Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

October 2024

Pearson Edexcel International Advanced Subsidiary Level in Physics (WPH11) Paper 01 Mechanics and Materials

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Introduction

The unit WPH11 covers candidate’s ability to understand and apply the physics involved in basic mechanics and properties of materials. The application of this knowledge in a range of familiar and unfamiliar contexts was examined.

The skills assessed in this exam included the ability to recall knowledge, to apply knowledge to a range of familiar and unfamiliar contexts and carry out calculations, and to give explanations. Knowledge of skills developed by doing the core practical tasks was also tested.

Several questions asked for candidates to recall and apply knowledge, such as the application of Newton’s laws, or the conditions for Stokes’ law to apply. While some candidates were able to answer these questions well, answers often lacked the detail needed to give complete answers. Learning definitions of key physics terminology can be helpful to candidates, not just in terms of giving a definition when asked, but also in terms of understanding the physics related to these concepts.

Most candidates demonstrated a good ability to answer questions requiring calculations. However, when calculating volumes or areas which involve use of a radius or diameter it was common to see simple errors. Candidates should be encouraged to stop for a moment to consider whether they have been given a radius or diameter, and whether they have chosen the correct equation for the quantity needed.

The core practical task to determine the acceleration of a freely-falling object was assessed in question 14. This question proved to be challenging for many candidates. In particular, explaining how a graph of the results should be used to determine a value is a skill which candidates need to practice. Candidates should also be encouraged to consider whether the final value of a quantity they have determined seems reasonable, and to double check their working if the answer seems unrealistic.

Most candidates recorded their knowledge of physics clearly, even if not always in the best English. Apart from the * questions, where the structure of the candidates’ responses was being assessed along with the physics, lack of skill in written English was not penalised if answers were clear and unambiguous.

Section A: Multiple Choice

	Subject	Correct response	Comment
1	Unit equivalent to the Watt	**D**	$\text{Power} = \dfrac{\text{energy transferred}}{\text{time taken}}$
2	Scalars and vectors	**A**	Acceleration and weight are both vectors
3	Interpreting a displacement-time graph	**D**	$\text{average velocity} = \dfrac{\text{total displacement}}{\text{total time taken}}$
4	Newton’s third law	**B**	The weight of the cable car is caused by the gravitational pull of the Earth on the cable car. The Newton’s third law

			pair is therefore the gravitational pull of the cable car on the Earth.
5	Newton's first law	**A**	At a constant velocity, the resultant force on the box is zero. Resistive forces act parallel to the slope and are equal to the component of weight parallel to the slope.
6	Power and efficiency.	**C**	$\text{Useful power output} = \frac{\Delta E_{\text{grav}}}{t} = \frac{5000\text{ J}}{42\text{ s}}$ $\text{Efficiency} = \frac{\text{useful power output}}{\text{total power input}}$ $0.63 = \frac{\frac{5000\text{ J}}{42\text{ s}}}{\text{total power input}}$ $\text{(total) power input} = \frac{5000\text{ J}}{42\text{ s} \times 0.63}$
7	Elastic limit	**A**	At the elastic limit, a wire is elastically deformed.
8	Conservation of momentum	**B**	Using the ball of mass m, $\Delta p = mv$ Using the ball of mass $3m$, $2\Delta p = 3mv'$ Therefore $2mv = 3mv'$ So $v' = \frac{2}{3}v$
9	Resolving forces	**C**	The forwards component of each force is $F \times \cos(\theta)$ So the resultant forwards force is $F_A \cos(31°) + F_B \times \cos(27°)$
10	Principle of moments	**A**	Total clockwise moment about the top of the cylinder = total anticlockwise moment about the top of the cylinder So $Fx = (W - F)y$ And $Fx = Wy - Fy$ Therefore $Wy = \frac{Fx}{y} + \frac{Fy}{y} = \frac{Fx}{y} + F$

Question 11

Most candidates scored at least one mark on this question, but less than half gained both marks.

It is conventional to draw arrows in the middle of vector lines. Candidates who drew arrows at the ends of the lines could still score marking point 1, but it was often difficult to identify the arrow heads as they had a tendency to overlap each other. Many candidates drew a free-body force diagram rather than a scaled vector diagram.

It was common to see candidates using Pythagoras to calculate the magnitude of the resultant force, even if they had also drawn a correct vector diagram. Whichever method candidates used to arrive at the correct answer, marking point 2 was scored.

Question 12

The majority of candidates were able to correctly use $\Delta F = k\Delta x$ and score both marks.

The most common error was for candidates to forgot to add the original length to the extension, and therefore not scoring the second marking point.

Question 13

13(a)

Roughly half of all candidates scored all three marks on this question.

The most common error was to use incorrect trigonometry. Candidates who used sin instead of cos could still score marking point 2 for use of the equation for moment of a force. A small minority of candidates appeared to have their calculator in radians rather than in degrees, leading to an incorrect final answer but scoring the first two marks for correct working.

Very few candidates did not include a unit in their answer. A small proportion gave an incorrect unit, with common errors being Nm^{-1} or N instead of Nm.

13(b)

Many candidates found this question challenging, with only about four in ten scoring marks.

The most common route to gaining both marks was seen when candidates identified that as θ increases, cos(θ) decreases. Those who attempted to describe a decrease in the perpendicular distance between W and the pivot often missed crucial detail in their description so did not score the first marking point.

Some candidates misinterpreted the question, thinking that the moment should be constant and therefore the weight of the person should increase to achieve this. Candidates who made this error could still score marking point 1.

Question 14

14(a)

Candidates found this question difficult. Many did not grasp the idea that the duration of the flash had a smaller duration. The most common successful answers came from candidates who stated that the laboratory strobe would produce images that were less blurred, which was enough to score the first marking point. These candidates tended to go on to also score the second marking point.

14(b)(i)

Approximately 40% of candidates gained some credit on this question.

Many answers lacked some detail and therefore only gained one of the two marks.

14(b)(ii)

Around 80% of candidates scored at least one mark.

It was pleasing to see the number of candidates correctly determining the gradient. Some candidates did not then double this value.

A small proportion of candidates gave and answer of $g = 9.81\ \text{m s}^{-2}$ but showed no evidence of any working to support their answer. These candidates gained no credit.

Question 15

15(a)

About three-quarters of all candidates gained marks on this question, just over a fifth gaining all three marks.

Some candidates did not make a direct reference to Newton's third law, which prevented them from scoring the first mark. However, the majority were able to explain the resultant force on the athlete and so gained at least two marks.

15(b)

In question 15(b)(i), most candidates gave a fully correct answer and scored all three marks. Some candidates did not round their answer correctly, and so only scored two.

Question 15(b)(ii) proved more problematic to candidates, but around one in six candidates scored all marks in question 15(b) as a whole. A reasonably common error was seen from candidates who correctly determined the final vertical velocity but assumed that this was the final resultant velocity. These candidates scored marking point 1, but then used incorrect trigonometry to determine the angle from the vertical so tended to score no further marks.

There were a number of approaches that could score full marks. Any approach taken that led to the correct answers by using correct physics gained full credit.

Question 16

16(a)

Over half of all candidates gained full marks on this question.

Some candidates drew three arrows, including an arrow representing drag. This prevented any marks from being scored.

A sizeable minority of candidates labelled their weight arrow with a 'G' which is not acceptable as an abbreviation for weight.

16(b)(i)

To score all three marks on this question, candidates needed to be clear about what was being referred to. Many referred to weight, but did not specify whether this was the weight of the hydrometer, the weight of the displaced pure water or the weight of the displaced seawater. Similarly, many did not use the term displacement at all, and alternatives such as replacement were not sufficient.

Many candidates described a situation where the pure water suddenly changed to seawater, causing a resultant upward force on the hydrometer. This was not what the question asked, and answers which took this approach were unlikely to score all three marks.

About half the candidates gained some credit on this question.

16(b)(ii)

About a quarter of candidates gained full marks on this calculation, with about three quarters gaining at least one mark.

It was relatively common for candidates to use an incorrect equation for the volume of a cylinder, with many using the volume of a sphere, or using the diameter where they should have used radius.

Some candidates calculated the change of volume but were then unsure how to determine the change in vertical position of the hydrometer from this.

Question 17

***17(a)**

In order to explain the acceleration, candidates needed to describe the forces acting on the student and relate these to the resultant force on the student. The clearest answers presented these ideas by considering the forces at each position, A, B and C, in turn.

Weaker responses that scored credit tended to focus on describing the acceleration, describing the forces, or describing the resultant force, but not linking these ideas together.

Some candidates talked about increasing extension of the elastic rope, but did not link this to an increased force on the student.

It was reasonably common for candidates to think that there would be maximum acceleration at the equilibrium point, with zero acceleration when the student was at the lowest point in the bungee jump.

Many candidates described the energy changes of the student, which is not sufficient to explain changes to acceleration.

Slightly more than half of all candidates scored at least one mark on this question.

17(b)

Around half of all candidates scored two marks on this question, but very few scored more than this.

A very common response was from candidates who used $F = k\Delta x$ with the force being the weight of the student. This approach would effectively lead to candidates finding the equilibrium position. However, this approach did score marking point 2, and if they made a valid comparison and conclusion they could also score another mark.

Question 18

18(a)

Most candidates scored at least one mark, with nearly 60% gaining full marks on this question.

Common errors included treating the radius as the diameter of the thread, incorrectly converting 4.3 MPa to pascals, and forgetting to square the radius when determining the cross-sectional area of the thread.

18(b)

Many candidates answered this question well, with about half gaining full marks, and over 80% scoring some credit.

Errors were most common when it came to re-arranging equations. A small proportion of candidates began by writing an incorrect combined equation, which prevented marks from being scored.

18(c)

In question 18(c)(i), most candidates realised the relationship between the Young modulus and the gradient of the graph, and drew a steeper line than that of the spider silk.

For candidates who only scored one mark, it was more common to have extended the line too far up the stress axis rather than to have the gradient incorrect.

In question 18(c)(ii), most candidates struggled to give an adequate explanation. For candidates scoring full marks, both routes described on the mark scheme were commonly seen. Some candidates who answered in terms of the area under the graph gained marking points 2 and 3, but incorrectly stated that the area under the graph is equal to the elastic strain energy rather than being proportional to the elastic strain energy.

Question 19

19(a)(i)

Most candidates scored both marks for recalling the conditions for Stokes' law to apply, with over 80% scoring at least one mark.

19(a)(ii)

Approximately three quarters of all candidates gained some credit, with most scoring at least three marks and just over one in five scoring the maximum mark.

Common errors included mistakes when converting cm^3 to m^3, and using an equation for the area of a circle instead of the equation for the volume of a sphere.

Candidates could score full marks for using Stoke's law and $v = \frac{s}{t}$ to calculating a value of, for example, the viscous drag force, the time taken, the distance fallen, the radius of the sphere or the viscosity of the water, and then making a valid comparison. The most common approach seen was to determine the viscous drag force and compare the value obtained with 4.6 N.

19(b)

Approximately 50% of candidates gained some credit across questions 19(b)(i) and 19(b)(ii).

On question 19(b)(i), many candidates did not mention the areas on the graph, with many responses referring to either the final velocity being zero, or to the gradient of the graph.

On question 19(b)(ii), most candidates who drew a tangent scored well. However, many candidates just read a value of velocity at 70s and divided one by the other. This approach scored no marks.

Concluding remarks

Candidates demonstrated a wide range of knowledge and skills on this paper. It was encouraging to see some outstanding responses, particularly to some of the more challenging questions on topics such as upthrust and moments.

While most candidates demonstrated a general understanding of key physics terms, greater attention to detail, particularly when giving explanations would enhance performance.

Additionally, many candidates would benefit from a more thorough understanding of the core practicals in the sections of the specification assessed on this paper.

The recommendations for improving student performance remain consistent with those from previous series, including:

- Dedicate more time to core practical activities, including describing the procedures and processing the results.
- Practice applying fundamental principles across a variety of contexts to build confidence and improve problem-solving abilities.
- Encourage candidates to read the questions carefully and review their answers to help them minimise errors and misunderstandings.
- Stress the importance of understanding and accurately recalling physics terms and quantities.
- Teach candidates to use calculators effectively, round final answers correctly, and to remember to include the appropriate unit.

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