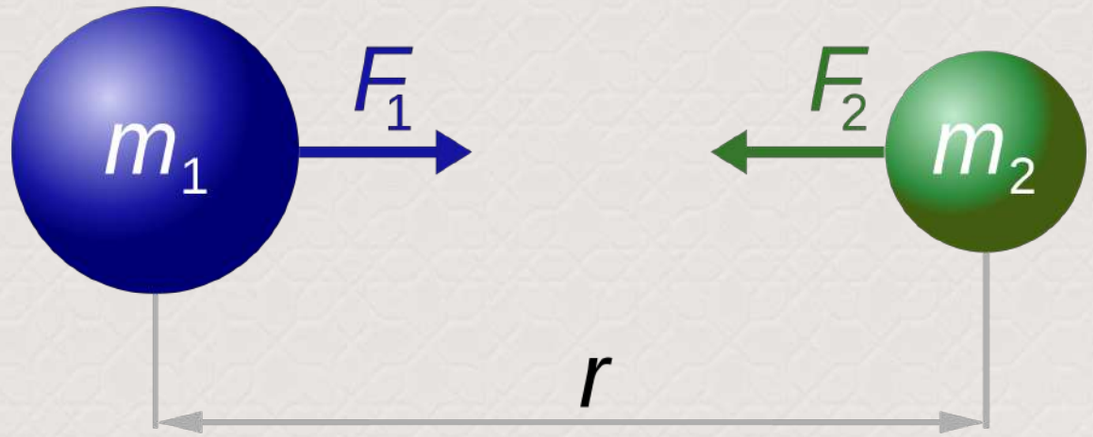
Any object that has mass attracts and is attracted to every other object with mass

G = gravitational constant = 6.67x10^-11 Nm^2/kg^2

m1= mass of object 1

m2= mass of object 2

r = distance between them



$$F_1 = F_2 = G\frac{m_1 \times m_2}{r^2}$$

Easy Problems

Calculate the gravitational attraction between:

Lloyd and Sophie if Lloyd is 75kg, Sophie is 15kg, and they are 2 meters apart

Lloyd and Sophie if Sophie spots Lloyd and moves an additional 8 meters away from him.

Lloyd and Sophie if Lloyd then picks up a 10kg chair.

Lloyd and Sophie if Lloyd puts down the chair and then picks up Matthew who is 225kg.

Gravitational Field

vector quantity

depends on the mass of the planet creating the field (M) and the distance from that planet's center (r)

$$g = \frac{GM}{r^2}$$

More Easy Problems

Kaitlyn is a comet that is 10,000 kg. What is the gravitational field Sophie experiences if she is 10 m away from Kaitlyn?

What is the gravitational field experienced by Mrs. Hornstein who is 100m away from Kaitlyn?

Gravitational Potential Energy

PE = mgh - for stuff in everyday life

$$PE = \frac{GMm}{r}$$

Even More Easy Problems

Erica is 463 kg. Kevin is 4 kg. They are 5 m apart. What is the gravitational potential energy?

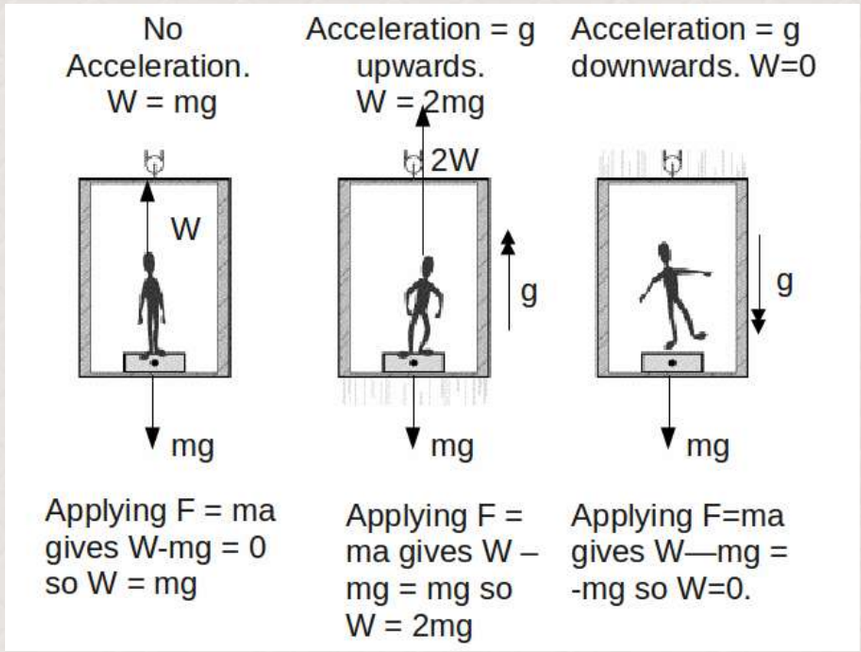
Tim the unicorn is 2,000 kg. He is 50 m from Erica. What is the gravitational potential energy?

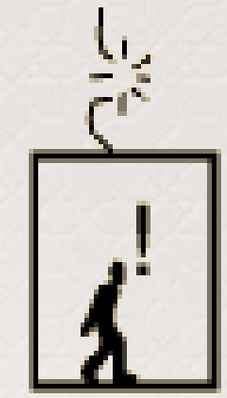
Weightlessness

Circles:

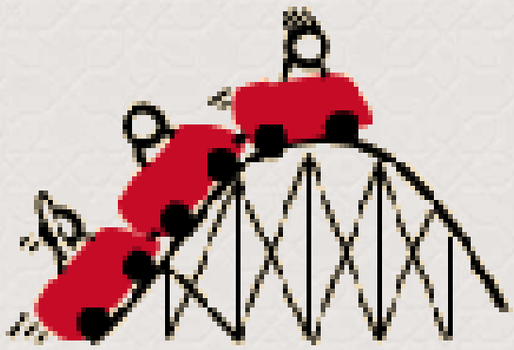
Top: -Fc = Fn - Fg

Bottom: Fc = Fn - Fg

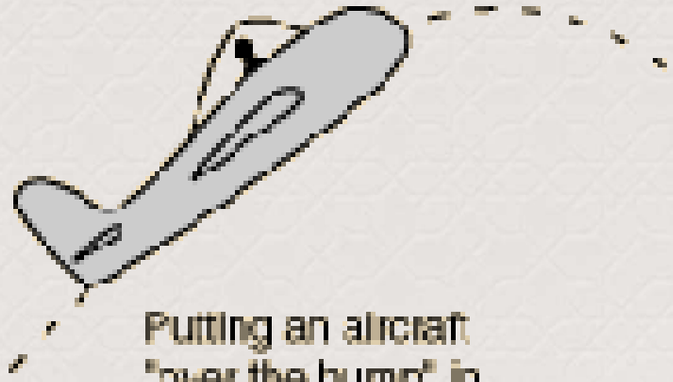




If the elevator cab e breaks.



Going over the top in a roll e coaster



Putting an aircraft "over the hump" in a ballistic trajectory

Being in orbit.

Last one

Zak is going around a loop on a rollercoaster. The centripetal force on Zak at the bottom is 10N. The normal force on Zak is 15N. What is Zak's mass?

Gravitational Fields	Newton's Law of Gravitation	Gravitational Potential Energy	Weightlessness
100	100	100	100
200	200	200	200
300	300	300	300

Gravitational Fields- 100

What is the gravitational field of Jupiter which has a mass of 3170000 kg that is experienced by a meteor of 90000 km away from it?

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Gravitational Fields - 200

As a spaceship experiences a gravitational field of 800 N/kg when it is 50000 m away from an unknown planet. What is the mass of the planet?

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Gravitational Fields - 300

As a spaceship of mass 100kg experiences a gravitational field of 1000 N/kg when it is 10000 m away from an unknown planet. What is the planet's gravitational acceleration at this point?

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Newton's Law of Gravitation - 100

Calculate the gravitational attraction between Ling-Ling and Hsing-Hsing, two pandas, if Ling-Ling is 85kg, Hsing-Hsing is 100kg, and they are 5 meters apart.

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Newton's Law of Gravitation- 200

When the moon, Earth, and sun are aligned, the gravitational pull of the moon and sun causes high tides. The sun exerts a gravitational pull of 3.510 x 10^22 N. What is the magnitude of the force that creates high tides if the mass of the Earth is 5.92 x 10^24 kg, the mass of the moon is 7.35 x 10^22 kg, and they are 384,400 km apart?

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Newton's Law of Gravitation- 300

An astronaut of mass 100kg has 5000J of potential energy when it is 900 m away from an unknown planet. What is the planet's gravitational acceleration at this point?

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Gravitational Potential Energy- 100

What is the gravitational potential energy of the Earth on a satellite that is 1.5x10^5 kg if it is 10^4 km away from the center of the earth and the earth's mass is 5.92 x 10^24?

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Gravitational Potential Energy- 200

If an object has a mass of 50kg, is 10 meters from the center of a planet, and has 700 J of gravitational potential energy, what is the mass of the planet?

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Gravitational Potential Energy- 300

In planet Physics, Newton drops a 200g apple from the top of an apple tree. The apple bounces off the ground (assuming no friction and no change in mass) at the speed of 0.5 m/s. If the tree is 5 meters tall, what is the gravitational acceleration of planet Physics?

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Weightlessness- 100

For a person of 50kg, what is the smallest acceleration that an elevator will have to go down at for the person to feel weightless?

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Weightlessness- 200

A Ferris wheel 24 m in diameter rotates once every 15.5 seconds. What is the ratio of a person's apparent weight to his real weight at the top? (a = v^2/r)

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Weightlessness- 300

A 17.0 kg monkey hangs from a cord suspended from the ceiling of an elevator. The chord can withstand a tension of 220N and breaks as the elevator accelerates. What is the minimum acceleration for that to occur?

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