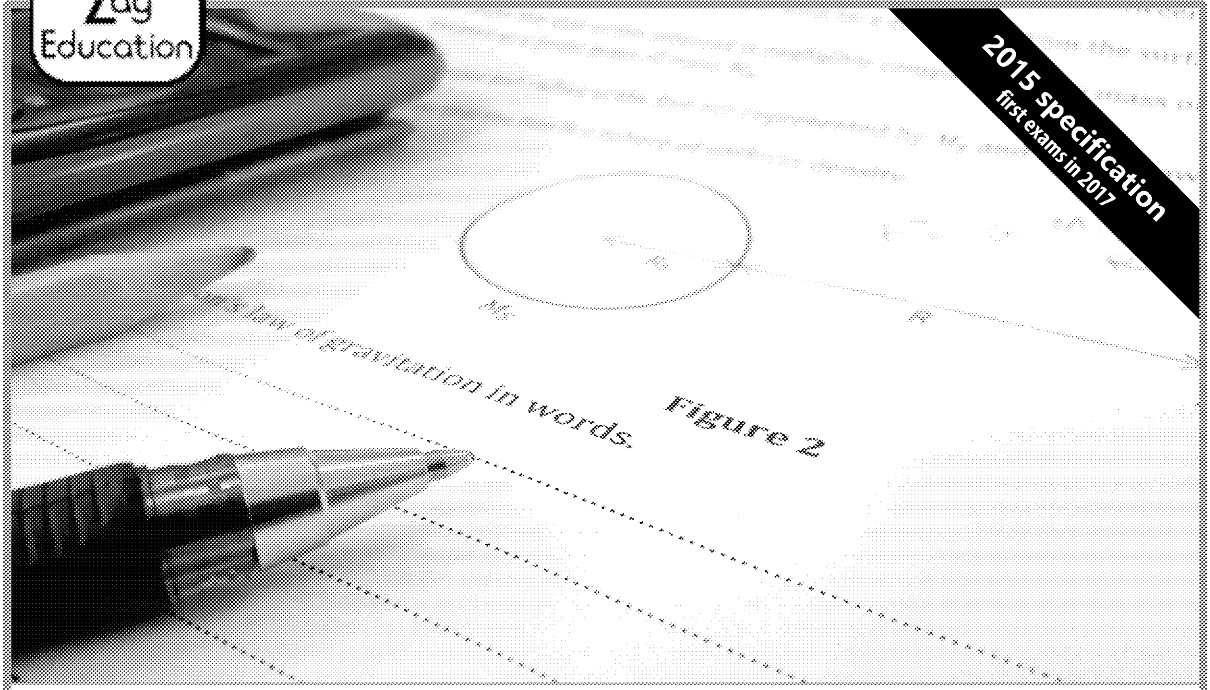
Physics A Level | AQA | 7408



Practice Exams for A Level AQA Physics

Paper 2

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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 2.

Each paper consists of a Section A, with questions that require written answers totalling 60 marks, and a Section B, with multiple choice questions totalling 25 marks, for a total of 85 marks per paper.

Each paper 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.

T Brown & S Khonji, April 2017

Specification Cross-refere

Paper:	1 (A)	1 (B)	1 (C)	1 (D)	2 (A)	2 (
1 Measurements and their errors						
1.1 Measurements and their errors						
1.1.1 Use of SI units and their prefixes			3			3
1.1.2 Limitation of physical measurements	3	3, 6		6, 27	2	
1.1.3 Estimation of physical quantities				4, 6	1, 15	1
2 Particles and radiation						
2.1 Particles						
2.1.1 Constituents of the atom	1	9	9	9	5, 6, 29	
2.1.2 Stable and unstable nuclei	1, 10					
2.1.3 Particles, antiparticles and photons	6		11	5		
2.1.4 Particle interactions	1, 6	10	8, 10	7		
2.1.5 Classifications of particles	6	5	8	29		3
2.1.6 Quarks and antiquarks	6	11		7		
2.1.7 Applications of conservation laws	6	1, 11	8, 10			
2.2 Electromagnetic radiation and quantum phenomena						
2.2.1 The photoelectric effect	7, 8	7	4			
2.2.2 Collisions of electrons with atoms		5	7			
2.2.3 Energy levels and photon emission	9	8				
2.2.4 Wave–particle duality		5,7	4	10	6	

Paper:	1 (A)	1 (B)	1 (C)	1 (D)	2 (A)	2 (
3 Waves						
3.1 Progressive and stationary waves						
3.1.1 Progressive wave	15		1	[illegible], 13		
3.1.2 Longitudinal and transverse waves	11, 12	2	1	11, 14		
3.1.3 Principle of superposition of waves and formation of stationary waves	4	2	13			
3.2 Refraction, diffraction and interference						
3.2.1 Interference	5, 13	15	5	12		
3.2.2 Diffraction	5	5, 16	5, 15	10		
3.2.3 Refraction at a plane surface		12, 13, 14	12, 14, 16	3, 15		
4 Mechanics and materials						
4.1 Force, energy and momentum						
4.1.1 Scalars and vectors	2, 16, 19	20	6, 19		7	
4.1.2 Moments	17	18	22	6		
4.1.3 Motion along a straight line	2, 19, 21	1, 6	6, 17, 20, 21	1, 17, 20, 21	21	3
4.1.4 Projectile motion	2, 20	20	6			3,
4.1.5 Newton's laws of motion	2, 16	22	6		7, 9, 10	3
4.1.6 Momentum	[illegible]	[illegible], 19	18	1, 16, 19		
4.1.7 Work, energy and power	18	1, 6, 21, 22	6	2, 18	10	
4.1.8 Conservation of energy	18, 19	1, 3, 17	4	6	3, 5	6
4.2 Materials						
4.2.1 Bulk properties of solids	3, 23, 24, 25	3, 23, 24	2, 23	2, 22, 23, 24	2	
4.2.2 The Young modulus	3	25	2, 23, 24	22		

Paper:	1 (A)	1 (B)	1 (C)	1 (D)	2 (A)	2 (
5 Electricity						
5.1 Current electricity						
5.1.1 Basics of electricity	4, 28	4, [illegible]	[illegible]	4	18	
5.1.2 Current–voltage characteristics	[illegible]	4	3	25, 27		
5.1.3 Resistivity	27		3	28	2	
5.1.4 Circuits	4, 28	4, 28	25, 26	4, 26	24	1
5.1.5 Potential d[illegible]		4	28			
5.1.6 Electromotive force and internal resistance	4		27	4, 26		
6 Further mechanics and thermal physics						
6.1 Periodic motion						
6.1.1 Circular motion	29				6, 7, 8, 9, 10	
6.1.2 Simple harmonic motion	30			1	4, 17	6,
6.1.3 Simple harmonic system	31			1	4	6, 8
6.1.4 Forced vibrations and resonance					4	
6.2 Thermal physics						
6.2.1 Thermal e[illegible]		1, 29			19	1
6.2.2 Ideal gases		30				6, 1 11,
6.2.3 Molecular kinetic theory model		31				12, 15

Paper:	1 (A)	1 (B)	1 (C)	1 (D)	2 (A)	2 (
7.5 Magnetic fields						
7.5.1 Magnetic flux density						5
7.5.2 Moving charges in a magnetic field			21	29	6	27
7.5.3 Magnetic flux and flux linkage						5
7.5.4 Electromagnetic induction					21, 22	5, 2
7.5.5 Alternati[illegible]s				*4*	23	26
7.5.6 The operat[illegible] a transformer					24, 25	
8 Nuclear physics						
8.1 Radioactivity						
8.1.1 Rutherford scattering					5	31
8.1.2 α, β and γ radiation					26, 28	2
8.1.3 Radioactive decay	1, 9		30		29	2, 2
8.1.4 Nuclear instability		8			27, 30	
8.1.5 Nuclear radius					5	
8.1.6 Mass and energy			31			
8.1.7 Induced fission					31	30
8.1.8 Safety as[illegible]	1				31	2

Paper:	1 (A)	1 (B)	1 (C)	1 (D)	2 (A)	2 (
7 Fields and their consequences						
7.1 Fields						
Fields					11, 15	19
7.2 Gravitational fields						
7.2.1 Newton's law			29		3	
7.2.2 Gravitational field strength					11, 12	
7.2.3 Gravitational potential					3, 11, 12, 13	16,
7.2.4 Orbits of planets and satellites					3, 14	17,
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7.3.2 Electric field strength			30		1, 17	3
7.3.3 Electric potential						3, 20
7.4 Capacitance						
7.4.1 Capacitance						4
7.4.2 Parallel plate capacitor						4
7.4.3 Energy stored by a capacitor					2	24
7.4.4 Capacitor charge and discharge					2, 18, 19, 20	23,

ZigZag Practice Exam Papers

Supporting A Level AQA Physics

Practice Exam Paper 2

Set 2

Name	

Time allowed

2 hours

Instructions

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

Information

The total marks available for this paper is **85**. 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)

Section A

*Answer **all** questions in this section.*

1. A kettle contains 250 g of water at an initial temperature of 7 °C. It supplies t
rate of 560 W. The kettle automatically switches off when all of the water has r

1.1 The specific heat capacity of water is 4200 J kg^{-1} K^{-1}.
Explain the meaning of this statement.

....

....

1.2 Calculate how long it takes fo[r the te]mperature of the water to reach

1.3 A fault develops in the kettle and it fails to switch off. It continues to h
of the water has reached 100 °C. Calculate the percentage mass of wa
in that time. Assume there is no temperature change during this proc

The specific latent heat of vaporisation of water = 2.3×10^6 J kg^{-1}.

1.4 Discuss what happens [to the kin]etic, potential and internal energies o

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2. A student performs an experiment to determine how the intensity of γ ra
from a source of γ radiation.

The student moves a radiation detector to different distances from the ra

2.1 The intensity of γ radiation detected 1.00 m away from the source is
γ radiation will the student detect 4.50 m away from the source?

2.2 The student detects a higher amount of radiation than predicted fron
Explain why this is the case, and suggest a method the student could

2.3 The student states that it is possible to determine when a specific nu

Explain why the student is incorrect.

2.4 State one safety precaution the student should take to minimise the r
source of γ radiation.

2.5 The student's teacher tells them that other types of radiation are mor
the radiation given off by the source the student is using.

Explain why this is the case.

2.6 Despite the dangers that radiation presents, the use of radiation in th
common in medicine.

Give **two** precautions that must be taken into account when using rac

1...

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2...

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3. **Figure 1** shows an electron moving horizontally at a speed of 4.45×10^6 m
between two parallel charged plates, separated by a distance of 5.00 cm an
of 84.5 V.

Ignore gravitational and relativistic effects.

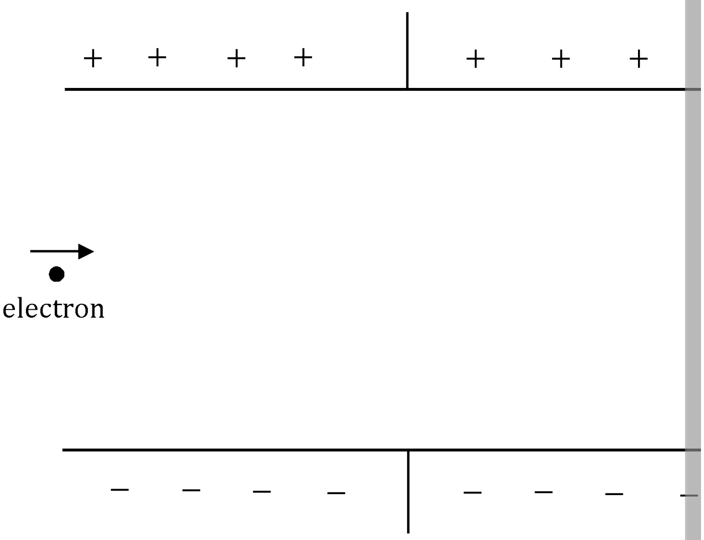

Figure 1

3.1 On **Figure 1**, sketch the path taken by the electron as it travels in bet

3.2 Explain how, if at all, the acceleration of the electron changes in betw

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3.3 The electron travels in and out of the plates in 1.40×10^{-8} s.

Calculate the maximum vertical speed reached by the electron.

3.4 Explain how th... p... would be different if the electron was replaced

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4. A parallel plate capacitor consists of two metal plates separated by a distanc

4.1 Define the capacitance of a capacitor.

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4.2 Explain how the rotation of polar molecules in the dielectric in a capa capacitance of the capacitor.

You may use a diagram to help explain your answer.

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4.3 A capacitor has a capacitance of 3.70 pF.

The two metal plates have an area of 4.28 cm² and are 8.14 mm apart

Calculate the relative permittivity of the dielectric in between the tw

5. **Figur** ow shows a rotating rectangular coil of wire in a uniform ma

- θ i angle between the normal to the cross-section of the coil of wire
- The cross-sectional area of the coil of wire is 0.348 m².
- The coil of wire contains 30 turns.
- The magnetic field strength of the uniform magnetic field is 0.0822 T

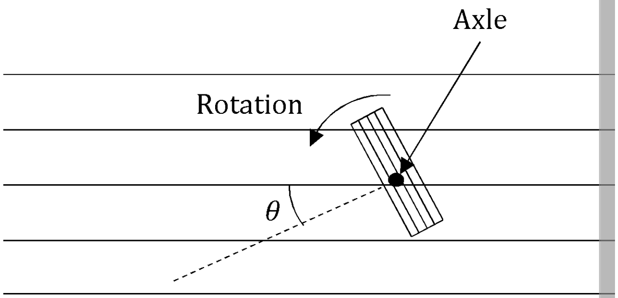

Figure 2

5.1 State Faraday's law.

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5.2 Calculate the magnetic flux of the coil.

5.3 Calculate the magnetic flux linkage of the coil when $\theta = 26.6$ °.

5.4 On **Figure 3** below, draw the graph of magnetic flux linkage in the co
with respect to the magnetic field as the coil rotates.

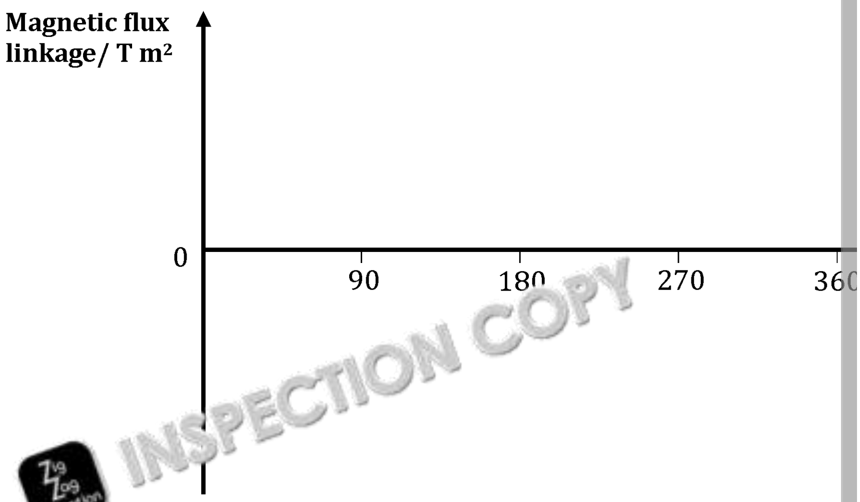

Figure 3

5.5 The magnetic flux of the coil changes by 0.549 T m^2 over the course o

Calculate the average emf induced in the coil.

5.6 The coil is turned through 90° so that the cross-section of the coil is f
Figure 2, with the axle parallel to the direction of the magnetic field.

How does this affect the emf generated in the coil as it rotates? Expla

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6. Read the following passage and answer the questions that follow.

A pendulum clock uses a swinging mass on the end of a rod, which acts a to keep track of the time. The 'seconds pendulum' is a particular type of length l in which each swing takes 1.00 s, meaning the time period of the

The error in the timekeeping of the clock increases with the amplitude o manufacturer of 'seconds pendulums' ensures that the perpendicular dis equilibrium position is limited to 5.50 cm. This limits the maximum angl equilibrium position, θ, as shown by Figure 4.

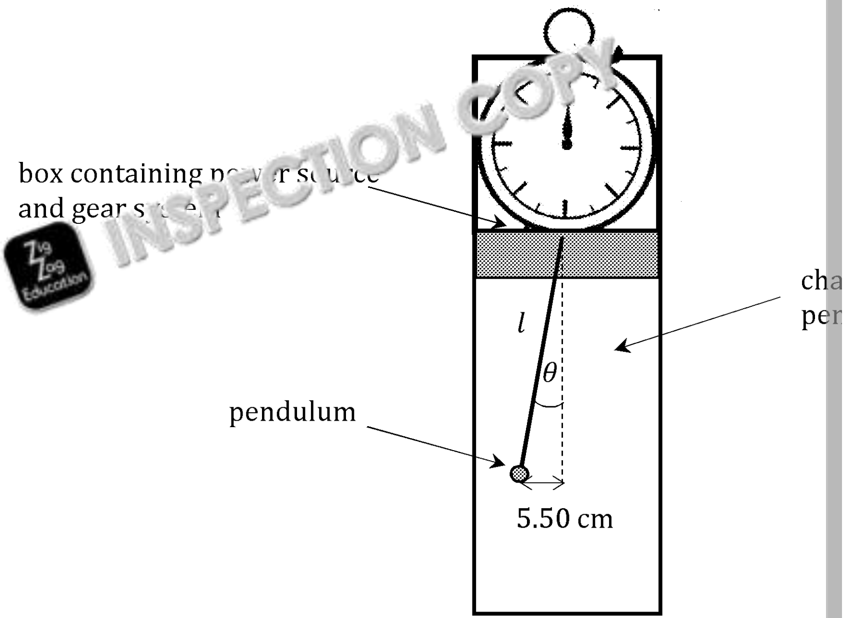

Figure 4

The chamber is at a low pressure because it has had as much air pumpec

Another source of error arises from thermal expansion, and so the manu rod out of wood instead of metal, as wood expands less than metal at a g therefore, also necessary to keep the clock in low-humidity conditions.

6.1 The condition for simple harmonic motion is $a \propto -x$.
State the significance of the negative sign in this relationship.

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6.2 Describe how th[illegible] energy of the pendulum changes at it swing to it[illegible] position.

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6.3 Calculate the length of the pendulum, l, shown in **Figure 4**.

6.4 Suggest why the manufacturer pumps air out of the chamber.

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6.5 Explain how thermal expansion of the rod causes error in the timeke

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6.6 Show that the restoring force for the pendulum in **Figure 4** above is

Section B

Each question in Section B is followed by four options: A, B, C and D.
*For each question, select **one** correct answer by shading the box alongside the a*

7. Which of the following gives the phase difference between the velocity an harmonic oscillator?

   A. 45°
   B. 90°
   C. 180°
   D. 360°

8. A mass is attached to a spring and displaced so that it oscillates until all o removed by light damping.

   Which of the following statements about the oscillations of the mass-sprin

   A. The oscillations are forced oscillations
   B. The equilibrium position of the system does not change throughout
   C. The amplitude of the oscillations gradually decreases
   D. It oscillates at its natural frequency

9. What type of damping, if any, will cause a system to resonate at the highest f

   A. Light damping
   B. Heavy damping
   C. No damping
   D. The effect does not depend on damping

10. A sealed box contains nitrogen molecules. If more nitrogen molecules are escaping, and the temperature inside the box is kept constant, what happ of the molecules and the average force on the walls of the box?

	Average speed of molecules inside the box	Average force o
A	Increases	Incr
B	Increases	Remains
C	Remains the same	Incr
D	Remains the same	Remains

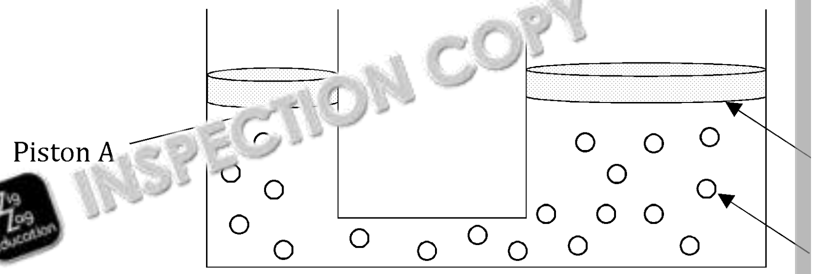
11. Neon is a monatomic gas with a molar mass of 20.2 g mol^{-1}. What is the w

   A. 3.[illegible] $\times 10^{-25}$ N
   B. 19.[illegible] $\times 10^{-2}$ N
   C. 3.36×10^{-26} N
   D. 1.65×10^{-25} N

12. When observed under a microscope, smoke particles suspended in air ca
unpredictably and at a high speed. Which of the following describes this t

A. Simple harmonic motion
B. Parabolic motion
C. Periodic motion
D. Brownian motion

13. A U-shaped tube filled with air particles and sealed off by two different si
The cross-sectional area of piston B is double the cross-sectional area of p



Which of the following statements about the pressure experienced by eac

A. Piston A experiences double the pressure of piston B
B. Piston B experiences double the pressure of piston A
C. Both piston A and piston B experience the same pressure
D. More information is needed to compare the pressure experienced by

14. An ideal gas particle with an initial momentum p_i strikes the wall of a con
bounces off with a momentum p_f. Which of the following gives the correc

A. p_i and p_f are equal in magnitude, but the direction of p_f is random
B. p_i and p_f are equal in magnitude but in opposite directions
C. The magnitude of p_f is less than the magnitude of p_i, and they are in
D. The magnitude of p_f is greater than the magnitude of p_i, and the dire

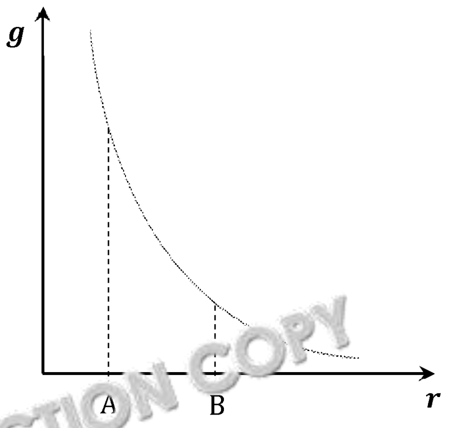
15. The speeds of three molecules contained within a cylinder are shown in t

Molecule number	Speed/ m s^{-1}
1	702
2	567
3	218

What is the root mean square speed of the molecules inside the cylinder?

A. 928 m s^{-1}
B. 496 m s^{-1}
C. 536 m s^{-1}
D. 859 m s^{-1}

16. A graph showing the variation of gravitational field strength, g, with dista
shown below. Two points A and B with different values of r are indicated



What represents the potential difference between point A and point B on

A. The difference in the magnitude of the gradient of the line at each poi
B. The area under the graph between the two points
C. The gradient of the tangent connecting the value of g for each point
D. The potential difference between point A and point B is not represen

17. A satellite kept in a geostationary orbit will always be the same distance f

What is the orbital period of a satellite in orbit at a distance of 2 d from th

A. 8.00 days
B. 2.00 days
C. 1.59 days
D. 2.83 days

18. Which of the following statements about equipotential surfaces in gravita

Statement 1: It is possible to have equipotential surfaces around a poi from the point mass
Statement 2: No work is done in moving between different equipotent
Statement 3: No work is done when moving along an equipotential su

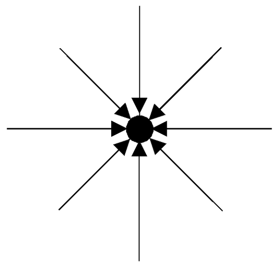
A. 1, 2 and 3
B. Only 1 and 2
C. Only 2 and 3
D. Only 1 and 3

19. A satellite is in orbit around the Earth at a height of 2,000 km above the s
escape velocity of the satellite?

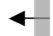
A. 9760 m s^{-1}
B. 95.1×10^6 m s^{-1}
C. 20,000 m s^{-1}
D. 11,100 m s^{-1}

20. Which of the diagrams below shows the equipotential surfaces of an elect
isolated positively charged sphere?

A.

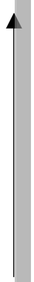


B.



C.

D.



21. How much force is required to move a point charge of 7.5 C by 12 cm thro

A. 130 N
B. 1000 N
C. 120 N
D. 14.4 N

22. Two charged spheres are hanging suspended in the air, 1.20 m apart, as s

The charge on sphere A is +25.0 C and the charge on sphere B is −30.0 C.

The diameter of each sphere is 10 cm.

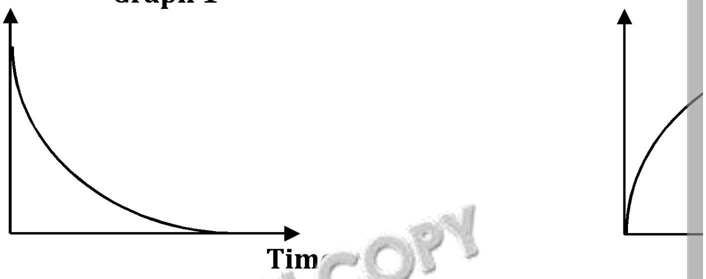
What is the magnitude of the electrostatic force that the charged spheres

A. 4.[illegible] N
B. 3.[illegible] 10^{12} N
C. 3.99×10^{12} N
D. 5.19×10^{12} N

23. A capacitor is charged through a resistor for a fixed time.

Which of the graphs below could apply to the potential difference across t
through the resistor **as the capacitor charges**?

Graph 1



	Potential difference across resistor	Current thr
A	Graph 1	Gr
B	Graph 1	Gr
C	Graph 2	Gr
D	Graph 2	Gr

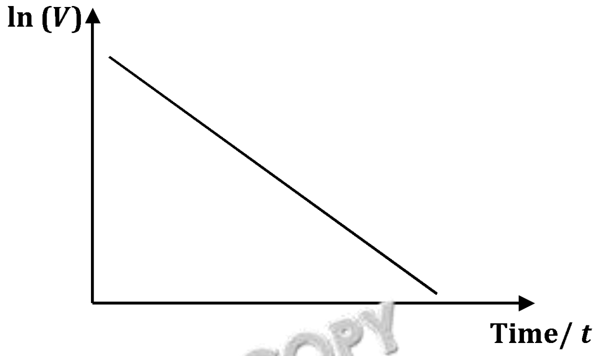
24. A capacitor with capacitance C can store a maximum energy of E and a m
capacitor is placed into a circuit so that there is a potential difference V ac

The capacitor is replaced with a different capacitor with a capacitance of

What is the maximum stored energy and maximum capacity of a capacito
the potential difference across the plates is V?

	Maximum stored energy	Maximum
A	E	
B	$2\,E$	
C	$2\,E$	
D	$4\,E$	

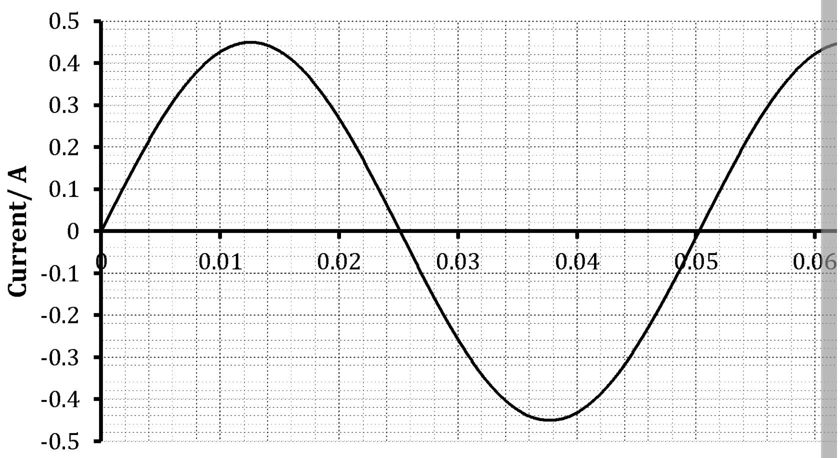
25. The graph below shows the natural log of potential difference (V) against discharged through a resistor.



What does the gradient of the graph represent?

A. Inverse of the time constant of the capacitor
B. Resistance of the resistor
C. Inverse of the capacitance of the capacitor
D. Current through the resistor

26. An oscilloscope measures an AC current over time, as shown below.



Calculate the average power loss of this AC current as it passes through a

A. 613 W
B. 1230 W
C. 1930 W
D. 2720 W

27. What requirements must be met for a charged particle with speed v to tra

A. Path perpendicular to magnetic field
B. Path perpendicular to electric field
C. Path perpendicular to magnetic field and electric field
D. Path perpendicular to magnetic field and parallel to electric field

28. Three blocks with identical dimensions and densities, but made from diff
through identical copper tubes at the same time.

Block A is made out of copper with a resistivity of $1.68 \times 10^{-8}\ \Omega$ m.
Block B is made out of iron with a resistivity of $9.71 \times 10^{-8}\ \Omega$ m.
Block C is made out of silicon with a resistivity of $6.40 \times 10^{2}\ \Omega$ m.

In what order will the blocks emerge from the bottom of the copper tube?

A. Block A, Block B, Block C
B. Block C, Block B, Block A
C. Block B, Block A, Block C
D. All will emerge at the same time

29. The initial activity of a sample of ^{11}Be is 92.4 kBq.

What is the activity of the sample after two minutes?

The decay constant of ^{11}Be is $0.0502\ s^{-1}$.

A. 413 Bq
B. 87.9 kBq
C. 1420 Bq
D. 224 Bq

30. Neutrons elastically collide with moderator molecules in a nuclear reacto

Why does heavy water make a good moderator?

A. Heavy water molecules are large compared to neutrons
B. Heavy water molecules are fast moving
C. Heavy water molecules absorb very little kinetic energy from neutro
D. Heavy water molecules absorb nearly all of the neutrons' kinetic ene

31. In α-particle scattering experiments, alpha particles are fired at gold foil.

What information can be taken from the deflection of α particles from the

A. The atom is mostly empty space.
B. The nucleus is positive.
C. The nucleus contains most of the mass of the atom.
D. Electrons orbit the nucleus.

ZigZag Practice Exam Papers

Supporting A Level AQA Physics

Practice Exam Paper 2

Set 2

Name	

Time allowed

2 hours

Instructions

Answer **all** of the questions.

Information

The total marks available for this paper is **85**. The number of marks available for each question is shown on the right.

For this paper, you will need:

- Data and Formulae and Relationships booklet

Additional materials required

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

Section A

*Answer **all** questions in this section.*

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What intensity of γ radiation will the student detect 4.50 m away fro

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Explain why this is the case, and suggest a method the student could

2.3 The student states that it is possible to determine when a specific nu

Explain why the student is incorrect.

2.4 State one safety precaution the student should take to minimise the r
source of γ radiation.

2.5 The student's teacher tells them that other types of radiation are mo
the γ radiation given off by the source the student is using.

Explain why this is the case.

2.6 Despite the dangers that radiation presents, the use of radiation in th
common in medicine.

Give **two** precautions that must be taken into account when using ra

3. **Figure 1** shows an electron moving horizontally at a speed of 4.45×10^6 m
between two parallel charged plates, separated by a distance of 5.00 cm an
of 84.5 V.

Ignore gravitational and relativistic effects.

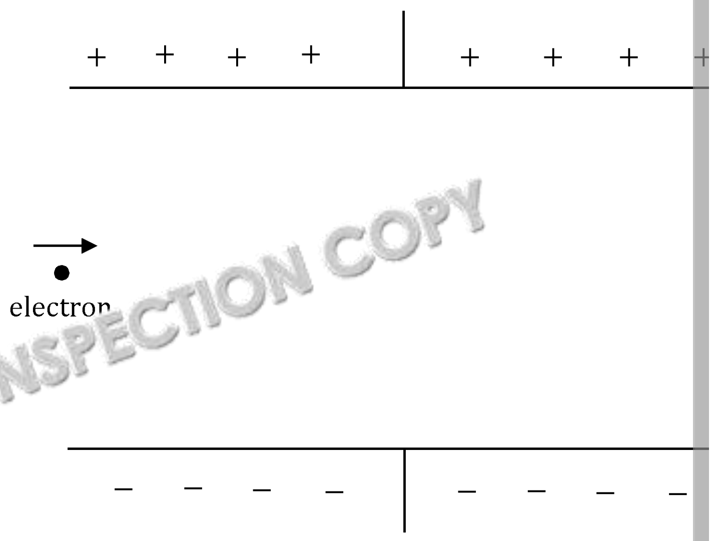


Figure 1

3.1 On **Figure 1**, sketch the path taken by the electron as it travels in bet

3.2 Explain how, if at all, the acceleration of the electron changes in betw

3.3 The electron travels in and out of the plates in 1.40×10^{-8} s.

Calculate the maximum vertical speed reached by the electron.

3.4 Explain how the path would be different if the electron was replaced

4. A parallel plate capacitor consists of two metal plates separated by a distance

4.1 Define the capacitance of a capacitor.

4.2 Explain how the rotation of polar molecules in the dielectric in a capa
capacitance of the capacitor.

You may use a diagram to help explain your answer.

4.3 A capacitor has a capacitance of 3.70 pF.

The two metal plates have an area of 4.28 cm² and are 8.14 mm apart

Calculate the relative permittivity of the dielectric in between the tw

5. **Figure 2** below shows a rotating rectangular coil of wire in a uniform ma

- θ is the angle between the normal to the cross-section of the coil of wire
- The cross-sectional area of the coil of wire is 0.348 m^2.
- The coil of wire contains 30 turns.
- The magnetic field strength of the uniform magnetic field is 0.0822 T

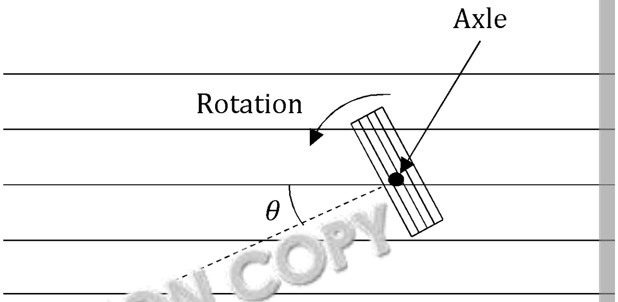


Figure 2

5.1 State Faraday's law.

5.2 Calculate the magnetic flux of the coil.

5.3 Calculate the magnetic flux linkage of the coil when $\theta = 26.6$ °.

5.4 Copy the axes in **Figure 3** and draw the graph of magnetic flux linkag of the coil with respect to the magnetic field as the coil rotates.

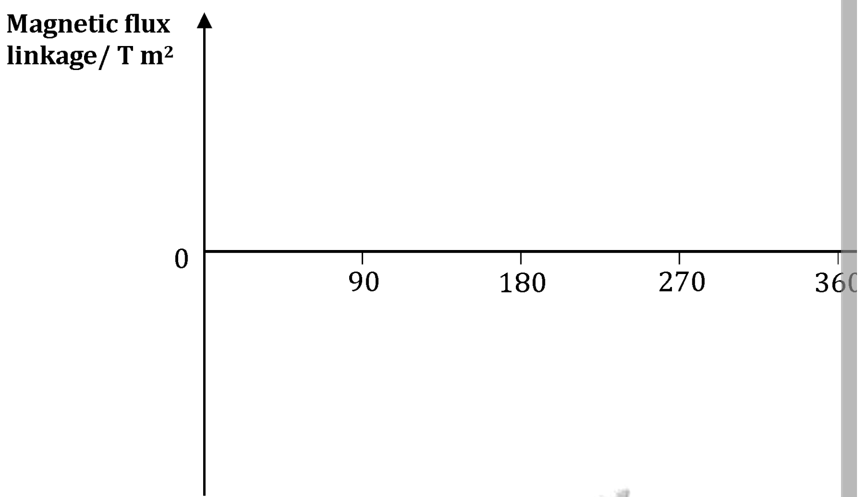


Figure 3

5.5 The magnetic flux of the coil changes by 0.549 T m^2 over the course o

Calculate the average emf induced in the coil.

5.6 The coil is turned through 90° so that the cross-section of the coil is f **Figure 2**, with the axle parallel to the direction of the magnetic field.

How does this affect the emf generated in the coil as it rotates? Expla

6. Read the following passage and answer the questions that follow.

A pendulum clock uses a swinging mass on the end of a rod, which acts a
to keep track of the time. The 'seconds pendulum' is a particular type of p
length l in which each swing takes 1.00 s, meaning the time period of the

The error in the timekeeping of the clock increases with the amplitude o
manufacturer of 'seconds pendulums' ensures that the perpendicular dis
equilibrium position is limited to 5.50 cm. This limits the maximum angl
equilibrium position, θ, as shown by Figure 4.

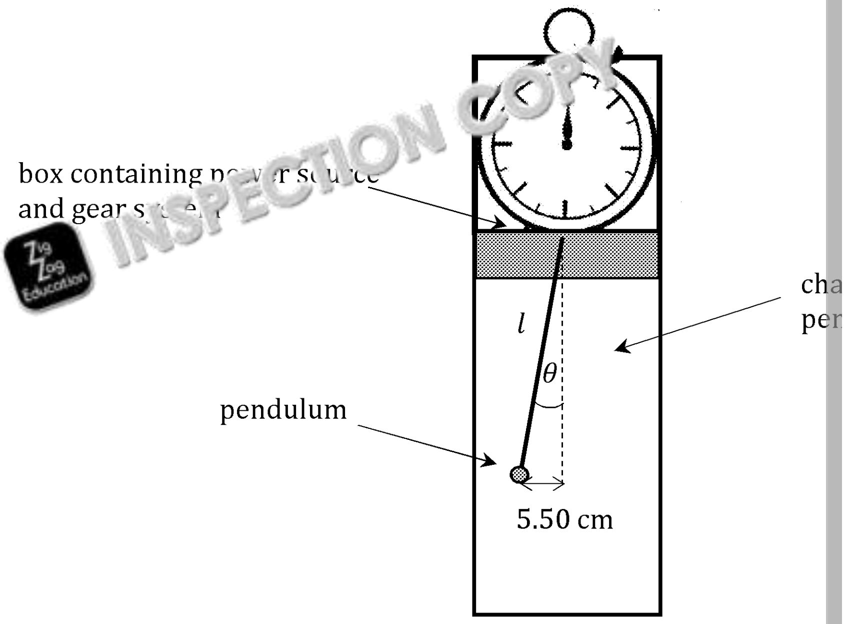


Figure 4

The chamber is at a low pressure because it has had as much air pumped

Another source of error arises from thermal expansion, and so the manu
rod out of wood instead of metal, as wood expands less than metal at a g
therefore, also necessary to keep the clock in low-humidity conditions.

6.1 The condition for simple harmonic motion is $a \propto -x$.
State the significance of the negative sign in this relationship.

6.2 Describe how the kinetic energy of the pendulum changes at it swing
to its equilibrium position.

6.3 Calculate the length of the pendulum, l, shown in **Figure 4**.

6.4 S[illegible] why the manufacturer pumps air out of the chamber.

6.5 Explain how thermal expansion of the rod causes error in the timeke

6.6 Show that the restoring force for the pendulum in **Figure 4** above is

Section B

Each question in Section B is followed by four options: A, B, C and D.
*For each question, select **one** correct answer.*

7. Which of the following gives the phase difference between the velocity an harmonic oscillator?

   A. 45°
   B. 90°
   C. 180°
   D. 360°

8. A mass is attached to a spring and displaced so that it oscillates until all o removed by light damping.

   Which of the following statements about the oscillations of the mass-sprin

   A. The oscillations are forced oscillations
   B. The equilibrium position of the system does not change throughout
   C. The amplitude of the oscillations gradually decreases
   D. It oscillates at its natural frequency

9. What type of damping, if any, will cause a system to resonate at the highest f

   A. Light damping
   B. Heavy damping
   C. No damping
   D. The effect does not depend on damping

10. A sealed box contains nitrogen molecules. If more nitrogen molecules are escaping, and the temperature inside the box is kept constant, what happe of the molecules and the average force on the walls of the box?

	Average speed of molecules inside the box	Average force o
A	Increases	Incr
B	Increases	Remains
C	Remains the same	Incr
D	Remains the same	Remains

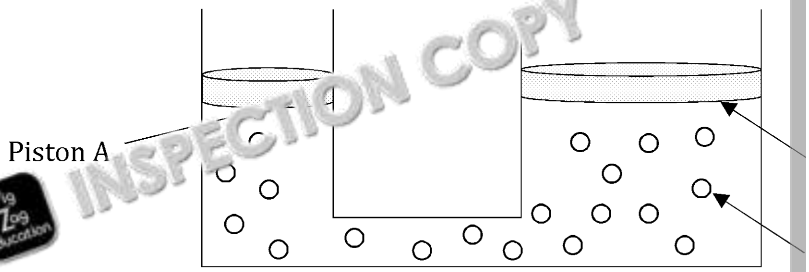
11. Neon is a monatomic gas with a molar mass of 20.2 g mol^{-1}. What is the w

   A. 3.[illegible] $\times 10^{-[illegible]}$ N
   B. 19.[illegible] $\times 10^{-2}$ N
   C. 3.36×10^{-26} N
   D. 1.65×10^{-25} N

12. When observed under a microscope, smoke particles suspended in air ca unpredictably and at a high speed. Which of the following describes this t

A. Simple harmonic motion
B. Parabolic motion
C. Periodic motion
D. Brownian motion

13. A U-shaped tube filled with air particles and sealed off by two different si The cross-sectional area of piston B is double the cross-sectional area of p



Which of the following statements about the pressure experienced by eac

A. Piston A experiences double the pressure of piston B
B. Piston B experiences double the pressure of piston A
C. Both piston A and piston B experience the same pressure
D. More information is needed to compare the pressure experienced by

14. An ideal gas particle with an initial momentum p_i strikes the wall of a con bounces off with a momentum p_f. Which of the following gives the correc

A. p_i and p_f are equal in magnitude, but the direction of p_f is random
B. p_i and p_f are equal in magnitude but in opposite directions
C. The magnitude of p_f is less than the magnitude of p_i, and they are in
D. The magnitude of p_f is greater than the magnitude of p_i, and the dire

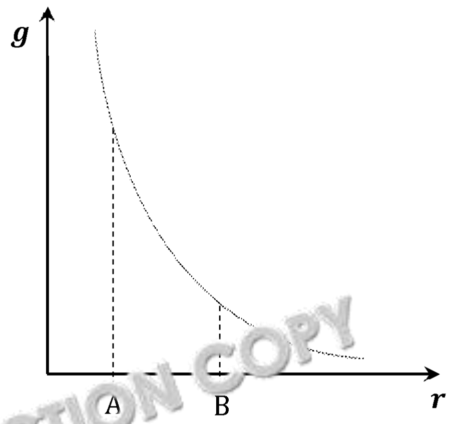
15. The speeds of three molecules contained within a cylinder are shown in t

Molecule number	Speed/ m s^{-1}
1	702
2	567
3	218

What is the root mean square speed of the molecules inside the cylinder?

A. 928 m s^{-1}
B. 496 m s^{-1}
C. 536 m s^{-1}
D. 859 m s^{-1}

16. A graph showing the variation of gravitational field strength, g, with dista
shown below. Two points A and B with different values of r are indicated



What represents the potential difference between point A and point B on

A. The difference in the magnitude of the gradient of the line at each poi
B. The area under the graph between the two points
C. The gradient of the tangent connecting the value of g for each point
D. The potential difference between point A and point B is not represen

17. A satellite kept in a geostationary orbit will always be the same distance f

What is the orbital period of a satellite in orbit at a distance of 2 d from th

A. 8.00 days
B. 2.00 days
C. 1.59 days
D. 2.83 days

18. Which of the following statements about equipotential surfaces in gravita

Statement 1:	It is possible to have equipotential surfaces around a poi from the point mass
Statement 2:	No work is done in moving between different equipotent
Statement 3:	No work is done when moving along an equipotential su

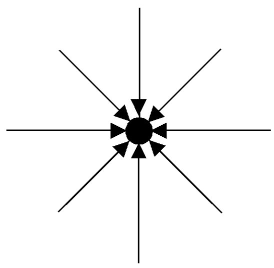
A. 1, 2 and 3
B. Only 1 and 2
C. Only 2 and 3
D. Only 1 and 3

19. A satellite is in orbit around the Earth at a height of 2,000 km above the su
escape velocity of the satellite?

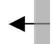
A. 9760 m s^{-1}
B. 95.1×10^6 m s^{-1}
C. 20,000 m s^{-1}
D. 11,100 m s^{-1}

20. Which of the diagrams below shows the equipotential surfaces of an elect
isolated positively charged sphere?

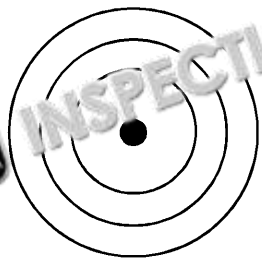
A.



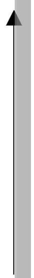
B.



C.



D.



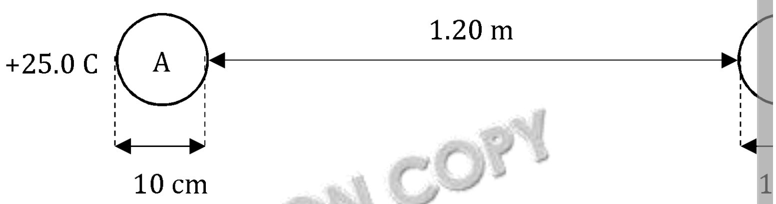
21. How much force is required to move a point charge of 7.5 C by 12 cm thro

A. 130 N
B. 1000 N
C. 120 N
D. 14.4 N

22. Two charged spheres are hanging suspended in the air, 1.20 m apart, as sl

The charge on sphere A is +25.0 C and the charge on sphere B is −30.0 C.

The diameter of each sphere is 10 cm.



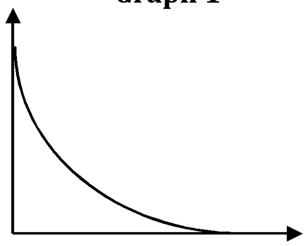
What is the magnitude of th[illegible]static force that the charged spheres

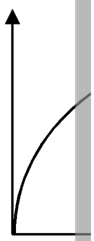
A. 4.68 × 10[illegible] N
B. 3.[illegible] N
C. 3.[illegible]0^{12} N
D. 5.19×10^{12} N

23. A capacitor is charged through a resistor for a fixed time.

Which of the graphs below could apply to the potential difference across t
through the resistor **as the capacitor charges**?

Graph 1





	Potential difference across resistor	Current thr
A	Graph 1	Gr
B	Graph 1	Gr
C	Graph 2	Gr
D	Graph 2	Gr

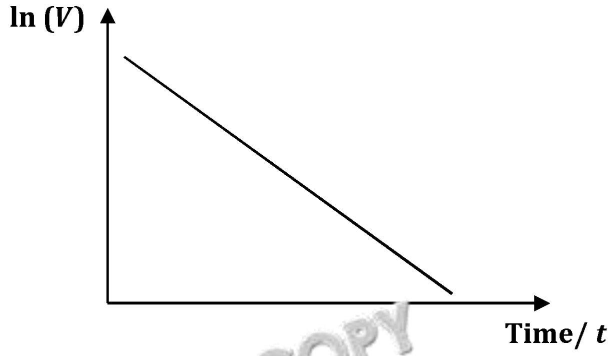
24. A capacitor with capacitance C can store a maximum energy of E and a m
capacitor is placed into a circuit so that there is a potential difference V ac

The capacitor is replaced with a different capacitor with a capacitance of

What is the maximum stored energy and maximum capacity of a capacito
the potential difference across the plates is V?

	Maximum stored energy	Maximum
A	E	
B	$2E$	
C	$2E$	
D	$4E$	

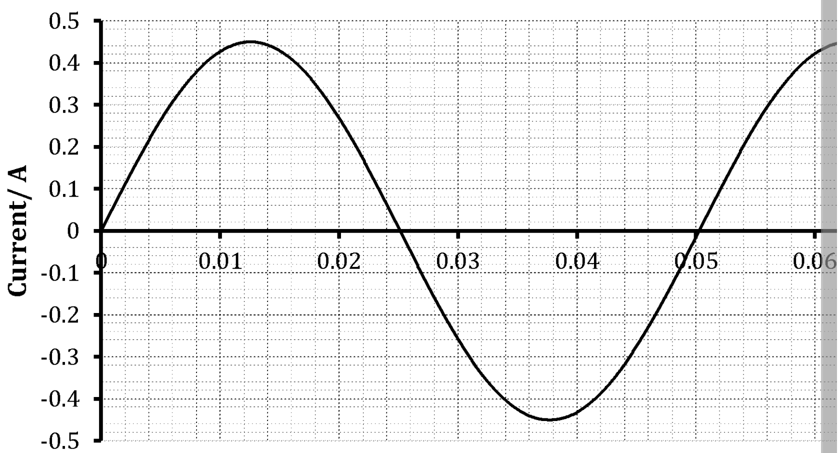
25. The graph below shows the natural log of potential difference (V) against
discharged through a resistor.



What does the gradient of the graph represent?

A. Inverse of the time constant of the capacitor
B. Resistance of the resistor
C. Inverse of the capacitance of the capacitor
D. Current through the resistor

26. An oscilloscope measures an AC current over time, as shown below.



Calculate the average power loss of this AC current as it passes through a

A. 613 W
B. 1230 W
C. 1930 W
D. 2720 W

27. What requirements must be met for a charged particle with speed v to tra

A. Path perpendicular to magnetic field
B. Path perpendicular to electric field
C. Path perpendicular to magnetic field and electric field
D. Path perpendicular to magnetic field and parallel to electric field

28. Three blocks with identical dimensions and densities, but made from diff
through identical copper tubes at the same time.

Block A is made out of copper with a resistivity of 1.68×10^{-8} Ω m.
Block B is made out of iron with a resistivity of 9.71×10^{-8} Ω m.
Block C is made out of silicon with a resistivity of 6.40×10^{2} Ω m.

In what order will the blocks emerge from the bottom of the copper tube?

A. Block A, Block B, Block C
B. Block C, Block B, Block A
C. Block B, Block A, Block C
D. All will emerge at the same time

29. The initial activity of a sample of ^{11}Be is 92.4 kBq.

What is the activity of the sample after two minutes?

The decay constant of ^{11}Be is 0.0502 s^{-1}.

A. 413 Bq
B. 87.9 kBq
C. 1420 Bq
D. 224 Bq

30. Neutrons elastically collide with moderator molecules in a nuclear reacto

Why does heavy water make a good moderator?

A. Heavy water molecules are large compared to neutrons
B. Heavy water molecules are fast moving
C. Heavy water molecules absorb very little kinetic energy from neutro
D. Heavy water molecules absorb nearly all of the neutrons' kinetic ene

31. In α-particle scattering experiments, alpha particles are fired at gold foil.

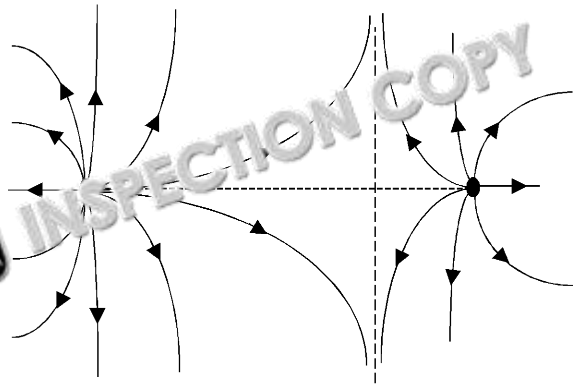
What information can be taken from the deflection of α particles from the

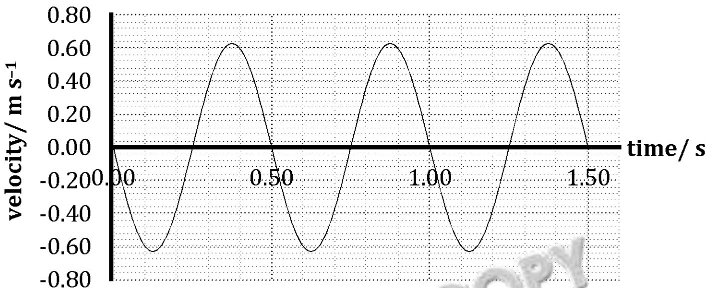
A. The atom is mostly empty space.
B. The nucleus is positive.
C. The nucleus contains most of the mass of the atom.
D. Electrons orbit the nucleus.

Preview of Questions Ends Here

This is a limited inspection copy. Sample of questions ends here to avoid students previewing questions before they are set. See contents page for details of the rest of the resource.

Mark Scheme: Set 1

Question	Answer	Marks
1.1	Force per unit charge ✓ On a positive test charge (placed at that point) ✓	1 1
1.2	Correct shape (radial field lines becoming non-radial at neutral point) ✓ Correct direction (out of charges) ✓ Asymmetrical (neutral point closer to 3.0 nC) ✓ 	1 1 1
1.3	$F = \frac{Q_1 Q_2}{4\pi\varepsilon_0 r^2}$ $F = \frac{6.9\times10^{-9} \times 3.0\times10^{-9}}{4\times\pi\times8.85\times10^{-12}\times(4.7\times10^{-2})^2}$ ✓ $F = 8.4 \times 10^{-5}$ N ✓ Assumption: air treated as a vacuum ✓	 1 1 1
1.4	$\frac{\lvert Q_1\rvert}{4\pi\varepsilon_0 r_1^2} = \frac{\lvert Q_2\rvert}{4\pi\varepsilon_0 r_2^2}$ ✓ $\left\lvert\frac{Q_1}{Q_2}\right\rvert = \frac{r_1^2}{r_2^2}$ $\frac{r_1}{r_2} = \sqrt{\left\lvert\frac{Q_1}{Q_2}\right\rvert}$ ✓ $\frac{r_1}{r_2} = \sqrt{\frac{6.9}{3}}$ $\frac{r_1}{r_2} = 1.5$ ✓	1 1 1
2.1	$\frac{1}{2}ke^2 = \frac{1}{2}CV^2$ $e = \sqrt{\frac{CV^2}{k}}$ ✓ $e = \sqrt{\frac{9.4\times10^{-6}\times4.7^2}{8.49\times10^{-3}}}$ ✓ $e = 0.156$ m ✓	 1 1 1
2.2	[illegible]r t[illegible]e [illegible]nstant ✓ [illegible] longer for capacitor to completely discharge ✓	1 1
2.3	Energy losses through heat, friction, etc. ✓ Capacitor discharge is exponential so will never lose all charge ✓	1 1
3.1	Force directly proportional to product of masses ✓ Inversely proportional to square of distance between the mass centres ✓	1 1
3.2	$F = \frac{GM_S M_A}{(R+R_S)^2}$ ✓	1

Question	Answer	Marks
3.3	$V = -\frac{GM_S}{R_S}$ (from data booklet) $M_s = 1.99 \times 10^{30}$ kg, $R_s = 6.96 \times 10^8$ m $V = \frac{-6.67\times10^{-11}\times1.99\times10^{30}}{6.96\times10^{8}}$ ✓ $V = -1.91 \times 10^{11}$ J kg^{-1} ✓	 1 1
3.4	Work is done when a force on an object causes the object to move in the *direction of the force* ✓ Asteroids orbit in a direction perpendicular to the gravitational force ✓	1 1
3.5	(Gravitational force is proportional to $\frac{1}{r^2}$) If r is halved, the force will be four times stronger ✓ (Gravitational potential is proportional to $\frac{1}{r}$) If r is halved, the potential will be doubled ✓ $T^2 \propto r^3$ ✓ If r is halved, the orbital period will decrease by a factor of $\sqrt{8}$ / orbit will be $^1/_{\sqrt{8}}$ orbital period of original asteroid ✓	 1 1 1 1
4.1	Datalogger (with camera) ✓	1
4.2	(from graph) $A = 0.05$ m, $T = 0.5$ s ✓ $\omega = \frac{2\pi}{T}$ $\omega = \frac{2\pi}{0.5} = 12.57$ rad s^{-1} ✓ $v_{max} = \omega A$ $v_{max} = 12.57 \times 0.05$ $v_{max} = 0.62$ m s^{-1} ✓ (range 0.59 to 0.65)	1 1 1
4.3	Negative *sine* curve with period 0.5 s and $v_{max} = 0.62$ m s^{-1} clearly shown ✓ Correct axis labels ✓ 	1 1
4.4	Amplitude of oscillations increases ✓ As system resonates / undergoes resonance ✓	1 1
4.5	$T = 2\pi\sqrt{\frac{m}{k}}$ [illegible] $\frac{}{T}$ $f = \frac{1}{2\pi\sqrt{\frac{m}{k}}}$ ✓ $f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$ ✓	 1 1
5.1	Reduction of kinetic energy as α particle approaches nucleus ✓ Particles that have been deflected more have made closest approach to nucleus ✓	1 1

Question	Answer	Marks
5.2	Minimum energy to overcome electric potential $\frac{Q_1Q_2}{4\pi\varepsilon_0 r} = E_k$ ✓ $r = \frac{Q_1Q_2}{4\pi\varepsilon_0 E_k}$ $r = \frac{79\times1.60\times10^{-19}\times2\times1.60\times10^{-19}}{4\times\pi\times8.85\times10^{-12}\times3.74\times10^{-12}}$ ✓ $r = 9.72 \times 10^{-15}$ m ✓	1 1 1
5.3	$R = R_0A^{\frac{1}{3}}$ $R = 1.25 \times 10^{-15} \times 197^{\frac{1}{3}}$ ✓ $R = 7.27$ fm ✓	1 1
5.4	$\rho = \frac{197u}{\frac{4}{3}\pi R^3}$ ✓ $\rho = 2.03 \times 1$[illegible] kg [illegible] ✓	1 1
6.1	[illegible]ed particle stationary ✓ [illegible]ged particle moving parallel to magnetic field ✓	1 1
6.2	Out of page ✓	1
6.3	$F = \frac{mv^2}{r} = Bev$ ✓ $v = \frac{rBe}{m}$ $\frac{1}{2}mv^2 = eV$ ✓ $\frac{1}{2}m\left(\frac{rBe}{m}\right)^2 = eV$ ✓ $\frac{r^2B^2e}{2m} = V$ $\frac{e}{m} = \frac{2V}{r^2B^2}$ ✓	1 1 1 1
6.4	$\frac{e}{m} = \frac{2V}{r^2B^2}$ $B = \sqrt{\frac{2Vm}{er^2}}$ ✓ $B = \sqrt{\frac{2\times1718\times9.11\times10^{-31}}{1.60\times10^{-19}\times(0.116\div2)^2}}$ $B = 2.41 \times 10^{-3}$ T ✓	1 1
6.5	Electrons must have momentum (or mass) ✓ To be curved by magnetic field ✓	1 1
6.6	Wider radius ✓ Opposite direction of movement ✓	1 1

7. C
8. A
9. D
10. B
11. B
12. D
13. D
14. C
15. A
16. D
17. B
18. A
19. D
20. C
21. D
22. B
23. C
24. C
25.
26.
27.
28.
29.
30.
31.

Preview of Answers Ends Here