Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

January 2019

Pearson Edexcel International Advanced Subsidiary
In Physics (WPH01)
Paper 1Physics On The Go

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Introduction

The unit WPH01 covers the candidates' ability to understand and apply the physics involved in basic mechanics and properties of matter. Their ability to apply their knowledge in a range of familiar and unfamiliar contexts was examined.

The candidates' ability to see calculations through to a correct solution was generally good, as was their response to short descriptive questions. In many cases, they did not respond well to questions requiring a definition or simple description of a property, such as "strong" and "tough", definitions they ought to know so that straightforward marks can be obtained quickly. They found the questions involving longer, extended writing much more challenging, not so much due to difficulty with the writing itself, but because they were unable generally to decide on the physics required. Applying Newton's laws in question 12, and describing a method to determine acceleration in question 15e were two such examples.

As always, it is also important that the students note the keyword of a question. "Describe" and "Explain" do not have the same meaning; explain requires reasoning as well as a description. "Deduce whether", as in question 14c, requires a conclusion to be reached. It would be worth learning the meaning of the possible keywords for these questions.

There was little problem caused by the standard of written English seen by the examiners in this paper. Apart from the * questions, where the candidate's quality of written communication is being assessed along with the physics, lack of skill in written English is not penalised, as long as the response is clear and unambiguous.

Section A

	Subject	% scoring the correct answer	Comment
1	Resolving a vector	91%	This question was answered well, but there was the usual confusion in some cases between the use of sin and cos.
2	Young modulus	71%	A few confused the limit of proportionality with the elastic limit and the yield point. Candidates are expected to understand the distinct meanings of all three terms.
3	Properties of materials	89%	Again, the four words the candidates were asked to choose from are all technical terms with a well-defined meaning which should be understood.
4	Equations of motion	87%	The responses all use the same equation of motion, the only difference being in the use of positive and negative to represent up and down. A few responses did not use a negative acceleration.
5	Vectors and scalars	94%	Only a few responses did not indicate that density is a scalar and velocity a vector.
6	Conservation of energy	73%	Some thought the equation $\Delta W = F\Delta s$ could be used.
7	Combination of forces	79%	The correct answer here is D, but sometimes C was given, having the direction of the force incorrect. Provided the meaning of "resultant" is understood, a look at the top diagram should indicate the general direction of that force.
8	Spring stiffness	51%	The most probable error was in converting to base units.
9	Free body force diagram	66%	Some gave forces on the wall or the ground rather than on the ladder as required.
10	Terminal velocity	84%	The great majority of candidates realised that there would be more than one force acting on an object falling at terminal velocity through a fluid.

Section B

Question 11a

For both positions in the channel, we were expecting the type of flow to be named and also described. For the description, it would not be sufficient to just give a positive and negative description of the same property, e.g. “flows in layers” and “does not flow in layers”. Most candidates gave more that a single property in any case, and so gained the marks.
A good example of the responses is shown below

(a) Describe the types of flow of the sewage before and after it passes the steel blades. (4)

Before it passes through the steel blades, it has a laminar flow. There is no sudden change in speed, no eddies and the particles move parrallel to each other, streamlined.
After it passes through the steel blades, it has a turbulant flow with lots of eddies and sudden change in speed and direction of flow. The particles cross over each other causing eddies and disrupting the flow.

Question 11b

This item was surprisingly poorly answered. We were expecting the responses to refer to the transfer of kinetic energy to thermal energy, with some supporting material, such as friction with the blades or within the liquid, or a link to the lower speed of the sewage after the blades. Many candidates introduced ideas for which there was no supporting information in the question, such as gravitational potential energy, or making the blades rotate. It is really important to consider the context of the question and only use the information on offer.

Question 12

This was a classic force description question, in which forces are being used to explain the motion of an object. A number of candidates insist on reciting Newton’s laws, which not only uses up time in the exam but gives the impression that mark criteria are being met when this is simply not the case. The candidates’ explanations using Newton’s laws must be applied directly to the context in the question, in this case the children in the boat and the ball. These are some points to bear in mind when responding to a question of this type:

- Where there is a force it must act on something and have an origin. E.g. Child X exerts a force on the ball.
- "There is therefore a resultant force" was often stated, but there are many resultant forces in this situation, so state what the resultant force acts on. E.g. There is a resultant force on the boat.
- Also, when saying there is an acceleration, state what is accelerating. E.g. According to Newton's second law, the boat accelerates.

The response below gained all but the final mark – the reason given for the boat coming to rest was often seen, but is clearly incorrect.

> As child X applies a force to the ball, the ball exerts an equal and opposite force on the child towards the left. ~~The +~~ according Newton's Third Law of motion. ~~&~~ There is a resultant ~~R~~ force ~~o~~ that acts on the boat so the boat accelerates to the left due to Newton's ~~A~~ Second Law of motion. As child Y catches the ball, child Y also applies a force on the ball and the ball applies an equal ~~force on the~~ and opposite force on the ~~bo~~ child Y. Child Y has a greater mass than Child X ~~so the force~~ and the ball so there is no unbalanced force created so boat stops.

Question 13a

The candidates were being asked to explain why the expression is correct, but they were required to explain it to the examiner and not just satisfying themselves that it is correct. The response therefore needs to be very clear about the principles used. Here we were expecting a clear statement that the horizontal component of the velocity includes the term cos 40°, and then we expected to see, clearly stated, the standard equation they have chosen to use, the correct substitution into it and the rearrangement to give the correct final expression.

The examiners will normally expect symbols used to be defined by the candidate. Candidates should not assume that there are "standard" symbols, such as v_H, that can be used in place of the full meaning "horizontal component of velocity".

Question 13b

This was a fairly standard projectile calculation, and many candidates produced good responses. Some common errors were to confuse the vertical and horizontal motion, often including s=250 m in $s=ut+½at^2$ rather than s=0, and to calculate the time to the top of the path and then forget to double the time to give the full time of flight. It would be good to see more candidates able to use that first option, with the vertical displacement = 0, and to solve the resulting quadratic, which makes the solution more straightforward.

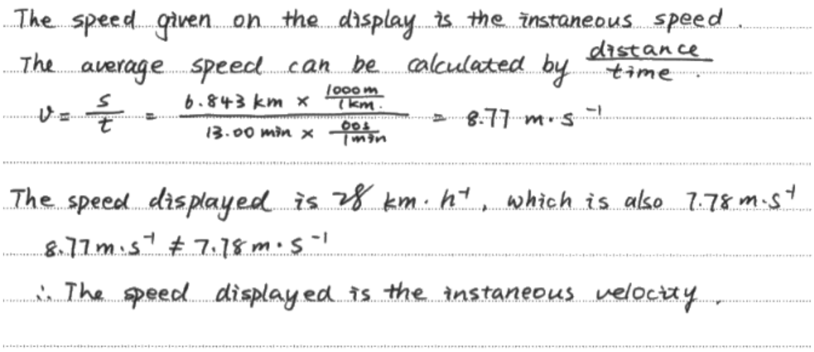
Question 14b

The most straightforward equation to use for this item is power = force × velocity, and most of the candidates did use that equation, although it is not listed on the data sheet. Otherwise power = force × distance / time can be used, but then they had to take care what values they used for distance and time. Ideally, they would use 28 m in 1 s, although any time can be used with the corresponding distance assuming a speed of 28 m s^{-1}. Some used the distance and time on the display, which was for the whole journey and therefore gave an incorrect answer for power, whereas the question asks them to show that the power displayed is consistent with the force and the speed.

Question 14c

The most straightforward way of responding to this question is to calculate the average speed using the total distance displayed of 6.843 km and the total time of 13.00 min. The great majority of candidates used this approach, although many could have explained what they were doing rather better, even by just saying that they were calculating the average velocity. However, a significant number of candidates completed the required calculation extremely well but did not gain the final mark because they missed the final comparison of values. In a deduce type question it is important to make that final deduction in order to complete the response. In this case it should be that the displayed value of 28 does not match the calculated average value of 32 and so the displayed value must be the instantaneous speed. State the actual values and then a comparison.

It is equally good to work in m s^{-1} and then compare those values, as the example below shows.

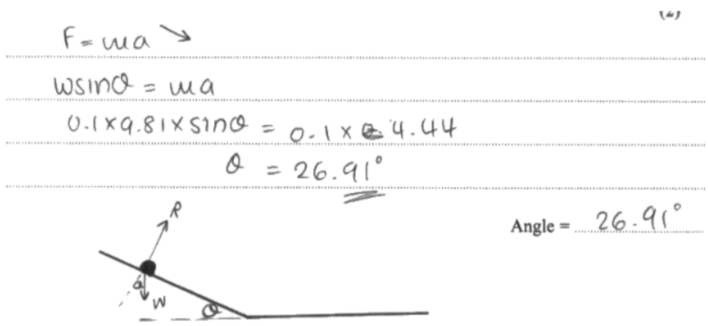


Question 15a

This item was answered well, with the candidates realising that the acceleration was the gradient of the velocity-time graph given. It was unfortunate that some did not use the longest line possible, in this case using the two ends of the diagonal line, which affected the accuracy of their answer and usually reduced the mark achieved.

Question 15b

The question here was quite poorly answered. Those that realised the angle could be calculated as $a = g \sin\theta$ obtained the correct value of the angle. Usually, those who obtained the correct angle did so by resolving the forces, i.e. $ma = mg \sin\theta$ with $m = 0.1$ kg and $a = 4.4$ m s^{-2}. See below:



Question 15c

In general it would seem that the candidates did not give this question the respect it deserved. The problem needed breaking down into the different types of motion involved, as the acceleration changes at 0.54 s. None of the required calculations were particularly complex but an overall strategy was required, and for many this was clearly lacking. A frequent incorrect response was to use $s = ut + ½at^2$ to find the time with $s = 0.74$ m, which assumed that the acceleration was constant up to 0.74 m. In fact it was constant up to 0.648 m, found by calculating the area under the diagonal.

Question 15d

The force on the trolley can be determined either by knowing that the work done ($F \times d$) is equal to the kinetic energy transformed ($\frac{1}{2}mv^2$) with v being the speed at the start of the sponge (2.4 m s^{-1}), or by calculating the acceleration using $v^2 = u^2 + 2as$ and then using $F = ma$. The great majority of responses seen used the latter method, but there was a lot of confusion about the method and values used to calculate the acceleration, with the result that most candidates just scored a single mark for the use of $F = ma$. The response below shows a correct calculation.

$v^2 = u^2 + 2as$

$0 = (2.4)^2 + 2(a)(0.25)$

$a = \frac{-(2.4)^2}{(0.25)\times 2}$ = ~~11.52~~ $-11.52\ ms^{-2}$

$F = ma \Rightarrow F = (0.1)(11.52) = 1.15\ N$

Average horizontal force = 1.15 N

Question 15e

Full marks were very rarely obtained for this question, and the candidates had difficulty describing the experiment in a clear and organised manner. There were many methods allowed, but the simplest would be to use two light gates connected to a data logger, measure the velocity at each light gate and the time taken to pass between them, explain how the velocity at the gate is measured, and use $a = (v-u)/t$ to calculate the acceleration. The candidates need to be able to describe fairly standard experiments in a concise way.

Although there were very few completely correct descriptions of the experiment, here is one that gained full marks:

~~The distance of the ram~~ 2 light gates must be set at
the beginning of the ramp and the end of the ramp.
The length of the ~~ramp distance between the 2 light gates~~ trolly
should be measured. The time taken ~~for~~ for the trolley
to pass ~~between the 2~~ each light gates will be read by a data logger
velocity of the lorry at the first gate and the 2nd light gate
can be calculated. ~~The~~ ~~Using the~~ total time for the ~~lorry~~ trolley to pass between
the light gates should be measured. Acceleration can be calculated using $\left(\frac{v-u}{t}\right)$

Question 16a

The expected answer was that the tendon did not obey Hooke's law because force was not proportional to extension, and a reason why the graph shows that should be given.

(a) Explain whether the tendon obeys Hooke's law.

(2)

No, because the graph is not a Straight line and the Force is not directly proportional to extension.

The response above gives both these points and so scored both marks.

Question 16b

This straightforward calculation of stress usually gained the three marks. The main error was in the conversion of mm^2 to m^2, although the learner could equally well leave the answer in N mm^{-2}.

Question 16c

The question was answered well. It involved taking a reading from the graph and then calculating the strain. The correct answer is 0.053 or 5.3%, but many gave it as 0.05. Note that it is not good practice to give an answer to 1 significant figure unless there is a good reason to do so.

Question 16di

This question involved estimating the area under the force-extension graph. There were many ways of doing that, but the most common was to count the number of large or small squares and multiply by the energy represented by each square (one small square being 0.04 J). A significant proportion of the learners relied on the area of a single large triangle to estimate the area under the curve, which was disappointing. There were many other ingenious strategies to estimate the area under the curve and most of these gained credit. The most common error was in dealing with the units of the area calculated.

Question 16dii

The question was well answered. Occasionally a response omitted the unit, which was penalised.

Question 16diii

Deciding on a reason for the tendon not being damaged required the candidate to apply their knowledge of physics to a situation outside anything they would have directly learnt during their course. It is reasonable to expect the candidates to realise that there is a lot more to a human leg than a single tendon, but very few were able to say that the energy would be absorbed by a lot more body parts (e.g. the muscles, other tendons) than the single tendon involved in item 16di. Those who made a power of ten, or other, error in 16di could get the mark by saying that the energy transferred after the jump was a lot less than the amount that their calculation showed was required to damage the tendon.

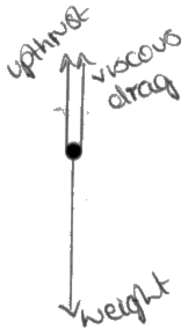
Question 17ai

The question was not a problem for most candidates. To gain the mark the response must be about a large force or stress, and it must be to break or fracture the material. Note that a definition of strength, rather than the meaning of strong would be penalised.

Question 17aii

It was usual for candidates to score one of the marking points. The most common one was that a large amount of energy could be absorbed before fracture, although some missed the point about the need for there to be a fracture. Some incorrectly mentioned absorbing a large amount of force which is a description of a strong material.

Question 17bi

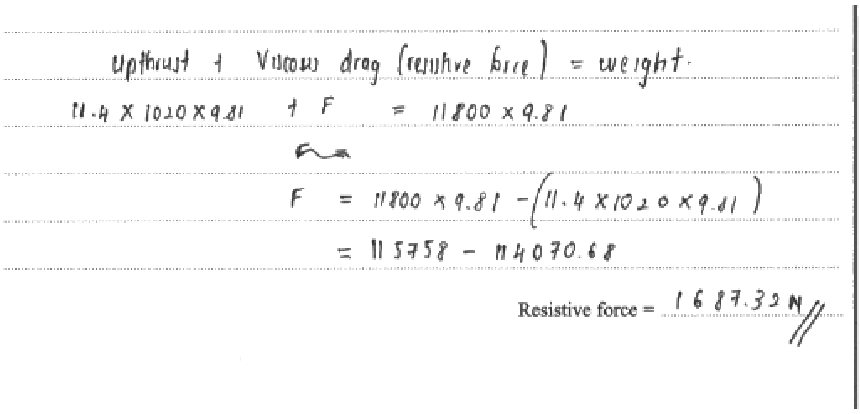


The question was generally well answered, with the two upward and one downward force shown. The examiners, for this test, were fairly lenient regarding the straightness of the lines, and whether they were vertical, but it would take very little time for the candidates to draw the lines with a ruler, and a careful drawing is more likely to get the full credit. Any lines not starting on the dot were penalised, as were any extra forces drawn in.

Question 17bii

It certainly helped in the response to this question if the free body force diagram for the previous item were correct. The candidates needed to understand that the resistive force was equal to the difference between the weight of the submersible and the upthrust, the upthrust being the weight of the displaced seawater. Many candidates, having obtained an incorrect answer for the resistive force, failed to get credit for calculation of the weight or upthrust because they did not make clear what they were calculating. It is very important to give full working in any calculation.

The sample below shows a good way to lay out a response. It is clear where the upthrust and the weight are being calculated.


upthrust + Viscous drag (resistive force) = weight.
11.4 X 1020 X 9.81 + F = 11800 X 9.81
F = 11800 X 9.81 − (11.4 X 1020 X 9.81)
= 115758 − 114070.68
Resistive force = 1687.32 N

Question 17biii

The difficulty for many candidates was being able to identify that the upthrust was now equal to the weight, or just slightly greater. There was no change in the upthrust so the new weight of the submersible must be calculated. Many candidates included the drag, applying it in the same direction as the weight, which generally resulted in a mark of zero. An alternative method of saying that the average density of the submersible is now equal to that of the seawater, leading to the calculation of a new mass for the submersible, was equally creditable. Either way, the change in mass then had to be calculated.

Question 17c

Being a two-step analysis using the graph to explain the motion did cause some issues. There was no need to describe the relationship in the graph since that was not been asked for. For many a lot of effort went into providing information that did not answer the question, such as how the viscosity changes as the temperature rises, and as it falls, whereas the question asks what happens as the depth increases. It is important to clearly identify what is being asked and deal with the question on its own merits, rather than treating it in the same way as a different question they had dealt with previously.

The sample below shows a good response.

~~As temperature increases, the viscosity~~. As the temperature decreases at greater depths, the viscosity of water increases. This increases the viscous drag (resistive force acting on the submersible). As the viscous drag is greater, there is a resultant force acting upwards and thus ~~velocity~~ speed of the submersible decreases due to deceleration.

Summary

This paper provided candidates with a wide range of contexts from which their knowledge and understanding of the physics contained within this unit could be tested.

A greater understanding of the context and question being asked would have helped many candidates. A sound knowledge of the subject was evident for many but the responses seen did not reflect this as the specific question was not always answered as intended.

Based on their performance on this paper, some candidates could benefit from more teaching time and extra practice on the following concepts and skills:

- Being able to concisely and clearly describe the main points involved in carrying out a standard experiment.
- Give clear and complete working in any calculation.
- Learn standard definitions.

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