edexcel

Mark Scheme (Results)

Summer 2015

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

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

Summer 2015
Publications Code IA042386

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.

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) 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.]	✓	**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. 'resonance'
   - 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:

     'Show that' calculation of weight

     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] **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

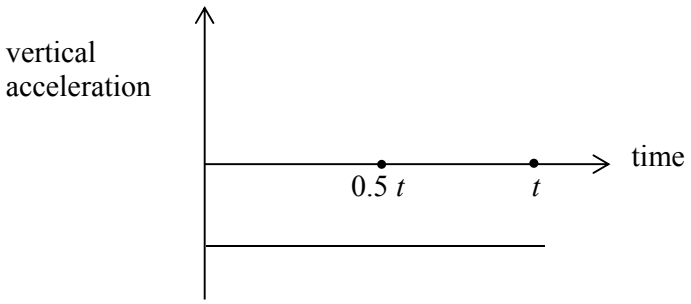
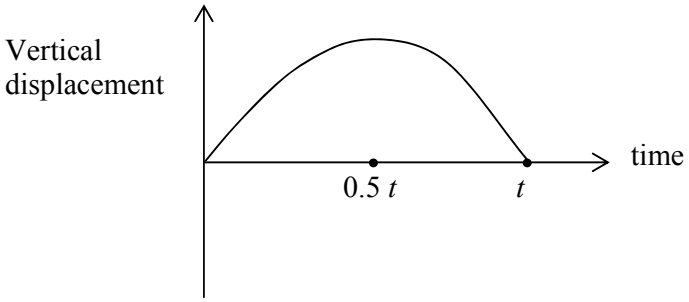
     = 49.4 N

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.

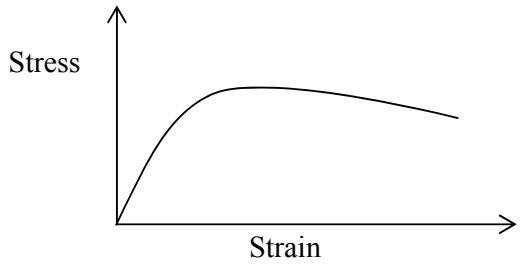
6. **Graphs**
   - 6.1 A mark given for axes requires both axes to be labelled with quantities and units, and drawn the correct way round.
   - 6.2 Sometimes a separate mark will be given for units or for each axis if the units are complex. This will be indicated on the mark scheme.
   - 6.3 A mark given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

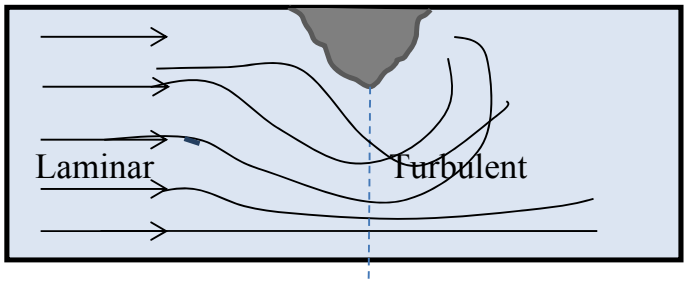
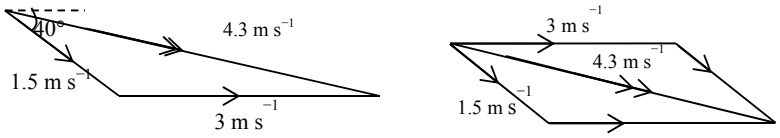
Question Number	Answer	Mark
1	A	**1**
2	D	**1**
3	C	**1**
4	C	**1**
5	C	**1**
6	D	**1**
7	B	**1**
8	B	**1**
9	C	**1**
10	C	**1**

Question Number	Answer	Mark
11(a)	The horizontal speed/velocity/ is constant **Or** the ball will move the same distance horizontally between every image **Or** there is no horizontal acceleration/deceleration **Or** there is no horizontal (resultant) force acting on the ball **Or** air resistance is negligible **(1)**	**1**
11(b)	There is a vertical deceleration of the ball **Or** there is a negative/downwards acceleration **Or** the vertical speed/velocity of the ball is decreasing **Or** the idea that there is an unbalanced force acting downwards on the ball **Or** the ball is accelerating vertically at $-9.81\ m\ s^{-2}$ **(1)** (a correct direction must be included in the answer)	**1**
	Total for Question 11	**2**

Question Number	Answer		Mark
12(a)	Horizontal line(s)	**(1)**	
	With a <u>constant</u> negative value ending at approximately time *t*	**(1)**	**2**
			
12(b)	Parabolic curve by eye (height caught not specified so allow all possibilities, 0 displacement may be taken as ground or at height from which it was hit)	**(1)**	
	Maximum positive value at time 0.5*t* and ending at *t*	**(1)**	**2**
			
	Total for Question 12		**4**

Question Number	Answer		Mark
13(a)	X is Upthrust **Or** weight of oil/fluid displaced	**(1)**	
	Y is Drag **Or** friction **Or** fluid resistance **Or** viscous/resistive force	**(1)**	
	Z is Weight **Or** gravitational pull/force	**(1)**	**3**
13(b)	Diameter of the ball	**(1)**	
	Distance and time (to travel measured distance)	**(1)**	**2**
	(1 mark max for radius **and** (terminal) velocity if neither mark awarded)		
	Total for Question 13		**5**

Question Number	Answer		Mark
14(a)	Elastic deformation: (When the applied force/load is removed) the material/wire will return to its original shape/length/size	**(1)**	
	Plastic deformation: (When the applied force/load is removed) the material/wire will be permanently deformed **Or** the material/wire will not return to its original shape/length/size	**(1)**	
	Mention of removal of (applied) force/load at least once	**(1)**	**3**
	(Treat references to Hooke's law as neutral)		
14(b)(i)	Initial positive straight line (do not award MP1 if there is no attempt at a plastic region)	**(1)**	
	Becomes a continuously negative gradient **and** negative gradient section longer, along the strain axis, than straight section	**(1)**	**2**
			
14(b)(ii)	Large region of plastic behaviour **Or** large region of negative gradient	**(1)**	**1**
	(Treat references to large strain or energy stored as neutral but references to large/small elastic region are **not** neutral)		
	Total for Question 14		**6**

Question Number	Answer		Mark
15(a)	There is(more) drag/friction/resistive force (in the shallow water) (Treat references to laminar/turbulent as neutral)	**(1)**	**1**
15(b)	Laminar **and** turbulent region correctly drawn with at least 2 of the laminar lines continuously becoming turbulent flow i.e. crossing, whorls eddies. These must not start before the dotted line identified Laminar **and** turbulent correctly labelled  	**(1)** **(1)**	**2**
15(c)	Vector diagram constructed with labels (and directions correct) (accept labels using the scale e.g. 3 cm and 6 cm) To scale Velocity = 4.2 – 4.4 m s^{-1} (MP3 only for candidates that resolve 1.5 m s^{-1} into its two components and then use Pythagoras or draw right angled triangle. Also MP3 only if cosine rule used)  	**(1)** **(1)** **(1)**	**3**
	Total for Question 15		**6**

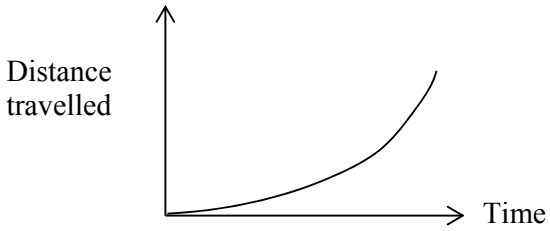
Question Number	Answer		Mark
16(a)(i)	Use of correct trig function to find the horizontal component of force	**(1)**	
	$F_{horizontal}$ = 34(N)	**(1)**	**2**
	Example of calculation $F_{horizontal}$ = 80 N × cos 65° $F_{horizontal}$ = 33.8 N		
16(a)(ii)	Use of $\Delta W = F \times \Delta s$	**(1)**	
	ΔW = 11 000 J(ecf from (a)(i))	**(1)**	**2**
	Example of calculation ΔW = 34 N × 320 m ΔW = 10 880 J		
16(a)(iii)	Use of correct trig function to find the vertical component of force **Or** use of Pythagoras	**(1)**	
	$F_{horizontal}$ = 72 - 74(N) (ecf from 16(a)(i) if tan or Pythagoras have been used)	**(1)**	**2**
	Example of calculation $F_{vertical}$ = 80 N × sin 65° $F_{vertical}$ = 72.5 N		
16(a)(iv)	The force is perpendicular to the direction of motion **Or** the resultant force/ΣF vertically is 0 **Or** the weight and normal force cancel out this component of applied force **Or** there is no displacement/distance/movement in the vertical direction **Or** the displacement/distance /movement in horizontal direction	**(1)**	**1**
***16(b)**	(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)		
	Horizontal component of force must increase	**(1)**	
	Vertical component of force must stay the same	**(1)**	
	(Magnitude of applied) force must increase	**(1)**	
	Angle (to the horizontal) decreases	**(1)**	**4**
	Total for Question 16		**11**

BLANK PAGE

Question Number	Answer	Mark
17(a)	Use of energy = area under graph e.g. $E = ½ F\Delta x$ or approximation to a rectangle **(1)** (do not accept use of $W = Fd$) Attempt to find area by counting squares (of any size) **Or** area found by dividing up the area under the graph into a series of regions/shapes etc. **(1)** Energy = 6.8 – 7.2 kJ **(1)** <u>Example of calculation</u> 1 small square = 25 J Area under the graph = 283 squares × 25 J Area under the graph = 7075 J	**3**
***17(b)(i)**	(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate) **Method 1** The strap is under tension **Or** the strap applies a <u>force</u> on the (trapped) car **(1)** The strap does work on the (trapped) car **Or** the strap makes the (trapped) car accelerate **Or** so that there is now an unbalanced force on the (trapped)car **(1)** **Method 2** The towing car transfers E_k to E_{el} in the strap **(1)** E_{el} in the strap is then transferred to work done (against friction) to get the trapped car moving **Or** E_{el} in the strap is transferred to E_k of the trapped car. **(1)**	**2**

17(b)(ii)	Use of strain = $\frac{\text{extension}}{\text{initial length}}$ (may be seen in energy equation) **Or** (for constant length) strain α extension **(1)** Use of ratio $\frac{E_{\text{nylon}}}{E_{\text{cable}}} = \frac{½ \times F \times 0.25 \times (l)}{½ \times F \times 0.0002 \times (l)}$ **Or** use of $\frac{E_{\text{nylon}}}{E_{\text{cable}}} = \frac{0.25}{0.0002}$ with both force and length constant **(1)** Ratio = 1300 (dependent mark) **(1)** (use of strain as extension without reference to length can score MP2 and MP3 only) (A bald 0.25/0.0002 = 1250 scores 0) <u>Example of calculation</u> $\text{Extension}_{\text{nylon}} = 0.25 \times l$ $\text{Extension}_{\text{cable}} = 0.0002 \times l$ $E_{\text{nylon}} = ½ \times F \times 0.25 \times l$ $E_{\text{cable}} = ½ \times F \times 0.0002 \times l$ $\frac{E_{\text{nylon}}}{E_{\text{cable}}} = \frac{½ \times F \times 0.25 \times l}{½ \times F \times 0.0002 \times l}$ $\frac{E_{\text{nylon}}}{E_{\text{cable}}} = \frac{0.25}{0.0002} = 1250$	**3**
17(b)(iii)	(elastic potential) energy stored by the cable is insufficient/small **Or** (compares to strap and) refers to a lot less energy **Or** the cable would snap due to the sudden large force **(1)**	**1**
	Total for Question 17	**9**

Question Number	Answer		Mark
18(a)(i)	Use of $W = mg$ Mass = 76 or 77 kg Example of calculation 750 N = m × 9.81 N kg^{-1} m = 76.5 kg	**(1)** **(1)**	**2**
18(b)(i)	The position through which all the weight can be assumed to act **Or** the point at which all the weight is centred upon **Or** the point that can be used to represent the whole weight	**(1)**	**1**
18(b)(ii)	Reaction force is less than the weight **Or** reaction force decreases (and then increases) There would now be a resultant (downward) force (hence an acceleration) **Or** the forces are no longer balanced	**(1)** **(1)**	**2**
***18(c)**	(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate) Due to N3, the floor will exert a force (upwards) on the athlete Force greater than the weight **Or** force not equal to weight **Or** there is a resultant/unbalanced force Due to N2/N1 the athlete accelerates (upwards)**Or** due to N2 (resultant) force is proportional to acceleration	**(1)** **(1)** **(1)**	**3**
18(d)	Resultant force = R - mg seen or substituted into Use of $F = ma$ to find a (with any force) a = 22.2 m s^{-2} (a = 21.25 m s^{-2} with show that mass of 80 kg) Example of calculation 2450 N − 750 N = 76.5 kg × a a = 1700 N/ 76.5 kg a = 22.2 m s^{-2}	**(1)** **(1)** **(1)**	**3**
18(e)(i)	Use of correct equation(s) of motion to find the displacement (accept calculation based on downward motion) s = 0.31 m (use of t = 0.5 s and/or incorrect a can score use of mark only) Example of calculation t = 0.50 s/2= 0.25 s s = 0 + (½ × 9.81 m s^{-2} × (0.25 s)^2) s = 0.307 m	**(1)** **(1)**	**2**
18(e)(ii)	Use of $v^2 = u^2 + 2as$ **Or** $v = u + at$ u = 2.5 m s^{-1} ecf from (e)(i) for s (use of t = 0.5 s and/or incorrect a can score use of mark only) **Or** Use of $E_p = mgh$ **and** E_k initial = E_p at top (ecf from (e)(i) for s) u = 2.5 m s^{-1} Example of calculation 0 = u + (−9.81 N m s^{-2})(0.25 s) u = 2.45 m s^{-1}	**(1)** **(1)** **(1)** **(1)**	**2**
	Total for Question 18		**15**

Question Number	Answer	Mark
19(a)(i)	**Diagram 2** (resultant) force is W/mg **Or** the acceleration is g **(1)** **Diagram 1** the (resultant) force is the component of the weight (along the plane) **Or** see a reference to $(F =) mg\sin\theta$ **Or** see a reference to $(a =) g\sin\theta$ **(1)** (This can be inferred from a diagram) A comparison between either $mg\sin\theta$ *or* $g\sin\theta$ **and** mg or g leading to a smaller acceleration in diagram 1 **(1)** (**Max 2 for answer in terms of energy:** Initial GPE in diagram 1 is less than in diagram 2, so KE at bottom is less, so max/final velocity is less (1) Objects move the same distance, so time for diagram 1 is longer(1))	**3**
19(a)(ii)	Use of or see $g\sin35$ **Or** $g\cos55$ **(1)** Acceleration = 5.6 m s^{-2} **(1)** <u>Example of calculation</u> $mg\sin35° = ma$ a = 9.81 N kg^{-1} × sin35° a = 5.63m s^{-2}	**2**
19(b)(i)	Straight line or curve of time initially increasing with distance from the origin **(1)** Correct shape curve **(1)**  	**2**
19(b)(ii)	Time taken = $\sqrt{1/2}\,(t)$ **Or** $t/\sqrt{2}$ **Or** $\frac{\sqrt{2}}{2}t$ **Or** $0.71t$ **Or** $t/1.4$ **(1)**	**1**
19(c)	Similar results indicate reliability/repeatability **Or** variation in pulse means results (on another day) might be different/unreliable **(1)** The time was to nearest second so measurements were not precise **(1)**	**2**
19(d)	Rule **(1)** video camera **Or** light gates (connected to a) data logger/computer/timer **Or** electromagnet, trap door(s), timer **(1)**	**2**
	Total for question 19	**12**

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom