Pearson Edexcel International Advanced Level

Monday 1 June 2026

Morning (Time: 1 hour 45 minutes)

Paper reference **WPH14/01A**

Physics

International Advanced Level

UNIT 4: Further Mechanics, Fields and Particles

Question Paper

You must have:
Scientific calculator, ruler and Answer Book (sent separately).
Do not return this question paper with the Answer Book.

- The list of data, formulae and relationships is printed at the end of this booklet.

Turn over ▶

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Pearson

SECTION A

Answer ALL questions.

1 Electrons are released from a hot electrode.

Which of the following is the name of this process?

A boiling

B evaporation

C ionisation

D thermionic emission

(Total for Question 1 = 1 mark)

---

2 Which of the following is not a fundamental particle?

A electron

B neutrino

C pion

D quark

(Total for Question 2 = 1 mark)

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3 The quark combination in a proton is u u d.

Which of the following is the quark combination in an anti-proton?

A u u d

B u d d

C $\bar{u}\bar{u}\bar{d}$

D $\bar{u}\bar{d}\bar{d}$

(Total for Question 3 = 1 mark)

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4 Which of the following units is equivalent to the farad?

A JC^{-1}

B JV^{-1}

C CV^{-1}

D VC^{-1}

(Total for Question 4 = 1 mark)

---

5 In a cyclotron, a charged particle moves in a spiral path.

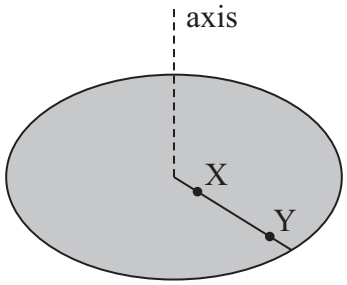
The speed of the particle increases.

Which row of the table shows how the time period and the radius of the path change?

	Time period	Radius
A	decreases	increases
B	no change	increases
C	decreases	decreases
D	no change	decreases

(Total for Question 5 = 1 mark)

6 A disk rotates about an axis through its centre. X and Y are two points on a straight line joining the centre to the edge of the disk.

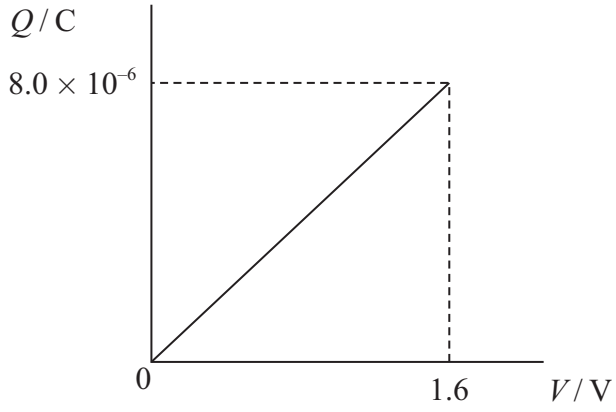


Which row of the table describes the velocity and angular velocity at Y compared to X?

	Velocity	Angular velocity
A	greater at Y	greater at Y
B	greater at Y	same at X and Y
C	same at X and Y	greater at Y
D	same at X and Y	same at X and Y

(Total for Question 6 = 1 mark)

7 The graph shows how the charge Q stored by a capacitor varies with potential difference V across the capacitor.



The charge stored on the capacitor is 8×10^{-6} C.

Which of the following gives the energy stored by the capacitor?

A $\frac{8 \times 10^{-6}}{2 \times 1.6}$ J

B $\frac{8 \times 10^{-6}}{1.6}$ J

C $\frac{8 \times 10^{-6} \times 1.6}{2}$ J

D $8 \times 10^{-6} \times 1.6$ J

(Total for Question 7 = 1 mark)

---

8 P is a point at a distance of 6.8×10^{-6} m from an alpha particle.

The electric potential at P due to the alpha particle is 4.2×10^{-4} JC^{-1}.

S is the midpoint between the alpha particle and P.

Which of the following gives the electric potential at S?

A $2 \times 4.2 \times 10^{-4}$ JC^{-1}

B $4 \times 4.2 \times 10^{-4}$ JC^{-1}

C $2 \times 4.2 \times 10^{-4} \times 6.8 \times 10^{-6}$ JC^{-1}

D $4 \times 4.2 \times 10^{-4} \times 6.8 \times 10^{-6}$ JC^{-1}

(Total for Question 8 = 1 mark)

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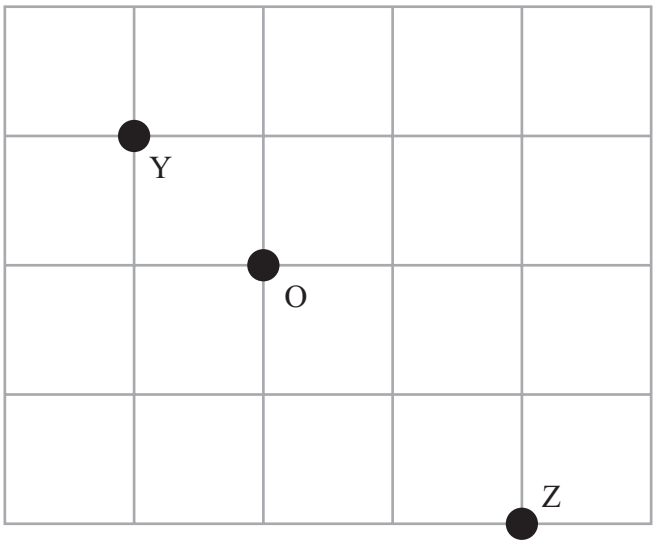
9 A charge Q is placed at point O.



Which of the following is equal to the ratio

$$\frac{\text{Electric field strength due to } Q \text{ at position Y}}{\text{Electric field strength due to } Q \text{ at position Z}}?$$

A 0.25

B 0.50

C 2.0

D 4.0

(Total for Question 9 = 1 mark)

10 A moving proton is within a magnetic field with magnetic flux density B.
The path of the proton is a circle with diameter D_1.

The speed of the proton doubles and the magnetic flux density decreases to $\frac{B}{4}$.

The path of the proton is now a circle with diameter D_2.

Which of the following is equal to the ratio $\frac{D_1}{D_2}$?

A $\frac{1}{8}$

B $\frac{1}{2}$

C 2

D 8

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

11 A helicopter maintains a constant height above the ground. The rotor blades push the air downwards, causing an upwards force on the helicopter.

Calculate the velocity of the air as it leaves the rotor blades.
Assume the air is initially stationary.

mass flow rate of air = 2480 kg s^{-1}
mass of helicopter = 3040 kg

(Total for Question 11 = 3 marks)

12 (a) A potassium bromide molecule can be represented by a K^+ ion and a Br^- ion.

(i) Draw, in the Answer Book, the electric field produced by the K^+ ion.

(2)

(ii) Draw, in the Answer Book, three equipotential lines around the Br^- ion.

The equipotential lines should be drawn so that the differences in potential between one line and the next are equal.

(2)

(b) In a potassium bromide molecule, the K^+ ion is close to the Br^- ion, as shown.

Explain why the strength of the electric field is **not** zero at any point between these two ions.

(2)

(Total for Question 12 = 6 marks)

13 Faraday's and Lenz's laws are combined to give the equation $\varepsilon = \dfrac{-\mathrm{d}(N\phi)}{\mathrm{d}t}$.

(a) (i) State the name of the term ϕ and state the unit of ϕ.

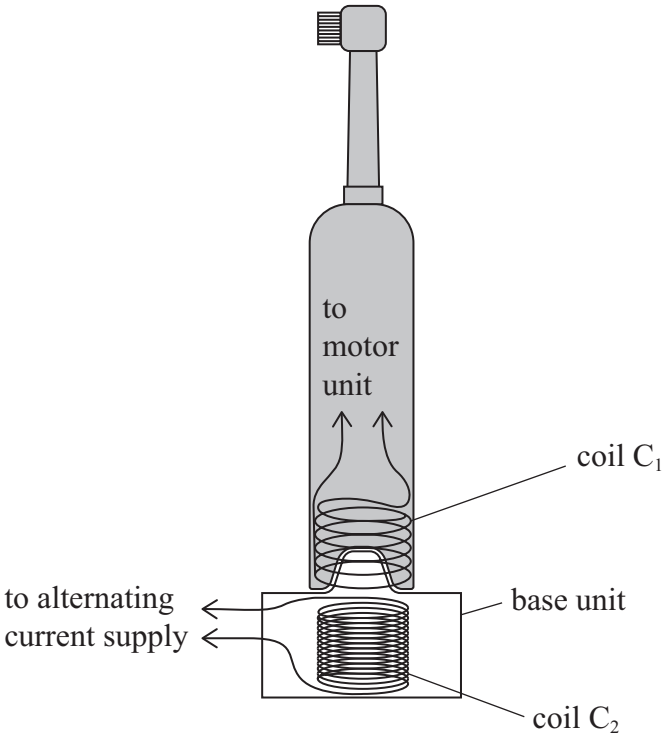
(2)

(ii) Explain the significance of the negative sign.

(2)

(b) An electric toothbrush contains a coil of wire C_1 and a motor unit.

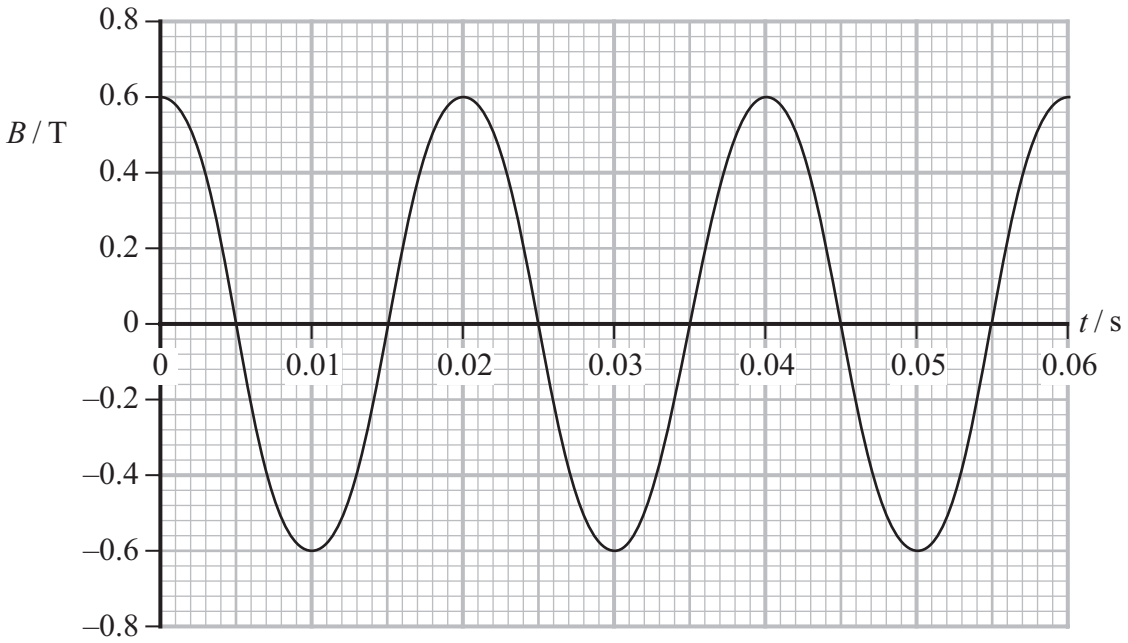
The base unit for the toothbrush contains a second coil of wire C_2. Coil C_2 is connected to an alternating current supply. The toothbrush is placed on the base unit so that the coils C_1 and C_2 are near to each other.



(i) Explain how an e.m.f. is induced across coil C_1.

(3)

(ii) The magnetic flux density B perpendicular to the plane of coil C_1 varies with time t as shown.



Determine the maximum e.m.f. induced across coil C_1. Show your working on the graph in the Answer Book.

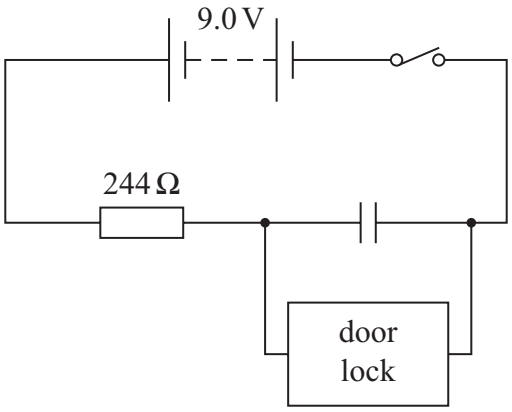
number of turns on coil C_1 = 180
diameter of coil C_1 = 12 mm

(5)

(Total for Question 13 = 12 marks)

14 A capacitor circuit provides a time delay for unlocking a door.

A 244 Ω resistor and a capacitor are connected in series with a 9.0 V battery, as shown.

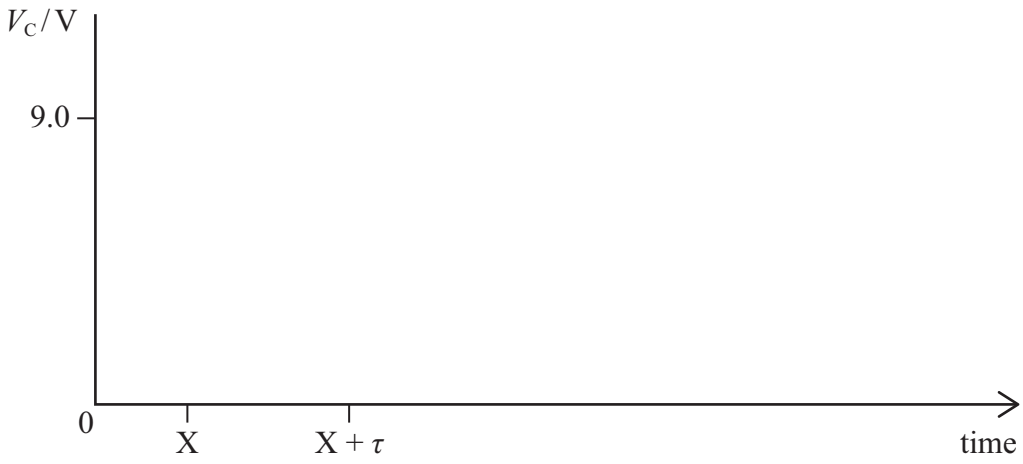


The switch is turned on at time X.

The capacitor is initially not charged.
The door lock can be assumed to have infinite resistance.

(a) (i) Sketch, in the Answer Book, a graph to show how the potential difference V_C across the capacitor varies with time. The time constant τ for this circuit is indicated on the time axis.

(3)



(ii) Explain how the potential difference across the resistor would change after time X.

(2)

(iii) Determine the current in the resistor at time X.

(2)

(b) The door lock requires a potential difference of 7.7 V to unlock the door. The time delay should be about 10 seconds.

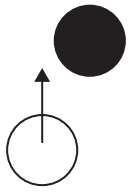
Capacitors with capacitance 4.7 mF, 6.8 mF, 10 mF, 22 mF and 33 mF are available.

Deduce which capacitor should be used in this circuit.

(3)

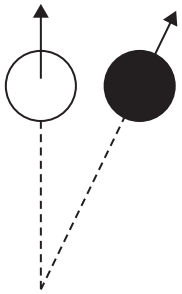
(Total for Question 14 = 10 marks)

15 A student used a snooker table and two snooker balls to investigate conservation of momentum. The balls were identical except for their colour.



before the collision

(a) The student drew a diagram to show his prediction for the path of the balls after the collision.



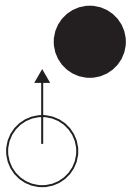
prediction after the collision

Explain why his prediction is incorrect.

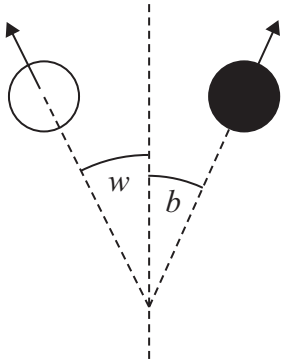
(3)

(b) The student observed a collision between a white ball and a black ball.

not to scale



before the collision



after the collision

The momentum of the white ball before the collision was $0.0426\,\text{kg m s}^{-1}$.

The momentum of the white ball after the collision was $0.0285\,\text{kg m s}^{-1}$.

Angle w was 28.0°.

After the collision, the black ball moves at an angle b. To win this particular game of snooker, angle b must be between 36.0° and 38.0°.

Deduce, by calculation, whether angle b is within this range.

(6)

(c) Deduce whether the collision between the two balls was elastic.

The mass of a snooker ball is 0.142 kg .

(5)

(Total for Question 15 = 14 marks)

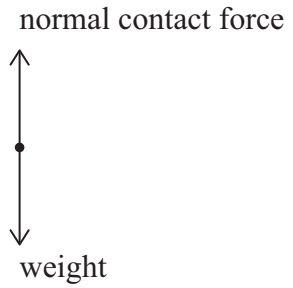
***16** In 1904, J.J. Thomson proposed a model of the atom which consisted of a solid positively charged mass with negatively charged electrons distributed within it.

Discuss how the results of the alpha particle scattering experiments led to the nuclear model of the atom.

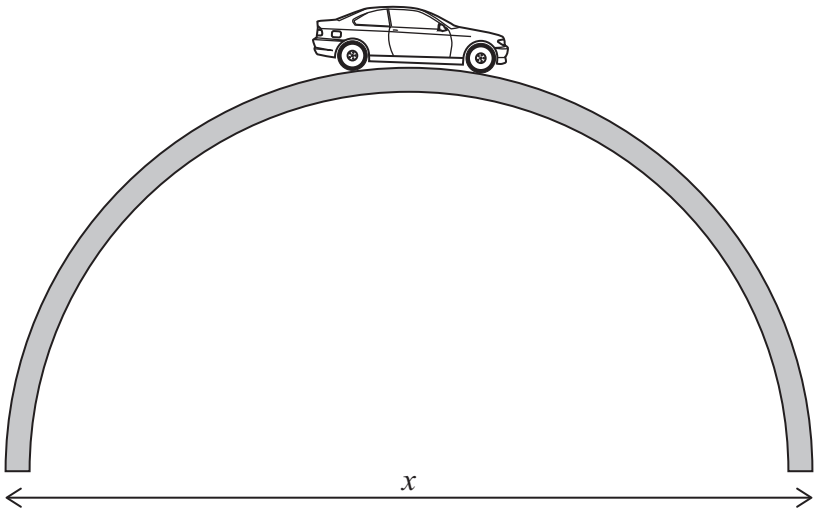
(Total for Question 16 = 6 marks)

17 A car is travelling at a constant velocity along a straight horizontal road.

The free-body force diagram for the vertical forces acting on the car is shown.



The car drives over a bridge which is in the shape of a semicircle of diameter x.



The car is in the position shown in the diagram.

If the velocity of the car is too large, the car will lose contact with the bridge.

(a) Explain why this happens.

(3)

(b) The car is travelling over the bridge with a velocity of $14.9\,\text{m}\,\text{s}^{-1}$.

Deduce whether the car loses contact with the bridge.

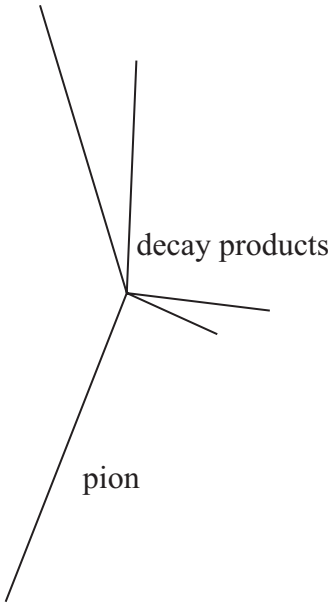
distance $x = 50.0\,\text{m}$

(4)

(Total for Question 17 = 7 marks)

18 In 1947 Cecil Powell made the first experimental observation of the pion. He studied the tracks of ionised particles left behind on photographic plates by a pion and the decay products.

The diagram shows a set of tracks.



(a) (i) State what is meant by ionisation.

(1)

(ii) In modern particle experiments, the tracks left by particles are usually curved.

Explain why the tracks are usually curved.

(2)

(b) High energy cosmic rays collide with atoms in the atmosphere to create pions.

(i) Explain why **high energy** cosmic rays are required to produce pions.

(3)

(ii) One example of a cosmic ray is a high energy proton. The following nuclear equation describes how three pions can be produced.

$$p \rightarrow p + \pi^+ + \pi^- + \pi^0$$

Justify that this interaction conserves charge, baryon number and lepton number.

(3)

(iii) Pions decay into other particles after a short time.

The quarks contained within each pion are shown in the table.

π^+	$u\bar{d}$
π^-	$\bar{u}d$
π^0	$u\bar{u}$ or $d\bar{d}$

Explain why π^+ and π^- particles have a much longer lifetime than π^0 particles.

(2)

(c) A stationary π^+ decays into a positive muon and neutrino:

$$\pi^+ \rightarrow \mu^+ + \upsilon$$

Determine the energy released in joules in this decay.

mass of $\pi^+ = 139.6\,\text{MeV/c}^2$
mass of $\mu^+ = 1.883 \times 10^{-28}\,\text{kg}$
mass of υ is negligible

(3)

(Total for Question 18 = 14 marks)

19 A hospital X-ray machine accelerates electrons using a uniform electric field. The diagram shows a simplified arrangement for producing the electric field.

The magnitude of the electric field strength between the negative plate and the metal target is $92\,\text{kN C}^{-1}$.

The electrons are initially at rest on the surface of the negative plate.

The electrons are accelerated over a distance of 1.30 m and strike the metal target and x-rays are produced.

(a) State what is meant by an electric field.

(1)

(b) Determine the final speed of the electrons.
Ignore relativistic effects.

(4)

(c) (i) Sketch, in the Answer Book, the graph of the electric potential V against distance from the negative plate.

(2)

(ii) Sketch, in the Answer Book, the graph of the electric field strength E against distance from the negative plate.

(1)

(Total for Question 19 = 8 marks)

TOTAL FOR SECTION B = 80 MARKS
TOTAL FOR PAPER = 90 MARKS

List of data, formulae and relationships

Acceleration of free fall	$g = 9.81 \text{ m s}^{-2}$	(close to Earth's surface)
Boltzmann constant	$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$	
Coulomb's law constant	$k = 1/4\pi\varepsilon_0$	
	$= 8.99 \times 10^{9} \text{ N m}^2 \text{ C}^{-2}$	
Electron charge	$e = -1.60 \times 10^{-19} \text{ C}$	
Electron mass	$m_e = 9.11 \times 10^{-31} \text{ kg}$	
Electronvolt	$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$	
Gravitational constant	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$	
Gravitational field strength	$g = 9.81 \text{ N kg}^{-1}$	(close to Earth's surface)
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$	
Planck constant	$h = 6.63 \times 10^{-34} \text{ J s}$	
Proton mass	$m_p = 1.67 \times 10^{-27} \text{ kg}$	
Speed of light in a vacuum	$c = 3.00 \times 10^{8} \text{ m s}^{-1}$	
Stefan-Boltzmann constant	$\sigma = 5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$	
Unified atomic mass unit	$u = 1.66 \times 10^{-27} \text{ kg}$	

Unit 1

Mechanics

Kinematic equations of motion

$$s = \frac{(u + v)t}{2}$$

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

Forces

$$\Sigma F = ma$$

$$g = \frac{F}{m}$$

$$W = mg$$

Momentum

$$p = mv$$

Moment of force

$$\text{moment} = Fx$$

Work and energy

$$\Delta W = F\Delta s$$

$$E_k = \frac{1}{2}mv^2$$

$$\Delta E_{grav} = mg\Delta h$$

Power

$$P = \frac{E}{t}$$

$$P = \frac{W}{t}$$

Efficiency

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}}$$

$$\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$$

Materials

Density $\rho = \frac{m}{V}$

Stokes' law $F = 6\pi\eta r v$

Hooke's law $\Delta F = k\Delta x$

Elastic strain energy $\Delta E_{el} = \frac{1}{2} F \Delta x$

Young modulus $E = \frac{\sigma}{\varepsilon}$ where

Stress $\sigma = \frac{F}{A}$

Strain $\varepsilon = \frac{\Delta x}{x}$

Unit 2

Waves

Wave speed	$v = f\lambda$
Speed of a transverse wave on a string	$v = \sqrt{\frac{T}{\mu}}$
Intensity of radiation	$I = \frac{P}{A}$
Refractive index	$n_1 \sin\theta_1 = n_2 \sin\theta_2$
	$n = \frac{c}{v}$
Critical angle	$\sin C = \frac{1}{n}$
Diffraction grating	$n\lambda = d\sin\theta$

Electricity

Potential difference	$V = \frac{W}{Q}$
Resistance	$R = \frac{V}{I}$
Electrical power, energy	$P = VI$
	$P = I^2R$
	$P = \frac{V^2}{R}$
	$W = VIt$
Resistivity	$R = \frac{\rho l}{A}$
Current	$I = \frac{\Delta Q}{\Delta t}$
	$I = nqvA$
Resistors in series	$R = R_1 + R_2 + R_3$
Resistors in parallel	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

Particle nature of light

Photon model	$E = hf$
Einstein's photoelectric equation	$hf = \phi + \frac{1}{2}mv^2_{max}$
de Broglie wavelength	$\lambda = \frac{h}{p}$

Unit 4

Further mechanics

Impulse	$F\Delta t = \Delta p$
Kinetic energy of a non-relativistic particle	$E_k = \frac{p^2}{2m}$
Motion in a circle	$v = \omega r$
	$T = \frac{2\pi}{\omega}$
	$a = \frac{v^2}{r}$
	$a = r\omega^2$
Centripetal force	$F = ma = \frac{mv^2}{r}$
	$F = mr\omega^2$

Electric and magnetic fields

Electric field	$E = \frac{F}{Q}$
Coulomb's law	$F = \frac{Q_1 Q_2}{4\pi\varepsilon_0 r^2}$
	$E = \frac{Q}{4\pi\varepsilon_0 r^2}$
	$E = \frac{V}{d}$
Electrical potential	$V = \frac{Q}{4\pi\varepsilon_0 r}$
Capacitance	$C = \frac{Q}{V}$
Energy stored in capacitor	$W = \frac{1}{2}QV$
	$W = \frac{1}{2}CV^2$
	$W = \frac{1}{2}\frac{Q^2}{C}$
Capacitor discharge	$Q = Q_0 e^{-t/RC}$

Resistor-capacitor discharge $I = I_0 e^{-t/RC}$

$V = V_0 e^{-t/RC}$

$\ln Q = \ln Q_0 - \frac{t}{RC}$

$\ln I = \ln I_0 - \frac{t}{RC}$

$\ln V = \ln V_0 - \frac{t}{RC}$

In a magnetic field $F = Bqv \sin \theta$

$F = BIl \sin \theta$

Faraday's and Lenz's laws $\mathscr{E} = \frac{-\mathrm{d}(N\phi)}{\mathrm{d}t}$

Nuclear and particle physics

In a magnetic field $r = \frac{p}{BQ}$

Mass-energy $\Delta E = c^2 \Delta m$

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Monday 1 June 2026

Morning (Time: 1 hour 45 minutes)

Paper reference **WPH14/01A**

Physics

International Advanced Level
UNIT 4: Further Mechanics, Fields and Particles
Answer Book

You must have:
Scientific calculator, ruler and Question book (sent separately).

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- **Show all your working out** in calculations and **include units** where appropriate.

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In the question marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P:1/

P 8 7 9 4 4 A 0 1 2 0

Pearson

SECTION A

Answer ALL questions.

For questions 1–10, in Section A, select one answer from A to D and put a cross in the box ☒. If you change your mind, put a line through the box ☒ and then mark your new answer with a cross ☒.

1

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 1 = 1 mark)

2

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 2 = 1 mark)

3

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 3 = 1 mark)

4

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 4 = 1 mark)

5

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 5 = 1 mark)

6

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 6 = 1 mark)

7

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 7 = 1 mark)

8

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 8 = 1 mark)

9

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 9 = 1 mark)

10

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11

Velocity of air = ...

(Total for Question 11 = 3 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

12 (a) (i)

(2)

K^+

12 (a) (ii)

(2)

Br^-

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

12 (b)

(2)

.....

.....

.....

.....

.....

(Total for Question 12 = 6 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

13 (a) (i)

(2)

13 (a) (ii)

(2)

13 (b) (i)

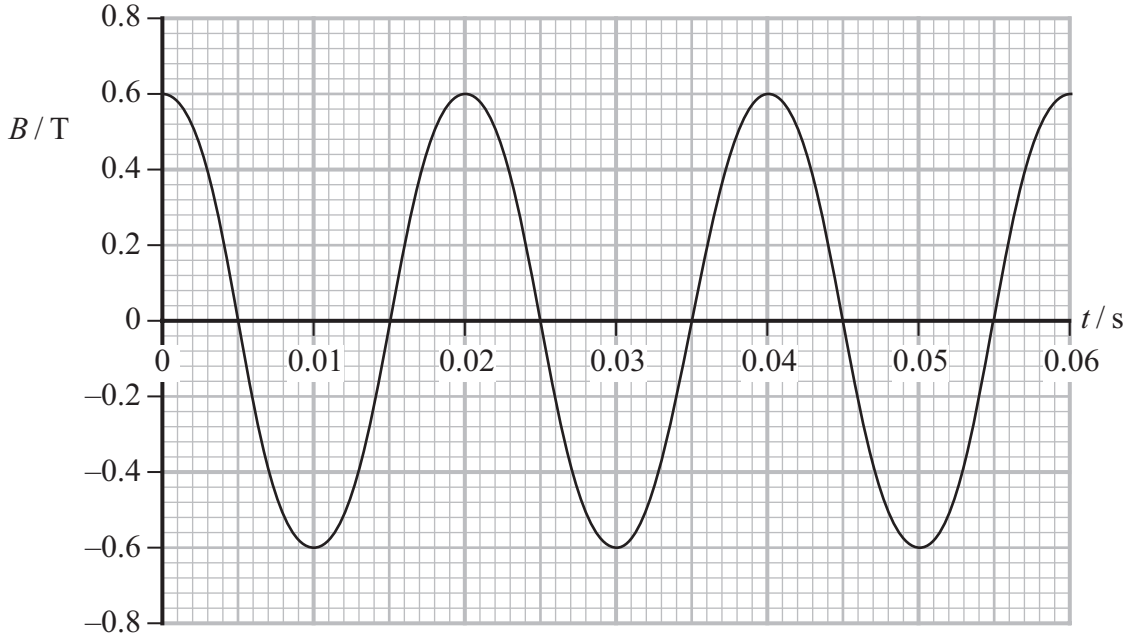
(3)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

13 (b)(ii)



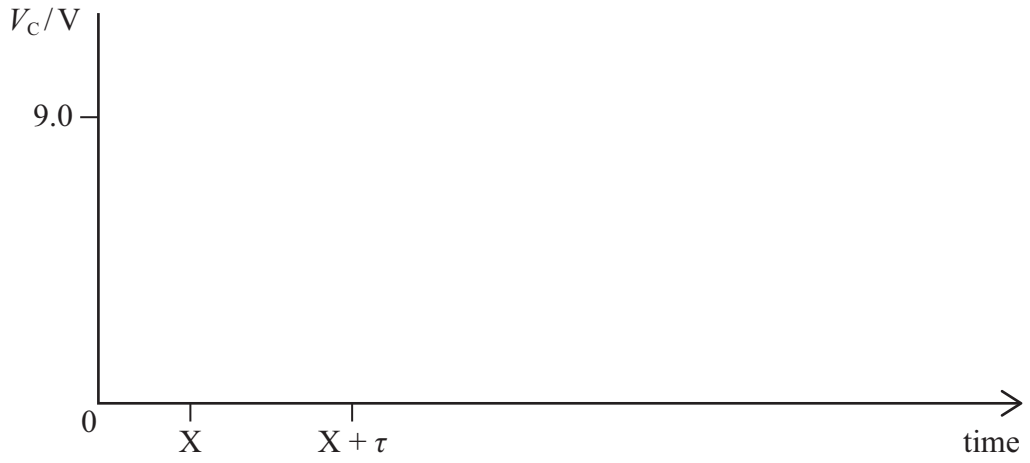
(5)

Maximum emf induced across coil C_1 = ...

(Total for Question 13 = 12 marks)

14 (a) (i)

(3)



14 (a) (ii)

(2)

.....

.....

.....

.....

14 (a)(iii)

(2)

.....

.....

.....

Current = ...

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

14 (b)

(3)

(Total for Question 14 = 10 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

15 (a)

(3)

15 (b)

(6)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

15 (c)

(5)

(Total for Question 15 = 14 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

***16**

(Total for Question 16 = 6 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

17 (a)

(3)

17 (b)

(4)

(Total for Question 17 = 7 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

18 (a) (i)

(1)

18 (a)(ii)

(2)

18 (b) (i)

(3)

18 (b)(ii)

(3)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

18 (b)(iii)

(2)

18 (c)

(3)

(Total for Question 18 = 14 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

19 (a)

(1)

.....

.....

19 (b)

(4)

.....

.....

.....

.....

.....

.....

.....

.....

Final speed = ...

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

19 (c) (i)

(2)

19 (c) (ii)

(1)

(Total for Question 19 = 8 marks)

TOTAL FOR SECTION B = 80 MARKS
TOTAL FOR PAPER = 90 MARKS

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