A-LEVEL PHYSICS • HOLIDAY HOMEWORK 假期作业

13 Gravitational fields – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	**中文**	**Write it 3 times** (English)		
gravitational field	重力场			
gravitational field strength	重力场强度			
test mass	检验质量			
Field lines	场线			

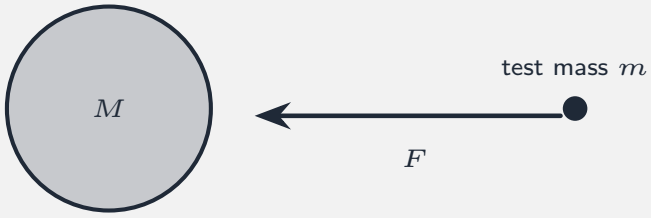
Recall

A **gravitational field** 重力场 is a region where a mass feels a force from other masses. It is what holds you to the ground, keeps the Moon circling the Earth, and the Earth circling the Sun.

New ideas

Read these first. Each idea has a short worked example. Then do the Practice.

■ 1 Field strength

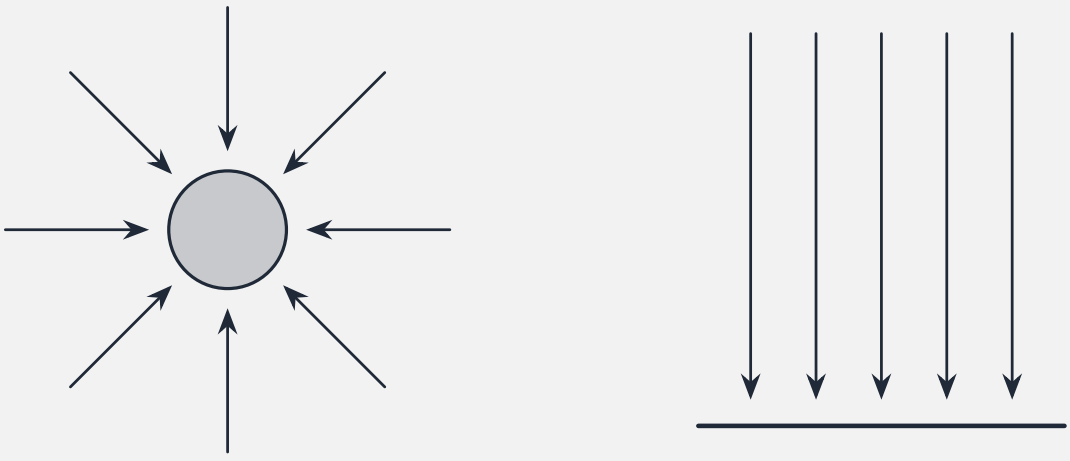


$$g = F/m \quad (\mathrm{N\,kg^{-1}})$$

The **gravitational field strength** 重力场强度 $g = F/m$ is the force per unit mass on a small **test mass** 检验质量. Its unit is N kg ^{1}. (This is the same number as the acceleration of free fall, so near the Earth $g \approx 9.8$.)

Worked example. A 4.0 kg bag is pulled down by a gravitational force of 39 N. The field strength is $g = F/m = 39/4.0 = 9.8$ N kg^{-1}.

2 Field lines



Field lines 场线 show the way the force acts. Around a point mass they are radial (pointing inwards); over a small area near a surface they are nearly uniform (parallel and evenly spaced). Closer lines mean a stronger field.

Worked example. Standing on the ground, you are in a tiny patch of the Earth's field, so the lines there look parallel and the field feels uniform. Seen from far out in space, the same field is clearly radial —all the lines aim at the Earth's centre.

Watch out: g is the force *per kilogram*, not the force itself. The units N kg ^{1} and m s ^{2} are the same thing.

Practice

Try these in order.

13.1 What is a *gravitational field*? [1]

13.2 Write the formula for *gravitational field strength*. [1]

13.3 A 5.0 kg mass is pulled down by a force of 49 N. Find the field strength g. [2]

13.4 What is the unit of g? [1]

13.5 Which way do the field lines point around a point mass? [1]

13.6 Near the Earth's surface the field lines look parallel, but far out in space they are clearly radial. Explain why. [2]

13.7 Challenge. On the Moon the field strength is about 1.6 N kg^{-1}. A rock weighs 12 N on the Moon. Find its mass, then find its weight on Earth ($g = 9.8$ N kg^{-1}). [3]