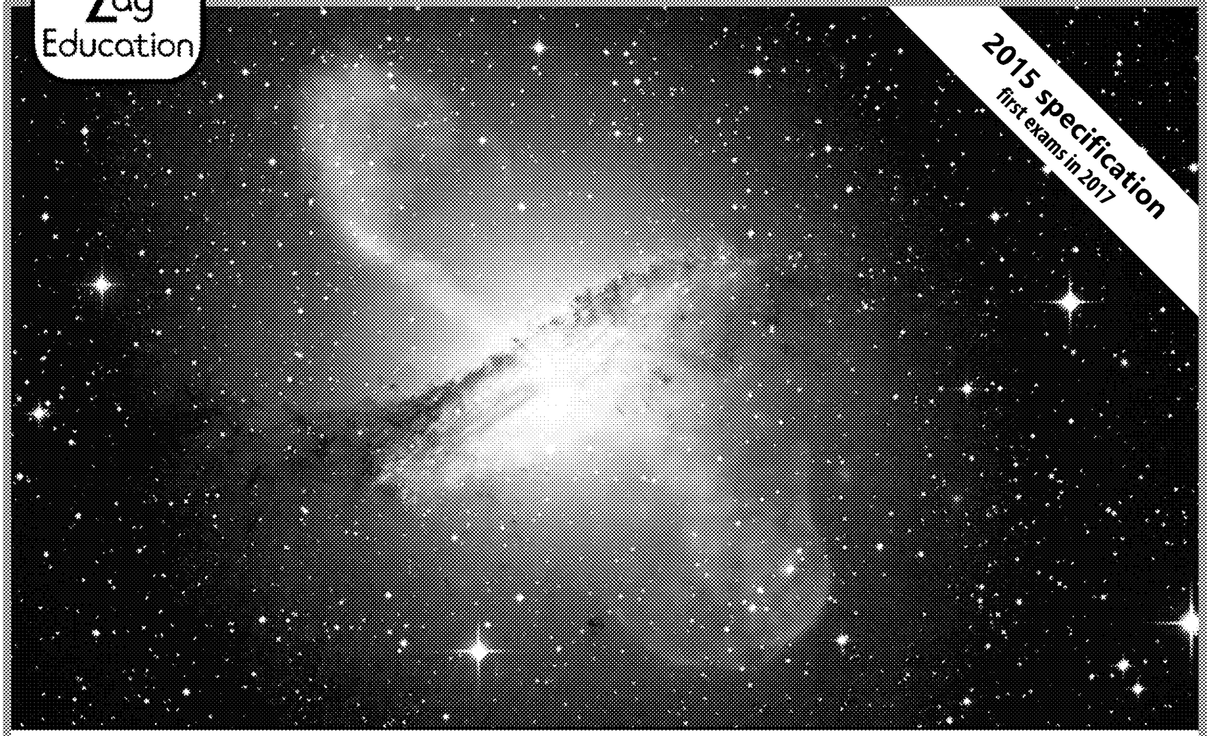
Zig Zag Education

Physics A Level | AQA | 7408



Practice Exams

for A Level AQA Physics Paper 3B

Option A: Astrophysics

zigzageducation.co.uk

POD 7635

Contents

Teacher’s Introduction

Remember!
Always check the exam board website for new information, including changes to the specification and sample assessment material.

This collection of four practice papers has been written to support the AQA A Level physics specification 7408 (first examination 2016). The pack consists of four sets of Paper 3B Option A: Astrophysics.

Each paper consists of 35 marks covering the content in the Astrophysics optional unit, including a 6 mark question testing communication skills. Paper 3 section A (Paper 3A) and Paper 3 section B (Paper 3B) are sat at the same time. Students are given 2 hours to complete both papers 3A and 3B, for a combined total of 80 marks.

Each paper follows a similar format to the AQA papers. Every item listed in the specification is covered, with most aspects visited several times in the pack. Each set of papers matches the weightings of assessment objectives, maths skills and practical skills set out by the exam board.

The mark schemes are written in a similar format to those written by AQA. The individual marking points are on separate lines with additional guidance to clarify points and indicate alternative acceptable answers.

Suggested Uses

1. Set as a mock examination under exam conditions, marked by the teacher. This provides the most reliable summative assessment.
2. Set as a complete paper under exam conditions which is then marked by the student. This provides a good formative assessment as the student gets a good understanding of how the mark schemes work and what they need to do to score. Such a session could be reinforced by a lesson on exam technique.
3. Set as a complete paper under exam conditions which is then peer marked. This could be by the teacher assigning scripts to students to mark or by students swapping amongst themselves. Group marking can be particularly helpful as the students get the chance to develop their ideas by discussing why things do and don’t score.
4. Go through a question at a time in a lesson. Get students to discuss their answers before revealing the mark scheme for that question.
5. Set a paper as a homework for the student to answer and mark. This would be an ideal activity for study leave, when the student could come to a tutorial to go through their script. They should be briefed to list questions that need addressing as a result of their marking of their script.

Samir Khonji and Toby Brown, April 2017

ZigZag Practice Exam Papers

Supporting A Level AQA Physics

Practice Exam Paper 3B

Option A: Astrophysics – Set B

Name	

Time allowed

2 hours (for 3A and 3B)

Instructions

Answer **all** of the questions and use the space provided.

Information

The total marks available for this paper is **35**. The number of marks available for each question is shown on the right.

For this paper, you will need:

- Data and formulae booklet

Additional materials required

- Pencil
- Electronic calculator
- Ruler (cm/mm)

1. The One-Mile Telescope at the Mullard Radio Astronomy Observatory (MR
long array of radio telescopes, situated outside Cambridge, UK.

Radio telescopes can be used to detect galaxies and high-energy events su

1.1 A galaxy is 370 Mpc from Earth and 20,000 ly across.

Calculate the angular size of the galaxy as observed from Earth.

1.2 Calculate the minimum angular resolution of the telescope when obse

1.3 How does a wide array of radio telescopes affect the collecting powe

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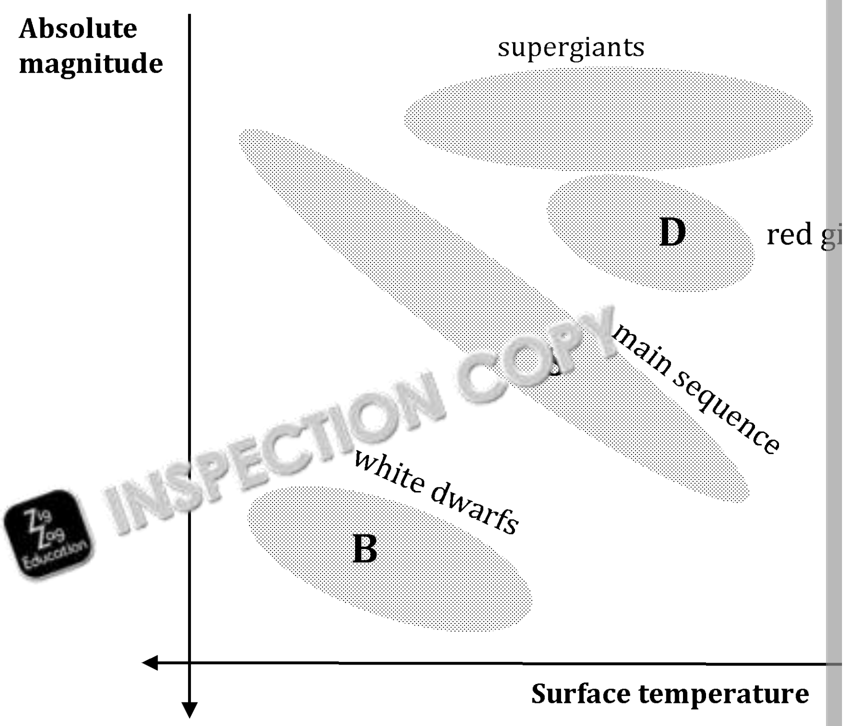
....

2. The Sun is marked on the Hertzsprung–Russell diagram below by **S**.



2.1 State the spectral class of the Sun.

....

2.2 Star A is redder than the Sun and of a significantly higher mass.

Mark star A on the Hertzsprung–Russell diagram by drawing an A.

2.3 Star **B** is a white dwarf. What spectral class is star **B** likely to belong

....

2.4 Star C has similar absorption lines to the Sun but has a larger diamete

Mark the position of star C on the Hertzsprung–Russell diagram.

2.5 Star **D**, marked on the Hertzsprung–Russell diagram, used to be ident

Explain why star **D** moved position on the Hertzsprung–Russell diagr

....

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....

3. The supernova SN1006 is the brightest stellar event ever observed in hu

The supernova is recorded to have appeared in numerous cultures in AD may have reached an apparent magnitude of -7.5.

The remnants of SN1006 are 2.2 kpc away from Earth.

3.1 Define a 'parsec'.

Include a diagram in your answer.

....

....

....

....

3.2 Calculate the absolute magnitude of SN1006.

3.3 What was the ratio of the absolute brightness of SN1006 to its appar

3.4 Discuss how various scales have been compiled to determine positio

4. **Figure 1** shows some of the data that was first used to calculate a value fo year 1929. While this data did not give the value for Hubble's constant cu provide some of the first evidence that the Universe was expanding.

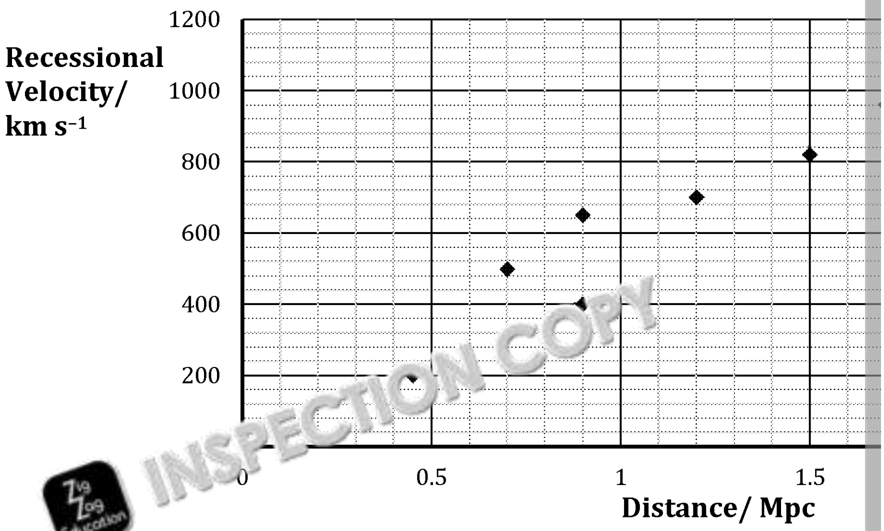

Figure 1

4.1 Use **Figure 1** to determine the value for Hubble's constant calculated

4.2 Use your value for Hubble's constant to estimate the age of the unive

4.3 Explain why the accepted value for Hubble's constant has changed co

....

....

4.4 Recent data suggests that the expansion of the universe might be acc

Explain why this data is controversial.

....

....

....

ZigZag Practice Exam Papers

Supporting A Level AQA Physics

Practice Exam Paper 3B

Option A: Astrophysics – Set B

Name	

Time allowed

2 hours (for 3A and 3B)

Instructions

Answer **all** of the questions.

Information

The total marks available for this paper is **35**. The number of marks available for each question is shown on the right.

For this paper, you will need:

- Data and formulae booklet

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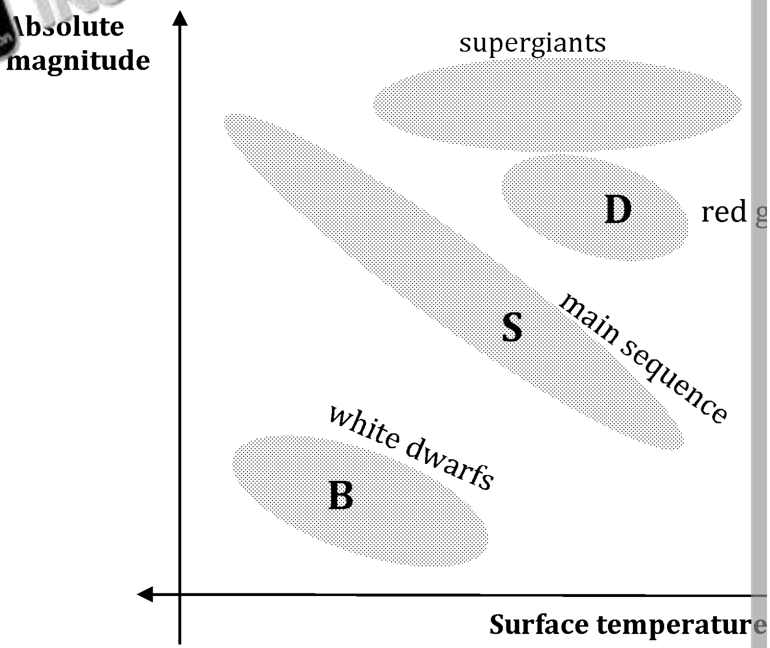
2. The Sun is marked on the Hertzsprung–Russell diagram below by **S**.



2.1 State the spectral class of the Sun.

2.2 Star A is redder than the Sun and of a significantly higher mass.

Mark star A on the Hertzsprung–Russell diagram by drawing an A.

2.3 Star **B** is a white dwarf. What spectral class is star **B** likely to belong t

2.4 Star has similar absorption lines to the Sun but has a larger diamete

Sketch a rough copy of the Hertzsprung–Russell diagram above and m

2.5 Star **D**, marked on the Hertzsprung–Russell diagram, used to be ident

Explain why star **D** moved position on the Hertzsprung–Russell diagr

3. The supernova SN1006 is the brightest stellar event ever observed in hu

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The remnants of SN1006 are 2.2 kpc away from Earth.

3.1 Define a 'parsec'.

Include a diagram in your answer.

3.2 Calculate the absolute magnitude of SN1006.

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3.4 Discuss how [illegible] scales have been compiled to determine positio

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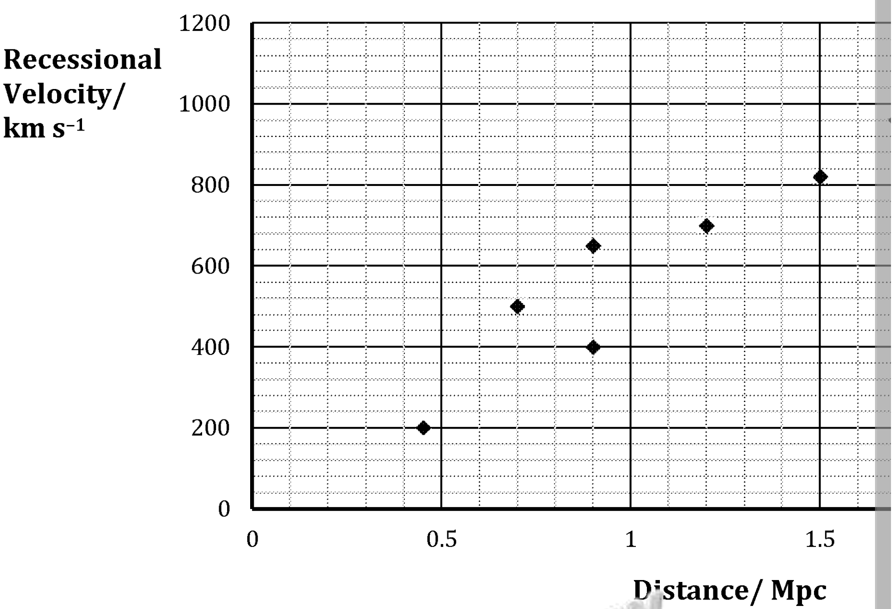

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Explain why this data is controversial.

Preview of Questions Ends Here

Mark Scheme: Set A

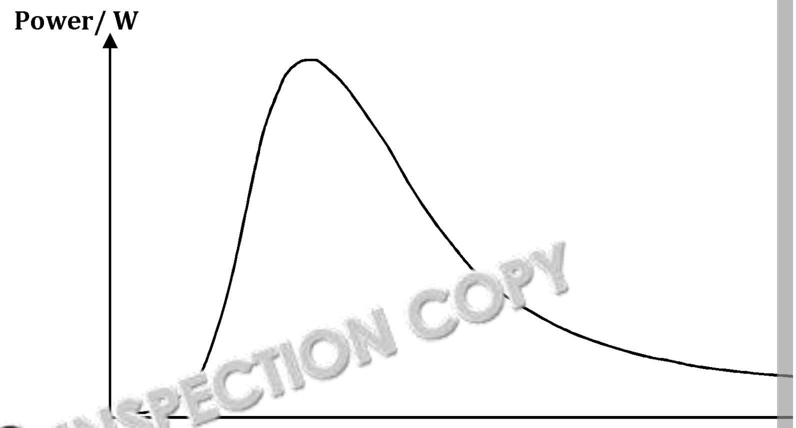
Question	Answer	Marks
1.1	(Telescopes at high altitude) reduce the effect of refraction of (short wavelengths of) light by the atmosphere OR reduce the effects of atmospheric turbulence ✓	1
1.2	Detected luminescence = quantum efficiency × area ✓ **For eye:** Detected luminescence = 0.0408 × 0.00100 = 4.08×10^{-5} **For CCD:** Detected luminescence = 0.848 × 97[illegible] = [illegible]29 Ratio = $\frac{829}{4.08 \times 10^{-5}}$ ✓ Ratio = 20.3 × [illegible]	1 1 1
1.3	[illegible] g[illegible] below outlines the features of a 1, 2, 3, 4, 5 and 6 mark a[illegible]	

[illegible]k	Criteria	
6	A detailed discussion of all three types of telescopes, with details on structure, position and use for all.	Releva cohere structu and gr handw
5	A detailed discussion of all three types of telescopes, with details on structure and position, with very minor gaps in detail.	
4	A discussion that includes the majority of main points about telescopes and their use, structure and location.	Inform which meani satisfa
3	A discussion that includes the main points about the telescopes and at least one point for each regarding structure, position or use. There are gaps in knowledge and missing details.	
2	Only a couple of points made correctly, significant knowledge is missing.	Some i preser and gr derive
1	Only one correct point made about the telescopes, such as a difference in use between two of them.	
0	No relevant information provided.	Preser seriou unders

Max 6 marks – The following statements are likely to be included:

Radio
- Extremely large dishes (constructed of wire mesh)
- May be multiple dishes [illegible] large area (which create a [illegible] image)
- Can view [illegible] dust clouds (which re[illegible] waves less)
- Can be used anytime
- Must be situated in isolated areas
- No real limitation on altitude
- Longer radio wavelengths (>10 m) are easily absorbed by upper atmosphere
- Lots of interference from man-made sources
- Radio telescope collecting areas must be much larger to obtain a similar resolution

Optical
- Parabolic mirror dish
- CCD detectors
- Located in high atmosphere
- Used to image bright optical region) object (such as galaxies)
- Can only be used dur the day
- Can be used in space mitigate some of the limitations of ground based observing

Question	Answer	Marks
2.1	Rapidly rises to peak ✓ Slow decrease after peak ✓  	1 1
2.2	...r temperature stars have lower power so the curve will peak at a lower power ✓ $\lambda_{\max} T = constant$ so peak is at a longer wavelength ✓	1 1
2.3	$\lambda_{\max} = \frac{c}{f} = \frac{3.0\times10^{8}}{6.0\times10^{14}} = 5.0\times10^{-7}$ m ✓ $\lambda_{\max} T = 2.9\times10^{-3}$ $T = \frac{2.9\times10^{-3}}{\lambda}$ $T = \frac{2.9\times10^{-3}}{5.0\times10^{-7}}$ ✓ ($T = 5800$ K)	1 1
2.4	Power from the Sun, $P_s = 4\pi R_s^2 \sigma T_s^4$ Power at Earth, $E_e = \frac{P_s}{4\pi a_0^2}$ ✓ Flux absorbed by Earth, $P_e = E_e \times \pi R_e^2$ $P_e = \frac{P_s}{4\pi a_0^2} \times \pi R_e^2$ $P_e = \frac{4\pi R_s^2 \sigma T_s^4}{4\pi a_0^2} \times \pi R_e^2$ $P_e = \frac{\pi R_e^2 R_s^2 \sigma T_s^4}{a_o^2}$ ✓ $P_e = \sigma A_e T_e^4 = \sigma 4\pi R_e^2 T_e^4$ $\sigma 4\pi R_e^2 T_e^4 = \frac{\pi R_e^2 R_s^2 \sigma T_s^4}{a_o^2}$ ✓ $T_e^4 = \frac{R_s^2 T_s^4}{4a_0^2}$ ✓ $\left(T_e = T_s\sqrt{\frac{R_s}{2a_0}}\right)$	1 1 1 1
3.1	Mass from core of galaxy ✓ falling into a supermassive black hole ✓	1 1
3.2	$z = \frac{v}{c}$ $z = \frac{48\ 200\times10^{3}}{3\times10^{8}}$ ✓ $z = 0.1607 = 0.161$ ✓	 1 1

Question	Answer	Marks
3.3	$\frac{\Delta f}{f} = z$ $\frac{f_{app} - f}{f} = z$ $f_{app} = f(z+1)$ $f = \frac{f_{app}}{z+1}$ ✓ $f_d = \frac{4.57 \times 10^{11}}{0.1607+1}$ $f_d = 3.94 \times 10^{11}$ Hz ✓	 1 1
4.1	Black hole: (region of space) in which the gravitational field is so strong that no light (or particles) may escape ✓ Event horizon: radius OR boundary (of black hole) ✓	1 1
4.2	Star with a very **large** mass reaches the end of its life cycle ✓ and collapses ✓ causing a supernova ✓ (which leaves behind a black hole)	1 1 1
4.3	$R_s \approx \frac{2GM}{c^2}$ $R_s \approx \frac{2 \times 6.67 \times 10^{-11} \times 17.6 \times 1.99 \times 10^{30}}{(3 \times 10^8)^2}$ ✓ $R_s = 51.91 \times 10^3$ m ✓ $\rho = \frac{M}{V}$ $\rho = \frac{17.6 \times 1.99 \times 10^{30}}{\frac{4}{3}\pi \times (51.91 \times 10^3)^3}$ ✓ $\rho = 5.98 \times 10^{16}$ kg m^{-3} ✓	 1 1 1 1

Preview of Answers Ends Here

This is a limited inspection copy. Sample of answers ends here to stop students looking up answers to their assessments. See contents page for details of the rest of the resource.