GET BETTER AT PHYSICS · MARK SCHEME

# Gravitational Potential & Escape Velocity: tiered multiple choice

AQA A-level Physics · 7408 · Specification 3.7.2.3 · 7 questions · 7 marks

1 mark per correct letter | Worked reasoning for every question | **How students did** = from AQA examiner reports, where available

## Answer key

| Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 |
|---|---|---|---|---|---|---|
| D | B | B | B | D | D | C |

## Easy

Questions 1–3

**1** **D**

Potential between two planets · AQA June 2018 · A-level Paper 2 · Q14

The potential at the surface of K is more negative than at the surface of L, so K is in a deeper 'potential well'. Moving 1 kg from the surface to a distant point (V = 0) needs work equal to the rise in potential, which is greater for K.

> **Watch out:** The maximum of the potential curve is nearer L, so L is the less massive planet: A, B and C are all the wrong way round.

**How students did:** 80.5% of students got this right in June 2018.

**2** **B**

What escape velocity is proportional to · AQA June 2023 · A-level Paper 2 · Q11

$\frac{1}{2}mu^2 = GMm / R$, so $u = \sqrt{(2GM / R)} \propto (M / R)^{\frac{1}{2}}$.

**How students did:** At least 70% of students got this right in June 2023.

**3** **B**

Escape velocity in terms of g and R · AQA June 2022 · A-level Paper 2 · Q11

$v = \sqrt{(2GM / R)}$. At the surface $g = GM / R^2$, so $GM = gR^2$. Then $v = \sqrt{(2gR^2 / R)} = \sqrt{(2gR)}$.

> **Watch out:** Escape velocity does not depend on the mass m of the escaping object.

## Medium

Questions 4–6

**4** **B**

Potential at the surface of a denser, bigger planet · AQA June 2018 · A-level Paper 2 · Q16

$V = -GM / R$ and $M = \rho \times (4/3)\pi R^3$, so $V \propto \rho R^2$. Doubling ρ and doubling R multiplies V by $2 \times 4 = 8$: $-8V$.

**How students did:** 47.6% of students got this right in June 2018.

**5** **D**

Work done between equipotentials · AQA June 2024 · A-level Paper 2 · Q23

R and S lie on the same equipotential, so moving from Q to R or from Q to S involves the same change in potential, and the same work. Work depends only on the start and end points (A is wrong); Q and R are on different equipotentials (B is wrong).

> **Watch out:** Field strength depends on how close the equipotentials are, which is different at R and S (C is wrong).

**6** **D**

Change in potential energy of a spacecraft · AQA June 2018 · A-level Paper 2 · Q17

$\Delta E_p = GMm(1/r_1 - 1/r_2) = 6.67 \times 10^{-11} \times 1.99 \times 10^{30} \times 1.0 \times 10^{6} \times (1/1.1 \times 10^{11} - 1/2.5 \times 10^{11}) = +6.76 \times 10^{14}$ J. Moving further out, the potential energy increases (becomes less negative).

> **Watch out:** Moving away from the Sun means doing work against gravity, so the change is positive.

**How students did:** 36.6% of students got this right in June 2018.

## Hard

Question 7

**7** **C**

Field direction from equipotentials · AQA June 2018 · A-level Paper 2 · Q15

The field is at right angles to the equipotentials and points towards lower (more negative) potential. Near X the potential falls from $-1.5 \times 10^{-9}$ to $-2.0 \times 10^{-9}$ J kg$^{-1}$ towards the left, so the field points to the left: arrow C.

> **Watch out:** A mass would accelerate 'downhill' in potential, towards more negative values.

**How students did:** 27.1% of students got this right in June 2018.

**End of mark scheme.** Answers from AQA's published keys; explanations written for this pack. AQA material is © AQA. More free packs and 1-to-1 tuition: **www.getbetteratphysics.co.uk**

GET BETTER AT PHYSICS · WHAT NEXT?

# Got some of these wrong?

Good. The questions you got wrong show you exactly what to work on next. The quickest way to fix them is to work through them with someone who marks these papers.

## Book a free 15-minute call

Tell me which questions caught you out. We'll talk about what's going wrong and whether 1-to-1 or small-group tuition would help. There's no obligation.

**Book your free call**

calendly.com/getbetteratphysics/freechat

Scan to book

**Current AQA examiner**
I know what the mark schemes reward and where marks are lost.

**Matched to your exam board**
Sessions follow your specification and the topics you find hardest.

**Pay per session**
No block booking. 1-to-1 or small groups of up to 4.

### More free packs

Tiered past-paper questions with full mark schemes, sorted by topic.
**getbetteratphysics.co.uk/free-revision-packs**

### Masterclasses are coming

Want to hear first? Email **helpme@getbetteratphysics.co.uk** and I'll let you know when dates are announced.

**Parents:** I use these packs in my own tutoring sessions. Tuition options and prices:
**getbetteratphysics.co.uk/tuitionpricing**