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Examiners' Report/
Principal Examiner Feedback

Summer 2014

Pearson Edexcel GCE
Chemistry Unit 6PH01 Paper 01R
Physics on the Go

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General

This is the second and final sitting of the 6PH01 01R paper. The mean mark was 39.9; this was 8 marks less than the mean on same paper last year but similar to the mean marks on the home 6PH01 paper this summer and 6PH02/01R. The range of marks was greater but the standard of responses seen was weaker in general, explaining the lower mean.

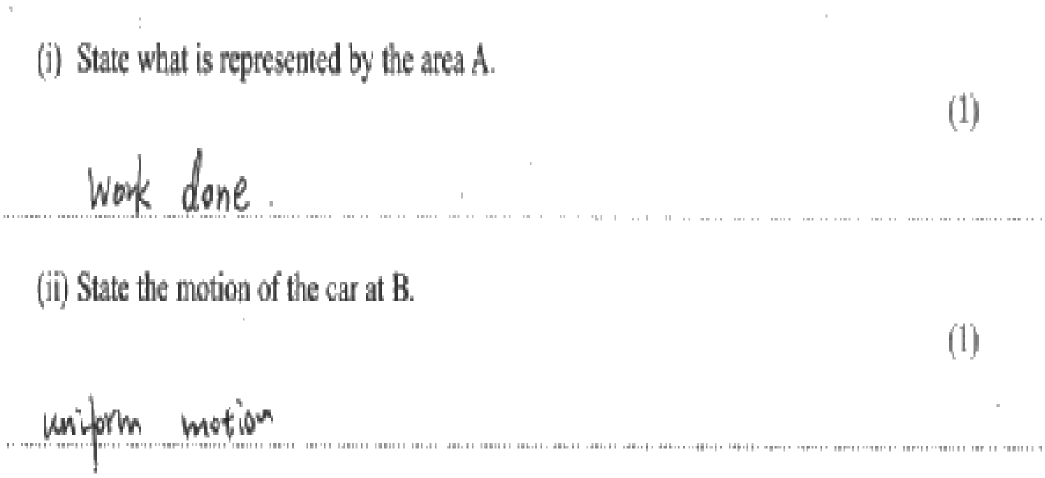
Overall, the quality of English seemed weaker than for last year's cohort, which drastically reduced the number of marks awarded for the longer, explanation style of questions.

11ai: Most candidates could recognise that the area between the graph and the axis represented energy, the stronger candidates describing fully that this was the work done on the car whist braking with weaker candidates just stating 'energy', both responses scoring the mark.

11aii: Many candidates managed to identify that the car was travelling with a constant velocity. Some did state 'constant' or 'uniform motion' but as this could include 'being stationary' it was not specific enough to score the mark.

As expected, a significant proportion of candidates, including some of A grade ability, that failed to score for this item, stated that the car was 'stationary'. These students had missed the continuation of the line and demonstrated a poor understanding of Newton's first law i.e., although the resultant force was zero, the object would continue to move at a constant velocity and not stop. This was seen again in question 14b where some candidates believed that the resultant force on the flicked coin was zero so it stopped rather than a resultant force causing a deceleration to bring it to rest.

The response below would have scored 1 for part (a)(i) and 0 for part (a)(ii). Uniform motion was considered to be too vague to score the mark.


(i) State what is represented by the area A.

(1)

Work done.

(ii) State the motion of the car at B.

(1)

uniform motion

11b: Most candidates could successfully define a vector quantity with the majority of lost marks due to candidates just repeating one of the given vector quantities from the stem of the question.

12: Most candidates that scored any marks managed to identify that Graph A contained a straight line and Graph B was not straight. Few candidates managed to explain the application to the graph of the directly proportional relationship between force and extension by including a reference to the line passing through the origin.

The question asked for the candidates to use the graph to explain the validity of the given statements, therefore they needed to describe the evidence from the graph i.e., straight line rather than re-state Hooke's law and describe that the force is proportional to extension, etc. Candidates have been asked in the past to define Hooke's law or describe the characteristics required for a material to obey Hooke's law and every time the reference to the origin is usually omitted.

This response scored marking points 1 and 3 but made no reference to where the line should cross the axis. 'At the beginning' is not a correct alternative to through the origin as the line could cross either axis anywhere and that would effectively be at the beginning and a non-zero value. Some candidates referred to the origin al the original point which was not sufficient to score the mark.

(3)

Hooke's law means that the force is proportional to the extension, which means that the graph must be a straight line or constant gradient. From sample A we can see there is a straight line ~~before~~ at beginning so, it obey Hooke's law, and sample B, at the start there is a curve, so it doesn't obey the Hooke's law

The response below scored all 3 marks.

exerted on the material (3)

A: For small extensions, the ~~fuer~~ force is proportional to the extension, which obeys the Hooke's law ($F = k\Delta x$) due to in this graph, the straight line ~~an~~ occur ~~and~~ which is passes ~~throug~~ through the origin. Sample A obeys Hooke's law.

B: According to Hooke's law, $F = k\Delta x$, F should be ~~a strai~~ proportional to extension. So in $F - \Delta x$ graph, the line must be straight and go through the origin. while in this graph it's a curve, which don't obey Hooke's law.

(Total for Question 12 = 3 marks)

13ai: This question was answered well with most candidates quoting the general relationship between viscosity and temperature. Few candidates managed to apply this to the question and identify that there were two viscosities as there were two temperatures of chocolate.

The following response scored both marks.

Chocolate are in different temperature.
In liquid state, higher temperature, ~~higher~~ lower viscosity.
So there are two different values of viscosity for chocolate.

13aii: This question was answered very well with 82 % of candidates correctly marking a position above 10^1 Pa s.

13b: Answers were quoted correctly with virtually no truncation or rounding errors. The viscosity was mostly read correctly from the chart with candidates not challenged by the logarithmic nature of the scale. A few candidates did not realise that the viscosity could be read from the chart on the previous page, leaving the viscosity as η in their substitution into $F = 6\pi r\eta v$ and, therefore, not being able to proceed with the calculation. Others struggled to manipulate the formula successfully. Some powers of 10 errors were seen but most significantly MP3 was not awarded due to a missing unit.

13c: Most candidates identified that the temperature should be increased. Many could link this to an increased velocity although not all explained why the velocity would increase, omitting references to the viscosity and hence the drag. There was often a fine line between repeating the information given in the question and using the information given to add to their explanation.

The response below scored all 3 marks.

Problem	Air bubbles become trapped in the chocolate because they cannot rise to the surface in time to escape before the chocolate has solidified.
Solution	put chocolate in a mechine whose temperature is ~~[illegible]~~ higher
Explanation	As the diagram on page 11, the ~~[illegible]~~ viscosity will be ~~[illegible]~~ smaller when temperature is ~~[illegible]~~ higher As it moves at constant speed, upthrust = viscous drag then $6\pi\eta r v$ = up thrust. So the ~~[illegible]~~ smaller the viscosity is, the biggor the velocity is. then $t = \frac{s}{v}$, t will be smaller, so they can rise to the surface in time.

14a: Unless the question specifically states that a law should be quoted, candidates when applying a law to the context of a question should answer in terms of the given context. Therefore just quoting the Newton's first law without any reference to the dominoes would not score any marks, nor would quoting the laws then just adding half a sentence stating that the dominoes fall. A misunderstanding seen across this question from some candidates, as well as in question 11, was that the forces were in equilibrium so the dominoes fell with a constant velocity. The strongest candidates automatically associated the resultant force of a domino to it accelerating, hence two marks awarded without any further explanation required.

Many responses just described the dominoes falling and dominoes hitting one another, but no mention of forces and of a change of motion from stationary to falling i.e. in the context of the law. Some references to an external rather than a resultant force were seen and were insufficient for scoring a mark.

14b: This had the potential to be a challenging question due to the context and the required amount of detail. However, most responses seen demonstrated an understanding of the context and the physics involved.

Unfortunately, the candidates did not always express their answers with sufficient detail to score the number of marks that reflected their understanding of the subject. Language was often an issue where a candidate's use of English caused the explanation to be ambiguous so the mark could not be awarded. The use of the term 'kick' rather than force was common and candidates should be encouraged to use language appropriate to the physics being examined in the question. In this case it would be (resultant) force and acceleration.

As seen in part (a) too many candidates assumed that the reaction force of the stack on the flicked coin caused the resultant force on the flicked coin to be 0, so it stopped with no consideration of a deceleration and the force that would provide it. Quite a few responses went into detail about the initial force on the flicked coin, some assuming that the force was still applied as it collided with the stack, perhaps explaining why some candidates assume that the resultant force would then be 0.

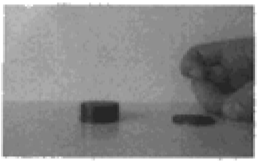
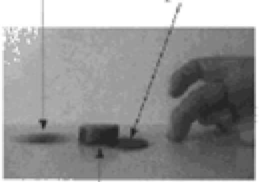
This item required three observations to be described and some responses seen went to go into far too much detail about one or two of them at the consequence of the other observations. As there were 6 marks available for all of 14 (b) it would be reasonable for a candidate to assign two marks to each observation and pace themselves when describing all events.

The fifth marking point was very rare with most candidates justifying the dropping of the stack of coins due to their weight. Good candidates included the detail of the removal of the reaction force between the bench and the coins, implying that the weight would be the only force or stating that there would be a vertical resultant force on the stack. Few considered that there was no horizontal force applied to these cons hence just a movement in a vertical direction.

The following response scored 4 marks (MP 1,2,3and 6): The green oval identifies the common misunderstanding that once the bottom coin exerts a force on the flicked coin(MP3) the flicked coin has no resultant force, no acceleration and stays stationary. Hence this candidate did not score MP4 as they did not fully understand the consequence of this applied force.

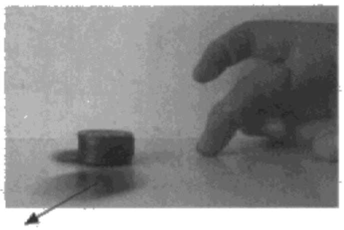
*(b) Apply Newton's laws of motion to explain the three observations in experiment 2.

(6)

Experiment 2	Explanation
Stacked coins A coin is flicked towards a stack of coins. 	The flicked coin stops ~~state~~ because when it hits the bottom coin, it exerts a force onto it, ~~equal to its kinetic energy~~. According to Newton's third law; for every action there is an equal and opposite reaction, the ~~*~~ bottom coin ~~exp~~ exerts a force ~~back~~ onto the flicked coin. Now that there is no resultant force on the coin, it obeys Newton's first law - it has no acceleration and thus stays stationary.
Observations The bottom coin is knocked out from under the stack. The flicked coin stops.  The stack drops down.	The bottom coin is knocked out since a force is exerted onto it - it obeys Newton's second law - an object will accelerate in the direction of the resultant force, hence it ~~move~~ accelerates away from the stack. The rest of the stack drops down since there is a downwards resultant force - there is no reaction force to keep it in place since the bottom coin was knocked out. The weight causes the resultant force ~~down~~.

14c: Many responses referred to N3 and opposite direction. The few that realised that the direction was not head on and so the reaction force would not be directly opposite often lost out as they were just talking about direction of motion and not the direction of the force.

The response below explained that the change in direction was due to N3 and scored 0 marks.

Observation	Reason
 The coin that was flicked changes its direction.	According to Netwon's third law. The flicked coin gives the stacked coins a force, the stacked coins will give a same type same magnitude force but in the opposite direction to the flicked coin. So it changes its direction.

The response below scored both marks.

Observation	Reason
 The coin that was flicked changes its direction.	The flicked coin changes its direction because it collides with the bottom coin at an angle that is not parallel to its direction of motion. Hence, the force that the bottom coin acts on it is not at the ~~comp~~ oopposite direction of its motion, so ~~the~~ the ~~coin~~ flicked coin accelerates sideways and changes its direction.

15ai: Most candidates could successfully use $v = s/t$ to calculate the average velocity from the start in column B whilst some did not realise that they just had to calculate the distance travelled during the previous second for the answer required in column A. Therefore the most common score was 2, mainly for correct answers in in column B.

15aii: 76 % of candidates scored the mark on this item, identifying that A was more accurate with an explanation that included the idea that the speed was measured over a smaller time interval. Just one mark was available, so no further detail was required other than a comparison of the times or a statement that the battery is accelerating. Many candidates did not give a reason or just repeated the question and explained that A was more accurate without qualifying as to why it would be more accurate.
The following response scored the mark.

A because it's only talking about the last 1 second of the inclined board which is pretty much the bottom where B is just the velocity throughout the whole journey although the velocity kept on changing.

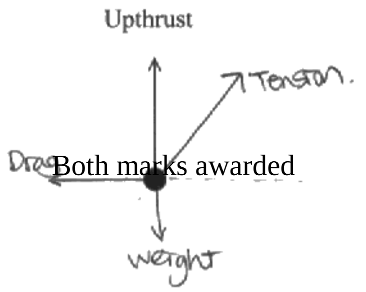
15b: The most common correct source of error was a reference to reaction time. However, the most common suggested change was to use light gates. This demonstrated a lack of understanding of how light gates are used as they can only time across a fixed distance and cannot be used as a continuous timer. In the context of the question, a continuous timing method was required which many candidates did not consider, choosing instead to give a standard response from experiments examined in the past. Some candidates did correctly suggest an alternative method although few could go on to give the additional detail such as including the measuring tape in the image for the video camera. Human error and human reaction were also seen and, without a reference to time are not equivalent to reaction time.

The following response score one mark for identifying the reaction time as a source of error but failed to score any further marks as light gates are not a suitable piece of equipment for measuring a continuous time.

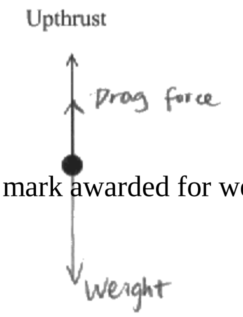
Source of error Human reaction time when measure the time using the manual stopwatch.

Changes ~~Usin~~ Use ~~light~~ two light gates instead of ~~man~~ manual stopwatch. Make certain displacements interval and measure the time taken to pass the certain distance.

16ai: Weight was correctly identified and labelled by most candidates. Those who included a force in the correct direction for tension often lost the mark due to an incorrect label. As 'F' could stand for friction or force it is not accepted as a label for a force unless defined. The question referred to the instant the surfer starts to move therefore frictional forces were not required. However, if included the direction was not usually opposing the direction of movement. This would have only been penalised if the candidate had already correctly drawn and labelled both weight and tension and was very rare however, it did leave to question how much some of the candidates understood the context of the surfer and kite and the forces involved.



Both marks awarded



1 mark awarded for weight

16aii: This response was answered well with a good use of trigonometry. Virtually all responses seen were quoted to at least 2 significant figures as required by a 'show that' style question.

16aiii: Most candidates identified that the vertical component of tension could be found using 1100sin40°, calculating the correct value of 707 N. Many then went on to use $W = mg$ either with the given value of 72 kg or to find 72 kg using the vertical component of weight to score 2 marks. Most candidates then went on to describe that if the weight was less than 72 kg then the surfer would fly up in the air.

The question specifically refers to the forces acting on the surfer and given that upthrust was included intentionally in the initial free-body diagram it should have been mentioned by all candidates. Therefore, two marks were generously awarded for use of two given equations clearly without the requirement of the understanding of the balanced forces involved in this context.

Those candidates who could write an equation for the vertical forces acting on the surfer often failed to explain the consequence of the mass being greater or less than 72 kg and usually gave no further explanation. The starting point for good candidates was a word equation such as:

$$\text{upthrust} + F\sin 40° = mg$$

Which would then lead to a discussion to include the two calculations explaining that the upthrust would be greater than 0 if the mass is greater than 72 kg.

The response below scored two marks for the calculation but there was no mention of upthrust so no correct attempt at explaining why the mass should be greater than 72 kg.

(3)

1100 x sin 40 = 707 N

W=mg 707=m×9.81 m=72.1kg, if mass is smaller than 72 kg, the vertical force is moving upward which will take human up.

16c: Most responses identified that C was the correct position. Many could explain the link between the smaller angle and the magnitude of the horizontal force correctly. Few included the trigonometry that would have explained the relationship between the horizontal force and the angle to horizontal i.e. state $T_{horizontal} = T \cos\theta$. Candidates found it more challenging to then make a successful link to the increase in power given to the surfer, most just opting for greater force so greater power omitting a reference to work done or time.

The response below scored two marks for identifying position C and then a good explanation of the third marking point describing the relationship between the smaller angle and a greater force.

(4)

The position 'C' would supply the most power to the surfer. This is because the smaller the angle to the horizontal (by the kite lines), the greater the horizontal component of the tension is. This would result in a greater resultant force horizontally, thus supplying the most 'power' to the surfer and enabling them to accelerate more and obtain a greater velocity.

Some responses heading in the right direction were sometime let down by the lack of precision when referring to forces. As the tension had both a vertical and a horizontal component just mentioning tension or force was not explaining which force or which direction they were referring to, often required by the second and third marking points.

The most common incorrect position was B where candidtes assumed that it as at 45° and assumed that this would travel the maximum horizontal distance and hence have the greaterst power.

17: Was answered very well with the majority of candidates able to carry out the straight forward, one step calculations involved.

17ai: Some good diagrams seen with clear parabolic paths with increasing gradients. Some responses did contain a large proportion of the path at a constant height which did not score the mark.

17aii-iii: Mostly answered well but some candidates failed to make the initial velocity 0 using the horizontal speed of 75 instead. However, most of these candidates on realising that they did not have a value near to the show that value then went on to use the given time of 4 s to calculate the distance in part (iii).

The following response scored 2, 2.

(ii) Show that the time taken for the supplies to reach the ground is about 4 s.

(2)

$s = ut + \frac{1}{2}at^2$

$63 = 0 + \frac{1}{2}(9.81\ ms^{-2})(t^2)$

$t^2 = 12.84\ s^2$

$t = 3.58\ s \approx 4\ s$

(iii) Calculate the horizontal distance of the plane from the drop zone when releasing the package.

(2)

$s = ut + \frac{1}{2}at^2$

~~s = 75(4) + 0~~

$s = 75\ ms^{-1} \times (4\ s)$

$s = 300m$

Horizontal distance = 300m.

17b: Most candidates could calculate the correct magnitudes of the kinetic energy and gravitational potential energy. The question required the candidates to show that the energies were equivalent to the ones given in kJ ie.6 kJ and 28 kJ; therefore some candidates did not score the second mark within each item if the energy was either not in kJ to the correct number of significant figures or in joules without a unit.

The response below scored 2,2.

(b) (i) Show that the change in gravitational potential energy of the package during the fall is about 6 kJ.

mass of package = 10 kg

(2)

gravitational potential energy = mgh = 10 × 9.81 × 63

= 6180.3 J ≈ 6 kJ

(ii) Show that the kinetic energy of the package on release is about 28 kJ.

(2)

Kinetic energy = $\frac{1}{2}mv^2$ = $\frac{1}{2}$ × 10 × 75^2

= 28125 J ≈ 28 kJ

The response below scored 1, 1, 0 as the energy was not quoted to at least 2 s.f. in kJ and the calculated value in joules did not have a unit.

(b) (i) Show that the change in gravitational potential energy of the package during the fall is about 6 kJ.

mass of package = 10 kg

(2)

E = mgh = 10 × 9.81 × 63 = 6180.3 ≈ 6kJ

(ii) Show that the kinetic energy of the package on release is about 28 kJ.

(2)

E = $\frac{1}{2}mv^2$ = $\frac{1}{2}$ × 10 × 75^2 = 28125 ≈ 28kJ

(iii) Determine the kinetic energy of the package on impact.

(1)

28 − 6 = 22kJ

Kinetic energy = 22kJ

17biii seemed to catch some candidates out as they assumed that a difference between the energies was required, not realising that the parcel was moving horizontally before the drop and therefore had an initial kinetic energy. Many subtracted rather than added the two energies as can be seen in the example above.

17biv A reference to air resistance alone was insufficient. The question specifically referred to the kinetic energy of the package so an answer in terms of energy was required. The following response scored the mark.

(iv) State why in practice the actual value for the kinetic energy on impact with the ground is less than the value you calculated in part (b)(iii).

(1)

Air resistance. It reduces the kinetic energy of the package.
Extra KE is dissipated to work against air resistance.

17c: Most candidates on a practical level could attempt an explanation as to why the parachute caused less damage.g. less impact, without a reference to force or velocity. The answer required an answer in terms of the physics invloved i.e. in terms of force, acceleration or velocity. However, as the parcel was accelerating during its motion, candidates often failed to specify as to whether the velocity being discussed was the terminal velocity or the velocity on impact.

The response below scored one mark.

(c) Most airdrops are not free fall and use parachutes.

State why using parachutes causes less damage to the package.

(1)

Parachute exerts an extra upwards force on the package
which greatly reduces its terminal velocity reaching the ground.
Less force hitting the ground, less damage.

18a: Many candidates misunderstood the question and defined all three properties listed rather than select the correct one and define it, often scoring just one or two marks for the definition of ductile. The definition of plastic deformation required a reference to ‘large’ which was omitted by some candidates and did not allow them to score the second marking point whilst others omitted the nature of the applied force and no mention to tension was made.

18bi: This item was answered successfully by many with the context and physics of the question understood and applied well. A large number of responses included a correct calculation of the upthrust with a compaison of the upthrust to the weight of each material to form an appropriate conclusion. Although a less popular method to use, candidates that calculated the desnity of each material often went on to successfully compare them to the density of the salt water and again, make an appropriate conclusion. Most incorrect approaches involved calulating the stress or pressure acting on the wire which usually contained no credible physics and scored 0.

The reposnse below scored all 4 marks.

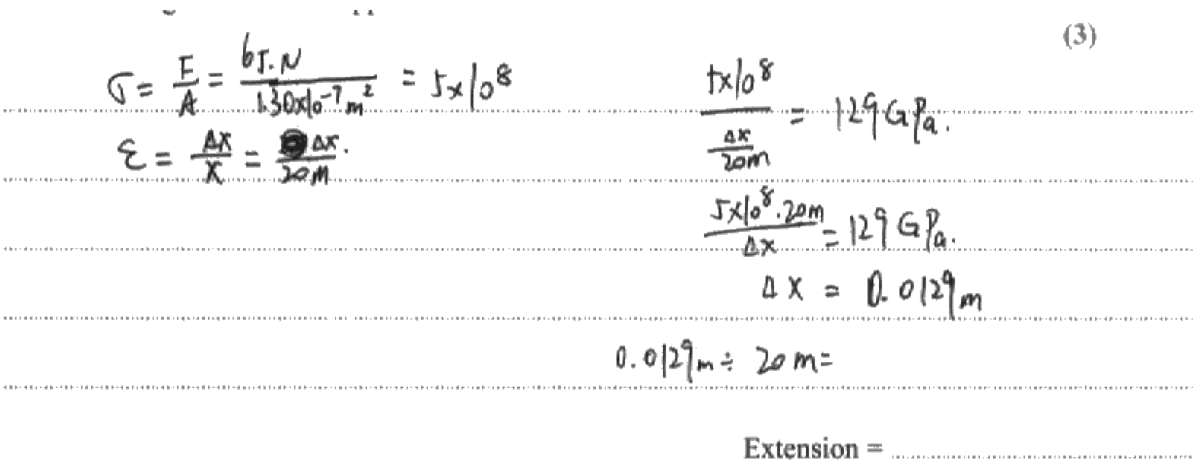
$1.3 \times 10^{-7} \times 20 = 2.6 \times 10^{-6}\ m^3$

$2.6 \times 10^{-6} \times 1030 \times 9.81 = 0.026N$ (upthrust)

The upthrust that is exerted on both lines are 0.026N
Weight of the nylon line is only slightly greater than the upthrust so it'll sink very slowly with not much acceleration. However the weight of the copper line is much greater than the upthrust so it'll sink faster with greater acceleration

18bii: Candidates are not required to know $E = Fl/A\triangle x$ so questions that require a use of the Young modulus, stress and strain are found challenging for many. The confusion usually occurs in the rearangementof the equation of $E = \sigma/\varepsilon$ once the quantities have been substituted into. Candidates that remenbered $E = Fl/A\triangle x$ were far more successful as the algebraic maniplaution was more straight forward and often obtained the correct answer. This question also caused some candidates confusion as many assumed that the prefix of giga was equivalent to 10^6 and not 10^9. Therefore, many answers only scored two marks because the order of the final answer was incorrect or had a missing unit.

The response below scored two marks. One mark for use of stress = force/area on the left and then a second mark for a correct substitution into $E = \sigma/\varepsilon$. However, the candidate did not manage to successfully rearrange the equaton and has an incorrect final answer.


(3)

$\sigma = \frac{F}{A} = \frac{65.N}{1.30\times10^{-7}m^2} = 5\times10^8$

$\varepsilon = \frac{\Delta x}{x} = \frac{\Delta x}{20m}$.

$\frac{5\times10^8}{\frac{\Delta x}{20m}} = 129\,GPa$.

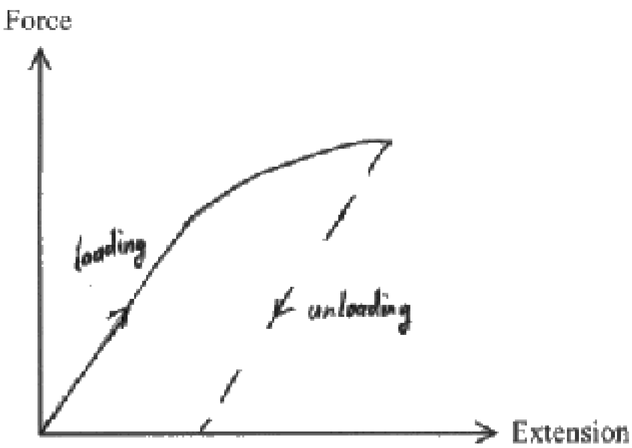
$\frac{5\times10^8 . 20m}{\Delta x} = 129\,GPa$.

$\Delta x = 0.0129\,m$

$0.0129m \div 20\,m =$

Extension = ...

18ci: Most responses seen included the correct force extension graph for loading, including some plastic deformation. Quite a few drew in an unloading graph but few included a permanent extension and just 10 % drew the unloading line as parallel to the loading line.



18cii: The concept of pre-loading the wire was grasped by many candidates and some good responses were seen describing less extension or a smaller force required. Just one candidate managed to describe the idea that the line would be more sensistive but overall this item saw some good responses with a better level of English seen than in other parts of the paper.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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