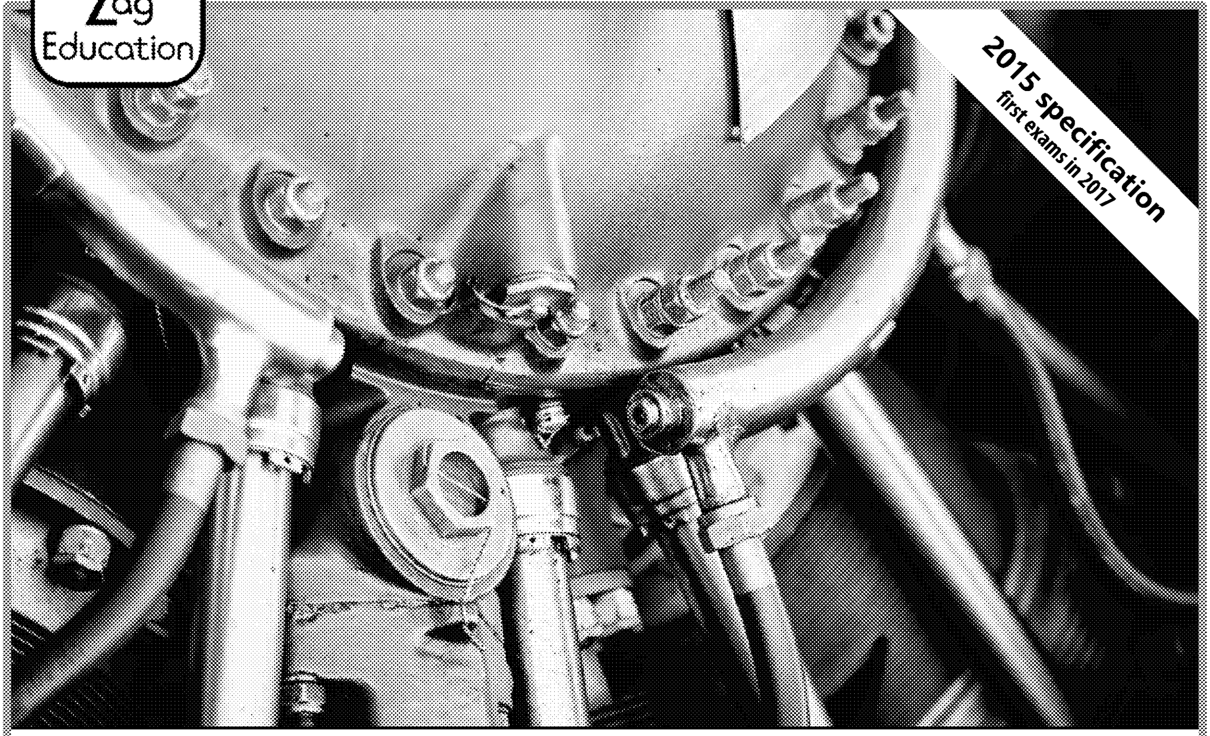
Physics

A Level | AQA | 7408



Practice Exams for A Level AQA Physics

Paper 3B Option C: Engineering

zigzageducation.co.uk

POD 7637

Contents

Teacher's Introduction

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 C: Engineering.

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

Each paper consists of 35 marks covering the content in the Engineering 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 the same format as the specimen paper released by the exam board. 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.

Toby Brown & Samir Khonji, May 2017

ZigZag Practice Exam Papers

Supporting A Level AQA Physics

Practice Exam Paper 3B

Option C: Engineering – 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 pa[illegible] **[illegible]5**. The number of marks available for each question [illegible] on the right.

For this [illegible] you will need:

- Data, Formulae and Relationships booklet

Additional materials required

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

1. A 'lazy Susan' is a disc-shaped, rotatable turntable that is used to assist in
drink when several people are dining together. **Figure 1** shows a plan vie
of 3.50 kg and diameter of 0.500 m. A 0.390 kg bottled drink, which may b
positioned at a distance of 15.0 cm from the centre.

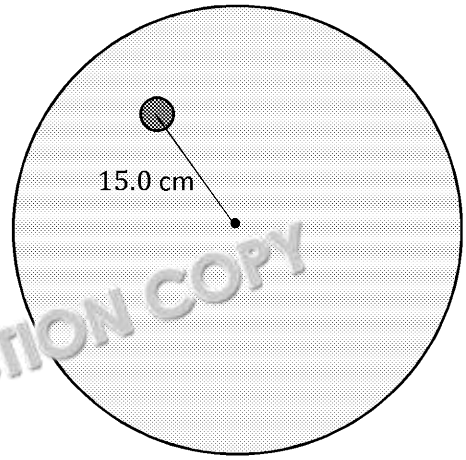


Figure 1

1.1 Calculate the total moment of inertia of the lazy Susan and bottle abo
[The moment of inertia of a disc is given by $I = \frac{1}{2}mr^2$.]

1.2 The 'lazy Susan' in **Figure 1** initially spins at an angular velocity of 3.
0.640 N is applied at a tangent to the edge of the lazy Susan for 4.00 s
[Ignore the effect of frictional torque]

Calculate the maximum angular velocity reached by the lazy Susan.

Maximum angular vel

1.3 When the lazy Susan is spun quickly enough, the bottle moves furthe

Explain what happens to the rotational speed of the lazy Susan when

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2. A flywheel is a mechanical device that is used to store rotational kinetic e

Discuss the energy transfer and storage that must be considered when de

In your answer you should include:

- the factors that affect the energy storage capacity of a flywheel and it
- what makes a flywheel particularly resistant to changes in rotational
- how energy is transferred to a flywheel
- how a flywheel releases energy

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3. **Figure 3** shows a simple cylinder filled with air, sealed by a piston, and c
The set-up can be used to demonstrate the relationship between pressur

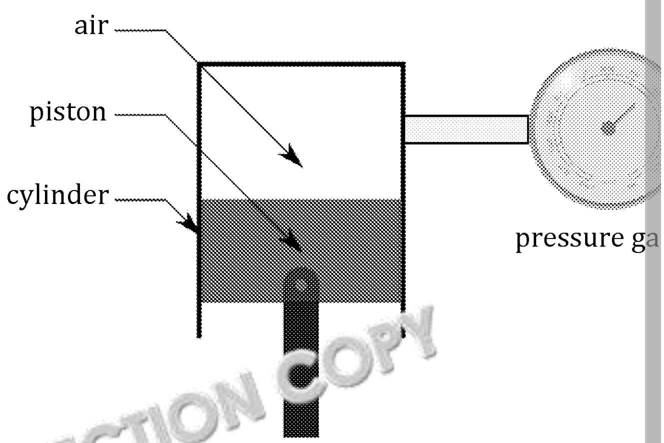

Figure 2

3.1 Ex[...], in words, what is meant by an adiabatic process.

....

3.2 The air inside the cylinder has an initial volume of 1.1×10^{-4} m³ and
piston is moved upwards, compressing the air adiabatically to a volu
the pressure inside the cylinder after compression.
[The adiabatic index of air = 1.4.]

Pres

3.3 State why it is not possible to apply the equation $W = p\Delta V$ to calcula
compression in the set-up above.

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3.4 Use the ideal gas [...] show that $TV^{\gamma-1} = constant$ for an adiabati
[Assume [...] escapes from the cylinder.]

3.5 Explain, in terms of work, what happens to the internal energy of the

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4. An engine contains three cylinders of equal power input. The indicator di
four-stroke engine cycle is shown by **Figure 3**. One complete cycle takes

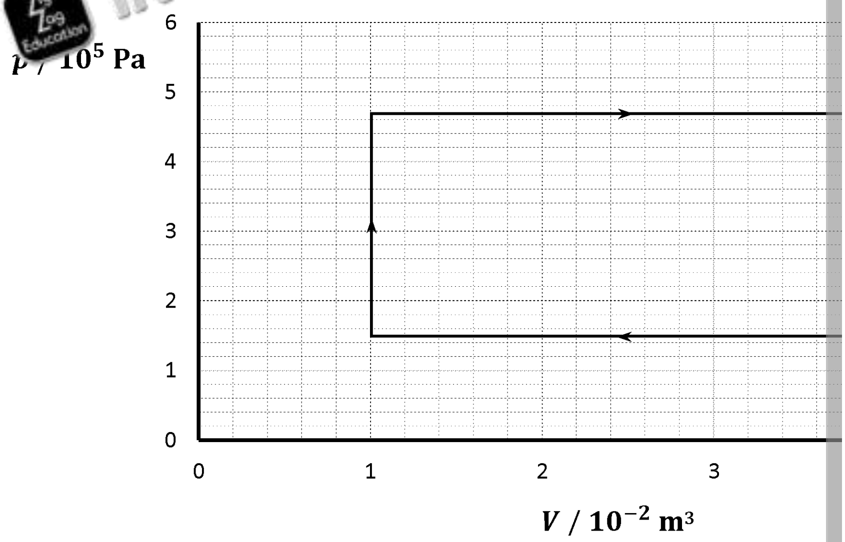

Figure 3

4.1 Explain the difference between the indicated power and brake powe

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4.2 Calculate the indicated power of the engine.

Indicated p

4.3 The fuel has a calorific value of 45 MJ litre^{-1} and is used up at a rate o

Calculate the thermal efficiency of the engine.

Thermal effici

4.4 State how the system would be different if the arrows pointed in an a

....

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4.5 Explain why the indicator diagram shown in **Figure 3** is not achievab

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ZigZag Practice Exam Papers

Supporting A Level AQA Physics

Practice Exam Paper 3B

Option C: Engineering – 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

Additional materials required

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

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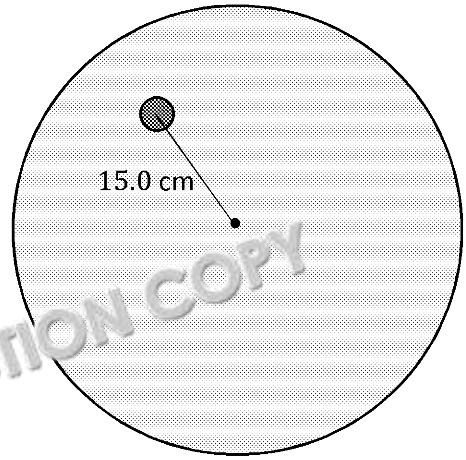

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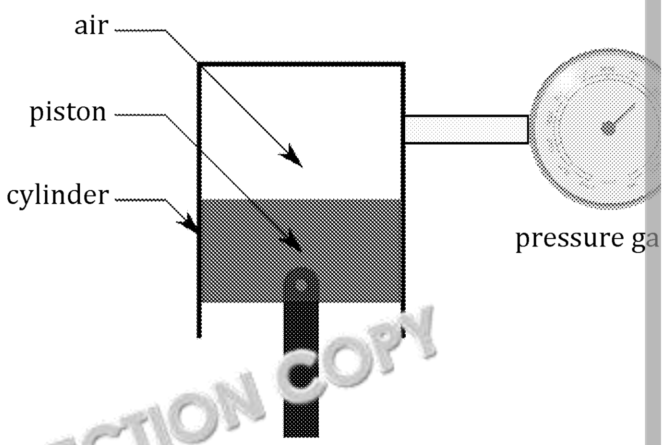

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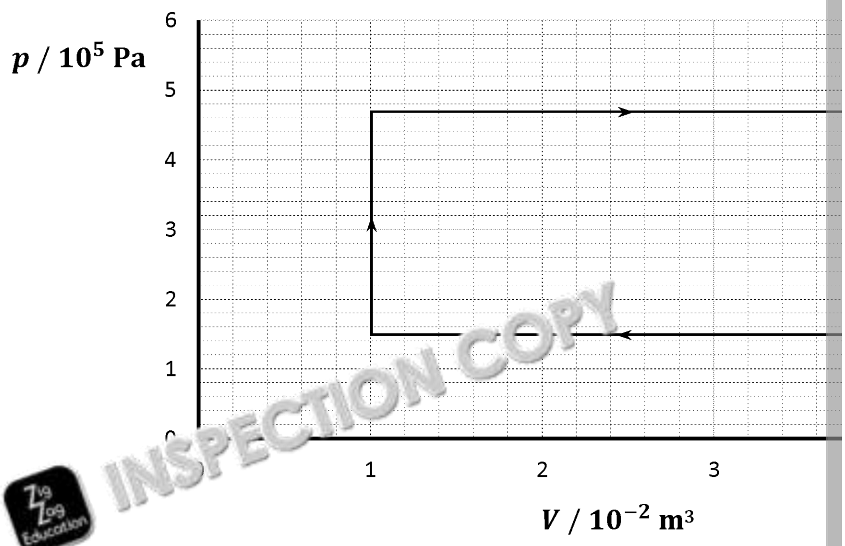

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Preview of Questions Ends Here

Mark Scheme: Set A

Question	Answer	Mar[k]
1.1	Total angular momentum (of a system) remains constant unless acted on by an external torque ✓	1
1.2	$m = \pi r^2 h\rho$ $\frac{1}{2}mr^2 = I$ $\frac{1}{2}\pi r^4 h\rho = I$ ✓ $\rho = \frac{2I}{\pi r^4 h}$ $\rho = \frac{2\times2.5\times10^{-6}}{\pi\times(7\times10^{-3})^4\times9[illegible]}$ ✓ $\rho = 7$ [illegible] ^{3} ✓	 1 1 1
1.3	[illegible]lar momentum $= I\omega$ [illegible]ombined angular momentum $= (I_1 + I_2)\omega$ $= (2.5\times10^{-6} + 7.1\times10^{-5})\times 35$ ✓ $= 2.6\times10^{-3}$ ✓ kg m^2 rad s^{-1} ✓	 1 1 1
1.4	Increases ✓ because more mass of disc at a greater radius from the axis ✓	1 1
2.1	$W = T\theta$ $W = 2.5\times10^{-3}\times 2\pi$ ✓ $W = 0.0157$ J ✓	 1 1
2.2	$\omega_1 = 22.0$ rad s^{-1}, $\omega_2 = 0$ $\alpha = \frac{\tau}{I}$ $\alpha = \frac{-2.5}{0.322}$ (angular deceleration) ✓ $\alpha = -7.764$ rad s^{-2} ✓ $\omega_2{}^2 = \omega_1{}^2 + 2\alpha\theta$ $\theta = \frac{(\omega_2{}^2 - \omega_1{}^2)}{2\alpha}$ $\theta = \frac{0-22^2}{2\times-7.764}$ ✓ $\theta = 31.17$ rad ✓ [illegible] = [illegible] full revolutions [illegible]nce lands on sector 8 ✓	 1 1 1 1 1
2.3	'Lubricant' / 'lubrication' OR use of ball bearings ✓	1

Question	Answer	Mar
3.1	The guidance below outlines the features of a 1-, 2-, 3-, 4-, 5- and 6-mar	

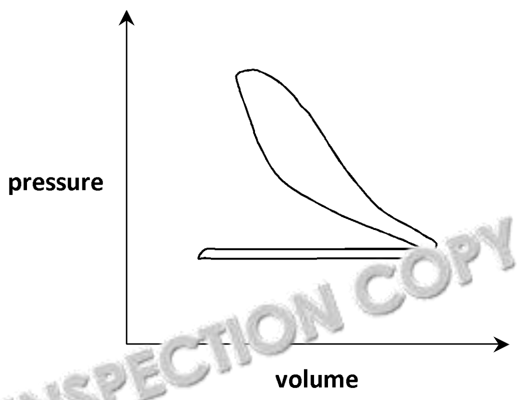
Mark	Criteria	
6	All six stages in the cycle covered correctly, displaying a high level of understanding of what happens to the air, piston and temperature at each stage.	Relevan coheren and clea gramma is legibl
5	All stages covered correctly with some missing details on the air, temperature and piston.	
4	At least four stages covered reasonably well, some missing details.	Informa is suffici Spelling and han
3	Only three stages covered correctly, limited detail.	
2	Two stages covered reasonably well, limited detail.	Some in present gramma but ther
1	One stage covered reasonably well, limited detail.	
0	Little to no relevant information on any of the stages in the cycle.	Present serious underst

Max 6

The following statements are likely to be included:

A' to A: air is drawn in to cylinder, piston is pushed (downwards)
A to B: piston compresses air adiabatically / work is done on the air. '
B to C: fuel is ignited within cylinder, piston forced down (at constant
C to D: fuel supply cut off, (burnt) gas expands adiabatically, forcing p falls.
D to A: (exhaust) gas is released, temperature of gas continues to fall.

Question	Answer	Mar
3.2	Similar shape but with smaller area enclosed ✓ Rounded corners ✓ A' to A and A to A' form a closed loop (i.e. no longer a straight line) ✓	1 1 1



Question	Answer	Mar
4.1	Work is done to transfer heat ✓ from a cold reservoir to a hot reservoir ✓	1 1
4.2	Heat does not move spontaneously ✓ (since work is done)	1
4.3	Thermal efficiency: $\varepsilon = \frac{W}{Q_H}$, $COP_{hp} = \frac{Q_H}{W}$ So if $COP_{hp} < 1, \varepsilon > 1$ which is not possible ✓	 1

Question	Answer	Mar[illegible]
4.4	Refrigerator 1: $COP_{ref} = \frac{T_C}{T_H - T_C}$ $T_C = 3 + 273 = 276\ \text{K}$ $T_H = 30 + 273 = 303\ \text{K}$ $COP_{ref} = \frac{276}{303-276}$ ✓ $COP_{ref} = 10.2$ ✓ Refrigerator 2: $COP_{ref} = \frac{Q_C}{W}$ $COP_{ref} = \frac{Q_C}{W} = \frac{P_{out}}{[illegible]}$ [illegible] $_{ref}$ = [illegible] 2 [illegible] [illegible] $_{ref} = 11.0$ ✓ Supermarket should buy refrigerator 2 ✓ (since it has a higher coefficient of performance)	 1 1 1 1 1

Preview of Answers Ends Here