GET BETTER AT PHYSICS · MARK SCHEME

Diffraction & Diffraction Gratings: tiered multiple choice

AQA A-level Physics · 7407 / 7408 · Specification 3.3.2.2 · 8 questions · 8 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	Q8
B	A	C	C	B	D	C	D

Easy

Questions 1–3

1 **B**

Wavelength from a third-order line · AQA June 2018 · A-level Paper 1 · Q17

$d = 1 \div 500$ mm $= 2.0 \times 10^{-6}$ m. $\lambda = d \sin\theta / n = 2.0 \times 10^{-6} \times \sin 60° \div 3 = 5.8 \times 10^{-7}$ m = 580 nm.

How students did: 83.2% of students got this right in June 2018.

2 **A**

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

$d = 1 \div 3.0 \times 10^{5} = 3.33 \times 10^{-6}$ m. $n_{max} \leq d / \lambda = 3.33 \times 10^{-6} \div 5.8 \times 10^{-7} = 5.7$, so the highest order is 5.

Watch out: Round down: sin θ can't be greater than 1.

How students did: Most students got this right in June 2019.

3 **C**

White light through a single slit · AQA June 2016 · AS Paper 2 · Q15

All wavelengths overlap at the centre, so the central maximum is white. Each colour diffracts by a different amount, so the side fringes are coloured.

How students did: 74% of students got this right in June 2016.

Medium

Questions 4–6

4 **C**

Widening a single slit · AQA June 2023 · A-level Paper 1 · Q17

A wider slit diffracts the light less, so the central maximum is narrower. More light passes through the wider slit and is concentrated into a narrower region, so it is brighter: row C.

Watch out: The central maximum gets narrower but brighter, not dimmer (B).

How students did: In June 2023 B was a popular wrong answer.

5 **B**

Wavelength from the angle between second orders · AQA November 2020 · A-level Paper 1 · Q19

44° is the angle between the two second-order maxima, so θ = 22°. $d = 1 \div 4.50 \times 10^{5} = 2.22 \times 10^{-6}$ m. $\lambda = d \sin 22° \div 2 = 4.16 \times 10^{-7}$ m = 416 nm.

Watch out: Using 44° as θ gives 772 nm (C). The angle in $d \sin\theta = n\lambda$ is measured from the zero order.

How students did: In November 2020 a wrong answer was more popular than the correct one.

6 **D**

Total number of maxima · AQA June 2022 · A-level Paper 1 · Q21

$d / \lambda = 2.5 \times 10^{-6} \div 5.8 \times 10^{-7} = 4.3$, so the highest order is 4. There are 4 orders on each side plus the zero order: $2 \times 4 + 1 = 9$ maxima.

Watch out: Count both sides and the central (zero-order) maximum.

How students did: This was the hardest question on the June 2022 paper; a wrong answer was more popular than the correct one.

Hard

Questions 7–8

7 **C**

Lines per mm from screen measurements · AQA June 2018 · AS Paper 2 · Q18

$\tan\theta = 0.30 \div 1.5 = 0.20$, so $\theta = 11.3°$ and $\sin\theta = 0.196$. $d = \lambda / \sin\theta = 6.5 \times 10^{-7} \div 0.196 = 3.3 \times 10^{-6}$ m. Lines per metre $= 1/d = 3.0 \times 10^{5}$, which is 3.0×10^{2} per mm.

Watch out: Convert lines per metre to lines per mm (÷ 1000), and don't stop at d (B is d in mm).

How students did: 25.5% of students got this right in June 2018.

8 **D**

Angle between the two second-order maxima · AQA June 2017 · AS Paper 2 · Q27

$d = 1 \div 400$ mm $= 2.5 \times 10^{-6}$ m. $\sin\theta = 2 \times 5.0 \times 10^{-7} \div 2.5 \times 10^{-6} = 0.40$, so $\theta = 23.6°$. The two second-order maxima are on opposite sides, so they are $2 \times 23.6 = 47.2°$ apart.

Watch out: 23.6° (C) is the angle to one second-order maximum, not the separation between the two.

How students did: Fewer than 20% of students got this right in June 2017; about 40% chose C.

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**

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