Mark Scheme (Results)

June 2017

Pearson Edexcel
GCE Advanced Level in Physics (9PH0/01)
Paper 1 Advanced Physics I

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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. '<u>resonance</u>'

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 means of [no ue].

3. Significant figures

3.1 Use of too many significant figures in the theory questions will not be 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 mean that one mark will not be awarded. (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 Bald (i.e. no working shown) correct answers score full marks unless in a 'show that' question.

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

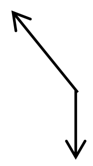
4.3 **use** of the formula means that the candidate demonstrates substitution of physically correct values, although there may be conversion errors e.g. power of 10 error.

4.4 **recall** of the correct formula will be awarded when the formula is seen or implied by substitution.

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

PHYSICS A PAPER 1

Question Number	Acceptable answers	Additional guidance	Mark
1	C	joule per coulomb.	**1**
	Incorrect Answers: A is reciprocal of volt B is definition of amp D is definition of watt		
2	B as equal to total momentum before = 1×2–0.5×2	1.0	**1**
	A is the answer if each trolley had the same momentum C is the momentum of the second trolley only D is the answer if the two trolleys were travelling in the same direction		
3	A uses the parallel resistors equation $\frac{1}{R_T}=\frac{1}{R}+\frac{1}{R}=\frac{2}{R}$	$\frac{R}{2}$	**1**
	B assumes resistors in parallel have the same total R as each individual R C is the addition of both resistances as if they were in series D is the product of both resistances		
4	C	mgh	**1**
	A uses the distance AB rather than height B uses a component of height D uses a component of height		
5	D uses $W=\frac{1}{2}CV^2$ so if V is doubled W is 4×	$4W$	**1**
	A divides the energy by 4 (rather than multiply) B forgets to square the potential difference and divides C forgets to square the potential difference		
6	D In the dark the resistance of the LDR will be very large so practically all the potential difference of 6V will be across it.	a little below 6 V	**1**
	A assumes the resistance of the LDR decreases to almost zero B assumes the resistance of the LDR decreases a little C assumes the resistance of the LDR increases a little		

7	B The induced emf in the coil will oppose the cell emf and cause a delay in the current to lamp Y	Lights after a delay with a final brightness the same as X		**1**
	A assumes the resistance of the coil is more than the resistor C ignores the magnetic effect of the coil and assumes the resistance of the coil is more than the resistor D ignores the magnetic effect of the coil			
8	C	Most alpha particles go straight through.	The atom is mainly empty space.	**1**
	A the observation is incorrect B the observation is incorrect D the observation is correct but this is not the corresponding conclusion			
9	B The two forces acting on the mass are its weight (vertically down) and a tension in the thread.			**1**
	A assumes there is a centripetal force only C assumes there is an additional centripetal force D assumes the additional centripetal force acts away from the centre of the circle			
10	A The p.d. across the resistor added to the p.d. across the thermistor must equal 6 V. This occurs when the current is 0.5 A.	0.5		**1**
	B assumes all the p.d. is across the thermistor C assumes that resistor and thermistor connected in parallel D assumes that the p.d. across the resistor and thermistor is more than 6 V			

(Total for Multiple Choice Questions = 10 marks)

Question Number	Acceptable answers		Additional guidance	Mark
11(a)	• Initial <u>acceleration</u> due to a resultant force • Decreasing acceleration as resistive forces increase **Or** Decreasing acceleration as resultant force decreases • No acceleration as resultant force is zero **Or** constant velocity as resultant force is zero	**(1)** **(1)** **(1)**	Accept reference to gradient of graph for acceleration for MP2 & MP3. Accept terminal velocity for constant velocity	**3**
11(b)	• Work done (by cyclist) results in a <u>transfer</u> of energy • initially there is an increase in E_k of (cyclist and bicycle) **Or** work done is transferred/converted to other forms of energy • when the velocity of the cyclist is constant, all the energy is being transferred to other forms	**(1)** **(1)** **(1)**		**3**

(Total for Question 11 = 6 marks)

Question Number	Acceptable answers		Additional guidance	Mark
12(a)	• Use of $v\cos\theta$ where θ is angle between v and vertical or sin equivalent • Component = 8.55 (m s^{-1})	**(1)** **(1)**	Example of calculation Component = 14.2 cos53° Component = 8.546 m s^{-1}	**2**
12(b)	• Use of $s = ut + ½ at^2$ (ecf value from (a) • Using a = $-9.81\,\mathrm{m\,s^{-2}}$ • h = 2.3 m above ground	**(1)** **(1)** **(1)**	If show that value used h = 2.2 m Example of calculation $s = 8.55\ \mathrm{m\,s^{-1}} \times 1.98\,\mathrm{s} + ½ \times (-9.81\,\mathrm{m\,s^{-2}}) \times 1.98^2\,\mathrm{s}^2$ s = 16.93 m - 19.23 m s = -2.3 m	**3**
12(c)	• Horizontal component velocity = v cos37° • R = horizontal component x time • R = 22.5 m	**(1)** **(1)** **(1)**	Example of calculation $R = 14.2\cos 37° \times 1.98$ R = 22.5 m	**3**

(Total for Question 12 = 8 marks)

Question Number	Acceptable answers	Additional guidance	Mark
*13(a)	This question assesses a student's ability to show a coherent and logical structured answer with linkage and fully-sustained reasoning. 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. Number of indicative points seen in answer / Number of marks awarded for indicative points: 6 – 4 5-4 – 3 3-2 – 2 1 – 1 0 – 0 **Indicative content** • There is an alternating p.d./E-field • P.d./E-field accelerates protons between dees • Magnetic field perpendicular to plane of dees • Proton path curved by magnetic field • As velocity of protons increases radius of path in dees increases • The time for which a proton is in a dee remains constant **Or** the frequency of p.d./E-field is constant	Guidance on how the mark scheme should be applied: The mark for The following table shows how the marks should be awarded for structure and lines of reasoning Number of marks awarded for structure and lines of reasoning: Answer shows a coherent and logical structure with linkage and fully sustained lines of reasoning demonstrated throughout – 2 Answer is partially structured with some linkages and lines of reasoning – 1 Answer has no linkage between points and is unstructured – 0 **Number of IC points** / **Possible linkage marks**: 0, 1 – 0 2, 3 – 1 4, 5, 6 – 2 IC2 accept 'in the gap' for between dees. Accept increases E_k for accelerates IC3 accept vertical or upwards for perpendicular to plane. IC5 accept reference to $r = p/BQ$	**6**

Number of indicative points seen in answer and marks awarded:

Number of indicative points seen in answer	Number of marks awarded for indicative points
6	4
5-4	3
3-2	2
1	1
0	0

	Number of marks awarded for structure and lines of reasoning
Answer shows a coherent and logical structure with linkage and fully sustained lines of reasoning demonstrated throughout	2
Answer is partially structured with some linkages and lines of reasoning	1
Answer has no linkage between points and is unstructured	0

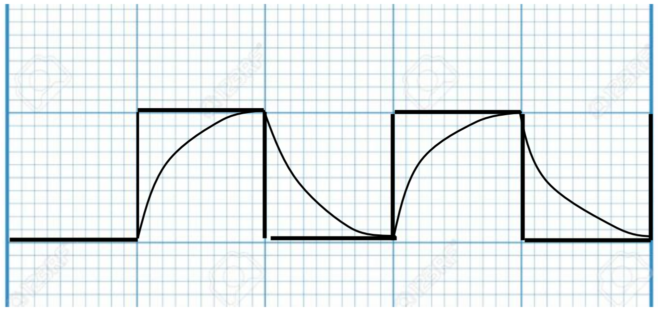
Number of IC points	**Possible linkage marks**
0, 1	0
2, 3	1
4, 5, 6	2

13(b)	**For the proton beam** • Proton beam deposits more energy in tumour than the X-rays (1) • Proton beam results in less energy absorbed by surrounding tissue compared to X-rays (1)	Accept converse statement for both marks related to X-rays	**2**
13(c)	Any two from: • Cost of treatment reduced in the long-term (1) • Better chances of success compared with previous treatment (1) • Fewer side effects compared to previous **Or** patient recover more quickly (1)		**2**

(Total for Question 13 = 10 marks)

Question Number	Acceptable answers	Additional guidance	Mark
14(a)	Direction out of page (1)	The arrow needs to be parallel to the length of the pipe by eye.	**1**
14(b)(i)	• Use of $R=\rho l/A$ (1) • Using $A=0.5\times28$ ($\times10^{-6}$ m^2) (1) • Use of $V=IR$ (1) • I = 22 (mA) (1)	<u>Example of calculation</u> $R = \dfrac{1.6\Omega\text{m}\times0.6\times10^{-3}\text{m}}{0.5\times10^{-3}\text{m}\times28\times10^{-3}\text{m}}$ $R = 68.6\Omega$ $1.5V = I\times68.6\Omega$ $I = 1.5\text{V}/68.6\Omega$ $I = 0.022\text{A} = 22\text{mA}$	**4**
14(b)(ii)	• Use of $F=BIL$ ecf values from (b)(i) (1) • Force = 5.3×10^{-6} N (1)	Use of show that values gives 4.8×10^{-6} N <u>Example of calculation</u> $F = 0.40\text{T}\times0.022\text{A}\times0.6\times10^{-3}\text{m}$ $F = 5.3\times10^{-6}\text{N}$	**2**

(Total for Question 14 = 7 marks)

Question Number	Acceptable answers	Additional guidance	Mark
15a	• p.d. across capacitor increases **Or** p.d. across resistor decreases (1) • p.d. across capacitor increases to 5V (1) • p.d. across resistor starts at 5V and reduces to 0V (1) • Exponentially (1)		**4**
15b	• Time axis: one cycle = 50 OR two cycles =100 (1) • Use of time constant = *RC* (1) • Charging curve, from 25 ms to 50 ms, just about reaching 5V as shown (ecf from their T) (1) • One corresponding discharge curve (1) • Curve should look exponential (1)	<u>Example of calculation</u> $T = 1/f = 1/20\ \text{Hz} = 0.050\ \text{s}$ $\text{Two cycles} = 2 \times 0.050\ \text{s} = 0.10\ \text{s} = 100\ \text{ms}$ $\text{Time Constant} = 100 \times 50 \times 10^{-6} = 0.005\ \text{s}$ $\text{In half a cycle } (0.025\ \text{s}) \text{ there are } 0.025\ \text{s} / 0.005\ \text{s}$ $= 5 \text{ Time constants}$ Ignore anything drawn in the first half cycle  Time period should be marked 50 ms or equivalent	**5**

(Total for Question 15 = 9 marks)

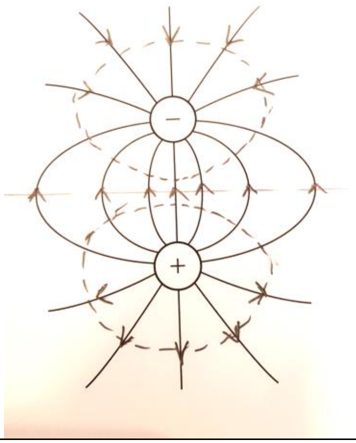
Question Number	Acceptable answers	Additional guidance	Mark
16(a)	• See u d s (1) • Comment that charge is zero (1)	If a meson or an incorrect baryon is given which has zero charge, MP2 can be awarded for comment of zero charge.	2
16(b)	• converts eV using 1.6×10^{-19} (1) • divides by c^2 i.e. $(3 \times 10^8)^2$ (1) • mass = 2.0×10^{-27} kg (1)	Example of calculation $m = \frac{1116\text{V} \times 10^6 \times 1.6 \times 10^{-19}\text{C}}{(3 \times 10^8 \text{m s}^{-1})^2}$ $m = 2.0 \times 10^{-27}$ kg	3
16(c)	$\Lambda^0 \rightarrow e^+ + e^-$ (no 2) (1) baryon number not conserved (1) $\Lambda^0 \rightarrow$ n only (no 4) (1) momentum **or** energy cannot be conserved (1) $\Lambda^0 \rightarrow$ p and π^0 (no 5) (1) charge not conserved (1)	More than 3 decays identified as not possible max 2 marks for the decays.	6
16(d)	• Energy of cosmic ray could be turned into matter/mass (1) • According to $\Delta E = c^2 \Delta m$ (1)		2
16(e)	• Neutral particles do not leave a track/ionise (1) • Reference to conservation laws to deduce the properties of particles (1) • Tracks of decay particles can determine momentum of lambda particle (1)		3

(Total for Question 16 = 16 marks)

Question Number	Acceptable answers		Additional guidance	Mark
17(a)	• V at top/start = 0V **Or** recognition "potential divider" **Or** V increases (by implication) **Or** V at bottom = 1.5V • Two sections of wire act as series resistors **Or** $R=\rho l/A$ **Or** comment about R proportional to length **Or** $\frac{V}{1.5}=\frac{R}{R_T}$ • potential difference proportional to length of wire	**(1)** **(1)** **(1)**	**Alternative MS** Constant Current (I) in wire (1) p.d. across section of wire $=Ir$ between A and loop (1) Increases from 0V to 1.5V linearly (1)	**3**
17(b)	• Tangent drawn at 1.5 s • Scales p.d. to give distance • Gradient determined using a base of triangle of at least 1.0 s **Or** use of $s=\frac{(u+v)}{2}t$ **and** correct V read from graph • velocity = 1.0 m s^{-1} – 1.3 m s^{-1}	**(1)** **(1)** **(1)** **(1)**	<u>Example of calculation</u> Gradient = $\frac{1.1\text{V}-0.2\text{V}}{1.0\text{s}}=0.9\text{Vs}^{-1}$ As 1.5 V represents 2.00 m v = 0.9 Vs^{-1} $\times \frac{2.00\text{m}}{1.5\text{V}} =$ 1.2 ms^{-1}	**4**
17(c)	• Use of $v=u+at$ • Use of $a=g\sin\theta$ • Calculates a value for a, θ or v (using a SUVAT AND $a=g\sin\theta$) • Valid comparison of their calculated quantity and the stated quoted uncertainty.	**(1)** **(1)** **(1)** **(1)**	<u>Example of calculation</u> $1.5\,\text{ms}^{-1}=1.2\,\text{m s}^{-1}+\text{a}\times 0.5\,\text{s}$ $a=\frac{0.3\,\text{m s}^{-1}}{0.5}=0.6\,\text{m s}^{-2}$ $0.6\,\text{m s}^{-2}=9.81\,\text{m s}^{-2}\sin\theta$ $\theta=3.6^{\circ}$	**4**

(Total for Question 17 = 11 marks)

perp

Question Number	Acceptable answers		Additional guidance	Mark
18(a)	• Replace Work W by force × distance • Replace distance ÷ time by velocity v • Use $v = r$ × Angular velocity • Recognise $F \times r$ is the moment of F	**(1)** **(1)** **(1)** **(1)**	Alternative method: Consider one revolution of axle , Load rises $2\pi r$ Work done = $2\pi rF$ Time taken = $2\pi \div \omega$ Power = Work ÷ time= $2\pi rF \div 2\pi/\omega$ to give reqd eq	**4**
18(b)(i)	• Arrow away from + charge **Or** arrow towards − charge • At least 3 Equipotential lines, perpendicular to field lines • Symmetrical about vertical/horizontal axis **and** not touching/crossing	**(1)** **(1)** **(1)**	MP3 dependent on lines being perpendicular in MP2 	**3**

18(b)(ii)	• Use of $F = \frac{Q_1 Q_2}{4\pi\varepsilon_o r^2}$ **(1)** • F = 0.036 (N) **(1)**	<u>Example of calculation:</u> $F = 8.99 \times 10^9 \text{ Nm}^2\text{C}^{-2} \frac{(0.1 \times 10^{-6}\text{ C})^2}{(0.05\text{m})^2}$ F = 0.036N	**2**
18(c)	• Use of moment = $F\,x$ **(1)** • Expression for correct moment **(1)** • Use of power = moment of force x angular velocity **(1)** • Only realistic possibility is pond pump and P = 0.6W (calculated answer could also be force and then comparison with b(i)) **(1)**	Show that value gives 3.2×10^{-3} Nm and 0.64 W <u>Example of calculation:</u> Moment $= 0.036\text{N} \times 0.04\text{m} \times 2 = 2.89 \times 10^{-3}\text{ Nm}$ $\text{Power} = 2.89 \times 10^{-3}\text{ N m} \times 200\text{s}^{-1} = 0.58\text{W}$	**4**

(Total for Question 18 = 13 marks)

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