Essential Pre-Uni Physics F5.1

A Level

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

Complete the questions in the table; you may assume all measurements are made above the surface of the astronomical body.

Mass of body / kg	Distance from centre of body	Gravitational field strength at this distance / $\mathrm{N\,kg^{-1}}$
(a)	$6400\,\mathrm{km}$ = Earth's radius	9.8
Earth's mass	$2 \times$ Earth's radius	(b)
4.8×10^8 (asteroid)	$6100\,\mathrm{km}$	(c)
(d)	$3.2 \times 10^6\,\mathrm{m}$	4.0

Part A Mass of body

Mass of body / kg	Distance from centre of body	Gravitational field strength at this distance / $\mathrm{N\,kg^{-1}}$
(a)	$6400\,\mathrm{km}$ = Earth's radius	9.8

a) What is the mass of the planet?

Part B Gravitational field strength

Mass of body / kg	Distance from centre of body	Gravitational field strength at this distance / $\mathrm{N\,kg^{-1}}$
$\mathrm{Earth's\ mass}$	$2 \times \mathrm{Earth's\ radius}$	(b)

b) What is the gravitational field strength to 3 significant figures? You should not need to use any data which is not given in the table or the hint tab.

Part C Gravitational field strength

Mass of body / kg	Distance from centre of body	Gravitational field strength at this distance / $\mathrm{N\,kg^{-1}}$
4.8×10^8 (asteroid)	$6100\,\mathrm{km}$	(c)

c) What is the gravitational field strength?

Part D Mass of body

Mass of body / kg	Distance from centre of body	Gravitational field strength at this distance / $\mathrm{N\,kg^{-1}}$
(d)	$3.2 \times 10^6\,\mathrm{m}$	4.0

d) What is the mass of the planet?

Essential Pre-Uni Physics F5.5

A Level

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

A planet has mass $1.0 \times 10^{24}\,\mathrm{kg}$.

Part A Gravitational potential at two distances

a) calculate the gravitational potential, in $\mathrm{J\,kg^{-1}}$, at the following distances from the centre of the planet:

(i) $2.0 \times 10^{7}\,\mathrm{m}$

(ii) $4.0 \times 10^{7}\,\mathrm{m}$

Part B Gravitational potential energy of a satellite

Calculate the gravitational potential energy of a $200\,\mathrm{kg}$ satellite at the point mentioned in part (a)(ii).

Gameboard:

STEM SMART Physics 40 - School of Fields - Field and Potential

Essential Pre-Uni Physics F5.8

A Level

C C C

A $2.400 \times 10^{22}\,\text{kg}$ moon orbits a $7.200 \times 10^{24}\,\text{kg}$ planet with an orbital radius of $2.500 \times 10^{8}\,\text{m}$.

Part A Between a planet and its moon

Calculate the gravitational potential at the point half way between the **centres** of the planet and its moon. You should take the universal gravitational constant to be $G = 6.674 \times 10^{-11}\,\text{N}\,\text{m}^2\,\text{kg}^{-2}$.

Part B Beyond the moon

Calculate the gravitational potential at a point $6.800 \times 10^{8}\,\text{m}$ from the centre of the planet and on the same side of the planet as its moon. You should take the universal gravitational constant to be $G = 6.674 \times 10^{-11}\,\text{N}\,\text{m}^2\,\text{kg}^{-2}$.

Gameboard:

STEM SMART Physics 40 - School of Fields - Field and Potential

Essential Pre-Uni Physics F5.10

A Level

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

Calculate the minimum velocity which a space probe needs to be given to escape from the gravitational field of a star if it starts $1.5 \times 10^{11}\ \mathrm{m}$ from the centre of the star. The mass of the star is $3.3 \times 10^{30}\ \mathrm{kg}$.

Gameboard:

STEM SMART Physics 40 - School of Fields - Field and Potential

Essential Pre-Uni Physics H2.8

A Level

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

The electric field $1.0\,\mathrm{cm}$ away from a strongly charged object is $4.5 \times 10^{8}\,\mathrm{N\,C^{-1}}$. What is the charge on the object?

Gameboard:

STEM SMART Physics 40 - School of Fields - Field and Potential

Essential Pre-Uni Physics H2.5

A Level

C C C

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

Two $+1.0\,\mathrm{nC}$ charges are placed 1 mm apart. Calculate the electric field strength at the point half way between the charges

Gameboard:

STEM SMART Physics 40 - School of Fields - Field and Potential

Essential Pre-Uni Physics H9.1

A Level

Remember that all of your answers must be given with the correct sign.

This question concerns the region between two large, horizontal metal plates which are $2.00\,\mathrm{mm}$ apart, and are connected to the terminals of a $1.60\,\mathrm{kV}$ power supply. The negative terminal of the power supply is earthed, and this is connected to the bottom plate. In these questions, ignore any complications caused by the edges of the plates.

Part A $1.00\,\mathrm{mm}$ above the bottom plate

Calculate the potential of a point $1.00\,\mathrm{mm}$ above the bottom plate.

Part B $0.75\,\mathrm{mm}$ above the bottom plate

Calculate the potential of a point $0.75\,\mathrm{mm}$ above the bottom plate.

Gameboard:

STEM SMART Physics 40 - School of Fields - Field and Potential

Essential Pre-Uni Physics H9.5

A Level

Remember that all of your answers must be given with the correct sign.

Part A Charge on a sphere

A metal sphere with a radius of $7.4\,\mathrm{cm}$ is at a potential of $1.8\,\mathrm{MV}$. Calculate the charge stored on the sphere.

Part B Potential outside the sphere

Calculate the potential of a point $13.6\,\mathrm{cm}$ from the centre of the sphere.

Gameboard:

STEM SMART Physics 40 - School of Fields - Field and Potential

Essential Pre-Uni Physics H9.6

A Level

Remember that all of your answers must be given with the correct sign.

Calculate the electrostatic potential energy when a proton is $0.43\,\text{nm}$ from an electron.

Gameboard:

STEM SMART Physics 40 - School of Fields - Field and Potential

Essential Pre-Uni Physics H9.8

A Level

C C C

Remember that all of your answers must be given with the correct sign.

Part A Charges on a metre stick

Two charges are stuck to a metre stick: a $+1.0\,\mathrm{pC}$ charge is stuck to the $0.0\,\mathrm{cm}$ mark, and a $-1.0\,\mathrm{pC}$ charge is stuck to the $10\,\mathrm{cm}$ mark. Calculate the electrostatic potential at the $20.0\,\mathrm{cm}$ mark.

Part B Potential at the $5.0\,\mathrm{cm}$ mark

Find the electrostatic potential at the $5.0\,\mathrm{cm}$ mark.