edexcel

Mark Scheme (Results)

Summer 2014

Pearson Edexcel International
Advanced Level
in Physics (WPH01)
Paper 01 Physics on the Go

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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.

For example:

(iii)	<u>Horizontal force of hinge on table top</u> 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.]	✓	1

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

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.
   - 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 Incorrect use of case e.g. 'Watt' or 'w' will not be penalised.
   - 2.3 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, for example in a spreadsheet.
   - 2.4 The same missing or incorrect unit will not be penalised more than once within one question (one clip in epen).
   - 2.5 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.
   - 2.6 The mark scheme will indicate if no unit error penalty is to be applied by means of [no ue].

3. Significant figures
   - 3.1 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.

3.2 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}

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.
   - 4.6 Example of mark scheme for a calculation:

<u>'Show that' calculation of weight</u> Use of L × W × H Substitution into density equation with a volume and density Correct answer [49.4 (N)] to at least 3 sig fig. [No ue] [If 5040 g rounded to 5000 g or 5 kg, do not give 3rd mark; if conversion to kg is omitted and then answer fudged, do not give 3rd mark] [Bald answer scores 0, reverse calculation 2/3] Example of answer: 80 cm × 50 cm × 1.8 cm = 7200 cm^3 7200 cm^3 × 0.70 g cm^{-3} = 5040 g 5040 × 10^{-3} kg × 9.81 N/kg = 49.4 N	✓ ✓ ✓	3

5. Quality of Written Communication
   - 5.1 Indicated by QoWC in mark scheme. QWC – Work must be clear and organised in a logical manner using technical wording where appropriate.
   - 5.2 Usually it is part of a max mark, the final mark not being awarded unless the QoWC condition has been satisfied.

6. Graphs
   - 6.1 A mark given for axes requires both axes to be labelled with quantities and units, and drawn the correct way round.
   - 6.2 Sometimes a separate mark will be given for units or for each axis if the units are complex. This will be indicated on the mark scheme.

6.3 A mark given for choosing a scale requires that the chosen scale allows all points to be plotted, spreads plotted points over more than half of each axis and is not an awkward scale e.g. multiples of 3, 7 etc.

6.4 Points should be plotted to within 1 mm.

- Check the two points furthest from the best line. If both OK award mark.
- If either is 2 mm out do not award mark.
- If both are 1 mm out do not award mark.
- If either is 1 mm out then check another two and award mark if both of these OK, otherwise no mark.

6.5 For a line mark there must be a thin continuous line which is the best-fit line for the candidate's results.

Question Number	Answer	Mark
1	C	**1**
2	B	**1**
3	B	**1**
4	D	**1**
5	B	**1**
6	C	**1**
7	A	**1**
8	C	**1**
9	C	**1**
10	D	**1**

Question Number	Answer		Mark
11a	Malleable	**(1)**	
	(Large) plastic deformation **Or** the material does not return to its original shape (when the compressive force is removed) **Or** the material is permanently deformed (when the compressive force is removed)	**(1)**	**2**
	(Treat references to tough as neutral in both marking points)		
11b	Elastic behaviour **Or** does not deform plastically (for low stresses)	**(1)**	
	Returns to original shape/position (when the force/stress is removed) **Or** no permanent deformation	**(1)**	**2**
	Total for question 11		**4**

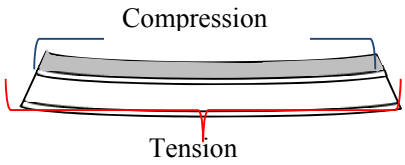
Question Number	Answer		Mark
***12**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)**		
	Vertical velocity/motion is independent of the horizontal velocity/motion	**(1)**	
	The ball (always) has the same horizontal velocity as the skateboarder	**(1)**	
	The (only) force acting on the ball is weight/vertically (downwards) **Or** the (only) acceleration acting on the ball is vertically (downwards) **Or** there are no horizontal forces/acceleration	**(1)**	
	The idea that the ball and skateboarder are in the same horizontal position (relative to each other) **e.g.** the ball and the skateboarder have the same horizontal displacement/distance/position at the same time **e.g.** the ball will stay directly above the skateboarder	**(1)**	**4**
	Total for question 12		**4**

Question Number	Answer		Mark
13(a)	$mg = T\cos\theta$ (seen or substituted into) Substitute into $mg = T\cos\theta$ $T = 0.16$ (N) Example of calculation $0.015\ \text{kg} \times 9.81\ \text{N kg}^{-1} = T\cos 20°$ $T = 0.16$ N	**(1)** **(1)** **(1)**	**3**
13(b)	$R = T\sin 20°$ **Or** $R = mg\tan 20°$ (seen or substituted into) **Or** use of Pythagoras (e.g. if terms added or subtracted) Use of $R = T\sin 20°$ **Or** $R = mg\tan 20°$ **Or** correct use of Pythagoras $R = 0.06$ N (ecf from (a)) (Accept answers in the range $R = 0.05$ to 0.07 N) Example of calculation $R = 0.16\ \text{N} \times \sin 20°$ $R = 0.055$ N	**(1)** **(1)** **(1)**	**3**
13(c)	$\text{Force}_{\text{X on Y}} = 0.06$ (N) (ecf from (b)) Due to N3 **Or** (repulsive) force of X on Y is equal (and opposite) to (repulsive) force of Y on X. (do not award MP2 if candidates have linked their response to the idea of identical magnets)	**(1)** **(1)**	**2**
	Total for question 13		**8**

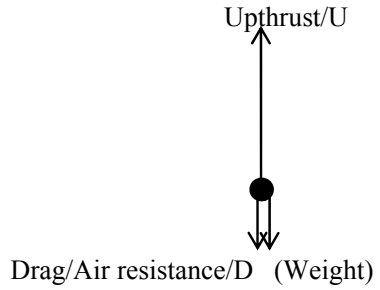
Question Number	Answer	Mark
14(a)	Child's (resultant) velocity = 0 **Or** +1.9 + (−1.9) **Or** −1.9 +1.9 **Or** The child and the walkway have the same speed but in the opposite direction **Or** in 1 s the child will walk 1.9 m backward and the walkway moves 1.9 m forward **(1)** The idea that the child will appear (to a stationary observer) to stay in the same position on the walk way. **(1)** Examples of answers The child has no displacement (MP2 only) Their velocity relative to the ground/start is zero (MP1 and MP2)	**2**
14(b)(i)	Use of $v = s/t$ **(1)** Use of trigonometry to find the height (12.3m) **Or** the component of the force acting along the slope (114 N) **(1)** Use of work done = force × distance **(1)** Work done = 5400 (J) **(1)** Example of calculation Distance walked along ramp = 1.90 m s^{-1} x 25.0 s = 47.5 m F = 45.0 kg × 9.81 N kg^{-1} × sin15°= 114.3 N Work done = $F \times d$ = 114.3 N × 47.5 m = 5429 J	**4**
14(b)(ii)	Work done to walk along the ramp = work done to climb the stairs **Or** use of 5400 = power × 12 **(1)** Power = 450 W (ecf from (b)(i) for energy) **(1)** (P = 417 W using show that value) Example of calculation Power = $\frac{5430\ \text{J}}{12\ \text{s}}$ Power = 453 W	**2**
	Total for question 14	**8**

Question Number	Answer		Mark
15(a)(i)	Mg **Or** mass of hanging masses × g **Or** weight of hanging masses	**(1)**	**1**
15(a)(ii)	Use $s = ut + ½ at^2$ **Or** average velocity = s/t **and** use $a = (v-u)/t$ with $v = 2s/t$	**(1)**	
	With $u = 0$	**(1)**	**2**
	($s = ½ at^2$ scores both MP1 and MP2)		
15(a)(iii)	Both objects are being accelerated and not just the trolley **Or** the idea that the relationship between F and a is being investigated and so m must be constant/controlled **Or** so you get a straight line when F is plotted against a	**(1)**	**1**
15(b)(i)	Straight line through the origin	**(1)**	**1**
15(b)(ii)	Gradient = (total accelerated) mass	**(1)**	**1**
	(Do not award the mark if the candidate refers to the mass of the trolley, the hanging masses or the added masses)		
15(c)	**Max 2 from**		
	Parallax	**(1)**	
	(Human) reaction time	**(1)**	
	Knowing exact point it passes markers	**(1)**	
	Zero error in stopwatch	**(1)**	**2**
	Total for question 15		**8**

Question Number	Answer		Mark
16(a)(i)	Use of density = mass/volume Mass = 1.1×10^6 (kg) Example of calculation Mass of water passing through turbines in 1 second = 1060 $m^3 \times$ 997 kg m^{-3} Mass of water passing through turbines in 1 second = 1.06×10^6 kg	**(1)** **(1)**	**2**
16(a)(ii)	Use of GPE = mgh **Or** GPE per second = $\frac{m}{t} \times g \times h$ Power = 1.9 $\times 10^9$ (W) (ecf) (range 1.8 to 2.0 GW) Example of calculation GPE per second = 1.06×10^6 kg $s^{-1} \times$ 9.81 N $kg^{-1} \times$ 185 m = 1924 MJ s^{-1} Power = 1.924 GW	**(1)** **(1)**	**2**
16(a)(iii)	Use of 0.8 x either power or energy Use of power = $\frac{\text{energy}}{\text{time}}$ with an attempt at a time conversion for the year Total energy = 4.9×10^{16} J (ecf) (accept answers in the range(4.5 to 5.1) $\times 10^{16}$ J) Example of calculation Output power = $0.8 \times 1.924 \times 10^9$ W = 1.539×10^9 W 60s × 60 s × 24 h× 365 days = 31.54×10^6 s Total energy output in 1 year = 1.539×10^9 W × 31.54×10^6 s = 4.86×10^{16} J	**(1)** **(1)** **(1)**	**3**
16(a)(iv)	The water still has a velocity after passing through the turbines **Or** energy is transferred (to surroundings) as thermal energy **Or** energy is dissipated (to surroundings) as heat **Or** work is done against friction **Or** friction acts between the water and the turbine/dam **Or** friction acts between moving parts (accept in bearings) (Treat references to sound as neutral. Do not credit 'energy lost/wasted as...' but treat as neutral if within correct response)	**(1)**	**1**
16(b)	**Max 2** Rate of flow of saltwater less (accept lower velocity/speed) Less mass of (salt) water reaching turbine blades per sec Greater transfer of energy (away from the salt water) due to more friction (Salt) water has a lower (kinetic) energy on reaching the turbines Turbine rotates at a lower speed Less GPE converted to KE Lower efficiency of the dam	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**2**
	Total for question 16		**10**

Question Number	Answer		Mark
17(a)(i)	Compression anywhere in the concrete layer	**(1)**	
	Tension anywhere in the steel beam	**(1)**	**2**
			
	(Do not award each marking point if the force is labelled in both materials)		
17(a)(ii)	Concrete is strong under compression	**(1)**	
	Steel is strong under tension (and buckles under compression) **Or** has a high UTS	**(1)**	**2**
17(b)(i)	Brittle	**(1)**	
	Undergoes little/no plastic deformation before breaking **Or** breaks just after limit of proportionality/elastic limit	**(1)**	**2**
17(b)(ii)	Steel is ductile	**(1)**	
	At the elastic limit **Or** yield point	**(1)**	
	steel becomes plastic **Or** there is a large (increase in) strain for little/no stress **Or** little/no force produces a large (increase in) extension	**(1)**	
	steel would change shape/buckle/distort/neck/stretch **Or** steel would show permanent deformation **Or** the concrete would crack	**(1)**	**4**
17(c)(i)	Use of $E = \frac{\sigma}{\varepsilon}$ using points up (0.9, 155) **Or** use of the gradient of the linear section of the graph	**(1)**	
	$E = 177 \times 10^9$ Pa (Accept answers in the range 170 to 180 GPa)	**(1)**	**2**
	<u>Example of calculation</u> $E = \frac{150 \times 10^6 \text{ Pa}}{0.85 \times 10^{-3}}$ $E = 176.5 \times 10^9$ Pa		

17(c)(ii)	<u>Elastic limit</u> point at which material stops behaving elastically **Or** point at which plastic behaviour/deformation begins **O**r beyond this point the material will no longer return to its original length if the (deforming) force is removed **Or** up to this point the material will return to its original length if the (deforming) force is removed **(1)** <u>Yield point</u> (Point at which) for little/no increase in load/force/stress there will be a large extension/strain **(1)**	**2**
	Total for question 17	**14**

Question Number	Answer		Mark
18(a)(i)	Upthrust/U vertically upwards Drag vertically downwards (-1 for any additional forces if MP1 & MP2 awarded. Lines must be vertical by eye and touch the dot)  	**(1)** **(1)**	**2**
18(a)(ii)	Upthrust – weight – drag = 0 **Or** weight + drag – upthrust = 0	**(1)**	**1**
***18(a)(iii)**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)** **Max 4 from** • Density of air decreases **Or** difference between the density of the air and the helium/gas/ in the ballon decreased • Hence the upthrust decreases **(MP2 cannot be awarded without MP1being attempted)** • Volume of balloon/ displaced air/envelope increases • This would increase the upthrust **Or** this would increase the weight of displaced fluid/air **(MP4 cannot be awarded without MP3 being attempted)** • Effect of air density decreasing is greater than that of the volume increasing • Changes in g are negligible (at these heights) **Or** air resistance/drag negligible (towards maxiumum height)	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**4**
18(a)(iv)	Use of speed = distance/time **Or** attempt to find the gradient of the graph (using a pair of values from the graph) Speed = 4.9 m s^{-1} (at least 2 SF) (Accept answers in the range 4.75 m s^{-1} to 4.94 m s^{-1}) <u>Example of calculation</u> Speed = $\frac{35\,000\text{ m}}{7200\text{ s}}$ Speed = 4.86 m s^{-1}	**(1)** **(1)**	**2**

18(b)(i)	Use of $v = u + at$ with $u = 0$ **Or** $s = ut + ½ at^2$ **and** $v^2 = u^2 + 2as$ with $u = 0$ **(1)** $v = 491$ (m s^{-1}) **(1)** Example of calculation $v = 0 + (9.81 \text{ N kg}^{-1} \times 50 \text{ s})$ $v = 490.5$ m s^{-1}	**2**
18(b)(ii)	Air resistance reduced his (downwards) acceleration **Or**Air resistance was acting on him **Or** Air resistance was not considered when calculating the speed **Or** 380 m s^{-1} is the terminal velocity **Or** this is when weight = drag (+ upthrust) **Or** this is when the resultant force is zero **Or** work done against frictional forces **(1)**	**1**
18(c)	Use of max speed = 1.2 × speed of sound **(1)** Speed of sound = 317 m s^{-1} **(1)** Example of calculation Speed of sound = $\frac{380 \text{ m s}^{-1}}{1.2}$ Speed of sound = 317 m s^{-1}	**2**
	Total for question 18	**14**

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