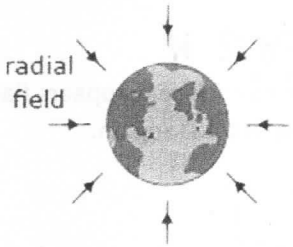
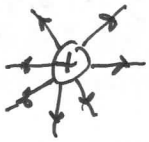
Answers

Gravity Force	Electric Force
Gravity is a force that exists between two objects with **mass.** It is attractive between two masses. A heavy object like the earth attracts other masses towards it – any object near the earth's surface will feel a force toward the center of the earth.	Static Electricity is a force that exists between two objects with charge. It is attractive between two objects with opposite charge and repulsive between two objects with the same charge.
Another way to think of this is that the earth has a **gravitational field.** It points *radially inwards* towards the earth's center.  	A charge has an electric field. negative charges point toward the center while positive charges point away.  
We represent the field using lines with arrows on them. The arrow points in the direction of the field.	→ Same
The field lines are closer together where the field is stronger and further apart where it is weaker.	→ same
You can see the field gets stronger as you get closer to the center of the earth,	The field gets stronger as it gets closer to the charge
This field has the symbol **g** and has a strength at the surface of g = 9.81 ms^{-2}. or N/kg Any object with a mass, m, that is placed in the field will experience a force. This force will be **in the direction of the field lines.** The size of the force is F = m x g	This field has the symbol E and the strength can vary greatly. It can have the units N/c OR V/m An object with + charge will experience a force while in the field ~~...~~ in the direction of the field lines while an object with – charge will experience a force in the opposite direction.
For example a human standing on the earth's surface is in a gravitational field g = 9.81ms^{-2}. If they have a mass of 65kg, they feel a force of F = m x g = 65 x 9.81 = 638N Which is their gravity force, or **weight** force	The strength of the force is represented by F = Eq

Remember $m/s^2 = N/kg$

Part A: Using F = mg

1) Calculate the force due to gravity on a cricket ball near the earth's surface if its mass is 150g. (Gravitational Field strength at earth's surface is $9.81 ms^{-2}$.)

$F = mg = 0.150\ kg \times 9.81\ N/kg = 1.47\ N$

2) Calculate the mass of an object on the earth's surface that has a weight force of 1500N.

$m = \frac{F}{g} = \frac{1500\ N}{9.81\ m/s^2} = 153\ kg$

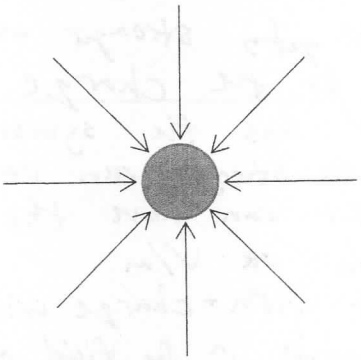
3) The 65kg person ~~from the example~~ is an astronaut. Now, they are in orbit 300km above the earth's surface. Here the gravitational field is weaker, with a value of $8.95 ms^{-2}$. What is the Force of Gravity on the astronaut?

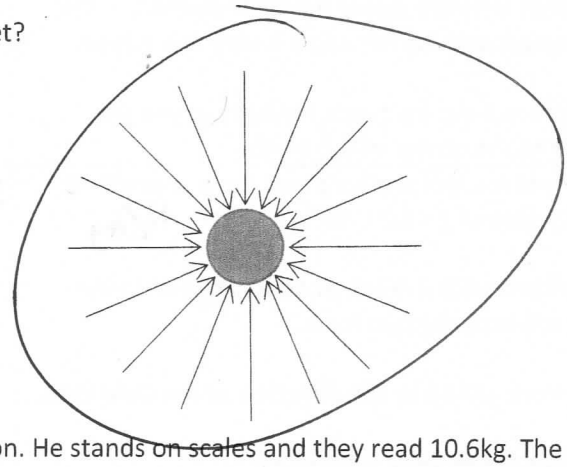
$g = 8.95\ N/kg$

$F = mg = 65\ kg \times 8.95\ N/kg = 582\ N$

4) Even though the earth is round, it is so big that when we stand on its surface it appears flat. Add field lines to the diagram below to show the earth's gravitational field over a small region.

5) Which diagram below represents a heavier planet?





6)The astronaut from question 3 is now on the moon. He stands ~~on scales~~ and they read 10.6kg. The scales are still calibrated for earth.

a) What force on earth would give a reading of 10.6kg?

$F = mg = 10.6\ kg \times 9.8\ N/kg = 104\ N$

b) What is the strength of the gravitational field on the moon?

$g = \frac{F}{m} = \frac{104\ N}{65\ kg} = 1.6\ N/kg$

Remember $N/C = V/m$

Part B: Using F = qE

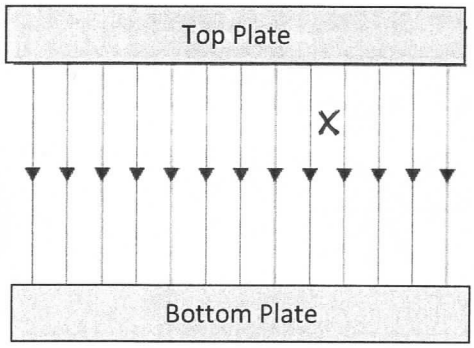
1) Calculate the electric force on an electron ($q = 1.6 \times 10^{-19}$ C) in an electric field of strength $2000 Vm^{-1}$.

$F = Eq = 2000\ N/C \times 1.6\,10^{-19} C = 3.2\,10^{-16} N$

2) Calculate the charge of an object that experiences an electric force of 0.02N in an electric field of strength $3 MVm^{-1}$.

$q = \frac{F}{E} = \frac{0.02\ N}{3\,10^{6}\ N/C} = 6.7\,10^{-9} C$

3) An electric field is set up in a region of space between two large, charged metal plates. The diagram below shows the electric field lines.



a) In what direction would a proton feel the electric force if it were placed at point X?

Down

b) In what direction would an electron feel the electric force if it were placed at point X?

UP

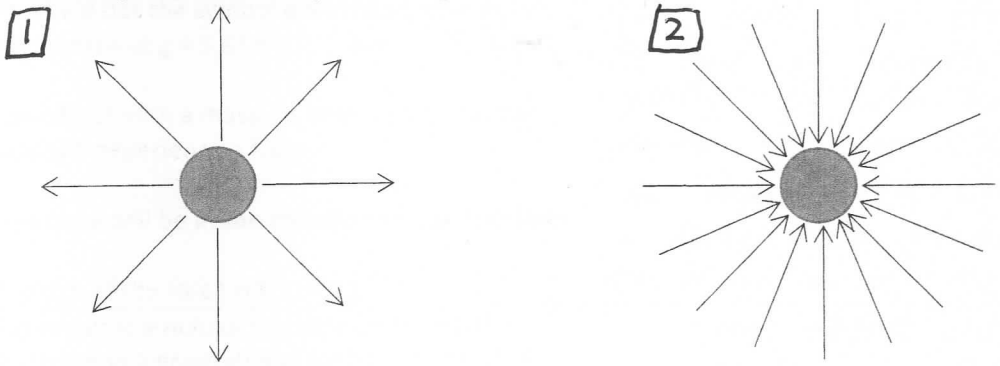
c) Which plate is positively charged?

Bottom

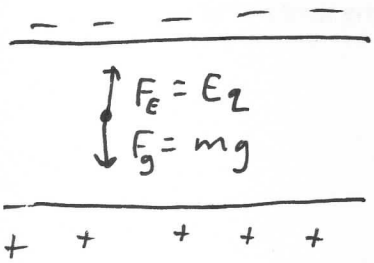
4)

a) What diagram shows a larger charge? 2

b) What diagram shows a negative charge? 2



5) A small dust particle is suspended between the plates in question 3. The particle has gained 3×10^{10} electrons and so is negatively charged. If the mass of the particle is 0.3μg, what does the Electric field strength need to be in order to keep the particle hanging?



$m = 0.3\,10^{-9} kg$

$g = 9.81\ N/kg$

$F_g = F_E = 2.9\,10^{-9} N$

$E = ?$

$q = 4.8\,10^{-9} C$

$q = 1.6\,10^{-19} C/e^- \times 3\,10^{10} e^- = 4.8\,10^{-9} C$

$F_g = mg = 0.3\,10^{-9} kg \times 9.81\ N/kg = 2.9\,10^{-9} N$

$E = \frac{F}{q} = \frac{2.9\,10^{-9} N}{4.8\,10^{-9} C} = \boxed{0.604\ N/C}$