Examiners' Report
Principal Examiner Feedback

January 2020

Pearson Edexcel International Advanced Subsidiary Level In Physics (WPH13)
Paper 01 Practical Skills in Physics I

Introduction

The Pearson Edexcel International AS-level paper WPH13, Practical Skills in Physics I is worth 50 marks and consists of five questions, which enabling students of all abilities to apply their knowledge and skills to a variety of styles of question.

Each question assesses the student's knowledge, understanding and skills developed while completing practical investigations.

As a student's understanding of the 8 core practical tasks will be assessed by the WPH11 and WPH12 papers, the practical contexts in met in the WPH13 paper may be less familiar but are similar to practical investigations students may complete during their AS Physics studies. As such, the practical tasks described will be related to content taught for WPH11 and WPH12.

However, the focus of WPH13 is the assessment of the practical skills the students have developed, as applied to the physics context described in the question.

There will be questions that are familiar for students who had studied the previous series WPH03 papers, but there are some questions where performances would suggest they were unfamiliar with the practical skills outlined in the specification for Unit 3.

At all ability levels, there were some questions where students answered with generic and pre-learned responses, rather than being specific to the particular scenario as described in the question. Understanding the meaning of command words (such as justify) proved a challenge to students at the lower end of the ability range.

Question 1 (a)

The introduction to question 1 tells students the investigation involved changing the temperature of a diode and measuring the potential difference when the diode starts to conduct.

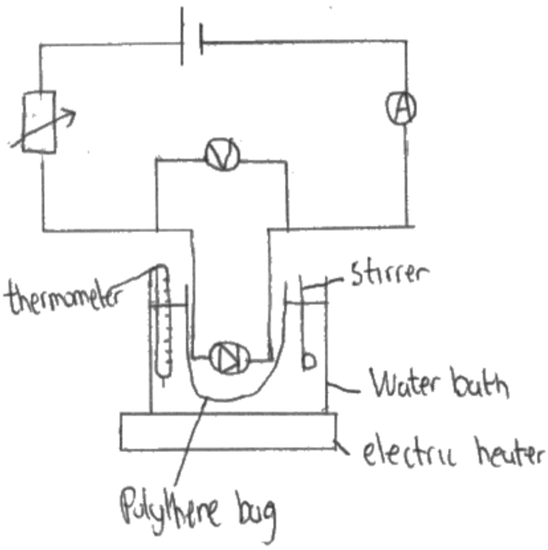
As such the diagram needed to show equipment to;

- change and measure the temperature of the diode – eg a water bath and thermometer
- supply and change the potential difference of the diode – eg cell and a variable resistor
- measure the current through the diode – eg an ammeter connected in series
- measure the potential difference across the diode – eg a voltmeter in parallel

The diagram could be drawn as two parts, an electrical circuit diagram and a heating apparatus diagram. But most students chose to draw a compound diagram, including circuit symbols alongside the symbols for beaker, thermometer, etc.

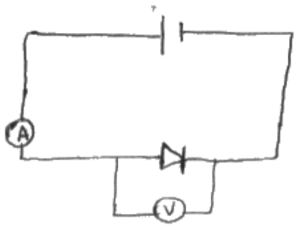
(a) Draw a labelled diagram showing how she could carry out this investigation using school laboratory apparatus.

(4)



This example clearly shows the apparatus for all 4 marks.

Some students did not include the thermometer or a method of varying the potential difference, so most students scored 2 or 3 marks.



This response scored 2 marks, for the ammeter and voltmeter connected correctly.

Question 1 (b)

This question asked students to identify one safety issue. However, in the majority of responses, there was a lack of detail concerning the impact on safety for the identified issue.

(b) Identify one safety issue with this investigation and how it may be dealt with.

(2)

- wire will become hot
- wear protective gloves

“wire will become hot” is not by itself a safety issue as many wires become hot without issue, eg the wires in a toaster. However, the second mark was awarded, as wearing protective gloves would prevent a potential safety issue (eg burns) caused by the hot wire.

(b) Identify one safety issue with this investigation and how it may be dealt with.

(2)

Increasing temperature on a diode may lead to minor skin burns if touched, therefore wearing gloves (safety gloves) will help here. As well as protecting from any form of shock.

This example gives a clear safety issue, burns to the skin if touching the diode when the temperature has been increased. The response also makes clear, wearing gloves would help prevent burns.

As seen in many responses, this student ignored the instruction to identify **one** safety issue. In this case, the second safety issue was ignored.

Question 2 (a)

As a “show that” question, students were given the expected final equation. As with a numerical “show that” calculation, answers would be expected to show clear steps in students work.

Most students skipped steps, such as identifying that upthrust is equal to the weight of the displaced fluid. In most responses, students did not demonstrate the use of $W = mg$ and $m = V\rho$ or $V = Ad$ and $A = \pi r^2$.

However, marks were awarded for seeing the combined versions, $W = V\rho g$ and $V = \pi r^2 d$ So 2 or 3 marks were the most commonly awarded.

The factor of 1000 was often unconvincing. However, the final mark was awarded for the correct conversion of a unit in the question to the standard SI unit (eg g to kg, cm to m), unless contradicted.

The simplest conversion to give the required factor was converting density from 1 g cm^{-3} to 1/1000 kg cm^{-3}. Converting density to 1000 kg m^{-3} was seen regularly, but without explaining how 1000 moved from the top to the bottom of the equation (eg the corresponding conversion from cm to m in r and d to give 1 cm^3 = 1/1000000 m^3)

(a) Show that the upthrust U on the beaker could be calculated using the equation

$$U = \frac{\pi r^2 dg}{1000}$$

where d is in cm and U is in N.

(4)

Upthrust = ~~volume~~ weight of the fluid ~~pl~~ displaced

$= mg$

but density $= \frac{\text{mass}}{\text{volume}}$

$\therefore \rho V_b g = \text{upthrust}$

$1\ \text{gcm}^{-3} = 1000\ \text{Kgm}^{-3}$

$= 1000 \times \pi r^2 dg$; Density is in gcm^{-1}

volume of cylinder $= \pi r^2 h$

$\rightarrow U = \frac{\pi r^2 dg}{1000}$

In this case volume is $\pi r^2 d$

Although this example includes the unexplained movement of the 1000 factor, this response did score all 4 marks for linking upthrust to the weight of the fluid, showing $W = mg$ and $m = V\rho$ and $V = \pi r^2 d$, and converting 1 g cm^{-3} to 1000 kg m^{-3}.

Question 2 (b)

The question gives students a graph and an equation arranged in $y = mx$ format. As such students were expected to use the gradient of the line to calculate the value of the radius, then double this.

When the beaker is in equilibrium upthrust = weight, leading him to the following equation

$$m = \rho\pi r^2 d$$

where $\rho = 1\ \text{g cm}^{-3}$.

Determine the diameter of the beaker, using information from the graph.

(3)

$y = mx + c$

gradient $\quad d = \dfrac{m}{\rho\pi r^2} \quad d = \dfrac{1}{\rho\pi r^2} \times m$

(50, 2.8) (150, 5.4)

$\dfrac{5.4 - 2.8}{100} = 0.026 \quad \dfrac{d}{m} = \text{gradient} = \dfrac{1}{\rho\pi r^2}$

$0.026 \times 1 \times \pi \times r^2 = 1 \quad \sqrt{\dfrac{1}{0.026 \times 1 \times \pi}} = r$

$r = 3.5$ cm

Diameter of beaker = 7.0 cm

However, many students ignored the intercept on the graph and selected a pair of values for *d* and *m*. This was then substituted into the equation given.

Although this is an incorrect use of the equation and graph, as the value of r would vary depending on the values chosen, we awarded 1 mark for a correct calculation using a pair of values taken from the line of the graph.

$\cancel{m = p\pi r^2 d}$ upthrust = weight • when mass is

• when mass = 100 m/g

$m = p\pi r^2 d$

$100 = 1 \times 3.142 \times r^2 \times 4.1$

$100 = 12.8822 \times r^2$

$r^2 = 7.7626$ → $r = 2.786153$

$\therefore$ diameter $= 2.786153 \times 2$

$= 5.57230$ cm

Diameter of beaker = 5.57230 cm

Question 2 (c)

The intercept of the line on the graph is 1.6 cm. The students were told the slotted masses were 10g each. As such, the memorised standard answers given by many students (parallax when measuring distance, zero error on balance) were not relevant. Many students only gave these pre-learnt responses, rather than consider the scenario presented to them in the question.

In the introduction to the question, *m* is defined as the mass a boat can carry and the boat was modelled using a glass beaker. The mass of the glass beaker is approximately 60 g, but this was not included in the equations.

Most students who scored marks identified the mass of the beaker as being the issue.

However, many students subtracted this from the mass added to the beaker. This would translate the line to the left, increasing the *y*-intercept value.

Some suggested using a thinner or a plastic beaker. But that would not correct the systematic error in the data/graph.

To correct for the mass of the beaker, either the masses needed to be added to give a total mass, or the depth with 0 mass added needed to be subtracted.

(c) The graph shows that the beaker would have a depth under the water surface with no mass added.

Identify the source of the systematic error and how it could be corrected.

(2)

~~He~~ The mass of the beaker. He would have calculated the mass of the beaker and add with masses which has been placed in the beaker.

(c) The graph shows that the beaker would have a depth under the water surface with no mass added.

Identify the source of the systematic error and how it could be corrected.

(2)

The mass of the beaker was neglected and the depth of the beaker without added mass should ~~b~~ have been measured. ~~Measure~~ draw a gaph of difference in depth against mass added.

Question 3 (a)

Although question 3 as a whole describes an investigation of refraction in different density salt solutions, part (a) asks students to describe a method to determine the density of a single salt solution.

Determining the density of liquids is a standard practical that students should know from unit 1 work, but also from previous physics courses studied. As students were asked to describe a method, the equipment used should form part of the answer.

(a) Describe a method the student could use to determine the density of the salt solution.

(3)

Density = mass/volume ~~on usinfe~~

Measure the mass of the salt solution by placing empty beaker on an electronic balance and measure its mass then add salt solution and measure its final mass. Subtract these two values for ~~f~~ mass of salt solution then record its volume by the graduated beaker and apply in formula. to give in g cm^{-3}.

This example scored all 3 marks, the equipment used for measuring mass and volume was given and the equation is clear in the first line.

Many students demonstrated a clear misconception that determining the refractive index gave a value for density.

(a) Describe a method the student could use to determine the density of the salt solution.

(3)

- use the values of θ_1 and θ_2, and calculate sin values of θ_1 and θ_2 to find refractive index (n) $n = \frac{\sin\theta_1}{\sin\theta_2}$ $n = \frac{c}{V}$
- using that value of "n", substitute in $n = \frac{c}{V}$, using the concentration of the solution to find the volume (V)
- calculate the density, by measuring mass of solution and substituting values into $d = \frac{m}{V}$

This example did score 1 mark. It is clear this student incorrectly thought n = c/v could be used to give a volume (with c being concentration).

Fortunately, the student defined V as volume, so the mark could be awarded for d (density) = m/V.

Most describing a method to determine the refractive index scored 0 marks.

Question 3 (b)

At this level, it was expected that students would remember refractive index is greater than 0 and that water (and hence the salt solution) would have a refractive index > 1 (air or a vacuum). So a positive *y*-intercept was expected.

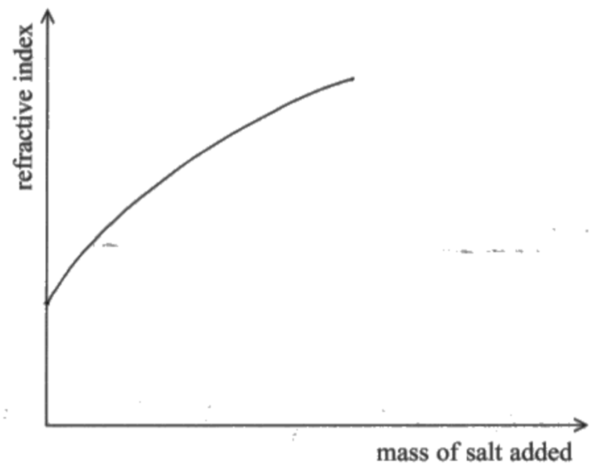
The introduction to question 3 tells students that as solution density increases, the speed of light slows. As $n = c/v$ – as v decreases n increases, so as mass increases, refractive index increases.

However, it was not expected that students know if this is a linear or non-linear relationship for salt.

(b) The student increased the density of the salt solution by adding different masses of salt.

Sketch, on the axes below, a graph to show how the refractive index of the salt solution varies with the mass of salt added.

(2)



Most students scored 1 mark, an increasing line starting at the origin.

Question 3 (c)

It was at this stage students were expected to describe a method to determine the refractive index. Snell's law was quoted in *y=mx* format, and a graphical method was requested. As such, answers were expected to include details of the measurements to be taken, the graph to be plotted, how this was to be analysed.

Most students scored only 2 marks, describing the graph to be plotted and the use of the gradient, but not describing how the data was obtained or how many pairs of angles were to be measured.
There were some examples of language issues, eg angles being "calculated" using a protractor.

The equation $\sin\theta_1 = n \sin\theta_2$ can be compared with the equation $y = mx + c$, where $c = 0$ and $m = n$ which is the refractive index. If we draw a graph of $\sin\theta_1$ on the y-axis and $\sin\theta_2$ on the x-axis, the ~~gradient~~ graph will be a straight line passing through the origin. If we calculate the gradient then it will give us the value for the refractive index.

This example scored 2, for the description of the graph to be plotted and how the gradient is to be used.

① use accurate measuring device to measure the angle of incidence θ_1 and the angle of refraction θ_2, every value should measure over three times and calculate the average value.

② use calculator to calculate $\sin\theta_1$ and $\sin\theta_2$

③ ~~As θ_1 inc~~ make the value of θ_1 increase as a certain range and ~~calcula~~ repeat step ① and the value of θ_1 should in range of $0 \sim 90°$ and over 5 sets.

④ plot a graph $\sin\theta_1 - \sin\theta_2$, the gradient of this graph is equal to n.

This example scored all 4 marks. It included a clear identification that 5 or more sets of data were needed to plot a graph with an accurate line of best fit.

Question 3 (d)

(d)(i) Students had been given the necessary equation in part (c). Most students used this equation and the maximum and minimum angles, to calculate the maximum and minimum values of *n*.

3 marks for this question was common. Some used the incorrect combinations of maximum and minimum angles, so scored 1 mark.

(d)(ii) Having 3 values of *n* (calculated max/min values and the value given in the table) it was expected that students would apply the methods outlined in appendix 10 of the specification.

(i) The uncertainty in the measurement of the angles was ± 0.5°.

Calculate the maximum and minimum values of *n*.

(3)

33.0° might be any value between 32.5° ~ 33.5°.

24.0° might be any value between 23.5° ~ 24.5°.

$n = \frac{\sin\theta_1}{\sin\theta_2}$.

when $\theta_1 = 33.5°$ $\theta_2 = 23.5°$ $n_{max} = 1.38$.

When $\theta_1 = 32.5°$ $\theta_2 = 24.5°$ $n_{min} = 1.30$.

Maximum value of *n* = 1.38

Minimum value of *n* = 1.30.

(ii) Calculate the percentage uncertainty in the student's value of *n*.

(2)

$p = \frac{\frac{1}{2}(1.38-1.30)}{1.34} \times 100\% = 2.99\%$

Percentage uncertainty = 2.99%

This example scored 3 and 2 marks.

(i) The uncertainty in the measurement of the angles was ± 0.5°.

Calculate the maximum and minimum values of *n*.

(3)

$\sin\theta_1 = n \sin\theta_2$ max: $= \frac{\sin(23.5°)}{\sin(24.5)} = n$

$\theta_1 = 32.0° \pm 0.5° = 33.5°$ and 32.5 $= \cancel{0.96}\ 1.33$

$\theta_2 = 24.0 \pm 0.5° = 24.5°$ 23.5 min: $= \frac{\sin(32.5°)}{\sin(23.5°)} = n$

$= 1.34746$

Maximum value of *n* = ~~0.960~~ 1.350

Minimum value of *n* = ~~1.350~~ 1.330

(ii) Calculate the percentage uncertainty in the student's value of *n*.

(2)

$1.33 + \frac{1.34}{3} + 1.35 = \frac{4.05}{3}$ $1.35 - 1.33 = 0.02$

$= 1.34$ $\frac{\frac{1}{2} \times 0.02}{1.24} \times 100$

$= 0.7462686567$

Percentage uncertainty = 0.75

This example used the incorrect combinations of maximum and minimum angles in the calculations, so scored only 1 mark for (d)(i). However, error carried forward was applied. So (d)(ii) still scored 2 marks.

Some attempted to compound the uncertainties for the equation by adding the percentage uncertainties. This is an A-level skill but would have been credited marks is carried out correctly. However, most students that attempted this method incorrectly assumed the percentage uncertainty in sin θ is equal to the percentage uncertainty in θ.

(ii) Calculate the percentage uncertainty in the student's value of *n*.

(2)

$\frac{0.5}{33} \times 100 + \frac{0.5}{24} \times 100$

$1.52\% + 2.08 = 3.60$

Percentage uncertainty = 3.60 %

Question 4 (a)

This question generated vague, pre-learnt responses. It was common to see “no repeats”, “no average” despite the table showing 3 trials and a mean calculated. Also common was “too small a range”, but the table shows a range of 0.02 to 0.12 for mass (0.12 is 6×0.02, a suitable range is usually at least 4× bigger, so this range is suitable). In future, students should ensure they are clear which aspect of the data they are criticising and to avoid generic lists that do not apply to the scenario.

There were 4 sets of data recorded in the table, both measured and calculated.

Measurement data should be recorded to the same number of decimal places as the resolution of the measuring device, so one criticism could be that the mass was rounded to the nearest 20 g not recorded to the nearest gram (3 decimal places) if students assumed 10 g slotted masses were used.

Calculated values should match the significant figures of the data used. As mass was recorded to 1 or 2 significant figures and height was 2 significant figures, one criticism could be that the number of significant figures for GPE should be 2, or that they are inconsistent. The energy supplied is measured using a joulemeter to 2 decimal places. This table gives values record to 2 decimal places (2 or 3 significant figures). So the mean energy supplied should also be to 3 significant figures (or 2 decimal places) but is inconsistent in the table.

(a) Criticise these results.

(2)

Inconsistent ~~so~~ number of significant figures of change in gravitational potential energy. Range of values of mass is too small. There should be more readings. Mean not given to the same ~~pe~~ ~~re~~number of significant ~~result~~ figures as the Trials or results.

This response gave 4 criticisms, two of which were irrelevant and ignored, but two were correct so scored both marks. Although for mean energy the student has not identified the number of significant figures should be 3, this response does make it clear that it should match the trials.

(a) Criticise these results.

(2)

The results in the second and last column are inconsistent in terms of significant figures. Some numbers are 2, while others are 3.

This response has identified that GPE has inconsistent significant figures, but the mean energy we needed a little more detail, that it should be 3 to match the trials values.

Question 4 (b)

There were few errors in the calculations. Most students scored all 3 marks.

Some students did not use E = mgh to calculate the change in GPE. Instead, they used some form of ratio calculation or adding the change in GPE from 0.08 kg to 0.10 kg to the value of GPE at 0.10 kg.

(b) Complete the last row of the table.

(3)

$0.02 \rightarrow 0.147$

$0.12 \rightarrow \frac{0.147}{0.02} \times 0.12 = 0.89$

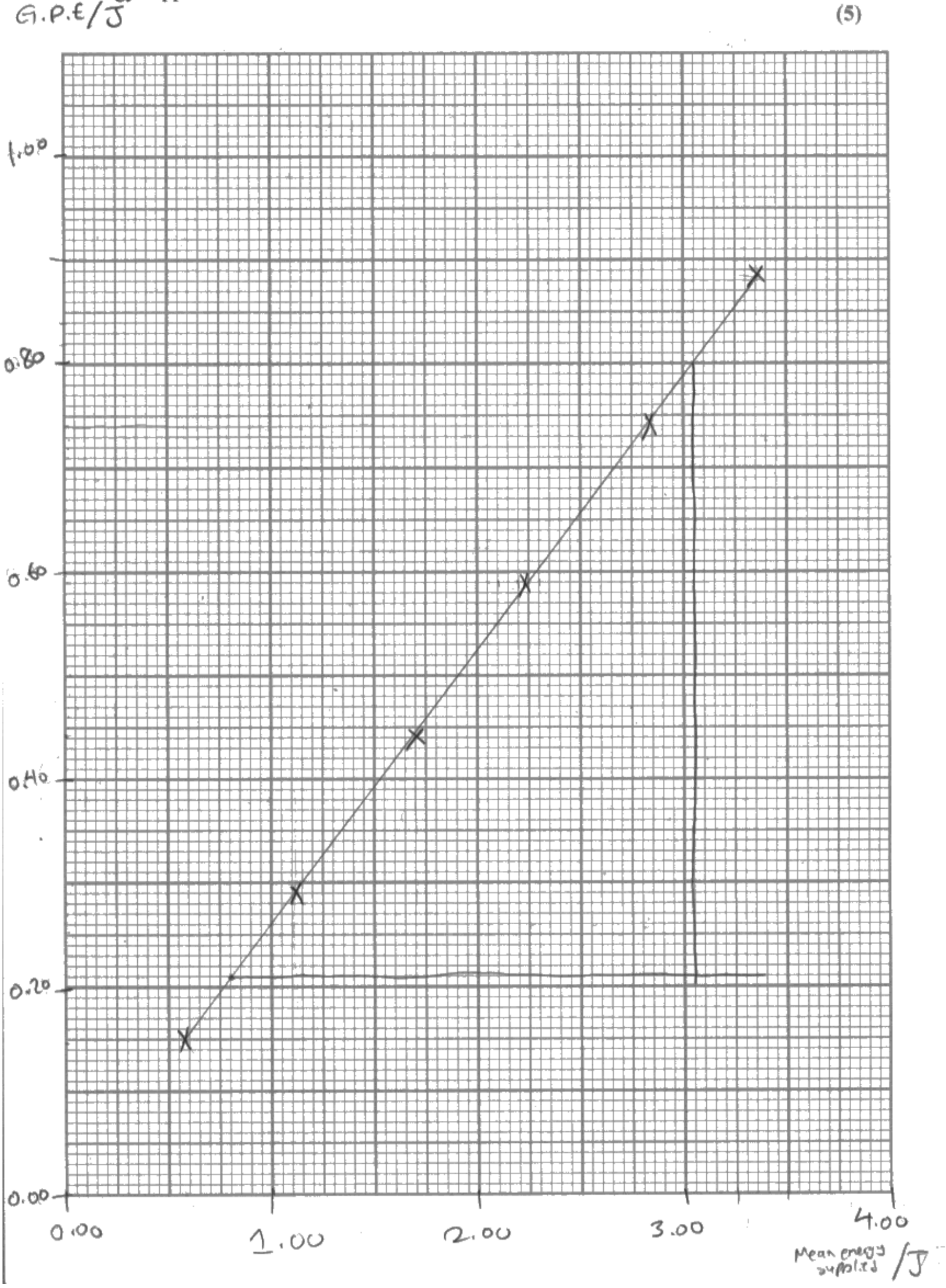
Question 4 (c)

The plotting of the graph demonstrated many of the issues seen in the two previous series of WPH13, and WPH03 before that.

- Axes were labelled without units or units incorrectly shown.
- As 5 of the 6 sets of data pairs to be plotted were given in the table, there was less variation in the choices of scales. But it was still common to see *y*-axis scales of 0.15 per 2 cm or *x*-axis scales of 0.4 per 2 cm
- Plotting accuracy was often poor, with points marked more than 2 mm from their correct position. It was still common to see ● rather ×used to mark points. Often the ● was filling the whole 2 mm square– so accuracy could not be checked.
- Lines of best fit should be straight and have a balance of points (and distances) above and below the line.

(c) Plot a graph of change in gravitational potential energy on the *y*-axis against mean energy supplied on the *x*-axis.

(5)



This is an example of a graph that was awarded 5 marks. The axes are labelled correctly, the scale increases by 0.1 per 2 cm on the *y*-axis and 0.5 per 2 cm on the *x*-axis, the plots are within 2 mm and the line is straight and balanced (with 2 points above and 2 points below the line).

Question 4 (d)

Students were given the efficiency equation in the “List of data, formulae and relationships”

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}}$$

As such efficiency = change in GPE / mean energy supplied, so the efficiency can be determined by calculating the gradient of the graph plotted.

(d) Determine the efficiency of the motor. (2)

$$\text{Gradient} = \frac{\text{change in G.P.E}}{\text{change in mean energy supplied}} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{0.80 - 0.21}{3.05 - 0.8} = 0.262222$$

$$= 26.2\% \approx 26\%$$

Efficiency = 26.2%

This example scored both marks.

As in the previous series, there were some common errors.

- Calculating the gradient using less than half the line of best fit
- Calculating the gradient using table data, when those points are not on the line of best fit
- Using a single pair of values when the line does not pass through the origin.

Question 4 (e)

This question expected students to describe how the experiment being carried out in the question could be extended to determine the mass lifted which caused efficiency to decrease.

As (d) had linked gradient to efficiency, it was expected that students would describe how the current graph would be extended with values of GPE and energy supplied for trials done using larger masses.

As masses were increased by 20 g each time, there should be some indication that data recorded using smaller increments of mass would be needed to accurately identify the mass at which efficiency starts to decrease.

Describe how they should collect and use data to determine the mass at which the efficiency starts to decrease.

(3)

The students should plot a graph of ΔE_{grav} against mean energy supplied, with the masses' range at a much greater value, with larger equal intervals. As the gradient changes, the students can find the ΔE_{grav} at which the gradient changes, and divide that value by $(9.81\ N\ kg^{-1} \times 0.75\ m)$ to find mass. As the gradient begins to decrease, the intervals of mass added should decrease, to find an accurate value for mass.

However, some students took a different approach, restarting the experiment and calculating efficiency for each trial. A new graph of efficiency against mass was to be plotted and the maximum mass before the line began to fall was to be determined. This was given credit for the equivalent stages.

Question 5 (a)

The command word used in this question is **justify** which appendix 9 defines as Give evidence to support (either the statement given in the question or an earlier answer).

Most responses gave no evidence to demonstrate the support of the teacher's opinion that it would be safe. Some answers contradicted the teacher's opinion that it would be safe.

The diameter of the teacher's sample was 1/20 of the original bungee rope diameter, as such the area of the teacher's sample is 1/400 of the original diameter. Assuming the breaking stress is the same for both, the breaking force should also be 1/400 of the original bungee rope – so 20N.

Calculations using the stress equation were not required but this was a common approach used by those who scored full marks.

(a) A teacher is given a sample of the same material with diameter 1 mm.

Justify the teacher's decision that it would be safe for her students to determine the breaking stress of the sample.

(2)

The maximum stress of the bungee rope is $\frac{8000}{\pi(0.01)^2} = 2.55 \times 10^7 \, Nm^{-2}$

The force needed to break the 1mm sample will be $2.55 \times 10^7 = \frac{F}{\pi(0.0005)^2}$

and $F = 2.55 \times 10^7 \times \pi(0.0005)^2 = \cancel{20.0}$ 20N. As this weight is not very high, it would be safe ~~to use~~ for her students to determine the breaking stress experimentally, although it would be recommended to wear protective shoes and goggles ~~when~~ for then ~~the~~ the sample snaps.

Others who used the stress equation incorrectly applied 8000N to both diameters of bungee rope material, arguing that breaking stress was higher for the 1 mm sample, it would be safer.

But most scored 0 marks, as they simply discussed rather than justified the teacher's view.

(a) A teacher is given a sample of the same material with diameter 1 mm.

Justify the teacher's decision that it would be safe for her students to determine the breaking stress of the sample.

(2)

The ~~height~~ ~~diameter~~ diameter of the ~~fall~~ of the rope will be less therefore the less stress as the cross-sectional area will be less therefore being safe fore her students.

Question 5 (b)

This question asked students to determine whether the results support the manufacturer's value. As such, the final mark is for a comparison and a corresponding correct statement.

The calculation itself has many steps, with the most common error being the use of diameter (rather than radius) in $A = \pi r^2$. The majority did correctly complete the calculation. However, the comparison was often lacking or made an incorrect conclusion. So 3 and 4 were the most commonly awarded marks.

There were two values given in the question with which to compare. Breaking stress and mass (from which force can be calculated).

Determine whether the student's result supports the manufacturer's value.

(4)

$F = mg = 1.9 \times 9.8 = \cancel{16}\ 18.62\ N$

$C.S.A = \pi (4.75 \times 10^{-4})^2$

$\frac{0.95}{1000}$

diameter $= 9.5 \times 10^{-4}$

radius $= 4.75 \times 10^{-4}$

$Stress = \frac{18.62}{\pi (4.75 \times 10^{-4})^2}$

$= 2.63 \times 10^7\ Pa$

The student's result do not support manufacturer's value as student's value for breaking stress is greater.

This example scored 4 marks. Many students calculated breaking stress to be 2.62×10^7 and correctly stated this was **greater** than be 2.55×10^7 but then also stated the manufacturer's value was correct.

(4)

~~1.9k~~ Force $= 1.9 \times 9.81$

$= 18.64\,N$

Area $= \dfrac{\pi \times (0.95 \times 10^{-3})^2}{4}$

$= 7.09 \times 10^{-7}\,m^2$

~~st~~ breaking stress $= \dfrac{18.64}{7.09 \times 10^{-7}}$

$= 2.63 \times 10^{7}\,Pa$

$= 2.6 \times 10^{7}\,Pa$

% difference $= \dfrac{(2.63 \times 10^7 - 2.55 \times 10^7) \times 100}{2.55 \times 10^7}$

$= \dfrac{8}{255} \times 100\%$

$= 3.13\%$

Yes the students result support the manufacturer's value as % difference is less than 10 %

This example scored 4, the comparison statement making use of a percentage difference calculation.

Area $= \left(\dfrac{\pi \times (0.95 \times 10^{-3})^2}{4}\right)$

$= 7.08 \times 10^{-7}$

Breaking stress $= \dfrac{\text{force}}{\text{area}}$

$2.55 \times 10^{7} \times 7.08 \times 10^{-7} = $ force

force $= 18.054$.

$w = mg$

$18.054 = m \times 9.81$

$m = 1.84\,kg$

As 1.84 closer to 1.9 kg so yes the student's result support the manufacturer's value.

This is an example of a rarely seen approach. This student calculated the mass at which the manufacturer's values suggests the material should break, then compares this to the mass given in the question, scoring all 4 marks.

Paper Summary

This paper provided students with a range of practical contexts from which their knowledge, understanding and skills developed within this unit could be tested.

Sound knowledge of the subject was evident for many, but some responses seen did not reflect this. Some answers did not match the question, or the context being assessed.

Based on their performance on this paper, students are offered the following advice:

- Ensure answers are specific to the context of the question, rather than generic statements supplied as a list of answers based on a previous mark scheme.
- When describing a method, the answer should include the measuring apparatus, not just the variables being **measured**.
- When plotting graphs, **plots** must be clear (eg small × drawn with a sharp pencil,) so that the accuracy of plotting can be checked. Large marks that fill a 2 mm square cannot be checked for accuracy.
- Straight lines of best fit should be continuous (so should not change direction), with a balance of plots above and below the line, and the line should be **thin.** (eg the line of best fit should be a single line, drawn with a sharp pencil and a ruler).
- When using a graph to determine a gradient, the points taken for the gradient must sit on your line of best fit. If a plotted point does not sit on the line of best fit, then it should not be one of the points of data used for the gradient.
- Review **appendices 9** of the specification, particularly the command words used to identify the task students need to complete to answer the question.

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