

Force Field Facts

Calculate forces between two objects.

HIGH SCHOOL · HS-PS2-4

HS-PS2-4 "Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects..."

NAME _____

DATE _____

FORCE EQUATIONS

Use $F_g = Gm_1m_2/r^2$ for gravity and $F_e = k|q_1q_2|/r^2$ for electric force, where $G = 6.7 \times 10^{-11}$ and $k = 9.0 \times 10^9$. Gravity always attracts, while unlike charges attract and like charges repel. Both forces decrease with the square of distance.

WORKED EXAMPLE

Two 11 kg objects are 11 m apart.
Find the gravitational force.

1. $F_g = Gm_1m_2/r^2$
2. $F_g = (6.7 \times 10^{-11})(11 \times 11)/11^2$
3. $F_g = (6.7 \times 10^{-11})(1)$

Answer: 6.7×10^{-11} N, attractive

PRACTICE 5 problems

- 1** Two objects have masses of 2 kg and 8 kg and are 4 m apart. Find F_g .

ANSWER _____

- 2** Two objects have masses of 6 kg and 3 kg and are 3 m apart. Find F_g .

ANSWER _____

- 3** If the distance between two masses triples, what happens to F_g ?

ANSWER _____

- 4** Charges of $+2 \times 10^{-6}$ C and -3×10^{-6} C are 2 m apart. Find F_e .

ANSWER _____

- 5** Charges of $+4 \times 10^{-6}$ C and $+5 \times 10^{-6}$ C are 3 m apart. Find F_e .

ANSWER _____

APPLY IT Show your work

- 1** A student tests static-cling phone decals. One decal has a charge of $+6 \times 10^{-6}$ C, and another has a charge of -2×10^{-6} C. They are 6 m apart. What electric force acts between them?

WORK SPACE

ANSWER _____

- 2** A space livestream follows two satellites with masses of 400 kg and 200 kg. They are 20 m apart. What gravitational force acts between them?

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

Charges of $+8 \times 10^{-6}$ C and -2×10^{-6} C attract with a force of 0.036 N. How far apart are they?

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	Two objects have masses of 2 kg and 8 kg and are 4 m apart. Find F_g .	6.7×10^{-11} N, attractive
2	Two objects have masses of 6 kg and 3 kg and are 3 m apart. Find F_g .	1.34×10^{-10} N, attractive
3	If the distance between two masses triples, what happens to F_g ?	F_g becomes $1/9$ as large.
4	Charges of $+2 \times 10^{-6}$ C and -3×10^{-6} C are 2 m apart. Find F_e .	0.0135 N, attractive
5	Charges of $+4 \times 10^{-6}$ C and $+5 \times 10^{-6}$ C are 3 m apart. Find F_e .	0.020 N, repulsive

PART 2 • APPLY IT

- 0.0030 N, attractive** Use $F_e = k|q_1q_2|/r^2$. The magnitude is $0.108/36 = 0.0030$ N, and opposite charges attract.
- 1.34×10^{-8} N, attractive** Use $F_g = Gm_1m_2/r^2$. The mass product divided by r^2 is $80,000/400 = 200$.

CHALLENGE

2 m apart, attractive

Accept equivalent scientific notation and trailing-zero forms. Force answers should include both magnitude and attraction or repulsion when requested.