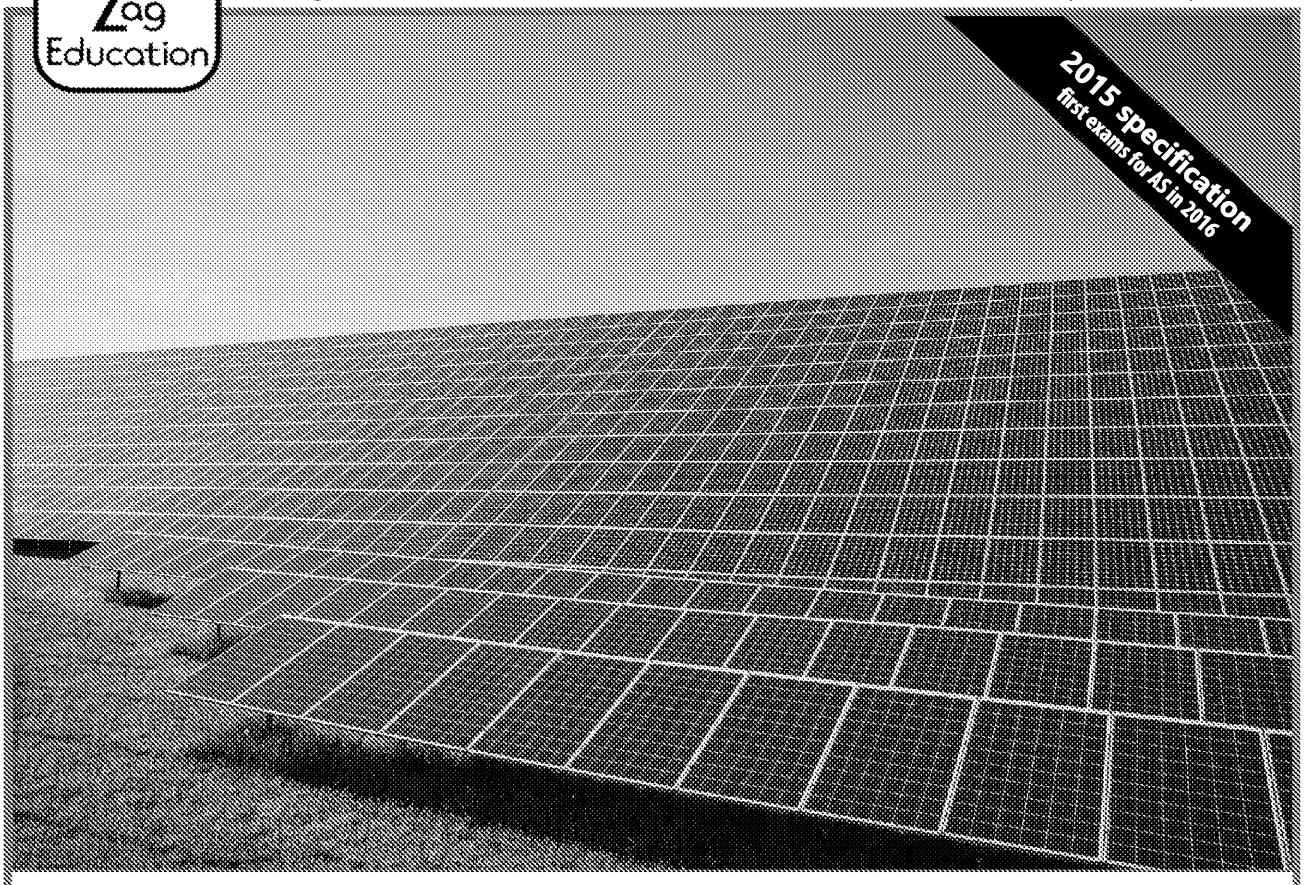
Zig Zag Education

Physics

AS | AQA | 7407



Practice Exams for AS AQA Physics

Paper 2

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POD 6631

Contents

Teacher's Introduction

This collection of **four practice papers** has been written to support **Paper 2** of the **AS AQA Physics specification 7407** (first examination 2016). A separate resource is available for Paper 1 practice.

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. All the papers meet the minimum 40% mathematical skills required by the specification.

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

Write-on and **non-write-on** versions are included in this pack. For **non-write-on** versions, inserts are provided at the end of each paper for questions that require the student to annotate a diagram, for example, drawing a line of best fit on a graph.

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.

March 2016

Remember!

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

Specification Cross-referencing Table

	Paper 1s (available separately)			
	Paper 1A	Paper 1B	Paper 1C	Paper 1D
3.1 Measurements and their errors				
3.1.1 Use of SI units	✓	✓	✓	✓
3.1.2 Limitation of physical measurements			✓	✓
3.1.3 Estimation of physical quantities		✓		
Number of marks for quantitative skills Level 2 or above	1	2	1	2
3.2.1 Particles				
3.2.1.1 Constituents of the atom	✓	✓		
3.2.1.2 Stable and unstable nuclei	✓	✓		
3.2.1.3 Particles, antiparticles and photons	✓		✓	
3.2.1.4 Particle interactions	✓			
3.2.1.5 Classification of particles			✓	✓
3.2.1.6 Quarks and antiquarks			✓	✓
3.2.1.7 Applications of conservation [illegible]	✓			✓
Number of marks for quanti[illegible] or above	0	3	5	0
3.2.2 Electromagnetic radiation and quantum phenomena				
3.2.2.1 Photoelectric effect	✓			✓
3.2.2.2 Collisions of electrons with atoms		✓	✓	
3.2.2.3 Energy levels and photon emission		✓	✓	
3.2.2.4 Wave–particle duality			✓	✓
Number of marks for quantitative skills Level 2 or above	4	4	2	6
3.3.1 Progressive and stationary waves				
3.3.1.1 Progressive waves			✓	✓
3.3.1.2 Longitudinal and transverse waves		✓		✓
3.3.1.3 Principle of superposition of waves	✓		✓	
Number of marks for quantitative skills Level 2 or above	0	0	3	5
3.3.2 Refraction, diffraction and interference				
3.3.2.1 Interference	✓			✓
3.3.2.2 Diffraction	✓			✓
3.3.2.3 Refraction at a plane surface		✓		
Number of marks for quantitative skills Level 2 or above	5	7	0	0
3.4.1 Force, energy and momentum				
3.4.1.1 Scalars and vectors		✓	✓	✓
3.4.1.2 Moments			✓	✓
3.4.1.3 Motion along a straight line		✓		✓
3.4.1.4 Projectile motion		✓		✓
3.4.1.5 Newton's laws of motion	✓			✓
3.4.1.6 Momentum	✓	✓		
3.4.1.7 Work, energy and power			✓	
3.4.1.8 Conservation of energy	✓		✓	
Number of marks for quantitative skills Level 2 or above	9	6	17	8
3.4.2 Materials				
3.4.2.1 Bulk properties of solids	✓	✓		✓
3.4.2.2 The Young modulus				✓
Number of marks for quantitative skills Level 2 or above		4	0	6
3.5.1 Current electricity				
3.5.1.1 Basics of electricity	✓		✓	
3.5.1.2 Current–voltage characteristics			✓	
3.5.1.3 Resistance		✓		✓
3.5.1.4 Circuits		✓	✓	
3.5.1.5 Potential divider	✓	✓		
3.5.1.6 Electromotive force and internal resistance	✓			✓
Number of marks for quantitative skills Level 2 or above	4	4	6	4
Number of marks for assessment of practical skills	5	0	6	6
Overall quantitative skills	**41%**	**43%**	**49%**	**44%**
Required practicals covered (practical code)	**2&6**	**4**		**3&5**
Overall practical skills	**14%**	**17%**	**16%**	**16%**

AS Physics
Unit 7407/2

Practice Paper 2B

Name	

Time allowed
1 hour 30 minutes

Instructions
Answer **all** of the questions

Information
- The total marks available for this paper is **70**. The number of marks available for each question is shown in brackets.
- Students should have a data and formulae booklet, a ruler and calculator.
- Answer all questions and show all working.

Section A

1 A student measures the resistance of an unknown component using an digital voltmeter she uses reads 0.84 V.

1.1 Calculate the percentage uncertainty in the voltage reading.

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.....

.....

1.2 The student also measures the current. As she doesn't have another digital meter she uses one shown in Figure 1.

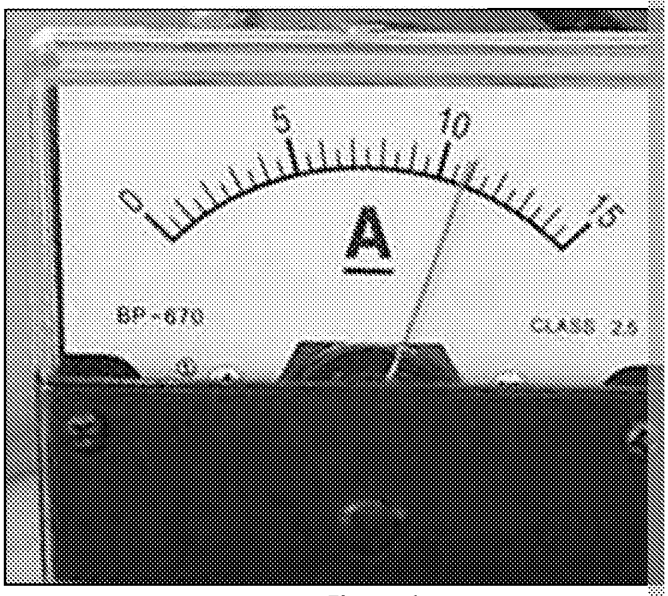

Figure 1

State the current through the component.

.....

1.3 Calculate the percentage uncertainty in one reading of current.

.....

.....

.....

1.4 Calculate the resistance of the component.

.....

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.....

1.5 Determine the absolute uncertainty in the resistance quoted.

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.....

.....

1.6 Suggest a safety precaution that should be taken when doing this expe

.....

.....

1.7 Another st[illegible]ed a different method and obtained a value of 0.09[illegible] th[illegible]po[illegible]ent.

State and explain whether the two values obtained by the students are

.....

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2 **Data analysis question**

A Jolly bulb full of air is sealed with a pressure gauge. The Jolly bulb is t
shown (Figure 2).

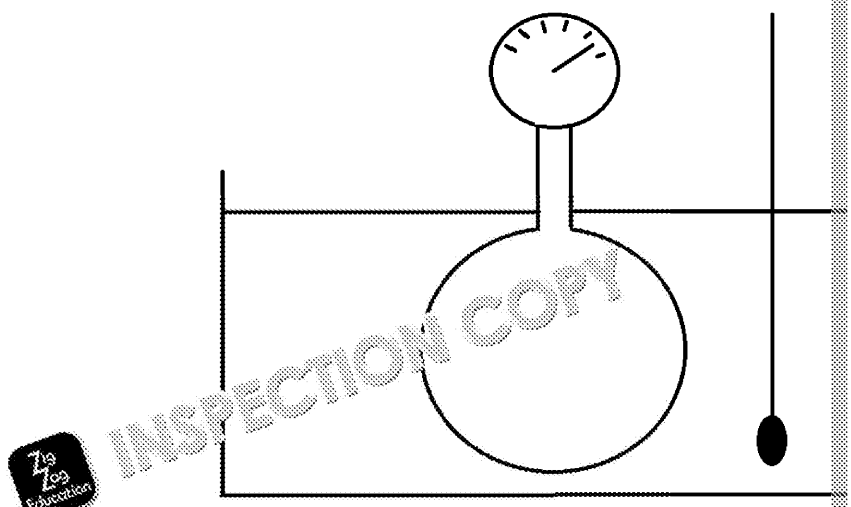

Figure 2

The pressure gauge reads 120 kPa when the thermometer reads 0 °C.

The water bath is then heated. The pressure is recorded at different te
pressure, p, with temperature, θ, is shown in Figure 3.

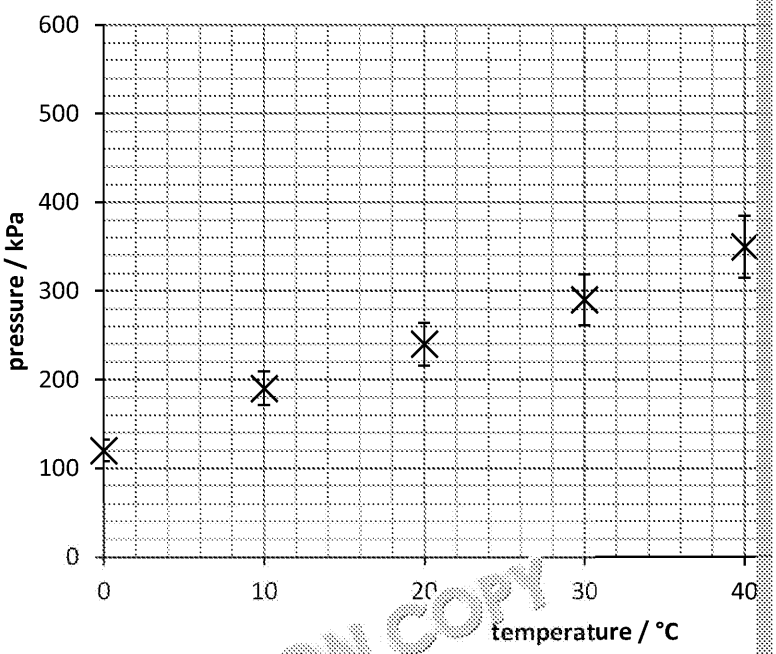

Figure 3

2.1 Dr lin t fit for these data.

2.2 A student suggests that the relationship between p and θ is

$$p = p_0 + kp_0\theta$$

Determine p_0.

.....

.....

2.3 Show that kp_0 is about 6 kPa °C^{-1}.

.....

.....

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.....

.....

2.4 Determine k and state its units.

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2.5 Each student carries out the experiment using a Jolly bulb with a differe
in p_0 with mass of air, m, is shown in Figure 4.

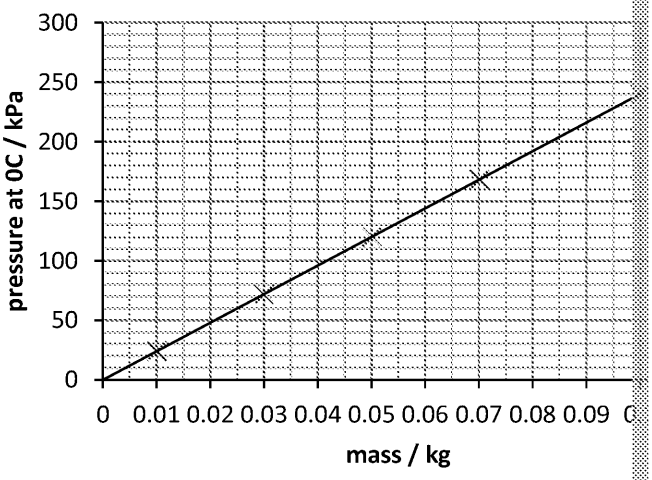

Figure 4

The Jolly bulbs are marked with a maximum safe pressure of 500 kPa.

The gradient of Figure 4 is 2400 °C kg^{-1}.

Calculate the maximum mass of gas a Jolly bulb can contain at 0 °C.

.....

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.....

.....

2.6 Comment on the accuracy of your answer to part 2.5.

.....

.....

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Section B

Question 3 is about atomic energy levels. Read this passage and then an

Niels Bohr came up with the following formula for the energy levels, E_n in ions co

$$E_n = \frac{Z^2 R_E}{n^2}$$

where Z is the number of protons in the nucleus, n is the number of the energy l
n = 1 represents the ground state.

The following table, Table 1, shows the energy of the second level in different io

Eleme	Z	E_n /
[illegible]	3	4.9×1
carbon	6	2.0×1

Table 1

3.1 Calculate the magnitude of the constant R_E.

.....

.....

3.2 Give the SI fundamental units for the constant R_E.

.....

3.3 The passage says that 'n = 1 represents the ground state'.

Explain what being the ground state means.

.....

.....

3.4 The ground-state energy of ion X is four times that of ion Y.

Determine the ratio of number of protons of X to Y.

.....

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.....

3.5 Show that the frequency of a photon released as an electron drops fro
directly proportional to $\frac{1}{m^2} - 1$.

.....

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3.6 Using the data in Table 1, discuss the visibility of the photons emitted b
second to the ground state.

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4 Figure 5 shows data on the intensity of sunlight at different wavelength

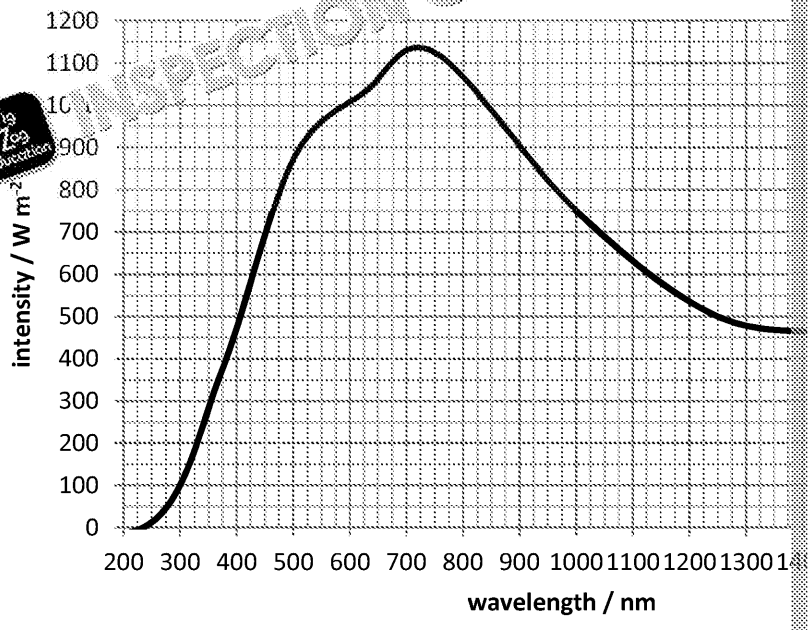

Figure 5

4.1 Calculate the power incident on a 5.0 m^2 solar panel tuned specifically

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.....

.....

4.2 Estimate the number of photons of this wavelength incident on the sol

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.....

.....

4.3 The cell outputs 10 V, 30 A electricity.

Calculate its efficiency.

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4.4 The company making the panel wants to sell it for fitting to the roofs o

State two pieces of extra information abo[illegible] the panels collect sun

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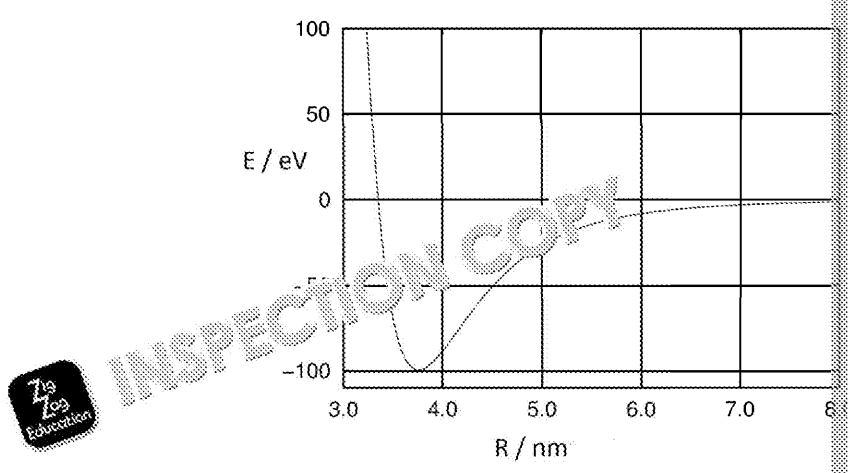
Section C

For each question, shade in the diamond beside the correct answer.

If you wish to change your answer, put a cross through the wrong choice and sha

5 What is the energy at a range of 5.0 nm?



A −25 eV ◇
B −75 eV ◇
C 3.4 eV ◇
D 4.5 eV ◇

6 Which of these is **not** a quantum number?

A baryon number ◇
B lepton number ◇
C strangeness ◇
D linear momentum ◇

7 A Σ^+ baryon has a charge of +1 and a strangeness of −1. What is its qua

A uds ◇
B uus ◇
C dss ◇
D uud ◇

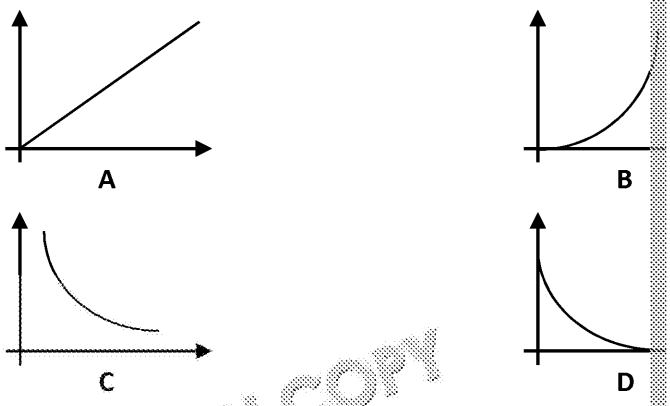
8 What is the stopping potential for 3.2×10^{-19} J el ons?

A 5.1×10^{-38} V ◇
B 3.2×10^{-19} V ◇
C 2.0 V
D 3.5×10^{11} V ◇

9 Which of these is **not** a possible result of an electron hitting an atom?

A an orbital electron is promoted to a higher energy level
B an orbital electron is knocked out of the atom
C the atom gains kinetic energy
D the electron is captured to create a positive ion

10 Which graph shows the de Broglie wavelength of an electron against its

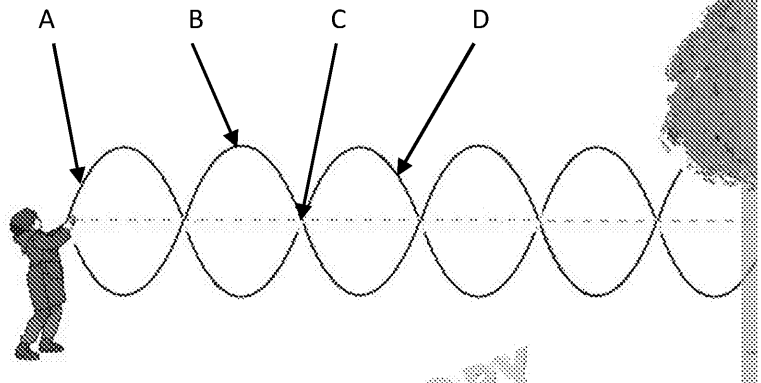


A ◇
B ◇
C ◇
D ◇

11 The phase difference between two points on a wave is 4.7 radians. Wh
fractions of a cycle?

A 0 ◇
B ¼ ◇
C ½ ◇
D ¾ ◇

12 Which of these points shows an antinode?



A ◇
B ◇
C ◇
D ◇

13 A ball of string has a mass of 0.0025 kg m^{-1}. How long is the piece of str
200 Hz when a tension of 12 N is applied?

A 12 cm ◇
B 17 cm ◇
C 35 cm ◇
D 60 cm ◇

14 Which one of these is a sensible precaution to take specifically when us
found in school laboratories?

A wear gloves ◇
B cover reflective surfaces with cloth ◇
C tie your hair back ◇
D keep ice on standby ◇

15 Light with a wavelength of 500 nm is incident on a diffraction grating w
maximum number of orders visible?

A 4 ◇
B 5 ◇
C 6 ◇
D 7

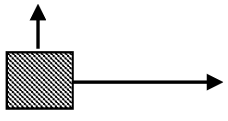
16 W ti ese lines best matches refraction from a low to a high refra

	angle of incidence	angle of refraction	
A	20°	24°	◇
B	30°	32°	◇
C	40°	36°	◇
D	50°	50°	◇

17 Which of these objects is **not** in equilibrium?

A a bullet being fired ◇
B a suitcase balanced on its end ◇
C a car travelling at its top speed in a straight line ◇
D a motor spinning at a constant frequency ◇

18 Two forces are applied to an object as shown.



Which of these forces would balance those in the diagram?

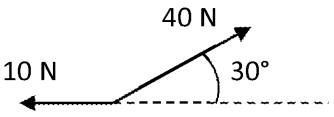
A ◇

B ◇

C ◇

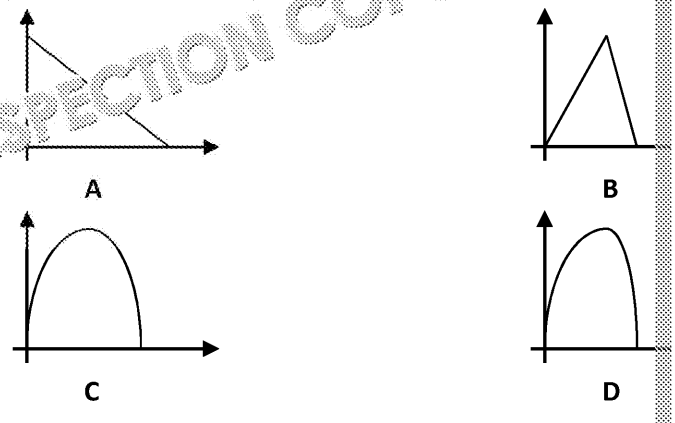
D ◇

19 What is the magnitude of the horizontal resultant of these vectors?



A 25 N ◇
B 30 N ◇
C 35 N ◇
D 45 N ◇

20 Which of these graphs shows the trajectory of a ball thrown with air re

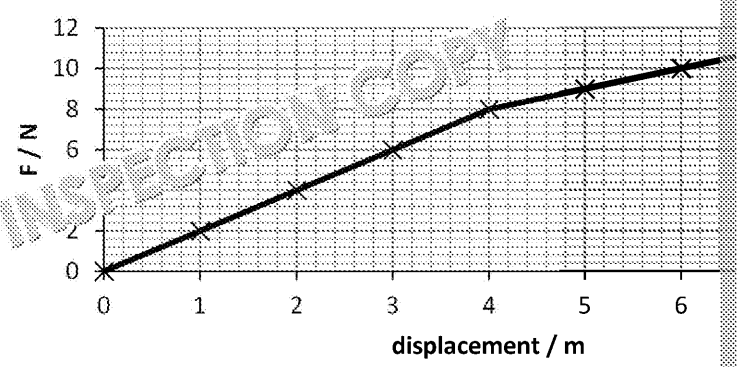


A ◇
B ◇
C ◇
D ◇

21 Which of Newton's laws says that the magnitude of the force I apply to magnitude of the force the ground applies on me?

A Newton's First Law of Motion ◇
B Newton's Second Law of Motion ◇
C Newton's Third Law of Motion ◇
D Newton's Law of Universal Gravitation ◇

22 This graph shows the force applied to an object against its displacemen



A 48 J ◇
B 56 J ◇
C 72 J ◇
D 96 J ◇

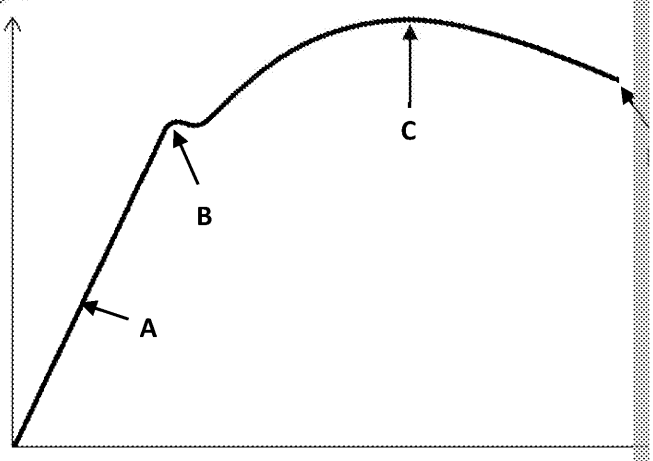
23 A 2.3 kg ball is dropped from a height of 12 m. How much kinetic energy the ground?

A 28 J ◇
B 140 J ◇
C 170 J ◇
D 270 J ◇

24 A spring is 2.3 cm long initially. When 5.0 N is hung from it, it stretches

A 0.44 N cm^{-1} ◇
B 1.1 N cm^{-1} ◇
C 2.3 N cm^{-1} ◇
D 11 N cm^{-1} ◇

25 Which of these points on the graph marks the maximum tensile stress of this material?



A ◇
B ◇
C ◇
D ◇

26 Calculate the volume of air that would have a mass of 60 kg. The density

A 0.020 m^3 ◇
B 50 m^3 ◇
C 72 m^3 ◇
D 800 m^3 ◇

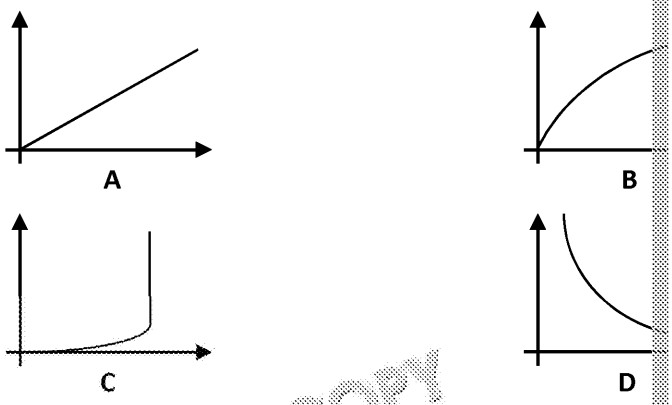
27 Which of these must be kept constant when carrying out an experiment modulus of a material?

A force applied ◇
B pressure ◇
C temperature ◇
D the person doing the experiment ◇

28 A current of 20 A flowed through a resistor for 45 s. How much charge

A 0.44 C ◇
B 2.3 C ◇
C 27 C ◇
D 900 C ◇

29 Which of these graphs shows the voltage against current for a semicon



A ◇
B ◇
C ◇
D ◇

30 What is the critical temperature of a superconductor?

A the temperature below which it has zero resistivity ◇
B the temperature above which it has zero resistivity ◇
C the only temperature at which it has zero resistivity ◇
D the temperature at which it melts ◇

31 How much energy is dissipated in a 6.0 V bulb supplied with 2.0 A for 2

A 6.0 J ◇
B 24 J ◇
C 360 J ◇
D 1400 J ◇

32 What is the combined resistance of a 1.0 Ω, 2.5 Ω and 3.6 Ω resistor in

A 0.60 Ω ◇
B 0.74 Ω ◇
C 1.4 Ω ◇
D 1.7 Ω ◇

33 A cell with an emf of 1.5 V is connected to a load of 3.2 Ω. A current of internal resistance of the cell.

A 0.26 Ω ◇
B 2.2 Ω ◇
C 3.9 Ω ◇
D Ω ◇

34 Which of these is the best estimate for the volume of a person's head?

A 10^{-7} m^3 ◇
B 10^{-5} m^3 ◇
C 10^{-3} m^3 ◇
D 10^{-1} m^3 ◇

AS Physics
Unit 7407/2

Practice Paper 2B

Name	

Time allowed
1 hour 30 minutes

Instructions
Answer **all** of the questions

Information
- The total marks available for this paper is **70**. The number of marks available for each question is shown in brackets.
- Students should have a data and formulae booklet, graph pape a ruler and a calculator.
- Answer all questions and show all working.

Section A

1 A student measures the resistance of an unknown component using an digital voltmeter she uses reads 0.84 V.

1.1 Calculate the percentage uncertainty in the voltage reading.

1.2 The student also measures the current. As she doesn't have another di one, as shown in Figure 1.

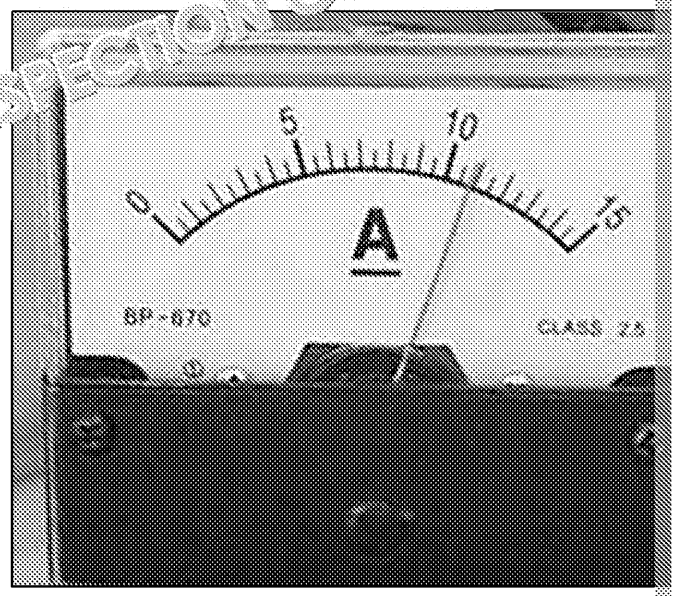


Figure 1

State the current through the component.

1.3 Calculate the percentage uncertainty in the reading of current.

1.4 Calculate the resistance of the component. (Units are Ω)

1.5 Determine the absolute uncertainty in the resistance quoted. (Units are

1.6 Suggest a safety precaution th d be taken when doing this expe

1.7 A st ased a different method and obtained a value of 0.09 th onent.

State and explain whether the two values obtained by the students are

2 **Data analysis question**

A Jolly bulb full of air is sealed with a pressure gauge. The Jolly bulb is t
shown (Figure 2).

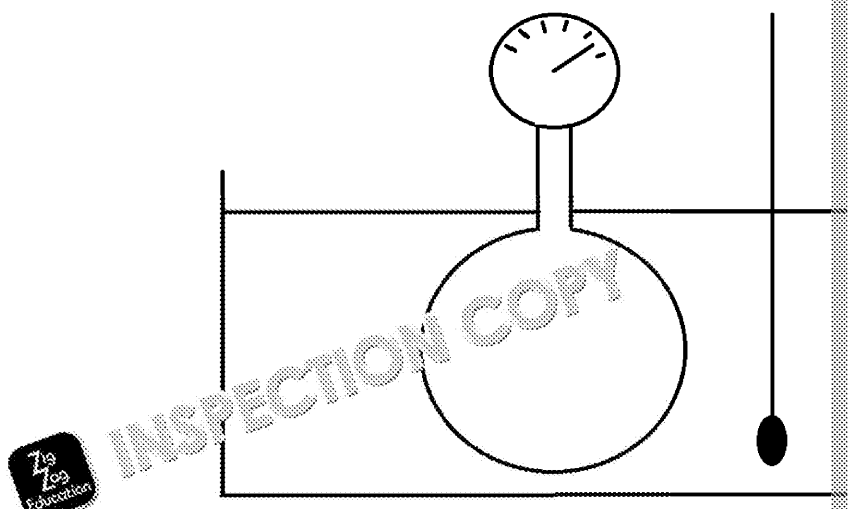


Figure 2

The pressure gauge reads 120 kPa when the thermometer reads 0 °C.

The water bath is then heated. The pressure is recorded at different te
pressure, p, with temperature, θ, is shown in Figure 3 (see insert).

2.1 Draw a line of best fit for these data.

2.2 A student suggests that the relationship between p and θ is

$$p = p_0 + kp_0\theta$$

Determine p_0.(Units are kPa)

2.3 Show that kp_0 is about 6 kPa °C^{-1}.

2.4 Determine k and state its units.

2.5 Each student carries out the experiment using a Jolly bulb with a differe
in p_0 with mass of air, m, is shown in Figure 4.

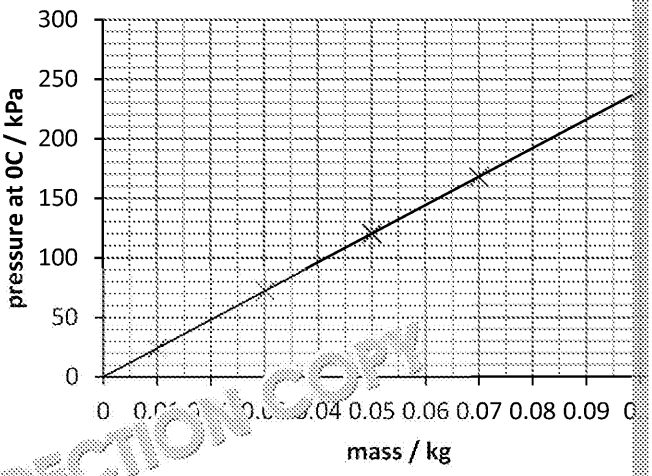


Figure 4

Th bulbs are marked with a maximum safe pressure of 500 kPa.

The gradient of Figure 4 is 2400 °C kg^{-1}.

Calculate the maximum mass of gas a Jolly bulb can contain at 0 °C. (Ur

2.6 Comment on the accuracy of your answer to part 2.5.

Section B

Question 3 is about atomic energy levels. Read this passage and then an

Niels Bohr came up with the following formula for the energy levels, E_n in ions co

$$E_n = \frac{Z^2 R_E}{n^2}$$

where Z is the number of protons in the nucleus, n is the number of the energy l
n = 1 represents the ground state.

The following table, Table 1, shows the energy of the second level in different io

Element		E_n /
lithium	3	4.9×1
[illegible]	6	2.0×1

Table 1

3.1 Ca the magnitude of the constant R_E.

3.2 Give the SI fundamental units for the constant R_E.

3.3 The passage says that 'n = 1 represents the ground state'.

Explain what being the ground state means.

3.4 The ground-state energy of ion X is four times that of ion Y.

Determine the ratio of number of protons of X and Y.

3.5 Show that the frequency of a photon released as an electron drops fro directly proportional to $\frac{1}{m^2} - 1$.

3.6 Using the data in Table 1, discuss the visibility of the photons emitted b second to the ground state.

4 Figure 5 shows data on the intensity of sunlight at different wavelengt

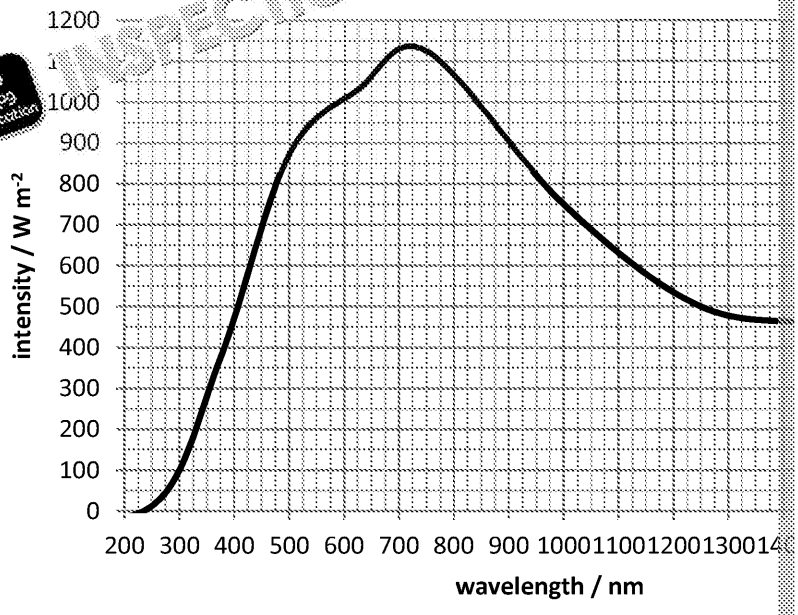


Figure 5

4.1 Calculate the power incident on a 5.0 m^2 solar panel tuned specifically to t

4.2 Estimate the number of photons of this wavelength incident on the sol

4.3 The cell outputs 10 V, 30 A electricity.

Calculate its efficiency.

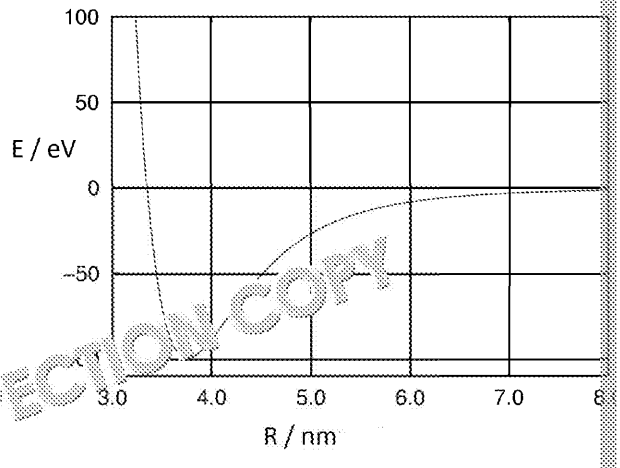
4.4 The compa panel wants to sell it for fitting to the roofs o

St pieces of extra information about how the panels collect sun

Section C

For each question, choose the correct answer.

5 What is the energy at a range of 5.0 nm?



A −25 eV
B −75 eV
C 3.4 eV
D 4.5 eV

6 Which of these is **not** a quantum number?

A baryon number
B lepton number
C strangeness
D linear momen

7 A Σ^+ baryon has a charge of +1 and a strangeness of −1. What is its qua

A uds
B uus
C dss
D uud

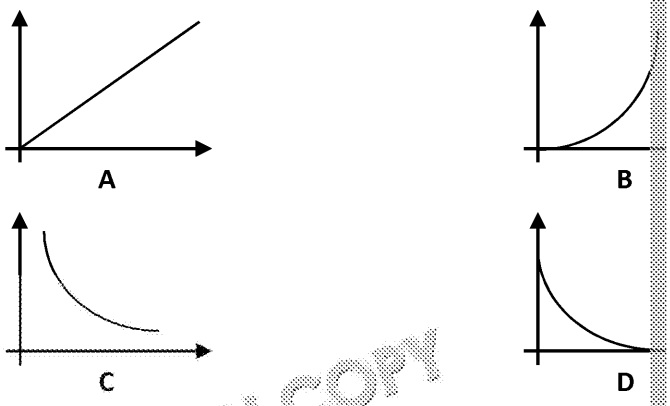
8 What is the stopping potential for 3.2×10^{-19} J electrons?

A 5.1×10^{-38} V
B 3.2×10^{-19} V
C 2.0 V
D 3.5×10^{11} V

9 Which of these is **not** a possible result of an electron hitting an atom?

A an orbital electron is promoted to a higher energy level
B an orbital electron is knocked out of the atom
C the atom gains kinetic energy
D the electron is captured to create a ... ti... on

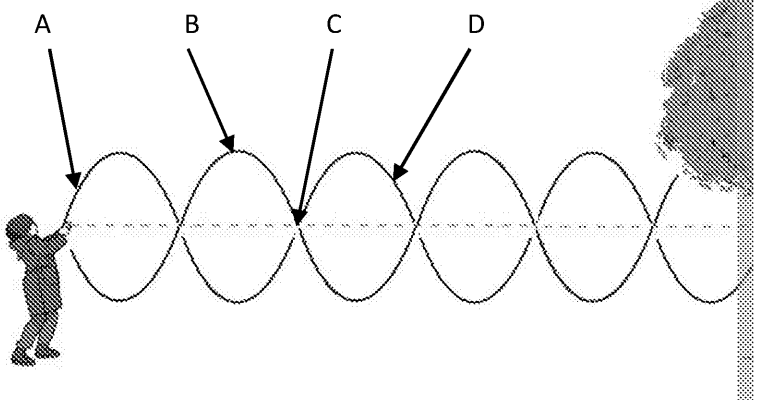
10 Which graph shows the de Broglie wavelength of an electron against its



11 The phase difference between two points on a wave is 4.7 radians. What fraction of a cycle?

A 1
B ¼
C ½
D ¾

12 Which of these points shows an antinode?



13 A ball of string has a mass of 0.0025 kg m^{-1}. How long is the piece of string 200 Hz when a tension of 12 N is applied?

A 12 cm
B 17 cm
C 35 cm
D 60 cm

14 Which one of these is a sensible precaution to take specifically when using in school laboratories?

A wear gloves
B cover reflective surfaces with cloth
C tie your hair back
D keep ice on standby

15 Light with a wavelength of 500 nm is incident on a diffraction grating with maximum number of orders visible?

A 4
B 5
C 6
D 7

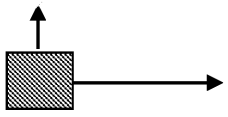
16 Which of these lines best matches refraction from a low to a high refra

	angle of incidence	angle of refraction
A	20°	24°
B	30°	32°
C	40°	36°
D	50°	50°

17 Which of these objects is **not** in equilibrium?

A a bullet being fired
B a suitcase balanced on its end
C a car travelling at its top speed in a straight line
D a motor spinning at a constant frequency

18 Two forces are applied to an object as shown.



Which of these forces would balance those in the diagram?

A

B

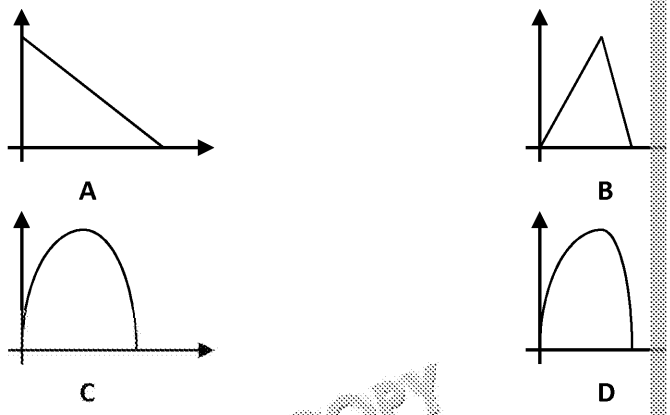
C

D

19 What is the magnitude of the horizontal resultant of these vectors?

A 25 N
B 30 N
C 35 N
D 45 N

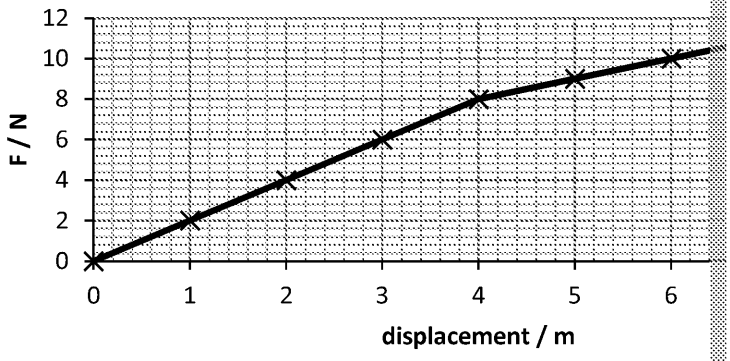
20 Which of these graphs shows the trajectory of a ball thrown with air re



21 Which of Newt[illegible]ys that the magnitude of the force I apply to ma[illegible]force the ground applies on me?

A [illegible]ton's First Law of Motion
B [illegible]ewton's Second Law of Motion
C Newton's Third Law of Motion
D Newton's Law of Universal Gravitation

22 This graph shows the force applied to an object against its displacemen



A 48 J
B 56 J
C 72 J
D 96 J

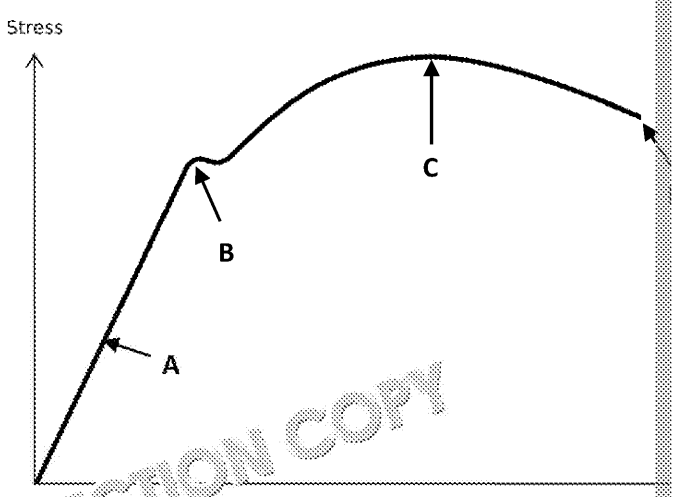
23 A 2.3 kg ball is dropped from a height of 12 m. How much kinetic energ the ground?

A 28 J
B 140 J
C 170 J
D 270 J

24 A spring is 2.3 cm [illegible] it [illegible]. When 5.0 N is hung from it, it stretches

A 0.44 N [illegible]
B [illegible] N cm^{-1}
C 2.3 N cm^{-1}
D 11 N cm^{-1}

25 Which of these points marks the maximum tensile stress of this materi



26 C[illegible] the volume of air that would have a mass of 60 kg. The densit

A [illegible]020 m^3 **C** 72 m^3

B 50 m^3 **D** 800 m^3

27 Which of these must be kept constant when carrying out an experimen modulus of a material?

A force applied **C** temperature

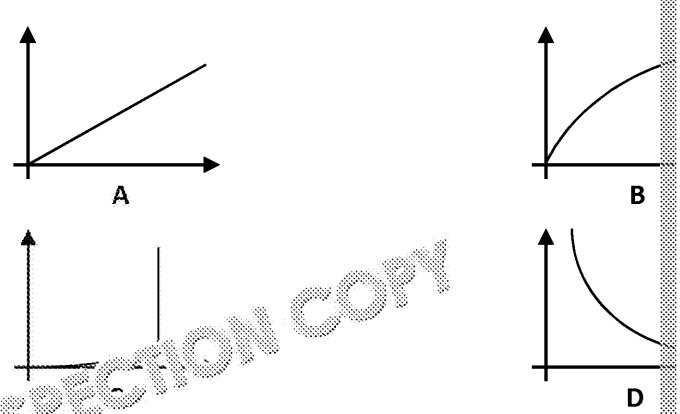
B air pressure **D** the person do

28 A current of 20 A flowed through a resistor for 45 s. How much charge

A 0.44 C **C** 27 C

B 2.3 C **D** 900 C

29 Which of these graphs shows the voltage against current for a semicon



30 What is the critical temperature of a superconductor?

A the temperature below which it has zero resistivity

B the temperature above which it has zero resistivity

C the only temperature at which it has zero resistivity

D the temperature at which it melts

31 How much energy is dissipated in a 6.0 V bulb supplied with 2.0 A for 2

A 6.0 J
B 24 J
C 360 J
D 1400 J

32 What is the combined resistance of a 1.0 Ω, 2.5 Ω and 3.6 Ω resistor in

A 0.60 Ω
B 0.74 Ω
C 1.4 Ω
D 1.7 Ω

33 A cell with an emf of 1.5 V is connected to a load of 3.2 Ω. A current of internal resistance of the cell.

A 0.26 Ω
B 2.2 Ω
C 3.9 Ω
D 10 Ω

34 Wh[illegible]f t[illegible]e best estimate for the volume of a person's head?

A [illegible] m
B [illegible] m^3
C $10^{-3}\ m^3$
D $10^{-1}\ m^3$

Insert for Paper 2B

Question 2

The variation of pressure, p, with temperature, θ, is shown in Figure 3.

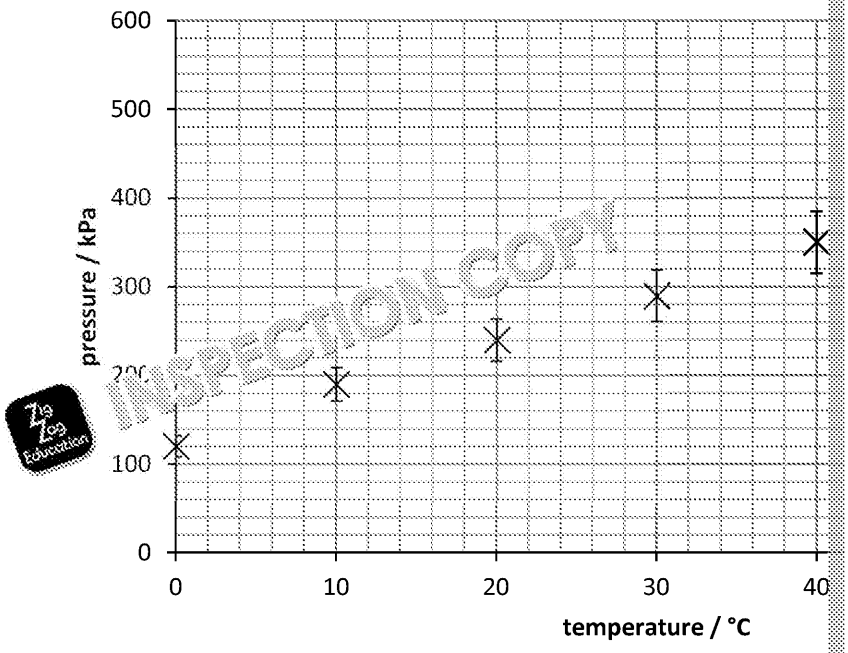


Figure 3

2.1 On the graph above, draw a line of best fit for these data.

Preview of Questions Ends Here

Mark Scheme

Paper 2A

Section A

Question	Answers	Additional C
1.1	21.8 – 11 ✓ = 10.8 ✓ cm	May be taken from any two e some idea of measuring with the printed ruler must be sho which are not next to the prin Allow ±0.2 cm on final result.
1.2	0.1 cm / 1 mm	
1.3	0.90%	ECF from 1.1 and 1.2 Expect answer in range 0.89–0
1.4	Hard to judge bottom of [illegible] measure from fixed point Adjust to bottom of ruler ✓	
1.5	[illegible]ns ✓	
1.6	$\frac{}{65} \times 100 + 0.90$ ✓ = 8.6%✓	ECF from 1.3 Expect answer in range 8.5–8
2.1	Line of best fit on graph	Judge by eye – will end up arc
2.2	Triangle drawn on graph ✓ Calculation of gradient ✓ Answer correct for their values ✓ $m^{-1} s^{-1}$✓	At least 0.0003 across E.g. 6.2/0.0004 E.g. 15 500 NB: must show rounding
2.3	Worst best-fit line gradient calculated ✓ Difference from best-fit value calculated ✓	Alternatively, half the differen lowest worst best-fit line grad E.g. 5.4/0.0004 = 13 500 OR 6 Allow in range 1000–2000
2.4	$\frac{16\,000}{0.23 \times 9.8} = 7800 - \rho_{oil}$✓ $\rho_{oil} = 700$ ✓ kg m^{-3}	
2.5	Any 1 of: Would require reading gradient to 3sf Line of best fit can't be drawn accurately enough	

Section B

Question	Answers	Additional C
3.1	$\frac{1288 \times 10^3}{5.676 \times 10^{23}}$ ✓ = 2.269×10^{-18} ✓ s^{-1} ✓	
3.2	(his) experiments gave [illegible] proof OR it was such a [illegible] it was only accurate [illegible] evidence	Accept a clear argument abou American/English-speaking ar spread of his work
3.3	[illegible] = $\frac{}{c}$✓ Identifies that H_0 and c are constants ✓	
3.4	4.293×10^{-3}	No units
3.5	$\Delta\lambda = 4.293 \times 10^{-3} \times 656 \times 10^{-9}$ ✓ $= 2.816 \times 10^{-9}$ ✓ m i.e. 10^{-12} resolution ✓	
4.1	$\frac{5}{0.25}$ ✓= 20 ✓ N	
4.2	1.6 (m)	

Question	Answers	Additional
4.3	1.3 (ms^{-1})	
4.4	20×1.3 ✓ = 26 ✓ W	
4.5	2×6 ✓ = 12 ✓ W	
4.6	$\frac{12}{26} \times 100$ ✓ = 46% ✓	Bald 0.46 scores 1 mark

Section C

Question	Answers	Marks	Question	Answers	Marks	Q
5	B	1	15	C	1	
6	A	1	16	A	1	
7	B	1	17		1	
8	C	1		D	1	
9	D	1	19	C	1	
10	A	1	20	A	1	
11	D	1	21	C	1	
12	A	1	22	D	1	
13	A	1	23	B	1	
14	B	1	24	B	1	

Preview of Answers Ends Here