Pearson Edexcel

Mark Scheme (Results)

June 2019

Pearson Edexcel GCE
In Physics (8PH0)
Paper 01 Core Physics I

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

June 2019
Publications Code 8PH0_01_MS_1906

These instructions should be the first page of all mark schemes

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.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- Organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Physics Specific Marking Guidance

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.

For example:

Horizontal force of hinge on table top

66.3 (N) or 66 (N) **and** correct indication of direction [no ue]

[Some examples of direction: acting from right (to left) / to the left / West / opposite direction to horizontal. May show direction by arrow. Do not accept a minus sign in front of number as direction.]

This has a clear statement of the principle for awarding the mark, supported by some examples illustrating acceptable boundaries.

Mark scheme format

- Bold lower case will be used for emphasis.
- Round brackets ( ) indicate words that are not essential e.g. "(hence) distance is increased".
- Square brackets [ ] indicate advice to examiners or examples e.g. [Do not accept gravity] [ecf].

Unit error penalties

- A separate mark is not usually given for a unit but a missing or incorrect unit will normally cause the final calculation mark to be lost.
- Incorrect use of case e.g. 'Watt' or 'w' will not be penalised.
- There will be no unit penalty applied in 'show that' questions or in any other question where the units to be used have been given.
- The same missing or incorrect unit will not be penalised more than once within one question but may be penalised again in another question.
- Occasionally, it may be decided not to penalise a missing or incorrect 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.
- The mark scheme will indicate if no unit error penalty is to be applied by means of [no ue].

Significant figures

- Use of an inappropriate number of significant figures in the theory papers will normally only be penalised in 'show that' questions where use of too few significant figures has resulted in the candidate not demonstrating the validity of the given answer.
- Use of an inappropriate number of significant figures will normally be penalised in the practical examinations or coursework.
- Using g = 10 m s^{-2} **will** be penalised.

Calculations

- Bald (i.e. no working shown) correct answers score full marks unless in a 'show that' question.
- Rounding errors will not be penalised.
- 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.
- 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.
- recall of the correct formula will be awarded when the formula is seen or implied by substitution.
  - The mark scheme will show a correctly worked answer for illustration only.

Question Number	Acceptable answers	Additional guidance	Mark
1	B		1
2	A		1
3	C		1
4	C		1
5	B		1
6	D		1
7	C		1
8	B		1

(Total for Multiple Choice Questions = 8 marks)

Question Number	Acceptable answers	Additional guidance	Mark
9	• Diode **(1)** • It conducts/allows current in one direction only **(1)** • The diode conducts when the p.d. is beyond 0.2-0.7V **Or** For negative p.d.s the <u>resistance</u> is (very) high **Or** in the reverse/backward direction the <u>resistance</u> is (very) high **Or** at breakdown/large voltage the diode will conduct in the reverse direction **(1)**	MP3 allow threshold voltage	**3**

(Total for Question 9 = 3 marks)

Question Number	Acceptable answers		Additional guidance	Mark
10	• calculation of gradient of the graph • Use of $s = \frac{1}{2}at^2$ to obtain value for g • Total uncertainty = 7 % • Calculation of % difference **Or** Range of calculated g • Judgment on accuracy of experiment with reason	**(1)** **(1)** **(1)** **(1)** **(1)**	MP2: use of $\frac{2}{\text{gradient}}$ MP3: percentage uncertainty = 3 % + 3 % + 1 % MP5: e.g. comparison of total uncertainty with % difference **Or** comparison of calculated range with 9.81 m s^{-2} Example of calculation Gradient = $\frac{0.385\ \text{s}^2 - 0.06\ \text{s}^2}{1.8\ \text{m} - 0.4\text{m}}$ = 0.232 s^2 m^{-1} $g = \frac{2}{0.232\ \text{s}^2\ \text{m}^{-1}}$ = 8.67 m s^{-2} Percentage difference=$\left(\frac{9.81\ \text{m s}^{-2} - 8.67\ \text{m s}^{-2}}{9.81\ \text{m s}^{-2}}\right) \times 100$ = 12 %	5

(Total for Question 10 = 5 marks)

Question Number	Acceptable answers	Additional guidance	Mark
11 (a)(i)	• Use of $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ to determine the total resistance of the parallel branch **(1)** • R_{TP} = 8.0 kΩ **(1)** • Comparison of measured to actual resistance **(1)** **OR** • Same p.d. across thermistor and voltmeter **(1)** • Calculation of ratio of currents **(1)** • States that current through voltmeter is significant **(1)**	<u>Example of calculation</u> $\frac{1}{R_{TP}} = \frac{1}{9.7\ \text{k}\Omega} + \frac{1}{45\ \text{k}\Omega}$ R_{TP} = 7.98 kΩ MP3: 7.98 kΩ is significantly less than 9.7 kΩ, so unsuitable MP3 dependent on MP2	**3**
11(a)(ii)	• Current flows through the voltmeter **(1)** • But in the new arrangement, the ammeter would read only the current passing through the thermistor **Or** current through ammeter equals current through thermistor **(1)**		**2**

11(b)	• As temperature increases number of (free) charge carriers (in thermistor) increases so its resistance decreases **Or** As temperature increases number of charge carriers in conduction band increases so (thermistor) resistance decreases **(1)** • Thermistor resistance as a proportion of total resistance decreases **Or** Current increases so p.d. across resistor increases **(1)** • P.D. (across thermistor) decreases **(1)**	Accept electrons for charge carriers	**3**

(Total for Question 11 = 8 marks)

Question Number	Acceptable answers		Additional guidance	Mark
12 (a)	• Use of efficiency = $\frac{\text{useful power output}}{\text{total power input}}$ • Use of $\Delta E_{grav} = mg\Delta h$ • Use of $E_k = ½ mv^2$ • Use of (output) power = $\frac{\Delta E_{grav}}{1\text{ s}} + \frac{E_k}{1\text{ s}}$ • $v = 7.8$ (m s^{-1})	**(1)** **(1)** **(1)** **(1)** **(1)**	Example of calculation Output power = 0.76 × 160 W = 121.6 W 121.6 W = (3.5 kg s^{-1})(9.81 N kg^{-1})(0.45 m) + ½(3.5 kg s^{-1})v^2 v = 7.78 m s^{-1}	**5**
12 (b)	• Use of trig to determine the vertical or horizontal component of the initial velocity • Use of equation(s) of motion to determine time the water in air • Use of $s = vt$ • s = 4.8 m Allow ecf from (a) (Using show that value, s = 5.0 m)	**(1)** **(1)** **(1)** **(1)**	Example of calculation u_h = 7.8 m s^{-1} × sin 25 = 3.30 m s^{-1} u_v = 7.8 m s^{-1} × cos 25 = 7.07 m s^{-1} 0 = (7.07 m s^{-1})t + ½ (–9.81 N kg^{-1})t^2 t = 1.44 s s = 1.44 s × 3.30 m s^{-1} = 4.75 m	**4**
12(c)	• There is friction between the water and the pipes • This will reduce the (initial) velocity of the water	**(1)** **(1)**	MP2 is dependent on MP1	**2**

(Total for Question 12 = 11 marks)

Question Number	Acceptable answers	Additional guidance	Mark
13(a)(i)	**MAX 2** • Statement describing 740cos20 as the (perpendicular) component of weight of the hiker **and** Statement describing *W*cos20 as the (perpendicular) component of the weight of the bag **(1)** • 2R is the push of the ground on the hiker **(1)** • Use of $\Sigma F = 0$ with reference to hiker being stationary **(1)**	 Accept reaction force	**2**

13(a)(ii)	• See 740 N × 0.25 m × cos 20 (= 173.8 N m) **(1)** • See W × 0.10 m × cos 20 (= 0.0940W N m) **(1)** • See R × 0.40 m (= 0.40N N m) **Or** 0.5(740cos20 + Wcos20) **(1)** • Use of principle of moments e.g. substitution into: moment of weight of man = moment of weight of bag + moment of R **(1)** • Use of equation of the resultant force with the equation obtained in MP4 **OR** Use of principle of moments about another point with the equation obtained in MP4 **(1)** • W = 120 N **(1)**	<u>Example of calculation</u> Moment of the weight of the man: 740 N × 0.25 m × cos 20 = 173.8 N m Moment of the weight of the bag: W × 0.10 m × cos 20 = 0.0940W N m Moment of R: R × 0.40 m = 0.40R N m 173.8 N m = 0.40R + 0.0940W N m Re-arranging to make R the subject of the equation: R = 435 N – 0.235W N Re-arranging the equation for the resultant force: R = 347.7 N + 0.470W 435 N – 0.235W N = 347.7 N + 0.470W 0.705W= 87.3 W = 124 N	**6**
13 (b)	• The position of the centre of gravity moves to the left/backwards **Or** the perpendicular distance (from O) would be greater **(1)** • The moment of the bag (about O) increases so the moment of R (and the size of R) decreases to preserve equilibrium **(1)**	MP1: accept lower for to the left	**2**

(Total for Question 13 = 10 marks)

<table>
<tr><th>Question Number</th><th>Additional guidance</th><th colspan="2">Mark</th></tr>
<tr><td>*14(a)</td><td>
This question assesses a student's ability to show a coherent and logically structured answer with linkages 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.
<table>
<tr><td>Number of indicative marking points seen in answer</td><td>Number of marks awarded for indicative marking points</td></tr>
<tr><td>6</td><td>4</td></tr>
<tr><td>5 - 4</td><td>3</td></tr>
<tr><td>3 - 2</td><td>2</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
</table>
Indicative content
• Sphere A applies a force to sphere B (on impact)
• According to Newtons third law Sphere B will apply an (equal and) opposite force to Sphere A
• This force opposes the motion of Sphere A
• Sphere A decelerates, according to N2
• The (resultant) force on sphere B accelerates B
• The forces/impulse acting (on the spheres) are equal so the change in speeds/momentum are the same for each sphere.
</td><td>
The following table shows how the marks should be awarded for structure and lines of reasoning

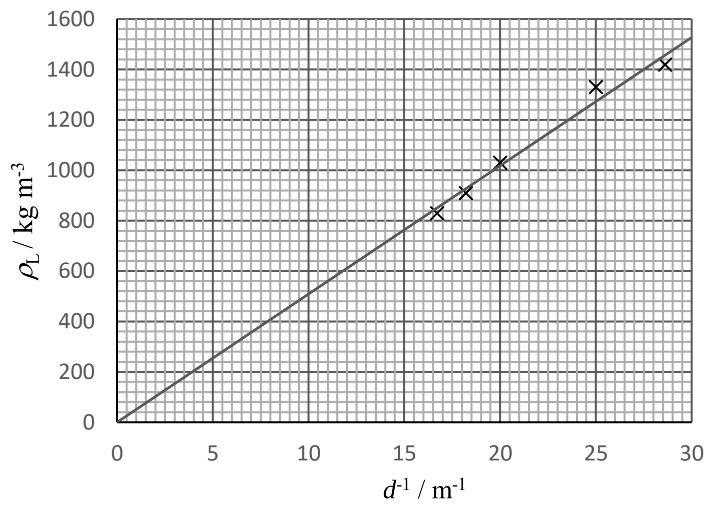
<table>
<tr><td></td><td>Number of marks awarded for structure of answer and sustained line of reasoning</td></tr>
<tr><td>Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout</td><td>2</td></tr>
<tr><td>Answer is partially structured 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>
</td><td>6</td></tr>
</table>

14 (b)	• Measurement of change in height of Sphere A **(1)** • actual height = $\frac{\text{image height} \times 11}{4.8}$ **(1)** • Use of E_k gained = E_{grav} lost to determine v **(1)** • Use of $p = mv$ **(1)** • $p_A = 0.025$ kg m s^{-1} **(1)**	Initial decrease in height from photo = 2.9 ± 0.1 cm Height of frame in photo = 4.8 ± 0.1 cm MP2-4 award even if measurement for the height is out of range MP3 use of equation of motion scores 0 <u>Example of calculation</u> $h_A = \frac{2.9 \text{ cm} \times 11 \text{ cm}}{4.8 \text{ cm}} = 6.6$ cm $\frac{1}{2} \times 0.022 \text{ kg} \times v_A^2 = 0.022 \text{ kg} \times 9.81 \text{ N kg}^{-1} \times 6.6 \times 10^{-2}$ m $v_A = 1.14$ m s^{-1} $p_A = 0.022 \text{ kg} \times 1.14 \text{ m s}^{-1} = 0.025$ kg m s^{-1} Accept p_A in range 0.024 – 0.026 kg m s^{-1}	**5**

(Total for Question 14 = 11 marks)

<table>
<tr><th>Question Number</th><th>Acceptable answers</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td>15 (a)</td><td>• Processing of data to calculate 1/d (1)
• Axes with labels and units (1)
• Scales (can include (0, 0)) (1)
• Plots (1)
• Line of best fit (1)</td><td>

Liquid	ρ_L / kg m^{-3}	d^{-1}/ m^{-1}
Honey	1420	29
Corn syrup	1330	25
Seawater	1030	20
Vegetable oil	920	18
Baby oil	830	17



</td><td>5</td></tr>
</table>

15 (b)	• Graph ($1/d$ against of ρ_L) is a straight line **(1)** • Through the origin **(1)**	For MP2 accept statement that line should go through the origin.	**2**
15 (c)	• Determine gradient from line of best fit **(1)** • Use of gradient = $\rho_s x$ **(1)** • ρ_s = 550 - 700 (kg m^{-3}) **(1)** • Type of wood identified appropriately from their ρ_s **(1)**	<u>Example of calculation</u> Gradient = $\frac{1500 \text{ kg m}^{-3}}{30 \text{ m}^{-1}}$ = 50 kg m^{-2} 50 kg m^{-2} = $0.09\rho_s$ ρ_s = 556 kg m^{-3}	**4**

(Total for Question 15 = 11 marks)

Question Number	Acceptable answers	Additional guidance	Mark
16(a)(i)	• (Moving) electrons collide with lattice/ions **(1)** • Transfer of energy to (lattice) ions so they vibrate with larger amplitude/speed (and the temperature increases) **(1)**		**2**
16(a)(ii)	• Electrons/ions in the tube collide with mercury/phosphor atoms and excite electrons (in the mercury/phosphor atoms) **(1)** • Energy is released in the form of photons as the electrons move back down (to the ground state) **(1)**	Mention of work function scores 0 MP2 Allow de-excite for move back down	**2**
16 (b)(i)	• Use of cross-sectional area = πr^2 **Or** $\frac{\pi d^2}{4}$ **(1)** • Use of $R = \frac{\rho l}{A}$ **(1)** • Correct use of factor of 14 **(1)** • Use of $P = \frac{V^2}{R}$ **(1)** • P = 52 W **(1)**	Example of calculation $A = \pi(1.9 \times 10^{-5}\text{ m})^2 = 1.134 \times 10^{-9}\text{ m}^2$ $R = \frac{(5.6 \times 10^{-8}\ \Omega\text{m})(1.6\text{ m})}{1.134\times10^{-9}\text{ m}^2} = 79.01\ \Omega$ $R_{max} = 14 \times 79.01\ \Omega = 1106.2\ \Omega$ $P = = \frac{(240\ V)^2}{1106.2\ \Omega} = 52.1\text{ W}$	**5**

16 (b)(ii)	**Either** • Initially(the resistance is low so) current will be the greatest **(1)** • As $P = I^2R$, the greatest power is transferred **(1)** • Change in current has more effect as it is squared **(1)** • Heating effect greatest when R is lowest, so breaks when switched on. **(1)** **OR** • p.d. is constant **(1)** • $P = V^2/R$ **(1)** • Power is greatest when R is lowest **(1)** • Heating effect is greatest when R is lowest, so breaks when switched on **(1)** **OR** • p.d. is constant **(1)** • Initially (resistance is low so) current will be the greatest **(1)** • As P=IV the greatest power is transferred **(1)** • Heating effect is greatest when R is lowest, so breaks when switched on **(1)**		**4**

(Total for Question 16 = 13 marks)