A-Level Edexcel

PHYSICS

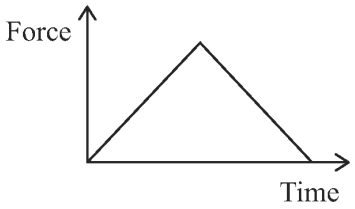
UNIT 4(IAL)

2020 — 2025

1 – (WPH11/4(IAL)_Summer_2024_Q8) – *Mechanics*

A ball collides with a wall and moves off in the opposite direction. The wall exerts a force on the ball during the collision.

The force-time graph for the collision is shown.



Which of the following is given by the area under the graph?

☒ **A** acceleration of the ball

☒ **B** average force acting on the ball

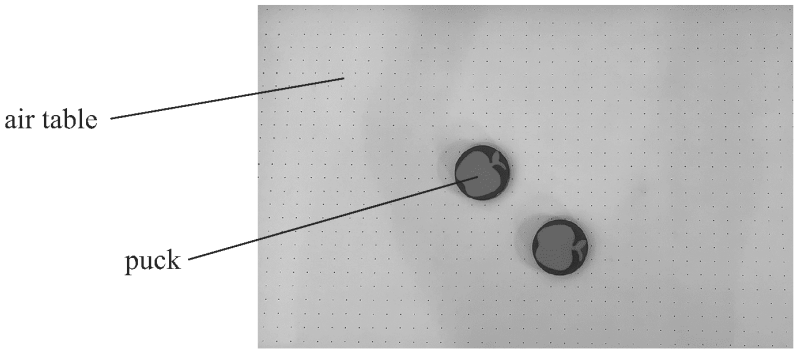
☒ **C** change in momentum of the ball

☒ **D** distance travelled by the ball

2 – (WPH11/4(IAL)_Summer_2024_Q15) – *Mechanics*

An air table has a surface with many small holes. Air is blown through the holes. Plastic pucks can move freely over the table on a cushion of air.

The photograph shows the surface of an air table with two pucks on it.



Some students used the air table to investigate conservation of momentum.

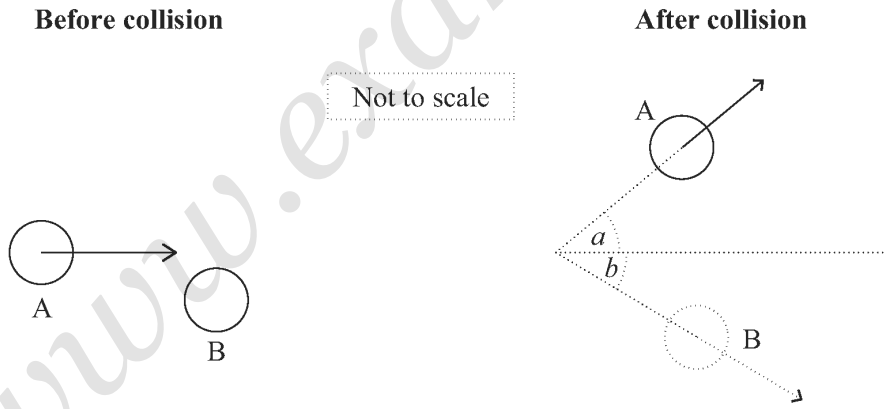
(a) Explain how using the air table ensured that momentum was conserved in collisions between the pucks.

(2)

(b) The students observed several collisions between two identical pucks, A and B. One puck was stationary before each collision.

They noticed that after each collision the two pucks seemed to follow paths at 90° to each other.

The diagram shows one of the collisions.



The students recorded the following data for this collision.

initial momentum of A	$0.046\,\text{kg m s}^{-1}$
angle a	33°
final momentum of A	$0.039\,\text{kg m s}^{-1}$

(i) Deduce whether the angle between the paths of the pucks after the collision was 90°.

You should use the principle of conservation of momentum.

(5)

(ii) Deduce whether the collision was elastic.

mass of each puck = 0.110 kg

(5)

1 – (WPH11/4(IAL)_Winter_2025_Q1) – *Waves And Particle Nature Of Light*

Two sources produce waves with a phase difference of 40°.

Which of the following gives the angle of 40° in radians?

☒ **A** $\frac{40 \times 2\pi}{360}$

☒ **B** $\frac{360}{40 \times 2\pi}$

☒ **C** $\frac{40 \times}{360}$

☒ **D** $\frac{360}{40 \times}$

2 – (WPH11/4(IAL)_Winter_2025_Q7) – *Nuclear And Particle Physics, Waves And Particle Nature Of Light*

In pair production, a high energy photon creates a particle-antiparticle pair.

In one interaction, a photon produces an electron and a positron.

Which of the following gives the photon energy, in joules?

☒ **A** $9.11 \times 10^{-31} \times (3 \times 10^{8})^{2}$

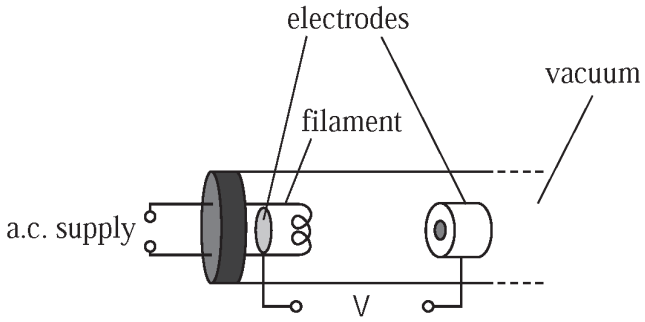
☒ **B** $1.67 \times 10^{-27} \times (3 \times 10^{8})^{2}$

☒ **C** $2 \times 1.67 \times 10^{-27} \times (3 \times 10^{8})^{2}$

☒ **D** $2 \times 9.11 \times 10^{-31} \times (3 \times 10^{8})^{2}$

3 – (WPH11/4(IAL)_Winter_2025_Q14) – *Waves And Particle Nature Of Light, Electric And Magnetic Fields*

A cathode ray tube can be used to demonstrate the properties of electrons. In the cathode ray tube, a beam of electrons is produced using the arrangement shown.



(a) Explain why electrons are released when there is a current in the filament.

(2)

(b) In one cathode ray tube, the electrons in the beam had a de Broglie wavelength of 2.65×10^{-11} m.

Calculate the potential difference V required to accelerate these electrons between the electrodes.

(4)

ANSWERS

1 – (WPH11/4(IAL)_Summer_2024_Q8) – *Mechanics*

	C is the only correct answer because the area under a force-time graph is the change in momentum A is not correct because the area under a force-time graph is not acceleration B is not correct because the area under a force-time graph is not force D is not correct because the area under a force-time graph is not distance	**1**

2 – (WPH11/4(IAL)_Summer_2024_Q15) – *Mechanics*

(a)	No/minimal/negligible friction (between the surfaces) **(1)** So there are no resultant/net/unbalanced external forces acting on the pucks **(1)** **Or** (so the pucks) can be treated as a closed system	**2**
(b)(i)	Use of trigonometrical function for *x* component of A momentum after collision **Or** Use of trigonometrical function for *y* component of A momentum after collision **(1)** Applies conservation of momentum **(1)** Applies trigonometry to calculate final angle for B **(1)** Angle between A and B = 91(°) **(1)** Comparison between calculated angle and 90° including conclusion in words **(1)** <u>Example of calculation</u> x component of A after = 0.039 kg m s^{-1} × cos 33° = 0.0327 kg m s^{-1} y component of A after = 0.039 kg m s^{-1} × sin 33° = 0.0212 kg m s^{-1} x component of B after = 0.046 kg m s^{-1} – 0.0327 kg m s^{-1} = 0.0133 kg m s^{-1} y component of B after = 0.0212 kg m s^{-1} tan θ = 0.0212 kg m s^{-1} ÷ 0.0133 kg m s^{-1} = 1.59 θ = 57.9° 58° + 33° = 91° which is about 90°	**5**
(b)(ii)	Applies trigonometry or Pythagoras appropriate to calculate magnitude of B momentum [mark may be awarded if calculated in (b)(i)] **(1)** Use of $E_k = \frac{p^2}{2m}$ **Or** Use of E_k = ½ mv^2 **and** $p = mv$ **(1)** Correct calculation of one kinetic energy (ecf from (a)) **(1)** Correct calculation of all kinetic energies (ecf from (a)) **(1)** Comparison and conclusion consistent with calculated values of kinetic energy (ecf from (a)) **(1)** <u>Example of calculation</u> Momentum of B = y component of B / sin 58° = 0.0212 kg m s^{-1} / sin 58° = 0.025 kg m s^{-1} $E_k = \frac{(0.046 \text{ kg m s}^{-1})^2}{2 \times 0.11 \text{ kg}} = 9.62 \times 10^{-3}$ J (A before) $E_k = \frac{(0.039 \text{ kg m s}^{-1})^2}{2 \times 0.11 \text{ kg}} = 6.91 \times 10^{-3}$ J (A after) $E_k = \frac{(0.025 \text{ kg m s}^{-1})^2}{2 \times 0.11 \text{ kg}} = 2.84 \times 10^{-3}$ J (B after) 6.91×10^{-3} J + 2.84×10^{-3} J = 9.75×10^{-3} J = initial disc A kinetic energy, so it is elastic	**5**

1 – (WPH11/4(IAL)_Winter_2025_Q1) – *Waves And Particle Nature Of Light*

	The only correct answer is A $\left(\frac{40 \times 2\pi}{360}\right)$ B is not correct because it does not equal 40° C is not correct because it does not equal 40° D is not correct because it does not equal 40°	**1**

2 – (WPH11/4(IAL)_Winter_2025_Q7) – *Nuclear And Particle Physics, Waves And Particle Nature Of Light*

	The only correct answer is D $(2 \times 9.11 \times 10^{-31} \times (3 \times 10^{8})^{2})$ A is not correct because this does not consider the mass of the positron B is not correct because this uses the mass of a single proton / antiproton C is not correct because this gives uses the mass of a proton / antiproton	**1**

3 – (WPH11/4(IAL)_Winter_2025_Q14) – *Waves And Particle Nature Of Light, Electric And Magnetic Fields*

(a)	The (metal in the) filament is heated (by the current) The electrons are released by <u>thermionic emission</u>	**(1)** **(1)**	**2**
(b)	Use of $p = \frac{h}{\lambda}$ Use of $E_{\text{k}} = \frac{p^{2}}{2m}$ **Or** p=mv and $E_{\text{k}} = \frac{1}{2}mv^{2}$ Use of $V = \frac{w}{Q}$ $V = 2100$ V <u>Example of calculation</u> $p = \frac{6.63 \times 10^{-34}\ \text{J s}}{2.65 \times 10^{-11}\ \text{m}} = 2.50 \times 10^{-23}\ \text{kg m s}^{-1}$ $E_{\text{k}} = \frac{(2.50 \times 10^{-23}\ \text{kg m s}^{-1})^{2}}{2 \times 9.11 \times 10^{-31}\ \text{kg}} = 3.44 \times 10^{-16}\ \text{J}$ $V = \frac{3.44 \times 10^{-16}\ \text{J}}{1.6 \times 10^{-19}\ \text{C}} = 2147\ \text{V}$	**(1)** **(1)** **(1)** **(1)**	**4**

1 – (WPH11/4(IAL)_Summer_2024_Q1) – *Electric Circuits*

	A is the correct answer because ampere is the only SI base unit given B is not correct because coulomb is not a base unit in SI C is not correct because joule is not a base unit in SI D is not correct because tesla is not a base unit in SI	**1**

2 – (WPH11/4(IAL)_Summer_2024_Q6) – *Electric Circuits*

	D is the only correct answer because $t = \frac{-t}{\ln\left(\frac{V}{V_0}\right)}$ A is not correct because it is not $\frac{-t}{\ln\left(\frac{V}{V_0}\right)}$ B is not correct because it is not $\frac{-t}{\ln\left(\frac{V}{V_0}\right)}$ C is not correct because it is not $\frac{-t}{\ln\left(\frac{V}{V_0}\right)}$	**1**