Pearson

Mark Scheme (Results)

Summer 2026

Pearson Edexcel International Advanced Level In Physics
WPH14/01A

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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.

Mark scheme notes

Underlying principle
The mark scheme will clearly indicate the concept that is being rewarded, backed up by examples. **It is not a set of model answers.**

1. Mark scheme format
1.1 You will not see 'wtte' (words to that effect). Alternative correct wording should be credited in every answer unless the MS has specified specific words that must be present. Such words will be indicated by underlining e.g. 'resonance'
1.2 Bold lower case will be used for emphasis e.g. '**and**' when two pieces of information are needed for 1 mark.
1.3 Round brackets ( ) indicate words that are not essential e.g. "(hence) distance is increased".
1.4 Square brackets [ ] indicate advice to examiners or examples e.g. [Do not accept gravity] [ecf].

2. Unit error penalties
2.1 A separate mark is not usually given for a unit but a missing or incorrect unit will normally mean that the final calculation mark will not be awarded.
2.2 This does not apply in 'show that' questions or in any other question where the units to be used have been given, for example in a spreadsheet.
2.3 The mark will not be awarded for the same missing or incorrect unit only once within one clip in epen.
2.4 Occasionally, it may be decided not to insist on a unit e.g the candidate may be calculating the gradient of a graph, resulting in a unit that is not one that should be known and is complex.
2.5 The mark scheme will indicate if no unit error is to be applied by placing brackets around the unit.

3. Significant figures
3.1 Use of too many significant figures in the theory questions will not prevent a mark being awarded if the answer given rounds to the answer in the MS.
3.2 Too few significant figures will mean that the final mark cannot be awarded in 'show that' questions where one more significant figure than the value in the question is needed for the candidate to demonstrate the validity of the given answer.
3.3 The use of one significant figure might be inappropriate in the context of the question e.g. reading a value off a graph. If this is the case, there will be a clear indication in the MS.
3.4 The use of $g = 10$ m s^{-2} or 10 N kg^{-1} instead of 9.81 m s^{-2} or 9.81 N kg^{-1} will be penalised by one mark (but not more than once per clip). Accept 9.8 m s^{-2} or 9.8 N kg^{-1}
3.5 In questions assessing practical skills, a specific number of significant figures will be required e.g. determining a constant from the gradient of a graph or in uncertainty calculations. The MS will clearly identify the number of significant figures required.

4. Calculations

4.1 **use of** the formula means that the candidate demonstrates substitution of physically correct values, although there may be conversion errors e.g. power of 10 error.

4.2 If a 'show that' question is worth 2 marks, then both marks will be available for a reverse working. If the question is worth 3 marks then only 2 marks will be available.

4.3 The mark scheme will show a correctly worked answer for illustration only.

5. Quality of Written Expression

5.1 Questions that asses the ability to show a coherent and logically structured answer are marked with an asterisk.

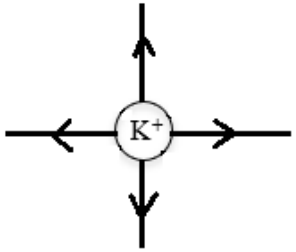
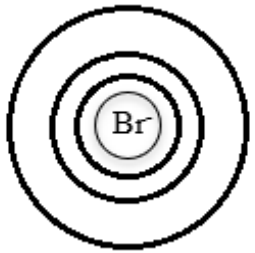
5.2 Marks are awarded for indicative content and for how the answer is structured.

5.3 Linkage between ideas, and fully-sustained reasoning is expected.

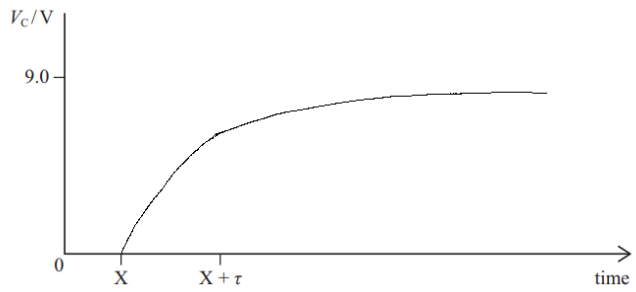
Question Number	Answer	Mark
1	**The only correct answer is D** (thermionic emission) A is not correct because this is the process of a liquid changing to a gas B is not correct because this is the process of a liquid changing to a gas C is not correct because this is the process of an atom gaining or losing an electron	1
2	**The only correct answer is C** (pion) A is not correct because electrons are fundamental particles B is not correct because neutrinos are fundamental particles D is not correct because quarks are fundamental particles	1
3	**The only correct answer is C** ($\bar{u}\bar{u}\bar{d}$) A is not correct because these quarks form a proton. B is not correct because these quarks form a neutron D is not correct because these quarks form an anti-neutron	1
4	**The only correct answer is C** ($C\ V^{-1}$) A is not correct because this is the unit for potential difference B is not correct because this unit is coulomb D is not correct because this is equivalent to F^{-1}	1
5	**The only correct answer is B** (Time period is no change and the radius increases) A is not correct because the time period is no change C is not correct because the time period is no change and the radius of the path increases D is not correct because radius of the path increases	1
6	**The only correct answer is B** (velocity is greater at Y and the angular velocity is the same at X and Y) A is not correct because the angular velocity is the same at X and Y C is not correct because the velocity is greater at Y and the angular velocity is the same at X and Y D is not correct because the velocity is greater at Y	1
7	**The only correct answer is C** ($\frac{8\times10^{-6}\times1.6}{2}$J) A is not correct because this is half the gradient of the line. B is not correct because this is the gradient of the line. D is not correct because this is the product QV	1
8	**The only correct answer is A** ($2 \times 4.2 \times 10^{-4} JC^{-1}$) B is not correct because the potential is proportional to one over distance and not one over distance squared. C is not correct because potential should not be multiplied by distance D is not correct because potential should not be multiplied by distance	1

9	**The only correct answer is D** (4) A is not correct because this is the electric field strength at Z divided by the electric field strength at Y B is not correct because this is the potential at Z divided by the potential at Y C is not correct because this is the potential at Y divided by the potential at Z	**1**
10	**The only correct answer is A** (1/8) B is not correct because B is 4 times less and v is double. The ratio $D_1/D_2 = V_1B_2/V_2B_1$. C is not correct because B is 4 times less and v is double. The ratio $D_1/D_2 = V_1B_2/V_2B_1$. D is not correct because B is 4 times less and v is double. The ratio $D_1/D_2 = V_1B_2/V_2B_1$.	**1**

Question Number	Answer		Additional Guidance	Mark
11	use of $W = mg$	**(1)**	Example of calculation $mg = v\frac{\Delta m}{\Delta t}$	
	use of $F\Delta t = \Delta p$	**(1)**		
	$v = 12\ \text{m s}^{-1}$	**(1)**	$3040\ \text{kg} \times 9.81\ \text{N kg}^{-1} = v \times 2480\ \text{kg s}^{-1}$ $v = \frac{29800\ \text{N}}{2480\ \text{kg s}^{-1}} = 12.0\ \text{m s}^{-1}$	**3**
	Total for question 11			**3**

Question Number	Answer	Additional Guidance	Mark
12(a)(i)	minimum of 4 lines arrows pointing outwards correct direction with no contradiction **(1)** straight lines equally spaced **(1)** 		**2**
12(a)(ii)	three circles drawn around ion **(1)** increasing spacing further from ion **(1)** 		**2**
12(b)	The electric field due to each ion is in the same direction **(1)** The fields (always) add together (to give a resultant field)(so it is not zero) **(1)** **Or** there is a resultant field to the right (so it is not zero) MP2 dependent on MP1		**2**
	Total for question 12		**6**

Question Number	Answer	Additional Guidance	Mark
13(a)(i)	magnetic flux **(1)** weber or Wb **(1)**		**2**
13(a)(ii)	(minus) indicates <u>direction</u> of emf **(1)** induced e.m.f. acts to oppose the change that caused it (Lenz's law) **(1)**		**2**
13(b)(i)	current (in base coil) creates magnetic field/flux **(1)** changing/varying/alternating current (in base coil) creates changing/varying/alternating (magnetic) field/flux **(1)** causes change in flux linkage with coil C_1 **(1)** **Or** Field lines cut coil in toothbrush		**3**
13(b)(ii)	Use of $\Delta B/\Delta t$ at crossing point with t axis **(1)** Determine area of coil **(1)** Use of $\phi = BA$ **(1)** Use of $\varepsilon = -\mathrm{d}(N\phi)/\mathrm{d}t$. **(1)** $\varepsilon = 4.1$ V (range – 'rounds to' 3.9 to 4.7 V) **(1)**	<u>Example of calculation</u> gradient = 1.2 T / 0.006 s = 200 $\mathrm{T\,s^{-1}}$ area of coil = $\pi(0.006\,\mathrm{m})^2 = 1.13 \times 10^{-4}\,\mathrm{m^2}$ $\varepsilon = 180 \times 200\,\mathrm{T\,s^{-1}} \times 1.13 \times 10^{-4}\,\mathrm{m^2}$ $\varepsilon = 4.07$ V	**5**
	Total for question 13		**12**

Question Number	Answer	Additional Guidance	Mark
14(a)(i)	charging curve **(1)** exponential charging curve increase from 0 V at X to 9 V and remains **(1)** getting to approx. 6 V at X+τ on a charging curve starting at X **(1)**		**3**
14(a)(ii)	(Initial) P.d. across resistor at X is 9 V. **Or** exponential decrease to 0 V **(1)** because $V_C+V_R = 9$ V **(1)**		**2**
14(a)(iii)	Use of $V=IR$ **(1)** 3.7×10^{-2} A **(1)**	Example of calculation $I=V/R = 9\text{ V} / 244\,\Omega = 3.7 \times 10^{-2}$ A	**2**
14(b)	Use of ln V = ln $V_0 - t/RC$ **or** Use of $V = V_0 e^{-t/CR}$ **(1)** Identify 9 $V = V_R + V_C$ **(1)** $C = 21$ mF, so 22 mF capacitor should be used **(1)**	Example of calculation 9 V − 7.7 V = 1.3 V ln 1.3 = ln 9 – 10 s / 244 Ω × C $C = 21.2 \times 10^{-3}$ F	**3**
	Total for question 14		**10**

Question Number	Answer	Additional Guidance	Mark
15(a)	**EITHER** (assuming white ball is correct) momentum is conserved (in the sideways direction) **(1)** initially there is no (component of) momentum sideways **(1)** **Or** initially momentum is upwards can't be sideways momentum after the collision **(1)** **or** – but there is sideways momentum after the collision **OR** (assuming black ball is correct) **(1)** momentum is conserved (in the sideways direction) **(1)** because the black ball has (a component of) momentum sideways after the collision **(1)** the white ball requires (an opposite component of) momentum sideways		**3**
15(b)	Use of trigonometry to obtain a component of momentum **(1)** Use of conservation of momentum horizontally **(1)** Use of conservation of momentum vertically **(1)** Use of trigonometry to calculate b **(1)** $b = 37.5(°)$ **(1)** comparison of their value of b with 36.0° and 38.0° and correct conclusion **(1)**	<u>Example of calculation</u> vertically: $0.0285\ \text{kg m s}^{-1} \times \cos 28 + p_b \cos b = 0.0426\ \text{kg m s}^{-1}$ horizontally: $0.0285\ \text{kg m s}^{-1} \times \sin 28 = p_b \sin b$ $\tan b = \dfrac{0.0285\ \text{kg m s}^{-1} \times \sin 28}{0.0426\ \text{kg m s}^{-1} - 0.0285\ \text{kg m s}^{-1} \times \cos 28}$ $b = 37.5°$ $36.0° < 37.5° < 38.0°$	**6**

15(c)	Use of trigonometry to calculate momentum of black ball after collision (ecf value of angle *b* from part (b)) **(1)** Use of $E_k = \frac{p^2}{2m}$ **Or** Use of $E_k = \frac{1}{2} mv^2$ **and** p = mv **(1)** Correct calculation of one kinetic energy **(1)** Calculation of total kinetic energy of white ball and black ball after collision **(1)** 0.00456 J ≠ 0.00639 J so it is not elastic (ecf for angle b) **(1)**	<u>Example of calculation</u> Momentum of black ball after: $0.0285 \text{ kg m s}^{-1} \times sin\ 28 = p_b\ sin\ 37.5$ $p_b = 0.0220 \text{ kg m s}^{-1}$ Before: $E_k = \frac{p^2}{2m} = \frac{(0.0426 \text{ kg m s}^{-1})^2}{2 \times 0.142 \text{ kg}} = 0.00639$ J After: $E_k = \frac{p^2}{2m} = \frac{(0.0285 \text{ kg m s}^{-1})^2}{2 \times 0.142 \text{ kg}} + \frac{(0.0220 \text{ kg m s}^{-1})^2}{2 \times 0.142 \text{ kg}}$ = 0.00286 J + 0.0017 J $= 0.00456$ J Kinetic energy after collision is not equal to kinetic energy before collision so collision is not elastic.	**5**
	Total for question 15		**14**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>*16</td><td>This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning.
Indicative content
IC1 Most alpha particles go straight through foil undeflected

IC2 Most of the atom is empty space

IC3 Some alphas are deflected (through small angles < 90°)

IC4 There is a concentration of charge (in the nucleus)

IC5 Very few alpha particles are deflected through angles > 90°

IC6 Most of the mass is in a small region called the nucleus</td><td>Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning. The following table shows how the marks should be awarded for indicative content.

<table><tr><th>IC points</th><th>IC mark</th><th>Max linkage mark</th><th>Max final mark</th></tr><tr><td>6</td><td>4</td><td>2</td><td>6</td></tr><tr><td>5</td><td>3</td><td>2</td><td>5</td></tr><tr><td>4</td><td>3</td><td>1</td><td>4</td></tr><tr><td>3</td><td>2</td><td>1</td><td>3</td></tr><tr><td>2</td><td>2</td><td>0</td><td>2</td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td></tr></table>
The following table shows how the marks should be awarded for
<table><tr><th></th><th>Number of marks awarded for structure of answer and sustained line of reasoning</th></tr><tr><td>Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout</td><td>2</td></tr><tr><td>Answer is partially structured with some linkages and lines of reasoning</td><td>1</td></tr><tr><td>Answer has no linkages between points and is unstructured</td><td>0</td></tr></table>structure and lines of reasoning.</td><td>6</td></tr>
<tr><td></td><td>Total for question 16</td><td></td><td>6</td></tr>
</table>

Question Number	Answer	Additional Guidance	Mark
17(a)	(For a circular path) there is a resultant force towards the centre **Or (**For a circular path) there is a centripetal force **(1)** when velocity increases centripetal force required increases **(1)** normal contact force = weight − centripetal force so contact force = zero (and car leaves bridge) **(1)**		**3**
17(b)	**EITHER** use of $W = mg$ **(1)** use of $F = mv^2 / r$ **(1)** $v = 15.7\ \text{m s}^{-1}$ **(1)** comparison with $14.9\ \text{m s}^{-1}$ and consistent conclusion **(1)** **OR** use of $a = v^2 / r$ **(1)** $a = 8.88\ \text{m s}^{-2}$ **(1)** maximum possible acceleration is g **(1)** **or** maximum possible acceleration is $9.81\ \text{m s}^{-2}$ comparison of their a with $9.81\ \text{m s}^{-2}$ and consistent conclusion **(1)**	<u>Example of Calculation</u> $mg = mv^2 / r$ $v = \sqrt{gr} = \sqrt{9.81\ \text{m s}^{-1} \times 25\ \text{m}} = 15.7\ \text{m s}^{-1}$	**17(b)**
	Total for question 17		**7**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>18(a)(i)</td><td>the gain or loss of electrons (1)</td><td></td><td>1</td></tr>
<tr><td>18(a)(ii)</td><td>There is (usually) a <u>magnetic</u> field (1)

The field exerts a force perpendicular to the direction of travel (1)</td><td></td><td>2</td></tr>
<tr><td>18(b)(i)</td><td>energy is converted into <u>mass</u> (when cosmic rays collide with atoms) (1)

by $E = mc^2$ (1)

only high energy particles have sufficient energy to create <u>mass</u> of <u>pion</u> (1)</td><td></td><td>3</td></tr>
<tr><td>18(b)(ii)</td><td>charge: $1 \rightarrow 1 + 1 - 1 + 0$ (1)

baryon number: $1 \rightarrow 1 + 0 + 0 + 0$ (1)

lepton number: $0 \rightarrow 0 + 0 + 0 + 0$ (1)</td><td></td><td>3</td></tr>
<tr><td>18(b)(iii)</td><td>u and $\bar{u}$ / d and $\bar{d}$ are a particle and its antiparticle (1)

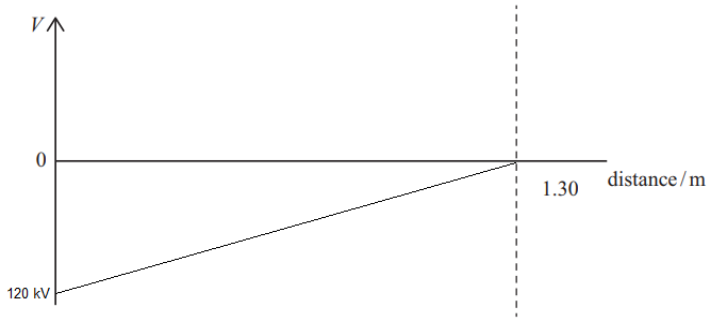
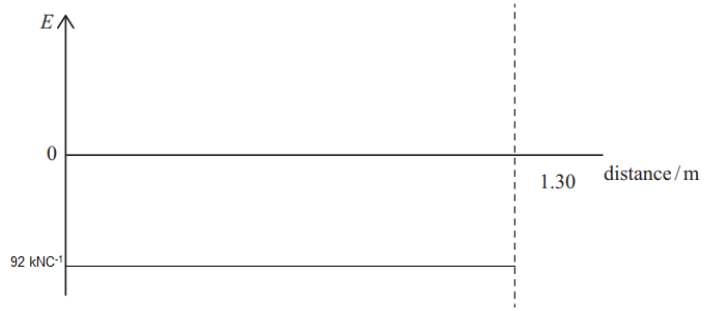
which can annihilate (1)</td><td></td><td>2</td></tr>
<tr><td>18(c)</td><td>Use of conversion eV to J (1)

Use of $\Delta E = c^2 \Delta m$ (1)

energy = 5.4×10^{-12} J (1)</td><td><u>Example of calculation</u>
$\frac{1.883\times10^{-28}\text{kg}\times(3\times10^{8}\text{ m s}^{-1})^2}{1.6\times10^{-13}\text{ J c}^2\text{ MeV}^{-1}} = 105.9\text{ MeV/c}^2$
$139.6\text{ MeV/c}^2 - 105.9\text{ MeV/c}^2 = 33.7\text{ MeV/c}^2$
$33.7\text{ MeV/c}^2 \times 1.6 \times 10^{-13}\text{J c}^2\text{ MeV}^{-1} = 5.39 \times 10^{-12}\text{ J}$

<table><tr><td></td><td>kg</td><td>MeV/c^2</td><td>J</td></tr><tr><td>pion</td><td>2.482×10^{-28}</td><td>139.6</td><td>2.236×10^{-11}</td></tr><tr><td>muon</td><td>1.883×10^{-28}</td><td>105.9</td><td>1.695×10^{-11}</td></tr><tr><td>difference</td><td>0.559×10^{-28}</td><td>33.7</td><td>0.541×10^{-11}</td></tr></table></td><td>3</td></tr>
<tr><td></td><td>Total for question 18</td><td></td><td>14</td></tr>
</table>

Question Number	Answer		Additional Guidance	Mark
19(a)	(a region of space) in which a <u>charged</u> particle experiences a <u>force</u>	**(1)**		**1**
19(b)	Use of $E = V/d$ Use of $V = W/Q$ Use of $E_k = {}^1/_2 mv^2$ $v = 2.0 \times 10^8$ ms^{-1} OR Use of $F = QE$ Use of $W = Fs$ Use of $E_k = {}^1/_2 mv^2$ $v = 2.0 \times 10^8$ ms^{-1} OR Use of $F = QE$ Use of $a = F / m$ Use of $v^2 = u^2 + 2as$ $v = 2.0 \times 10^8$ ms^{-1}	**(1)** **(1)** **(1)** **(1)**	<u>Example of calculation</u> $V = E\,d = 92\,000\ \text{N C}^{-1} \times 1.30\ \text{m} = 119\,600\ \text{V}$ $W = QV = 1.6 \times 10^{-19}\ \text{C} \times 119\,600\ \text{V}$ $= 1.91 \times 10^{-14}\ \text{J}$ $v = \sqrt{2E_k/m} = \sqrt{\frac{2 \times 1.91 \times 10^{-14}\ \text{J}}{9.11 \times 10^{-31}\ \text{kg}}}$ $= 2.0 \times 10^8\ \text{m s}^{-1}$	**4**

19(c)(i)	diagonal line with constant gradient **(1)** diagonal line begins at a negative V has a positive gradient ending at (1.3, 0) **(1)** MP2 dependent on MP1		**2**
19(c)(ii)	horizontal line at a negative value **(1)**		**1**
	Total for question 19		**8**