Pearson

Mark Scheme (Results)

October 2025

Pearson Edexcel International Advanced Subsidiary level In Physics
WPH14/01A

Edexcel and BTEC Qualifications

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer	Mark
1	**The only correct answer is A** (118) B is not correct because that is the total number of protons and neutrons C is not correct because this is just the number of protons D is not correct because this is the sum of mass and proton numbers	1
2	**The only correct answer is B** ($\frac{7.5 \times 2\pi}{9}$ =5.2) A is not correct because $\frac{7.5 \times 2\pi}{9} \neq 0.83$ C is not correct because $\frac{7.5 \times 2\pi}{9} \neq 68$ D is not correct because $\frac{7.5 \times 2\pi}{9} \neq 420$	1
3	**The only correct answer is B** (pion is a neutral particle) A is not correct because the initial momentum of the pion is unknown C is not correct because it is the mass to charge ratio that determines how much they curve and nothing is said of the charges D is not correct because we do not know the direction of the external magnetic field	1
4	**The only correct answer is D** (travelling close to speed of light) A is not correct because there is no evidence of an interaction B is not correct because moving in a circle does not affect the mass C is not correct because its mass has changed considerably (from rest mass 9.11×10^{-31} kg	1

5	**The only correct answer is D** ($\mathrm{N\ A^{-1}\ m^{-1}}$) A is not correct because $B = \frac{F}{Il}$, $B \neq FIl$ B is not correct because $B \neq FI/l$ C is not correct because $B \neq Fl/I$	**1**
6	**The only correct answer is B** (1×10^{-2}) A is not correct because $\left(\frac{V_1}{V_2}\right)^2 = \frac{\frac{E}{C_1/2}}{\frac{E}{C_2/2}} = \frac{C_2}{C_1} = \frac{10}{1000} \neq 1 \times 10^{-4}$ C is not correct because $\left(\frac{V_1}{V_2}\right)^2 = \frac{\frac{E}{C_1/2}}{\frac{E}{C_2/2}} = \frac{C_2}{C_1} = \frac{10}{1000} \neq 1 \times 10^{2}$ D is not correct because $\left(\frac{V_1}{V_2}\right)^2 = \frac{\frac{E}{C_1/2}}{\frac{E}{C_2/2}} = \frac{C_2}{C_1} = \frac{10}{1000} \neq 1 \times 10^{4}$	**1**
7	**The only correct answer is C** (colliding particles must have very high value of kinetic energy) A is not correct because charge is conserved B is not correct because the number of particles is not a quantity that must be conserved D is not correct because it is the initial energy that determines whether an interaction can take place	**1**
8	**The only correct answer is B** ($2\Delta p$) A is not correct because the alpha particle has 4 times the mass of the proton and $p = \sqrt{2mE}$ and $\sqrt{4} = 2 \neq \sqrt{2}$ C is not correct because the alpha particle has 4 times the mass of the proton and $p = \sqrt{2mE}$ and $\sqrt{4} = 2 \neq \sqrt{8}$ D is not correct because the alpha particle has 4 times the mass of the proton and $p = \sqrt{2mE}$ and $\sqrt{4} = 2 \neq 4$	**1**

9	**The only correct answer is B** (straight line with positive intercept and gradient) A is not correct because initially, there is still an increasing flux, so there is a non-zero e.m.f. C is not correct because the rate of change of flux through coil is increasing so emf should increase D is not correct because the rate of change of flux through coil is increasing so emf should increase	**1**
10	**The only correct answer is B** (nucleus contains protons) A is not correct because the nucleus containing most of the mass is a valid conclusion of the experiment C is not correct because the nucleus being charged is a valid conclusion of the experiment D is not correct because the nucleus being very small compared to the atom is a valid conclusion of the experiment	**1**

Question Number	Answer	Additional Guidance	Mark
11(a)	Sum of momenta before (collision) = sum of momenta after (collision) **Or** the total momentum before (a collision) = the total momentum after (a collision) **Or** total momentum (of a system) remains constant **(1)** Providing no external (resultant) force acts **(1)**	Accept in a closed system	**2**
11(b)(i)	Use of $p = mv$ **(1)** Subtraction of initial momenta **(1)** Velocity of ${}^{10}_{4}\mathrm{Be}$ = 168 m s^{-1} **(1)** States direction is to the right (consistent with value of velocity) **(1)** <u>Example of calculation</u> Initial momentum = (1.67 × 10^{-27} kg × 3250 m s^{-1}) − (1.50 × 10^{-26} kg × 175 m s^{-1}) = 2.80 × 10^{-24} kg m s^{-1} velocity of ${}^{10}_{4}\mathrm{Be}$ = (2.80 × 10^{-24} kg m s^{-1})/ 1.67 × 10^{-26} kg = 168 m s^{-1}		**4**
11(b)(ii)	Use of = $E_k = \frac{1}{2}mv^2$ **Or** use of $E_k = \frac{p^2}{2m}$ **(1)** Total KE before impact > KE after impact so collision was inelastic **(1)** <u>Example of calculation</u> $E_k = \frac{1.67 \times 10^{-27}\text{ kg} \times (3250\text{ m s}^{-1})^2}{2} + \frac{1.50 \times 10^{-26}\text{ kg} \times (175\text{ m s}^{-1})^2}{2} = 9.05 \times 10^{-21}\text{ J}$ $E_k = \frac{1.67 \times 10^{-27}\text{ kg} \times (168\text{ m s}^{-1})^2}{2} = 2.36 \times 10^{-22}\text{ J}$	Initial total KE must be correct, and compared with candidate's calculated values of final kinetic energy	**2**
	Total for question 11		**8**

Question Number	Answer	Additional Guidance	Mark
12(a)	**EITHER** Tension (and a component of the weight) provides a force towards the centre of the circle **(1)** (When the hammer is released) the tension becomes zero **(1)** **OR** Tension (and a component of the weight) provides a force perpendicular to the velocity **(1)** (When the hammer is released) there is no force perpendicular to the velocity **(1)**	Allow centripetal force is needed (to maintain circular motion)	**2**
12(b)(i)	Use of $v = r\omega$ **(1)** $\omega = 11$ rad s^{-1} **(1)** <u>Example of calculation</u> ω = 18 m s−1/ 1.7 m ω = 10.6 rad s−1		**2**
12(b)(ii)	Use of $F = mv^2/r$ **Or** $F = mr\omega^2$ **Or** $F = mv\omega$ **(1)** F = 1400 N **(1)** <u>Example of calculation</u> F= 7.3 kg × (18 m s^{-1})^2 / 1.7 m F = 1390 N		**2**
12(c)(i)	Three arrows all pointing to the centre of the circle **(1)** (accept free hand and lines of varying length)		**1**
12(c)(ii)	Maximum at Z / bottom **and** Minimum at X / top **(1)** At Z Tension T greater than weight (accept $T - W = mv^2/r$ or $T = W + mv^2/r$) **(1)** At X tension force is less than the weight. (accept $W + T = mv^2/r$ or $T = mv^2/r - W$) **(1)** Any statement that centripetal force is provided by weight/tension **(1)** **Or** centripetal force is the resultant force	Allow reference to $\frac{mv^2}{r}$	**4**
	Total for question 12		**11**

Question Number	Answer		Additional Guidance	Mark
13(a)(i)	Top terminal positive and bottom terminal negative Electron is repelled from B **Or** electron is attracted to C **Or** electric field acts from C to B	(1) (1)	Accept '+' marked on tube C **and** '–' marked on tube B Accept clear references in text if nothing is marked on diagram. Allow push for repel, pull for attract	2
13(a)(ii)	Electron needs to be in each tube for the same time	(1)		1
13(a)(iii)	Use of $V = W/Q$ to calculate energy $\times$ 3 Increase in KE = 1.2×10^{-13} (J) <u>Example of calculation</u> Increase in KE = $3 \times 250 \times 10^3$ V $\times 1.6 \times 10^{-19}$C Increase in KE = 1.2×10^{-13} J	(1) (1) (1)		3
13(b)(i)	Top box: anti-electron or positron **and** bottom box: anti-proton	(1)	Allow p− and $\bar{p}$ for anti-proton Allow e^+ for positron	1
13(b)(ii)	Same mass Opposite charge	(1) (1)	 Accept 'opposite' lepton number	2
13(b)(iii)	The idea that the particles will annihilate when they meet.	(1)	Allow "two photons will be produced"	1
13(c)(i)	Use of $F = \frac{1}{4\pi\varepsilon_0}\frac{Q_1Q_2}{r^2}$ $F = 8.2 \times 10^{-8}$ N	(1) (1)	<u>Example of calculation</u> $F = \frac{(1.6 \times 10^{-19}\ \text{C})^2}{4\pi \times 8.85 \times 10^{-12}\ \text{F m}^{-1} \times (5.3 \times 10^{-11}\text{m})^2}$ $F = 8.19 \times 10^{-8}$ N	2

13(c)(ii)	Use of electric potential $= \frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$ and $W = QV$ **(1)** Potential energy $= 4.3 \times 10^{-18}$ J **(1)**		Allow 27 eV (must have unit eV) <u>Example of calculation</u> $W = \frac{(1.6 \times 10^{-19}\text{ C})^2}{4\pi \times 8.85 \times 10^{-12}\text{ F m}^{-1} \times 5.3 \times 10^{-11}\text{m}}$ $W = 4.34 \times 10^{-18}$ J	2
13(d)(i)	2/3 of the electronic charge **Or** $2/3 \times 1.6 \times 10^{-19}$ C **(1)** Positive charge **(1)**		Accept electron for electronic charge Accept 1.07×10^{-19} C Accept reference to opposite charge if reference to electron has been made Accept 2/3 charge of a proton/positron for both marks	2
13(d)(ii)	Charge of $-\frac{2\text{ (e)}}{3}$ **(1)** Mass of 4 $(\frac{\text{MeV}}{\text{c}^2})$ **(1)**		Allow -1.07×10^{-19} (C) Allow 7.1×10^{30} (kg)	2
13(d)(iii)	Conversion of MeV to J **(1)** Use of $\Delta E = c^2 \Delta m$ **(1)** Mass = 1.42×10^{-28} (kg) **(1)** <u>Example of calculation</u> Mass = 80×10^6 eV $\times 1.6 \times 10^{-19}$ C / $(3 \times 10^8\text{ m s}^{-1})^2$ Mass = 1.42×10^{-28} kg			3
	Total for question 13			**21**

Question Number	Answer		Additional Guidance	Mark
14(a)	Use of $f = 1/T$	**(1)**	Accept any reasonable value for T when looking at MP1	**2**
	f = 100 Hz	**(1)**	MP2 unit must be Hz	
	Example of calculation $f = 1/T = 1/(10 \times 10^{-3}\ \text{s}) = 100$ Hz			
14(b)	See $\Phi = BA$	**(1)**		**2**
	B = 0.016 T	**(1)**	Allow Wb m^{-2}	
	Example of calculation N$\Phi = NBA$ $B = \Phi/A = 2 \times 10^{-2}$ Wb / ($500 \times 2.5 \times 10^{-3}\ \text{m}^2$) B = 0.016 T			
14(c)	**THE MAXIMUM MARK FOR THIS ITEM IS 2**			**2**
	Use of $\varepsilon = d(N\Phi)/dt$	**(1)**	Accept use of gradient	
	ε = 13 V (allow values in range 11V → 15V)	**(1)**	Accept answers that round to the given range)	
			Allow alternative method: Use of $\varepsilon = BNA\omega$ Use of $\omega = 2\pi f$ ε = 12.6 V	
	Total for question 14			**6**

Question Number	Answer	Additional Guidance	Mark
15(a)	**MAX 3** Reference to $I = V/R$ to justify current at any stage of the process **(1)** Initially p.d. across R is equal to V (producing the maximum current) **(1)** As capacitor charges, the p.d. across R decreases **(1)** When capacitor is fully charged the p.d. across R is zero (so current is zero) **(1)**	Allow p.d across R is a maximum/ 6 V	**3**
15(b)(i)	Evidence of area under graph being determined **(1)** Use of $C = Q/V$ **(1)** $C = 4.2 \times 10^{-2}$ F **(1)** <u>Example of calculation</u> $C = \frac{(100 \times 2.4 \times 10^{-3}\ \text{C}) + (0.5 \times 10 \times 2.4 \times 10^{-3}\ \text{C})}{6\ \text{V}} = 4.2 \times 10^{-2}$ F	Must see F as units (do not accept C V^{-1})	**3**
15(b)(ii)	Use of $E = \frac{1}{2}CV^2$ Or $E = \frac{1}{2}QV$ Or $E = \frac{1}{2}\frac{Q^2}{C}$ **(1)** $E = 0.76$ J **(1)** <u>Example of working</u> $E = 0.5 \times 0.0042\ \text{F} \times (6\ \text{V})^2 = 0.76$ J	0.72 J with C = 0.04; 0.86 J with C = 0,048	**2**
15(c)(i)	See $\ln I = \ln I_0 - \frac{t}{RC}$ **(1)** **(1)** Determine/identify gradient $C = -\frac{1}{R \times gradient}$ **(1)**	Allow MP2 if there is an indication that gradient is determined – ignore sign	**3**

15(c)(ii)	Use of $\tau = RC$ **(1)** $\tau = 0.86$ s **(1)** Statement recognising that capacitor would discharge in a very short time **(1)** <u>Example of working</u> $\tau = 390\ \Omega \times 2200 \times 10^{-6}$ F $= 0.86$ s	Accept discharge rate is too large	**3**
	Total for question 15		**14**

Question Number	Answer	Additional Guidance	Mark
16	**Indicative content** IC1 Momentum before collision is the same in each experiment IC2 Momentum is conserved (in both collisions) **Or** Impulse is equal to the change of momentum IC3 Contact time longer in expt. 2 (so larger impulse applied to ball) IC4 (Impulse equals momentum change so change in) momentum of ball is larger in experiment 2 Or (more work done so) more kinetic energy for ball in C IC5 Speed of ball after collision is greater in expt. 2 IC6 Ball would travel further (before coming to rest) in expt. 2	- IC2 Allow see $Ft = \Delta(mv)$ IC5 Allow ball with higher impulse/momentum has higher speed IC6 Allow ball with higher speed would travel further	**6**
	Total for question 16		**6**

Question Number	Answer	Additional Guidance	Mark
17(a)	Thermionic emission **(1)**	Allow Thermionic effect	**1**
17(b)	Use of $V = \frac{W}{Q}$ **(1)** Use of $E_k = \frac{1}{2}mv^2$ **(1)** $v = 4.1 \times 10^7$ (m s^{-1}) **(1)** Example of calculation $v^2 = \frac{2E_k}{m} = \frac{2eV}{m}$ $v^2 = \frac{2 \times 1.6 \times 10^{-19}\text{ C} \times 4800\text{ V}}{9.11 \times 10^{-31}\text{ kg}} = 1.69 \times 10^{15}\text{ m}^2\text{ s}^{-2}$ $v = 4.1 \times 10^7$ m s^{-1}		**3**
17(c)(i)	Use of $E = V/d$ **(1)** Use of $E = F/Q$ **(1)** $F = 2.6 \times 10^{-15}$ N **(1)** Example of calculation $F = VQ/d$ $F = (800\text{ V} \times 1.6 \times 10^{-19}\text{ C}) / 0.05\text{ m}$ $F = 2.56 \times 10^{-15}$ N	Allow $d = 2.5$ cm for "use of" in MP1	**3**
17(c)(ii)	Use of $F = ma$ **(1)** Use of $s = ut$ **(1)** Use of $h = \frac{1}{2}at^2$ **(1)** $h = 1.9 \times 10^{-2}$ m **(1)**	'Show that' value gives 2.0×10^{-2} m	**4**

	Example of calculation $a = 2.6 \times 10^{-15}$ N / 9.11×10^{-31} kg $= 2.85 \times 10^{15}$ m s^{-2} $t = 0.15$ m / 4.1×10^{7} m s$^{-1} = 3.66 \times 10^{-9}$ s $h = \frac{1}{2} \times (2.85 \times 10^{15} \text{ m s}^{-2} \times (3.66 \times 10^{-9} \text{ s})^2)$ $h = 1.88 \times 10^{-2}$ m		
17(d)(i)	Path A: less curved than original **(1)**		**1**
17(d)(ii)	Path B: more curved than original **(1)**	0 marks for both parts if neither path is labelled	**1**
	Total for question 17		**13**