

# WJEC A-Level Physics

## 4.2 Electrostatic and Gravitational Fields

### Flashcards

This work by [PMT Education](https://www.pmt.education) is licensed under [CC BY-NC-ND 4.0](https://creativecommons.org/licenses/by-nc-nd/4.0/)



What are some similarities between electrostatic and gravitational forces?



What are some similarities between electrostatic and gravitational forces?

- Inverse square force laws.
  - Potential concept.
- Equipotential surfaces.
  - Use of field lines.



What are some differences between electrostatic and gravitational forces?



What are some differences between electrostatic and gravitational forces?

The gravitational forces from masses always attract, whilst charges may repel or attract.



# What is gravity?



# What is gravity?

Gravity is the universal attractive force which acts between all matter.



# What is $G$ ?





## What is G?

The universal gravitational constant.

$$\text{Approx. } 6.67 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$$



What can field lines tell you about a field?



What can field lines tell you about a field?

The direction of the field (shown by arrows) and the strength of the field (shown by the density of the lines).



# What is $g$ ?



## What is $g$ ?

$g$  is the force per unit mass on a small test mass placed in a gravitational field.



# What are field lines?



## What are field lines?

- They show the direction of the force on a test mass placed in a gravitational field or a **positive** test charge placed in an electric field.
- For a point mass, the field lines point towards the centre of the mass.
- For a positive point charge, the field lines point radially outward.



Why can a spherical mass be treated as a point mass?





Why can a spherical mass be treated as a point mass?

The gravitational field around a spherical mass is essentially the same as if all of its mass was concentrated at its centre.



# What is gravitational potential?



What is gravitational potential at a point in a gravitational field?

The work done per unit mass in bringing an object from infinity to that point.

Denoted by  $V_g$ , with units  $\text{J kg}^{-1}$ .



# What is gravitational potential difference?



# What is gravitational potential difference?

Gravitational potential difference is the difference in the gravitational potentials of two points in a gravitational field.



# What is an equipotential surface?



What is an equipotential surface?

A surface in which every point on the surface has the same potential.

Equipotentials are perpendicular to field lines, so they're spherical for a point mass/charge.



How much work is done when you move 1km in any direction on an equipotential?





How much work is done when you move 1km in any direction on an equipotential surface?

No work is done when moving across equipotentials, as the potential at each point is the same.



# Why is gravitational potential a negative value?



# Why is gravitational potential a negative value?

Work needs to be done to move an object from inside the field to outside the field. Since outside the field's potential is defined as 0 (at infinite distance from the object) then the potential inside the field must be negative.



Compare the PE and KE of a lower orbit  
to a higher one.



Compare the PE and KE of a lower orbit to a higher one.

A lower orbit (smaller  $r$ ) has less potential energy and more kinetic energy than a higher orbit (bigger  $r$ ).



What symbol represents the permittivity of free space?



What symbol represents the permittivity of free space?

$\epsilon_0$



When calculating the force between two particles, air can be treated as a \_\_\_\_\_.





When calculating the force between two particles, air can be treated as a \_\_\_\_\_.

Vacuum.



Which is stronger: the gravitational force of subatomic particles or the electrostatic force?



Which is stronger: the gravitational force of subatomic particles or the electrostatic force?

The electrostatic force.



Electric field lines always go from \_\_\_\_\_  
to \_\_\_\_\_.



Electric field lines always go from \_\_\_\_\_ to \_\_\_\_\_.

Positive to negative.



# What is electric field strength?



## What is electric field strength?

The force per unit charge on a positive test charge placed in an electric field.



How is electric potential related to electric field strength?





How is electric potential related to electric field strength?

$$E = \Delta V / \Delta r$$

The change in electric potential with respect to the change in radius length.

