Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel Level 3 GCE

Wednesday 21 May 2025

Afternoon (Time: 1 hour 30 minutes) | **Paper reference** | **8PH0/02**

Physics

Advanced Subsidiary
PAPER 2: Core Physics II

You must have:
Scientific calculator and ruler
Data, Formulae and Relationships Booklet (enclosed)

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 in Sections A and B.
- Answer the questions in the spaces provided – *there may be more space than you need.*

Information

- The total mark for this paper is 80.
- 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.
- You are advised to show your working in calculations including units where appropriate.

Turn over ▶

Pearson

SECTION A

Answer ALL questions.

All multiple choice questions must be answered with a cross in the box ☒ for the correct answer from A to D. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Which of the following are S.I. units for intensity?

☒ **A** $J\,m^{-2}$

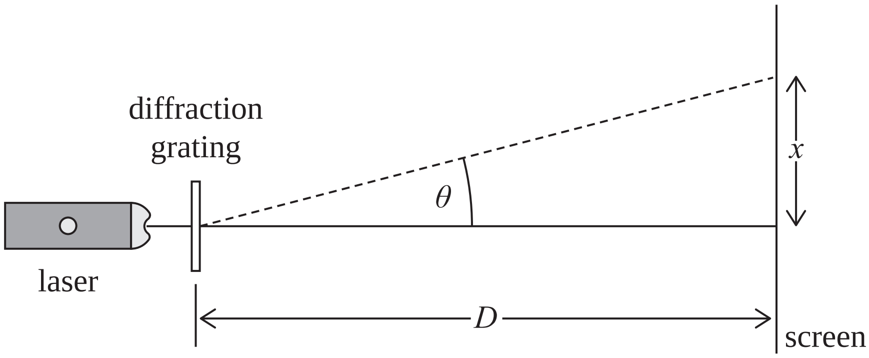
☒ **B** $J\,s^{-1}$

☒ **C** $W\,m^{-2}$

☒ **D** $W\,s^{-1}$

(Total for Question 1 = 1 mark)

2 A diffraction grating was illuminated with light from a laser, as shown.



A series of fringes was observed on the screen. x is the distance between the central maximum and a bright fringe.

The following measurements were recorded.

$D = 2.00\,\text{m}$
$x = 35.0\,\text{cm}$

Which of the following is the expression for the diffraction angle θ?

☒ **A** $\sin^{-1}\left(\dfrac{0.35}{2.00}\right)$

☒ **B** $\sin^{-1}\left(\dfrac{2.00}{0.35}\right)$

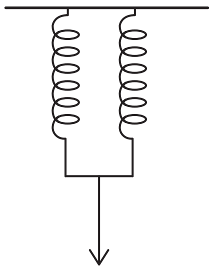
☒ **C** $\tan^{-1}\left(\dfrac{2.00}{0.35}\right)$

☒ **D** $\tan^{-1}\left(\dfrac{0.35}{2.00}\right)$

(Total for Question 2 = 1 mark)

3 When a force F is applied to a spring, the spring extends by a distance x. The spring has a spring constant k.

A second identical spring is connected in parallel with the first spring. The same force F is applied to the arrangement, as shown.



What is the extension of this arrangement?

☒ **A** $0.25x$

☒ **B** $0.5x$

☒ **C** x

☒ **D** $2x$

(Total for Question 3 = 1 mark)

4 Two waves of wavelength λ are produced from two coherent sources. The waves meet at a point X and constructively interfere.

Which of the following statements could describe the waves at X?

☒ **A** The phase difference of the waves is π.

☒ **B** The path difference of the waves is λ.

☒ **C** The frequency of the resultant wave is reduced.

☒ **D** The displacement of the resultant wave is 0.

(Total for Question 4 = 1 mark)

5 Two points on a wave are a distance $\frac{3}{4}\lambda$ apart.

Which of the following is the phase difference between the two points?

☒ **A** $\frac{\pi}{4}$

☒ **B** $\frac{3\pi}{4}$

☒ **C** $\frac{\pi}{2}$

☒ **D** $\frac{3\pi}{2}$

(Total for Question 5 = 1 mark)

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6 A teacher demonstrates the photoelectric effect. Monochromatic radiation is incident on the surface of a metal and photoelectrons are emitted.

The intensity of the radiation is increased.

Which row of the table describes what now happens to the maximum speed of the photoelectrons and the number of photoelectrons emitted per second?

		Maximum speed of the photoelectrons	**Number of photoelectrons emitted per second**
☒	**A**	increases	increases
☒	**B**	increases	no change
☒	**C**	no change	increases
☒	**D**	no change	no change

(Total for Question 6 = 1 mark)

Questions 7 and 8 refer to the experiment described below.

A falling-ball method is used to determine the viscosity of a liquid. The liquid is in a tall container.

A ball bearing is released at the top of the container and falls through the liquid.

7 Which row of the table gives two conditions for Stokes' law to apply to the ball bearing as it falls?

	Diameter of ball bearing relative to diameter of container	Speed of ball bearing
☒ **A**	large	fast
☒ **B**	large	slow
☒ **C**	small	fast
☒ **D**	small	slow

(Total for Question 7 = 1 mark)

8 The ball bearing has a volume V and falls through a liquid of density ρ.

Which of the following is an expression for the upthrust acting on the ball bearing?

☒ **A** $V\rho g$

☒ **B** $\frac{Vg}{\rho}$

☒ **C** $\frac{V}{\rho g}$

☒ **D** $\frac{\rho g}{V}$

(Total for Question 8 = 1 mark)

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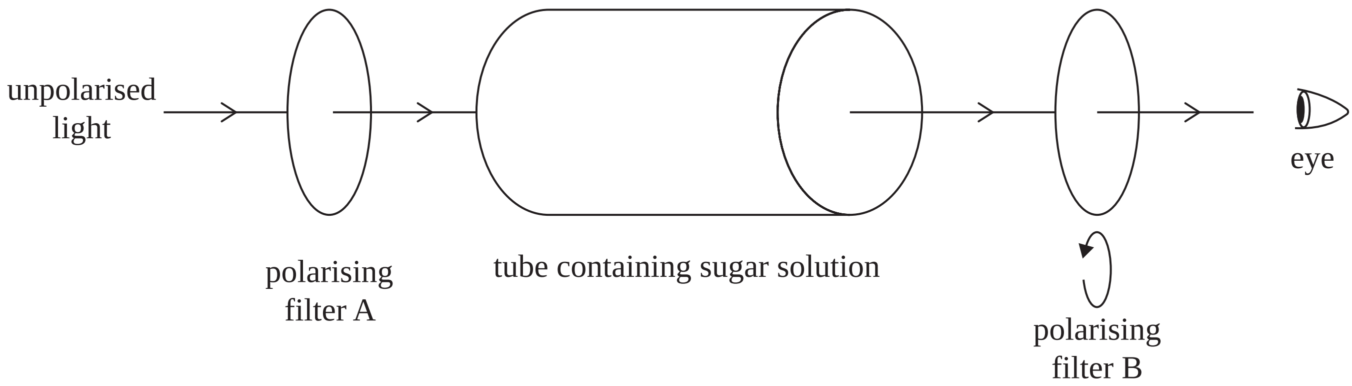
9 The concentration of a sugar solution can be determined using the apparatus shown.



Unpolarised light passes through polarising filter A. The transmitted polarised light then passes through a tube containing the sugar solution. This changes the plane of polarisation of the light.
Polarising filter B is rotated and the change in the angle of the plane of polarisation of the light is measured.

(a) Explain what is meant by the plane of polarisation of light.

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(b) (i) Initially the tube is empty. No light is observed.

Explain how A and B are aligned when no light is observed.

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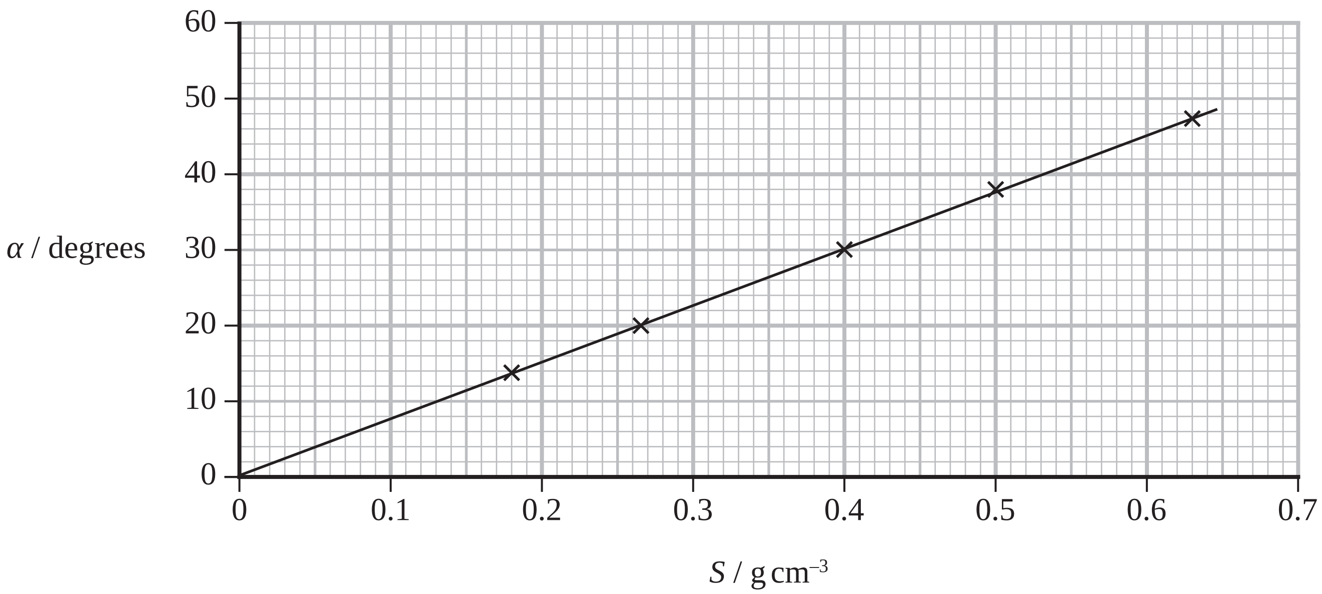
(ii) A student filled a tube of length l with a sugar solution of concentration S. She observed some light transmitted by filter B. She then rotated filter B until no light was observed. The angle α through which the filter was rotated was recorded.

S was changed and the measurement repeated.

The student plotted a graph of α against S and drew a line of best fit, as shown.



A textbook states that S is related to α by the formula

$$\alpha = klS$$

where k = 0.050 degrees $cm^2\,g^{-1}$
l = 15.0 cm

Deduce whether the student's results support this relationship.

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(Total for Question 9 = 7 marks)

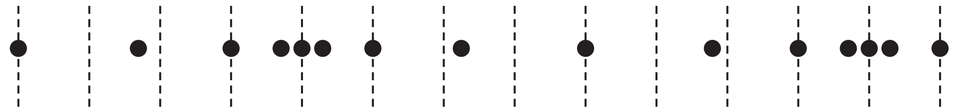
***10** A transducer on a ship produces soundwaves. These soundwaves are used with a pulse-echo technique to determine the depth of the sea.

Explain how the depth of the sea is determined using a pulse-echo technique.

(Total for Question 10 = 6 marks)

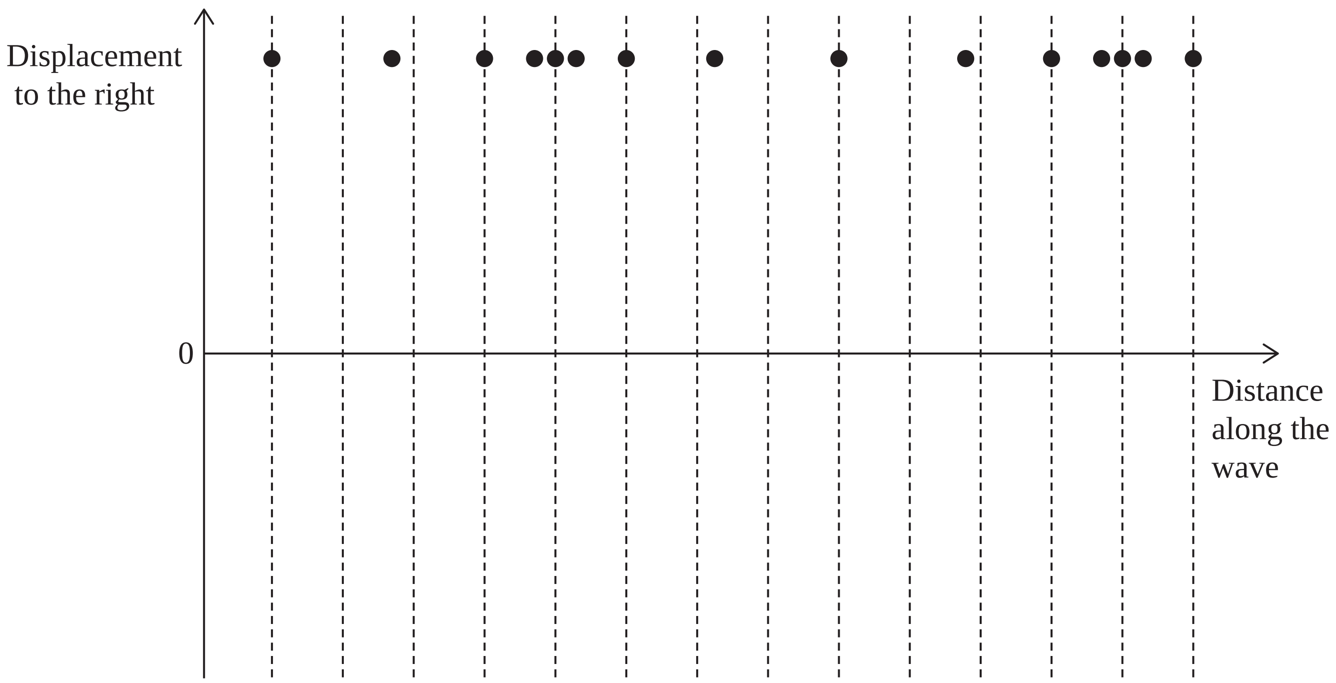
11 A violin is a musical instrument that has four strings under tension. When a string is plucked, a standing wave is produced on the string creating a longitudinal wave in the air.

(a) The diagram shows the position of particles along a longitudinal wave at a particular time. The vertical dotted lines represent the equilibrium positions of the particles.



Sketch, on the axes below, a displacement-distance graph that corresponds to the longitudinal wave. You do not need to add scales to the axes.

(2)



(b) Each of the four strings on a violin produces a different musical note when plucked.

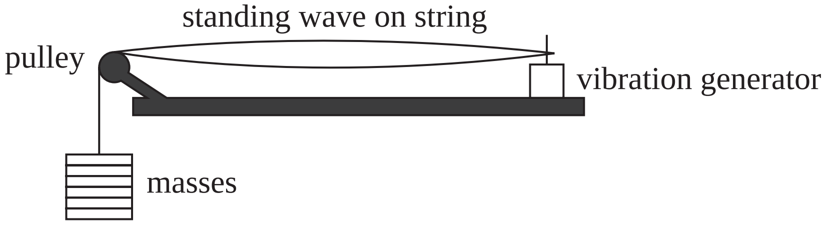
(i) One of the strings has a diameter 7.6×10^{-4} m.

Show that the mass per unit length μ of this string is about $0.0005\,\text{kg}\,\text{m}^{-1}$.

density of material of the strings = $1200\,\text{kg}\,\text{m}^{-3}$
length of string = 0.33 m

(3)

(ii) The effect of the tension of a string on the frequency at which standing waves are formed can be investigated using the apparatus shown.



One of the violin strings was investigated.

The frequency was increased until a standing wave with one antinode was observed.

The table shows the diameter D and the mass per unit length μ for the four strings on a violin.

	D / m	μ / kg m^{-1}
String 1	5.0×10^{-4}	0.00024
String 2	7.6×10^{-4}	0.0005
String 3	1.1×10^{-3}	0.0011
String 4	1.7×10^{-3}	0.0027

Deduce which violin string was being investigated.

frequency = 277 Hz
length of string between the pulley and the generator = 0.33 m
mass hung from string = 3.9 kg

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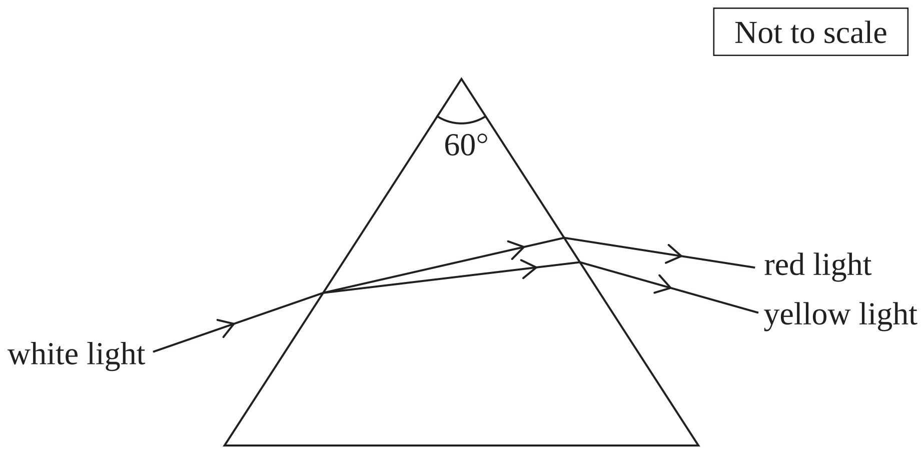
(Total for Question 11 = 8 marks)

Turn over

12 A glass prism can be used to disperse white light into a spectrum.

The diagram shows the paths of red and yellow light as they pass through the prism and back into air.



(a) Calculate the critical angle for yellow light travelling from glass to air.

refractive index of yellow light in glass = 1.63

(2)

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Critical angle = ...

P 7 8 5 2 1 A 0 1 4 2 8

(b) The white light is incident on the air-glass interface with an angle of incidence = 40°.

Calculate the angle of refraction of the red light as it leaves the prism.

speed of red light in glass = $1.9 \times 10^{8}\,\mathrm{m\,s^{-1}}$

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Angle of refraction = ...

(Total for Question 12 = 7 marks)

13 When designing a building, architects consider the properties of different materials.

(a) A student made measurements to determine the Young modulus of a metal in the form of a wire. He measured the initial length of the wire as 1.960 m.

He applied a force of 90 N to the wire and measured the corresponding extension.

The student measured three values for the extension.

12.9 cm 12.1 cm 13.7 cm

(i) Calculate a value for the mean strain and its absolute uncertainty from these values.

(4)

Mean strain = ...

Absolute uncertainty in value of strain = ...

(ii) Calculate the elastic strain energy in the extended wire.

(2)

Elastic strain energy = ...

(iii) Describe how the student could determine the cross-sectional area of the wire.

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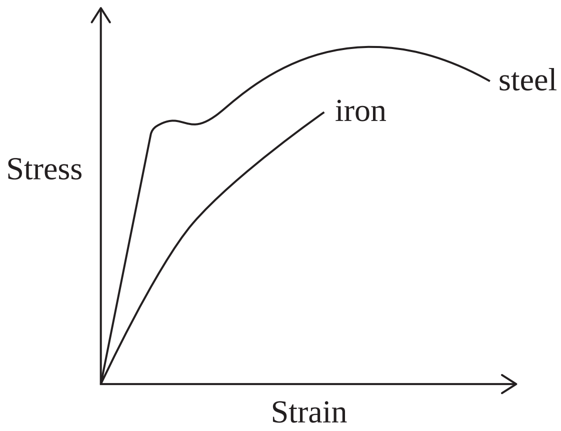
(b) The graph shows the stress-strain relationship of steel and iron up to the point of fracture.



Steel is used in the construction of buildings. Steel is made by adding different elements to iron to form an alloy.

Explain, using the properties shown in the graph, two reasons why steel might be preferred to iron in the construction of buildings.

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(Total for Question 13 = 14 marks)

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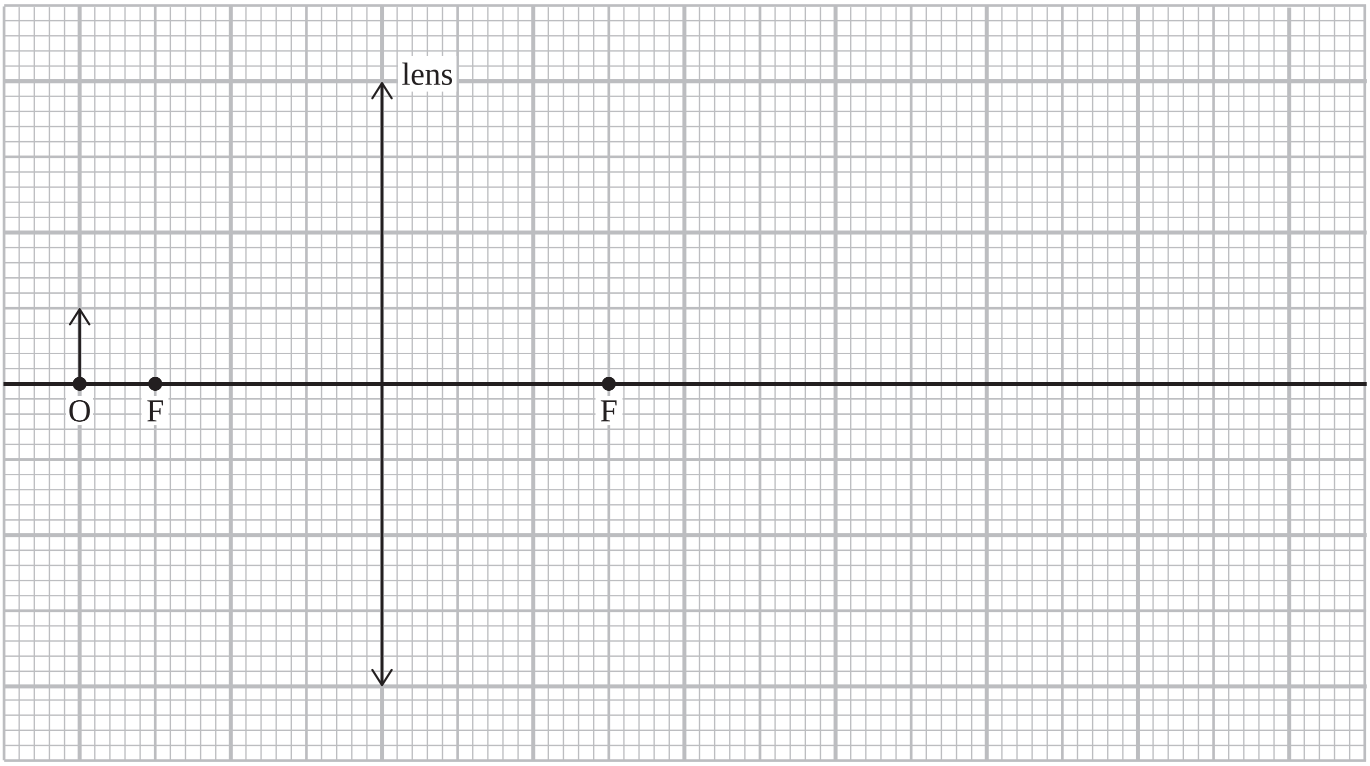
14 A converging lens can be used to produce an image of an object.

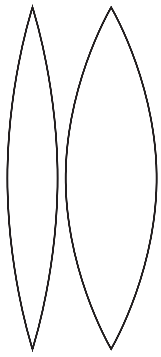
(a) The ray diagram shows an object placed in front of a converging lens.



Complete the ray diagram to locate the image formed by the lens.

(3)

(b) A student used a thin converging lens of power 6.7 D to produce an image on a screen. He adjusted the size of the image by adding a second thin converging lens close to the first lens, as shown.



The following lenses were available.

Lens	X	Y	Z
Power / D	5.3	5.7	6.1

The object was placed 20 cm from the lens combination, and the magnification produced was 0.71

Deduce which lens the student added.

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(Total for Question 14 = 8 marks)

TOTAL FOR SECTION A = 58 MARKS

SECTION B

Answer ALL questions in the spaces provided.

15 Read the extract and answer the questions that follow.

The MAVEN satellite orbits Mars, collecting data on the atmosphere of Mars. Analysis of the data has detected hydrogen atoms in the upper regions of the atmosphere.

It is thought that these atoms originate from water molecules that have risen from the surface of Mars. As the molecules ascend, the bonds between the oxygen and the two hydrogen atoms break.

A hydrogen atom with sufficient energy may escape the atmosphere of Mars.

(a) Radiation from the Sun passes through the gases in the atmosphere of Mars.

The electron in a hydrogen atom absorbs and re-emits radiation. Emission line spectra are detected by the satellite.

(i) Explain how these emission spectra are created.

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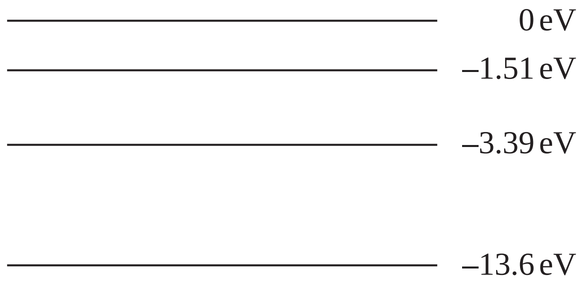
(ii) The diagram shows some of the energy levels for a hydrogen atom.



Deduce the transition which would result in the emission of light with a wavelength of 660 nm.

(4)

Transition .... eV to .... eV

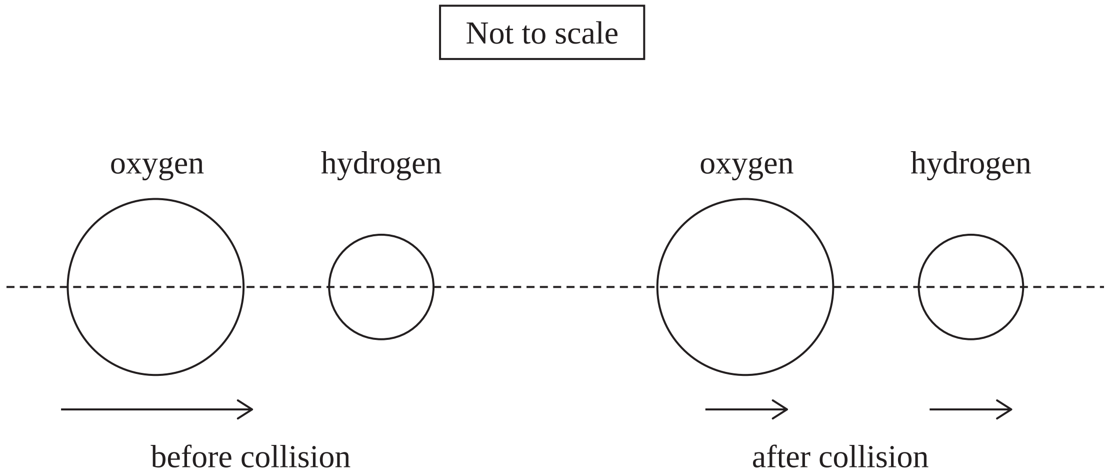
(iii) The concentration of hydrogen atoms in the atmosphere of Mars is not constant.

Explain why the intensity of the radiation received by the detectors on the satellite increases as the concentration of hydrogen atoms increases.

(2)

(b) Collisions between the atoms in the atmosphere of Mars cause the speed of these atoms to change.

An oxygen atom, travelling at $2210\,\mathrm{m\,s^{-1}}$, collides with a stationary hydrogen atom. Following the collision, the oxygen atom continues at a speed of $1870\,\mathrm{m\,s^{-1}}$. The hydrogen atom moves off in the same direction, as shown.



An atom can escape the atmosphere when it has a velocity of around $5000\,\mathrm{m\,s^{-1}}$.

Deduce whether this hydrogen atom can escape the atmosphere of Mars.

mass of hydrogen atom = $1.67 \times 10^{-27}\,\mathrm{kg}$
mass of oxygen atom = $2.66 \times 10^{-26}\,\mathrm{kg}$

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(Total for Question 15 = 14 marks)

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16 In 1930 Niels Bohr suggested that electrons in orbit in an atom exist at discrete energies. The scientist de Broglie suggested that an electron exhibits wave-like properties. This was used to explain why electrons exist at discrete energy levels.

(a) (i) The wave produced by the electron sets up a standing wave around the circumference of its orbit.

In the lowest energy state one wavelength fits into the circumference of the electron's orbit.

Calculate the wavelength at the lowest energy state.

radius of orbit of the electron = 5.3×10^{-11} m

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Wavelength at the lowest energy state = ...

(ii) Explain how electron standing waves can exist at different discrete energy levels.

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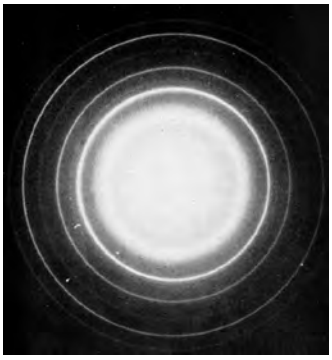
(b) Electrons exhibit wave-like properties when they undergo diffraction.

The photograph shows a diffraction pattern observed when an electron beam is passed through a thin piece of graphite.



(Source: © Bookworm/Alamy Stock Photo)

(i) An electron in the beam travels at $5.9 \times 10^6\,\mathrm{m\,s^{-1}}$.

Calculate the de Broglie wavelength of the electron.

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de Broglie wavelength = ...

(ii) The diameters of the rings in the diffraction pattern decrease as the speed of the electron beam is increased.

Explain why.

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(Total for Question 16 = 8 marks)

TOTAL FOR SECTION B = 22 MARKS
TOTAL FOR PAPER = 80 MARKS

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Pearson Edexcel Level 3 GCE

Wednesday 21 May 2025

Afternoon (Time: 1 hour 30 minutes)

Paper reference **8PH0/02**

Physics

Advanced Subsidiary
PAPER 2: Core Physics II

Data, Formulae and Relationships Booklet
Do not return this Booklet with the question paper.

Turn over

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P 7 8 5 2 1 A

Pearson

List of data, formulae and relationships

Acceleration of free fall	$g = 9.81\ \mathrm{m\,s^{-2}}$	(close to Earth's surface)
Electron charge	$e = -1.60 \times 10^{-19}\ \mathrm{C}$	
Electron mass	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$	
Electronvolt	$1\ \mathrm{eV} = 1.60 \times 10^{-19}\ \mathrm{J}$	
Gravitational field strength	$g = 9.81\ \mathrm{N\,kg^{-1}}$	(close to Earth's surface)
Planck constant	$h = 6.63 \times 10^{-34}\ \mathrm{J\,s}$	
Speed of light in a vacuum	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$	

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

$$\Sigma F = ma$$

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

$$W = mg$$

moment of force $= Fx$

Momentum

$$p = mv$$

Work, energy and power

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

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

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

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

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

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

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

Electricity

Potential difference

$$V = \frac{W}{Q}$$

Resistance

$$R = \frac{V}{I}$$

Electrical power and energy

$$P = VI$$

$$P = I^2R$$

$$P = \frac{V^2}{R}$$

$$W = VIt$$

Resistivity

$$R = \frac{\rho l}{A}$$

Current

$$I = \frac{\Delta Q}{\Delta t}$$

$$I = nqvA$$

Materials

Density

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

Stokes' law

$F = 6\pi\eta rv$

Hooke's law

$\Delta F = k\Delta x$

Young modulus

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

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

$$E = \frac{\sigma}{\varepsilon}$$

Elastic strain energy

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

Waves and particle nature of light

Wave speed

$v = f\lambda$

Speed of a transverse wave on a string

$$v = \sqrt{\frac{T}{\mu}}$$

Intensity of radiation

$$I = \frac{P}{A}$$

Power of a lens

$$P = \frac{1}{f}$$

$P = P_1 + P_2 + P_3 + \ldots$

Thin lens equation

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

Magnification for a lens

$$m = \frac{\text{image height}}{\text{object height}} = \frac{v}{u}$$

Diffraction grating

$n\lambda = d \sin \theta$

Refractive index

$n_1 \sin \theta_1 = n_2 \sin \theta_2$

$$n = \frac{c}{v}$$

Critical angle

$$\sin C = \frac{1}{n}$$

Photon model

$E = hf$

Einstein's photoelectric equation

$hf = \phi + \frac{1}{2}mv^2_{max}$

de Broglie wavelength

$$\lambda = \frac{h}{p}$$

END OF DATA, FORMULAE AND RELATIONSHIPS LIST

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