GET BETTER AT PHYSICS · MARK SCHEME

Don’t Fall for the Trap! Tiered multiple choice

A-level Physics · Theme pack · questions from AQA, OxfordAQA, Edexcel, Edexcel IAL, OCR A and OCR B · 28 questions · 28 marks

1 mark per correct letter

Worked reasoning for every question

How students did = from AQA, OxfordAQA, Pearson and OCR examiner reports, where available

Answer key

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
B	C	D	C	B	D	C	D	A	D
Q11	**Q12**	**Q13**	**Q14**	**Q15**	**Q16**	**Q17**	**Q18**	**Q19**	**Q20**
D	B	C	B	A	B	C	B	C	B
Q21	**Q22**	**Q23**	**Q24**	**Q25**	**Q26**	**Q27**	**Q28**		
C	B	A	C	B	A	B	C		

Easy

Questions 1–10

1 **B**

Newton’s third law pairs · Edexcel June 2023 · AS Paper 1 · Q5

A Newton’s third law pair acts on two **different** objects and is the same type of force. The normal force of the car on the road and the normal force of the road on the car fit both rules.

> **Watch out:** Weight and the road’s normal force on the car (D) are equal and opposite, but they both act on the car: they balance each other, so they are not a third-law pair.

2 **C**

What equilibrium really means · OxfordAQA January 2023 · Unit 1 · Q12

Equilibrium means the resultant force is zero, so the velocity (speed *and* direction) is constant. At terminal speed the drag equals the weight, so the ball is in equilibrium.

> **Watch out:** A car going round a bend at constant speed is changing direction, so it is accelerating towards the centre and is not in equilibrium.

3 **D**

Two gases at the same temperature · Edexcel IAL January 2021 · Unit 5 · Q1

Both gases are in the same mixture, so they are at the same temperature. Mean kinetic energy = 3/2 kT depends only on temperature, so it is the same for both. The heavier oxygen molecules therefore move more slowly on average.

> **Watch out:** The mean *velocity* of the molecules in a gas is zero, because they move randomly in all directions (A).

How students did: 68% of students got this right in January 2021.

4 **C**

A force at right angles to the motion · AQA June 2016 · AS Paper 2 · Q22

The force acts sideways, so it has no component in the forward direction. The forward speed is unchanged, and the probe gains a sideways velocity.

> **Watch out:** Treat the two directions separately, as you do for projectiles: a sideways force cannot speed up or slow down the forward motion.

How students did: 68% of students got this right in June 2016.

5 **B**

Drift velocity in two wires in series · Edexcel IAL October 2020 · Unit 2 · Q9

$I = nAvq$. The wires are in series, so the current I is the same. Both are copper, so the charge carrier density n is the same. If v is different, the cross-sectional area A must be different.

> **Watch out:** Length does not appear in $I = nAvq$, and n depends only on the material.

6 **D**

Time constant from a halving time · OxfordAQA January 2026 · Unit 3 · Q14

$Q = Q_0e^{-t/RC}$. Losing 50% means $Q/Q_0 = 0.5$ when $t = 10$ s, so $10/RC = \ln 2$ and $RC = 10 / \ln 2 = 14$ s.

> **Watch out:** 10 s is the halving time, not the time constant (C). In one time constant the charge falls to about 37%, which takes longer than halving.

How students did: Not one of the MCQs the examiners flagged as harder in January 2026.

7 **C**

Resistance and charge carrier density · OCR A June 2024 · AS Breadth in physics · Q3

$R = \rho L/A$. Same copper and same area, twice the length, so the resistance doubles to $2R$. The number density of charge carriers n is a property of copper, so it stays n.

> **Watch out:** Changing the size of a wire changes its resistance, not what it is made of (so not D).

How students did: Students did well on this in June 2024. The most common wrong answer was D.

8 **D**

Does the bob's mass matter? · Edexcel October 2020 · A-level Paper 2 · Q7

For a simple pendulum $f = (1/2\pi)\sqrt{(g/l)}$, which has no mass in it. Making the length $4l$ divides the frequency by $\sqrt{4} = 2$, so the new frequency is $f/2$.

> **Watch out:** Doubling the mass is a red herring: it changes neither the period nor the frequency.

9 **A**

Highest order from a grating · AQA June 2019 · AS Paper 2 · Q19

$d = 1 / (3.0 \times 10^5) = 3.33 \times 10^{-6}$ m. The largest possible n comes from $\sin\theta = 1$: $n = d/\lambda = 3.33 \times 10^{-6} / 5.8 \times 10^{-7} = 5.7$. An order must be a whole number with $\sin\theta \leq 1$, so the highest order is 5.

> **Watch out:** Never round up (B): a 6th order would need $\sin\theta$ greater than 1.

How students did: The examiners reported that most students got this right in June 2019.

10 **D**

Total number of maxima · AQA June 2025 · A-level Paper 1 · Q20

$d/\lambda = 3.6 \times 10^{-6} / 420 \times 10^{-9} = 8.6$, so the highest order is $n = 8$. There are 8 orders on each side of the centre plus the zero-order maximum: $2 \times 8 + 1 = 17$.

> **Watch out:** 8 is the highest order, 16 forgets the central maximum, and 9 counts only one side.

Medium

Questions 11–24

11 **D**

Average velocity of gas molecules · OxfordAQA June 2019 · Unit 4 · Q16

The molecules move randomly, in all directions equally. Velocity is a vector, so for every molecule moving one way there is, on average, one moving the opposite way. The average velocity is zero.

> **Watch out:** c_{rms} is the root mean square *speed*, which is not zero. The question asks for velocity.

How students did: One of the MCQs fewer students answered correctly in June 2019.

12 **B**

Mean kinetic energy in a mixture · Edexcel IAL January 2023 · Unit 5 · Q2

The gases are mixed, so they are at the same temperature. The mean kinetic energy of a molecule is 3/2 kT, which depends only on temperature, so $E_X = E_Y$.

> **Watch out:** The mass ratio is there to tempt you. Mass changes the r.m.s. speed, not the mean kinetic energy.

How students did: The examiners reported that many students thought the ratio of the masses mattered (January 2023).

13 **C**

Effect of doubling the mass · AQA June 2023 · A-level Paper 1 · Q24

With no friction, the accelerating force is the weight component mg sin θ, so doubling m doubles the force (A and B are wrong). Then a = mg sin θ / m = g sin θ, which does not depend on mass. The acceleration is unchanged.

> **Watch out:** A bigger mass means a bigger accelerating force *and* more inertia, and the two cancel.

14 **B**

Compressing a gas at constant temperature · AQA November 2021 · A-level Paper 2 · Q8

The mean kinetic energy $\frac{1}{2}m(c_{rms})^2 = 3/2\ kT$ depends only on temperature. The temperature is constant, so c_{rms} stays u. The pressure doubles because the molecules hit the walls more often, not because they move faster.

15 **A**

Doubling the intensity · OCR A October 2020 · A-level Exploring physics · Q3

Maximum KE = hf − φ, which depends only on the frequency (photon energy) and the work function. The frequency is unchanged, so the maximum KE is still 1.7 eV. Doubling the intensity doubles the number of photons, so more electrons are emitted per second.

> **Watch out:** 3.4 eV (C) wrongly doubles the KE with the intensity; 4.0 eV (D) is the photon energy, hf = 2.3 + 1.7.

16 **B**

What is the same for two wires in series · AQA June 2019 · A-level Paper 1 · Q25

Same material, so same resistivity. In series, so same current. The thicker wire P has a smaller resistance (R = ρL/A), so it also has a smaller p.d. across it.

> **Watch out:** Resistance and p.d. depend on the wire's size; resistivity depends only on the material.

17 **C**

Shorter wavelength, same power · AQA June 2017 · A-level Paper 1 · Q10

Halving λ doubles the photon energy hf, so the maximum KE (hf − φ) increases. The energy arriving per second is unchanged, but each photon now carries twice as much, so only half as many photons arrive each second. Fewer photons means fewer photoelectrons per second.

> **Watch out:** 'Energy per second kept the same' does not mean the number of photons stays the same (A).

18 **B**

Double the frequency, same intensity · OCR B June 2024 · A-level Fundamentals of physics · Q11

Each photon has twice the energy (E = hf), so the maximum KE of the photoelectrons increases. The intensity (energy per second per unit area) is the same, so there are half as many photons per second, and the rate of emission decreases.

> **Watch out:** A higher frequency does not mean more photons; at the same intensity it means fewer.

How students did: The examiners reported that a significant number chose D, thinking the rate would also increase (June 2024).

19 **C**

Speed after passing through two fields · AQA June 2018 · A-level Paper 2 · Q26

The magnetic force is always at right angles to the velocity, so it does no work and cannot change the speed. The particle leaves at 80 m s^{-1}. The radius halves because the second field is stronger (r = mv/BQ), not because the particle slows down.

> **Watch out:** 40 m s^{-1} (B) assumes the radius halved because the speed halved.

How students did: About 35% of students got this right in June 2018.

20 **B**

Pendulum and spring on another planet · AQA November 2021 · A-level Paper 1 · Q30

Pendulum: $T = 2\pi\sqrt{(l/g)}$. With g/4, T becomes $2\pi\sqrt{(4l/g)} = 2T$. Mass–spring: $T = 2\pi\sqrt{(m/k)}$, which has no g in it, so the period stays T.

> **Watch out:** Gravity only shifts the equilibrium position of a mass–spring system; it does not change its period.

21 **C**

Original length of a pendulum · OxfordAQA January 2023 · Unit 2 · Q24

Doubling the period needs four times the length ($T \propto \sqrt{L}$). So L + 1.5 = 4L, giving 3L = 1.5 and L = 0.50 m.

> **Watch out:** 0.38 m (B) is 1.5/4, which treats 1.5 m as the new length rather than the increase.

22 **B**

Period doubled when the length is increased · AQA November 2020 · A-level Paper 1 · Q30

$T \propto \sqrt{L}$, so doubling the period needs four times the length. The new length is L + 1.8, so L + 1.8 = 4L, giving 3L = 1.8 and L = 0.60 m.

> **Watch out:** The length is increased **by** 1.8 m, not **to** 1.8 m. 0.45 m (A) is 1.8/4.

23 **A**

Force when the distance is increased · AQA June 2023 · A-level Paper 2 · Q15

The distance is increased **by** 400 mm, from 200 mm to 600 mm: three times as far. $F \propto 1/r^2$, so the force is divided by $3^2 = 9$. New force = 180 / 9 = 20 µN.

> **Watch out:** 45 µN (B) uses a distance of 400 mm (twice as far); 60 µN (C) forgets to square.

How students did: Fewer than 35% of students got this right in June 2023.

24 **C**

Half-life with a background count · OxfordAQA June 2019 · Unit 1 · Q24

Only the source decays, so remove the background first: 140 − 20 = 120 counts per minute. 4.0 hours is two half-lives: 120 → 60 → 30. Then add the background back on for the measured count rate: 30 + 20 = 50 counts per minute.

> **Watch out:** 35 (B) halves the background too; 30 (A) forgets to add it back.

Hard

Questions 25–28

25 **B**

Two gases in one cylinder · OCR B June 2023 · A-level Fundamentals of physics · Q20

The gases share a cylinder, so they are at the same temperature, and the mean KE of a particle (3/2 kT) is the same for both: B. The lighter Y particles move faster, but $\frac{1}{2}m(c_{rms})^2$ is the same, so $c_{rms} \propto 1/\sqrt{m}$: Y is √2 times faster, not twice (C). Equal numbers at the same T and V exert equal pressures (pV = NkT), so D is wrong. Faster Y particles hit the walls more often, so A is wrong.

> **Watch out:** Double the mass gives √2, not 2, in the r.m.s. speed.

How students did: One of the two most challenging MCQs on the paper in June 2023.

26 **A**

Ratio of the resistivities · OCR A June 2023 · A-level Exploring physics · Q8

Resistivity is a property of the material, not of the wire's shape. Both wires are copper, so their resistivities are equal: the ratio is 1 : 1.

> **Watch out:** The lengths and diameters are there to make you calculate a resistance ratio (B).

How students did: Only a little over a quarter of students got this right in June 2023; most worked out the ratio of the resistances (B).

27 **B**

Drag at two terminal velocities · AQA June 2025 · A-level Paper 1 · Q21

At any terminal velocity the resultant force is zero, so the drag force equals her weight. Her weight is the same at v_1 and v_2, so the drag force is the same too.

> **Watch out:** Opening the parachute slows her down; it does not make her move upwards (A). Weight and drag act on the same body, so they are not a third-law pair (C). Gravity also does work between h_1 and h_2, so the drag's work alone does not equal the change in KE (D).

How students did: The correct answer was the least popular choice in June 2025.

28 **C**

Gravitational force on two satellites · OxfordAQA January 2019 · Unit 3 · Q16

Distances are measured from the centre of the Earth: P orbits at R + R = 2R and Q at R + 3R = 4R. $F = GMm/r^2$, so $F_Q = 600 \times 3 \times (2R/4R)^2 = 600 \times 3 / 4 = 450$ N.

> **Watch out:** 200 N (B) uses R and 3R as the distances; 150 N (A) forgets that Q has three times the mass.

How students did: One of the MCQs students found difficult in January 2019.

End of mark scheme. Answers from the exam boards' published mark schemes; explanations written for this pack. © AQA, OxfordAQA, Pearson Education Ltd and OCR. More free packs and 1-to-1 tuition: **www.getbetteratphysics.co.uk**

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