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Mark Scheme (Results)

October 2016

Pearson Edexcel International GCE
in Physics (WPH01) Paper 1

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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 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

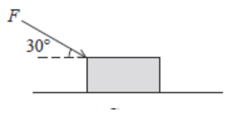
4.1 Bald (i.e. no working shown) correct answers score full marks unless in a 'show that' question.

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.

Question Number	Answer			Mark
1	B	s	**A:** m can be used for both displacement (vector) and distance (scalar) **C:** m s^{-1} can be used for both velocity (vector) and speed (scalar) **D:** m s^{-2} can only be used for acceleration (vector)	**1**
2	D	acceleration of block	**A:** normal reaction of ground should appear on the free-body force diagram **B:** mass × gravitational field strength should appear on the free-body force diagram **C:** friction should appear on the free-body force diagram	**1**
3	A	0.1 m	**B:** 0.2 m is obtained if each spring receives a force of 5.0 N **C:** 5 m is obtained if the incorrect F (5.0 N) and k are substituted into $F = k\Delta x$ the wrong way round **D:** 10 m is obtained if the correct F (2.5 N) and k are substituted into $F = k\Delta x$ the wrong way round	**1**
4	A	**Horizontal velocity**: decreasing **Vertical velocity**: increasing	**B**: horizontal velocity is correctly described but, due to the gravitational force the vertical velocity in not constant **C:** Due to drag, horizontal velocity is not constant and the vertical velocity is correctly described **D:** Due to drag (horizontally) and gravitational force (vertically) both statements are incorrect	**1**
5	C	 $0.87F\times$ displacement so is the most work done	Work done by force F on box = $(F\cos\theta)$ × displacement **A**: $(F\cos45)$ × displacement = $0.71F\times$ displacement **B**: $(F\cos60)$ × displacement = $0.50\ F\times$ displacement **D**: $(F\cos45)$ × displacement = 0.71 $F\times$displacement	**1**
6	B	$W > 0.5F_1e_1$	**A**: This assumes the area under the graph to be a triangle of area $0.5F_1e_1$ which is not the entire area under the graph **C**: $W = \frac{F_1}{e_1}$ is an incorrect formula **D**: $W < \frac{F_1}{e_1}$ uses an incorrect formula	**1**
7	D	tough	**A**: The plastic region of the graph is too large for the material to be brittle **B**: At an extension e_1, the elastic limit of the wire has been exceeded so there is also plastic behaviour **C**: Direction of applied force i.e. tensile/compressive not given so it cannot be deduced if the material is malleable	**1**
8	D	An upwards force of the hand on the ball	**A**: wrong object and direction **B**: correct object, wrong direction **C**: wrong object, correct direction	**1**

9	C	The speed of the object is very high	**A**: (laminar flow) must be correct to apply equation **B**: (small sphere) must be correct to apply equation **D**: (negligible upthrust) must be correct to apply equation	**1**
10	C	decreases increases	**A**:viscosity change incorrect and flow rate change correct **B**:viscosity change incorrect and flow rate change incorrect **D**:viscosity change correct and flow rate change incorrect	**1**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>11(a)</td><td>Identifies flow in the large diameter pipe as laminar flow and the flow in the small diameter pipe as turbulent flow (1)

Any statement from the first column about the large diameter pipe (1)

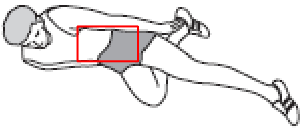
Any statement from the second column about the small diameter pipe (1)

<table>
<tr><th>Large diameter</th><th>Small diameter</th></tr>
<tr><td>the velocity of the fluid at a <u>point</u> is constant</td><td>the velocity at a <u>point</u> keeps on changing</td></tr>
<tr><td>No abrupt change in the direction/speed of flow</td><td>Abrupt/random changes in speed/direction</td></tr>
<tr><td>The lines of flow do not cross</td><td>Eddies/vortices/whirlpools form</td></tr>
<tr><td>Layers/flowlines/streamlines are parallel</td><td>Layers/flowlines/streamlines mix/cross</td></tr>
</table>
</td><td>3</td></tr>
<tr><td>11(b)</td><td>Different:
velocity Or speed Or viscosity Or density Or temperature Or rate of flow Or friction (between pipe and fluid) (1)

(Accept greater or smaller for different)</td><td>1</td></tr>
<tr><td></td><td>Total for question 11</td><td>4</td></tr>
</table>

Question Number	Answer		Mark
12(a)	Use of $\Delta E_{grav} = mg\Delta h$ Use of power = $\frac{\Delta E_{grav}}{time}$ Power = 330 W <u>Example of calculation</u> Change in GPE = 22 000 kg × 9.81 N kg^{-1} × 5.5 m = 1.19 × 10^6 J Power = $\frac{1.19 \times 10^6\ J}{60\ s \times 60\ s}$ = 329.7 W	**(1)** **(1)** **(1)**	**3**
12(b)	Additional work is done **Or** energy is transferred/dissipated to thermal energy (because of) **Or** energy is transferred to the surroundings (because of) friction between the air (molecules) and the water **Or** friction between moving parts in the pump **Or** viscous forces within the liquid	**(1)** **(1)**	**2**
	Total for question 12		**5**

Question Number	Answer		Mark
13	Use of $s = ut + ½at^2$ with $u = 0$ Calculated displacement of 0.049 (m) **Or** 0.44 (m) seen Use of scaling factor (0.215/0.50) for the candidate's value of displacement seen or implied from position on diagram (This can be awarded if the candidate has used an incorrect displacement) Correct positions of the two times at 0.02 m **and** 0.19 m from the 0 line	**(1)** **(1)** **(1)** **(1)**	**4**
	Total for question 13		**4**

<table>
<tr><th>Question Number</th><th>Answer</th><th></th><th>Mark</th></tr>
<tr><td>14(a)</td><td>
Straddle: centre of gravity to lie within rectangle</td><td>(1)</td><td>1</td></tr>
<tr><td>*14(b)</td><td>(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)

Either
The idea that less work is done by the athlete using the FF (to reach that height)

For the same height (of body)

An athlete using the FF has a lower centre of gravity Or for the straddle jump the C of G goes over the bar and for the FF the C of G is below/at the bar

Or
the same work will be done by the athlete

The idea that this will make the height of the athlete using the FF higher (so more likely to clear the bar)

For the same centre of gravity</td><td>(1)

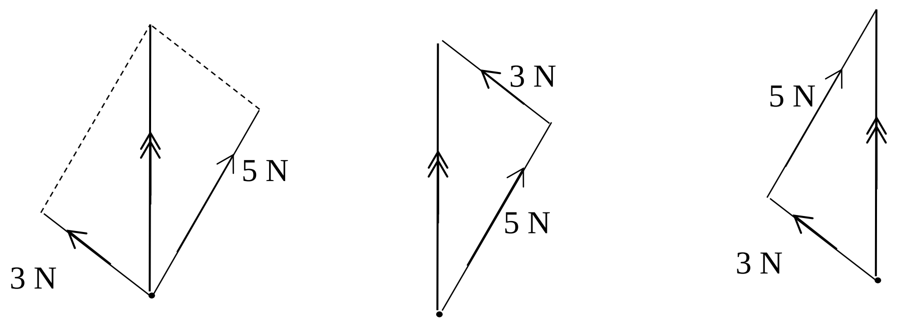
(1)

(1)

(1)

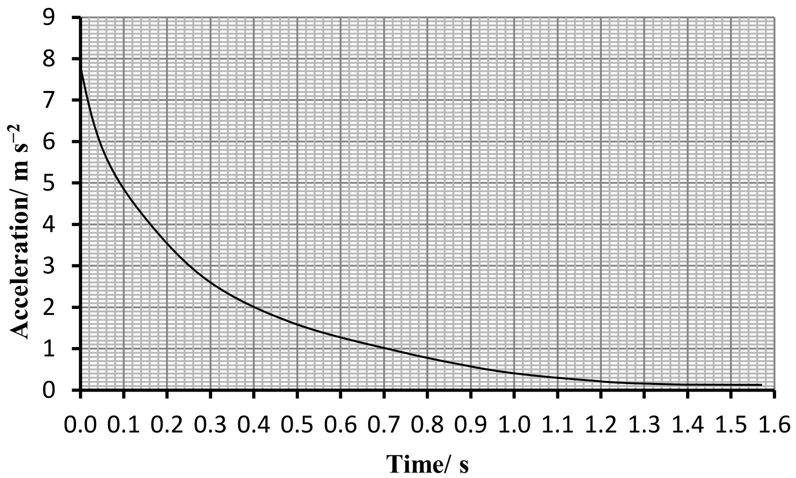
(1)

(1)</td><td>3</td></tr>
<tr><td></td><td>Total for question 14</td><td></td><td>4</td></tr>
</table>

Question Number	Answer		Mark
15(a)	Construction of correct vector triangle or parallelogram (from which a measurement for the resultant could be made) 3N and 5N correctly scaled Correct directions for 3N, 5N, and a single resultant Weight = 6 N (accept 5.9 N to 6.1 N) <u>Examples of diagrams</u> 	**(1)** **(1)** **(1)** **(1)**	**4**
15(b)	To reduce <u>parallax</u> It ensured the string was directly above its image in the mirror (and hence the paper) **Or** so that the mark made on the paper is directly beneath the string **Or** so that the eye is directly above the string/mark **Or** so that the position marked on the paper of the string is in line with the string **and** eye	**(1)** **(1)**	**2**
	Total for question 15		**6**

Question Number	Answer		Mark
16(a)	There is a component of weight parallel to the ramp (opposing motion) **Or** work is done against weight component Opposing/resultant force decelerates vehicle (**Max 1**: kinetic energy (of the car) is transferred to gravitational potential energy)	**(1)** **(1)**	**2**
16(b)(i)	Use of $W = mg$ Use of trigonometry to determine the component of the weight/g parallel to the ramp Component of weight parallel to ramp = 4.8×10^3 (N) <u>Example of calculation</u> $W_p = 2.8 \times 10^3$ kg× 9.81 N kg^{-1}× sin10° $W_p = 4.77 \times 10^3$ N	**(1)** **(1)** **(1)**	**3**
16(b)(ii)	Use of $\Delta W = F \times \Delta s$ **Or** Use of $\Delta W = mg\Delta h$ (with use of the appropriate trig to determine the vertical height) $\Delta W = 8.6 \times 10^5$ J (ecf for weight from (b)(i)) (Using show that value $\Delta W = 9.0 \times 10^5$ J) <u>Example of calculation</u> $\Delta W = 4.77 \times 10^3$ N × 180 m $\Delta W = 8.59 \times 10^5$ J	**(1)** **(1)**	**2**
16(b)(iii)	Use of $E_k = ½ mv^2$ with $E_k = \Delta W$ $v = 25$ m s^{-1} (ecf for ΔW from (b)(ii)) (Using show that value $v = 25.4$ m s^{-1}) <u>Example of calculation</u> $E_k = 8.6 \times 10^5$ J = ½ × (2.8×10^3 kg) × v^2 $v = 24.8$ m s^{-1}	**(1)** **(1)**	**2**
16(c)(i)	Shorter (ramp) distance needed **Or** the ramp can be at a lower/no/downwards incline	**(1)**	**1**
16(c)(ii)	Work is done to stretch the strips **Or** energy is transferred from the car to the strips The idea that this energy cannot be returned to the vehicle (beyond the elastic limit)	**(1)** **(1)**	**2**
	Total for question 16		**12**

Question Number	Answer		Mark
17(a)(i)	Reference to upthrust equals the weight (of ship in equilibrium) A greater weight requires a greater upthrust a greater volume of water will be displaced (when sitting lower in the water)	**(1)** **(1)** **(1)**	**3**
***17(a)(ii)**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)** The weight of water displaced must be the same (for the same load, regardless of the type of sea water) **Or** the upthrust is the same in fresh water and salt water The density of fresh water is less than the density of salt water The ship will sit lower in the water **Or** the volume of the submerged part of the ship is increased (Accept a converse answer in terms of the tropical salt water for MP2 and MP3)	**(1)** **(1)** **(1)**	**3**
17(b)	Use of $\rho = m/V$ **and** $W = mg$ **Or** see ρVg Use of or see submerged volume of straw = A × submerged length State that the weight will be the same in both situations **Or** equate the two expressions for upthrust Correct substitution of the densities into an appropriate equation Length straw below water (l) = 12 cm <u>Example of calculation</u> (in distilled water) $mg = \rho_{dw} \times (A \times 13.3\text{ cm}) \times g$ (in salt water) $mg = \rho_{sw} \times A(l) \times g$ $\rho_{dw} \times (A \times 13.3\text{ cm}) \times g = \rho_{sw} \times A(l) \times g$ $\rho_{dw} \times 13.3\text{ cm} = \rho_{sw} \times l$ $l = \frac{\rho_{dw} \times 13.3\text{ cm}}{\rho_{sw}} = \frac{998\text{ kg m}^3}{1150\text{ kg m}^3} \times 13.3\text{ cm} = 11.54\text{ cm}$	**(1)** **(1)** **(1)** **(1)** **(1)**	**5**
	Total for question 17		**11**

Question Number	Answer		Mark
18(a)	Use of area under the graph Use of counting squares method to find the area under the curve **Or** approximates the area to at least one triangle and one rectangle Height = 5.2 to 5.5 (m) <u>Example of calculation</u> Area under the graph = (27 cm squares × 0.2 s × 1 m s^{-1}) Height = 5.4 m	**(1)** **(1)** **(1)**	**3**
18(b)(i)	Use of gradient of the graph **Or** use of $a = (v-u)/t$ (using any <u>pair</u> of points on graph) Using a tangent up to t = 0.2 s **Or** a pair of values up to t = 0.2 s Maximum acceleration = 7.6 to 8.4 m s^{-2} <u>Example of calculation</u> Gradient of tangent = $\frac{(5.0-0)\ \text{m s}^{-1}}{(0.64-0)\ \text{s}}$ Maximum acceleration = 7.8 m s^{-2}	 **(1)** **(1)** **(1)**	**3**
18(b)(ii)	Their maximum acceleration value marked on vertical axis (ecf from bi) Maximum acceleration at t = 0 Curve with decreasing gradient drawn from t = 0 to t = 1.4s Acceleration of 0 or close to 0 from 1.4s to 1.58 s (The region of 0 acceleration may begin at any time from 1.2 to 1.4 s) 	**(1)** **(1)** **(1)** **(1)**	**4**
18(c)	Repeat experiment (using the same method) Check these values are similar to initial values **Or** compare results	**(1)** **(1)**	**2**
	Total for question 18		**12**

Question Number	Answer		Mark
19(a)	The <u>ratio</u> of (tensile) stress to (tensile) strain (in the region where Hooke's law applies) **Or** a measure of the stiffness of a material **Or** Young modulus = $\frac{Fx}{A\,\Delta x}$ with all terms defined	**(1)**	**1**
19(b)	**Fit:** the idea that the lens will not change shape (around eye) so is difficult to fit or is uncomfortable **Function:** The idea that the lens will keep its shape so that vision is corrected	**(1)** **(1)**	**2**
19(c)(i)	Use of the gradient of the graph from the linear section (up to 7 % strain) Young modulus = 0.62 to 0.65 (MPa) <u>Example of calculation</u> Gradient = $\frac{0.03\times10^{6}\,\text{Pa}}{4.8/100}$ Young Modulus = 625 000 Pa	**(1)** **(1)**	**2**
19(c)(ii)	Stress = 0.049 ± 0.001 MPa **Or** use of $E = \sigma/\varepsilon$ to determine the stress Use of $\sigma = F/A$ to determine the cross sectional area Use of $A = 5.5 \times 10^{-3}$ m × T $T = 3.5 \times 10^{-4}$ m to 3.8×10^{-4} m (accept an ecf for E from (c)(i)) <u>Example of calculation</u> $A = \frac{0.101\text{ N}}{0.049\times10^{6}\text{ Pa}} = 2.06 \times 10^{-6}\text{ m}^2$ $T = 2.06 \times 10^{-6}\text{ m}^2 \div 5.5 \times 10^{-3}\text{ m} = 3.75 \times 10^{-4}$ m	**(1)** **(1)** **(1)** **(1)**	**4**
***19(c)(iii)**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)** Where the lens is the thinner, the (cross sectional) area is smaller The applied force,(the original length) and the Young modulus are the same a greater stress and hence strain are produced (and hence a greater extension) **Or** see $\Delta x = \frac{Fx}{EA}$ (with Δx the subject) with an explanation leading to a greater extension	**(1)** **(1)** **(1)**	**3**
	Total for question 19		**12**

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