FREE REVISION PACK

Gravitational Potential & Escape Velocity

AQA A-level Physics · 7408 · Specification 3.7.2.3

Easy Medium Hard **Multiple choice · past-paper questions**

7	7	≈ 10 min
QUESTIONS	TOTAL MARKS	SUGGESTED TIME*

Contents

Q	LEVEL	FOCUS	SOURCE	MARKS
1	Easy	Potential between two planets	AQA June 2018 · A-level Paper 2 · Q14	1 mark
2	Easy	What escape velocity is proportional to	AQA June 2023 · A-level Paper 2 · Q11	1 mark
3	Easy	Escape velocity in terms of g and R	AQA June 2022 · A-level Paper 2 · Q11	1 mark
4	Medium	Potential at the surface of a denser, bigger planet	AQA June 2018 · A-level Paper 2 · Q16	1 mark
5	Medium	Work done between equipotentials	AQA June 2024 · A-level Paper 2 · Q23	1 mark
6	Medium	Change in potential energy of a spacecraft	AQA June 2018 · A-level Paper 2 · Q17	1 mark
7	Hard	Field direction from equipotentials	AQA June 2018 · A-level Paper 2 · Q15	1 mark

Key ideas to have ready

- Gravitational potential $V = -GM / r$: the work done per unit mass to bring a mass from infinity. It is zero at infinity and negative everywhere else.
- Work done moving mass m = $m\Delta V$, and it depends only on the start and end points. No work is done moving along an equipotential.
- $g = -\Delta V / \Delta r$: the field points at right angles to equipotentials, towards lower (more negative) potential. Closer equipotentials mean a stronger field.
- Escape velocity: $\frac{1}{2}mv^2 = GMm / R$, so $v = \sqrt{(2GM / R)} = \sqrt{(2gR)}$.

How to use this pack

1. The questions are grouped into levels (Easy, Medium and Hard). Work through them in order, and check your answers at the end of each level before moving on.
2. Every question is multiple choice with one correct answer. Write down your working anyway; that is how you find mistakes.
3. The separate mark scheme uses the same numbers and explains every answer.

Levels are based on how students did in AQA's examiner reports where that information exists, plus our own difficulty rating. *About 1.5 minutes per question.

Questions are reproduced from AQA past papers; AQA material is © AQA. Question numbers have been changed to suit this pack. Get Better At Physics is an independent tutor and is not affiliated with or endorsed by AQA. Free for personal revision and classroom use.

Easy

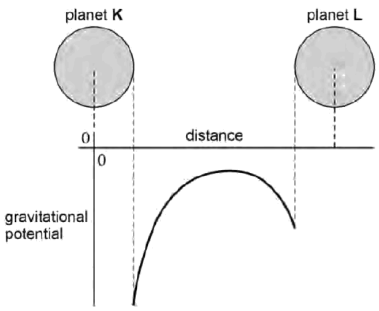
Definitions and one-step ideas. Most students get these right.

Questions 1–3

Only **one** answer per question is allowed. For each question, completely fill in the circle alongside the appropriate answer.

AQA June 2018 · A-level Paper 2 · Q14

1 The graph shows how the gravitational potential varies with distance between two planets, **K** and **L**, that have the same radius.



Which statement is correct?

[1 mark]

A The mass of **L** is greater than the mass of **K**. ⬭

B The gravitational field strength at the surface of **L** is greater than that at the surface of **K**. ⬭

C The escape velocity from planet **L** is greater than that from planet **K**. ⬭

D More work must be done to move a mass of $1\ \text{kg}$ from the surface of **K** to a distant point, than $1\ \text{kg}$ from the surface of **L**. ⬭

AQA June 2023 · A-level Paper 2 · Q11

2 Data are collected for the mass M, radius R and escape velocity u for each planet in the Solar System.

The data show that u is directly proportional to

[1 mark]

A $\left(\frac{M}{R}\right)^{-\frac{1}{2}}$ ⬭

B $\left(\frac{M}{R}\right)^{\frac{1}{2}}$ ⬭

C $\frac{M}{R}$ ⬭

D $\left(\frac{M}{R}\right)^{2}$ ⬭

AQA June 2022 · A-level Paper 2 · Q11

3 The radius of the Earth is R and the acceleration due to gravity at the surface of the Earth is g.

What is the escape velocity for a mass m at the surface of the Earth?

[1 mark]

A $\sqrt{gR}$ ⬭

B $\sqrt{2gR}$ ⬭

C $\sqrt{2mgR}$ ⬭

D $\sqrt{\frac{2gR}{m}}$ ⬭

Medium

Two or three steps. Roughly a third to a half of students get these right.

Questions 4–6

AQA June 2018 · A-level Paper 2 · Q16

4 Planet **N** has a gravitational potential $-V$ at its surface. Planet **M** has double the density and double the radius of planet **N**. Both planets are spherical and have uniform density.

What is the gravitational potential at the surface of planet **M**?

[1 mark]

A $-16V$ ⬭

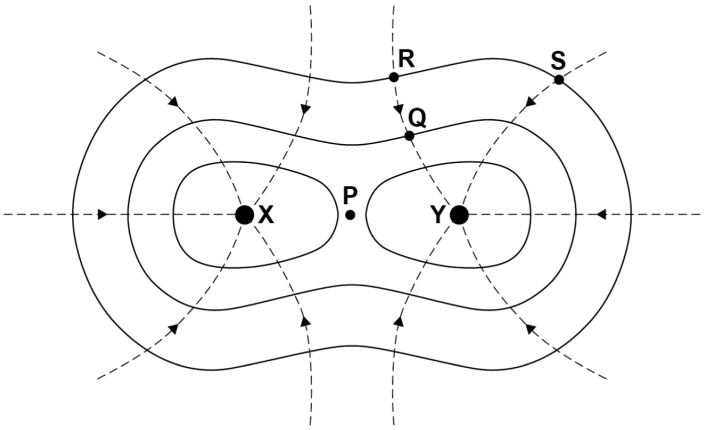
B $-8V$ ⬭

C $-4V$ ⬭

D $-0.2V$ ⬭

AQA June 2024 · A-level Paper 2 · Q23

5 The diagram shows the gravitational field for a binary star system consisting of two stars **X** and **Y** of equal mass.



Equipotential lines are shown as solid lines.
Gravitational field lines are shown as dashed lines.

Which statement is correct?

[1 mark]

A More work is done moving from **Q** to **S** to **R** than moving directly from **Q** to **R**. ⬭

B No work is done moving from **Q** to **R**. ⬭

C The gravitational field strength is the same at **R** and **S**. ⬭

D The work done moving from **Q** to **R** and moving from **Q** to **S** is the same. ⬭

AQA June 2018 · A-level Paper 2 · Q17

6 A spacecraft of mass 1.0×10^6 kg is in orbit around the Sun at a radius of 1.1×10^{11} m
The spacecraft moves into a new orbit of radius 2.5×10^{11} m around the Sun.

What is the total change in gravitational potential energy of the spacecraft?

[1 mark]

A -6.76×10^{14} J ○

B -3.38×10^{14} J ○

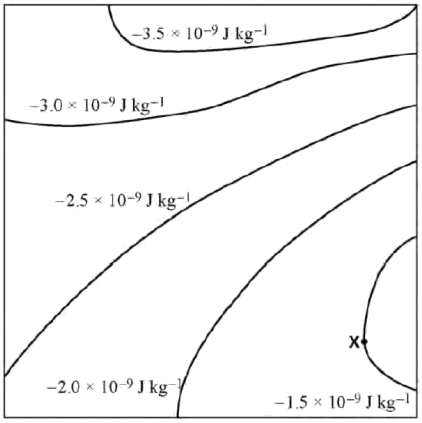
C 3.38×10^{14} J ○

D 6.76×10^{14} J ○

Hard Several steps, often with a trap built in. Fewer than 3 in 10 students get these right. **Question 7**

AQA June 2018 · A-level Paper 2 · Q15

7 The diagram shows equipotential lines near a group of asteroids.



Which arrow shows the direction of the gravitational field at **X**?

[1 mark]

A ↑ ⬭

B ↓ ⬭

C ← ⬭

D → ⬭

End of questions. Check your answers with the matching mark scheme. More free packs and 1-to-1 tuition:
www.getbetteratphysics.co.uk