Practically speaking at A-level

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Practical endorsement update

Overview of practical questions

AO grids document

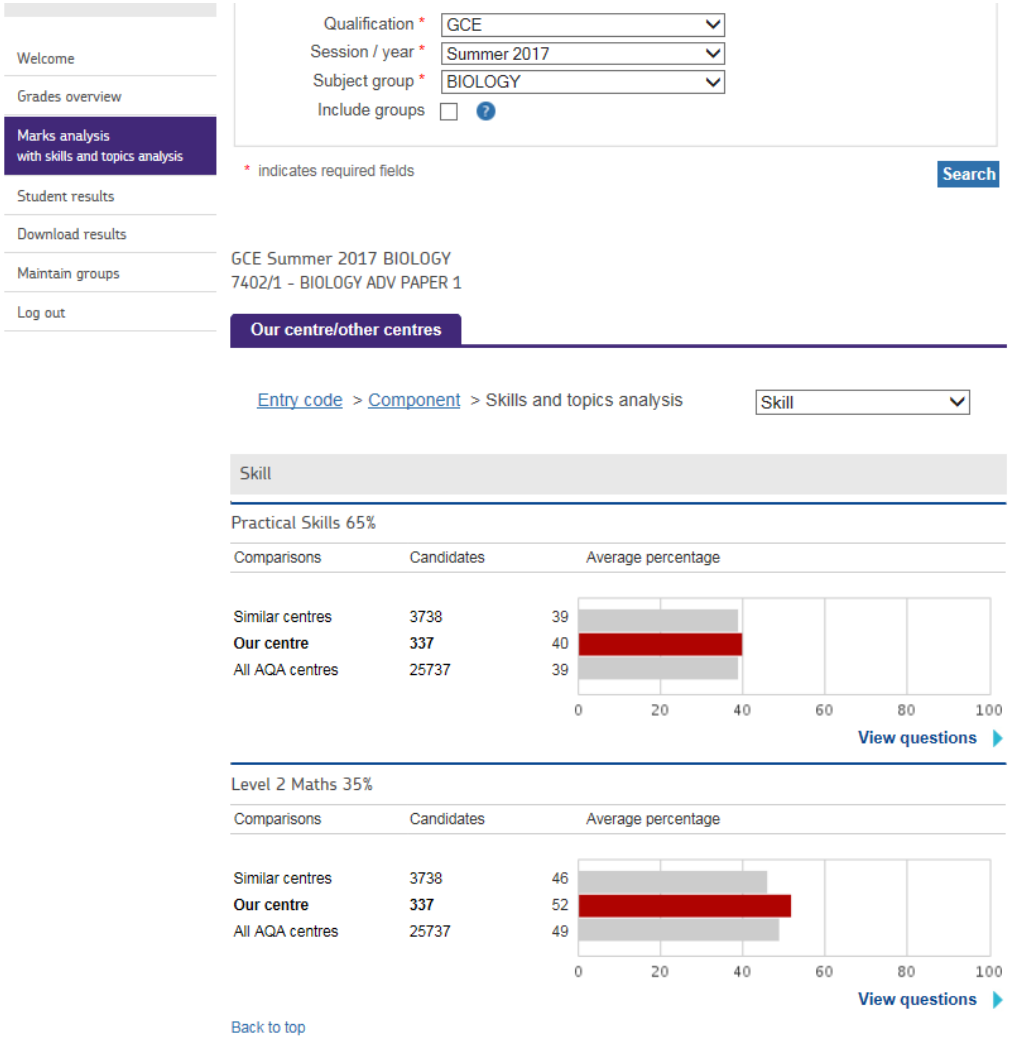
- Level 2 Maths
- Practical
- AOs.

AQA A-level Physics

June 2017 Paper 3A - 7408/3A

Question number	Level 2 Maths	Practical	AO1	AO2	AO3
1.1		1	1		
1.2		1		1	
1.3		2	2		
1.4	1	3	2	1	
1.5	2	2		2	
1.6	2	3		2	1
1.7	3	2		2	
1.8	2	4			4
2.1	1	1		1	
2.2	2	2		2	
2.3	2	2			2
2.4	1	3	1	2	
2.5	2	2	1	1	
2.6		2	1	1	
2.7		2	1	1	
3.1		1			1
3.2	1	1	1		
3.3	3	3	3		
3.4	1	1			1
3.5	3	3	1		2
3.6		4			4
Total	26	45	14	16	15

ERA tool - eAQA



Feedback on 2017 practical questions

Overall performance

Minimum 15% of marks on qualification must assess practical skills.

Mean mark	Biology	Chemistry	Physics (without option paper)
Qualification	122/260	171/300	106/215
Qualification %	47%	57%	49%
Practical questions	16.9/39	32.8/64	17.4/45
Practical questions %	43%	51%	39%

Practical skills assessment

- 12 required practicals per subject
- 12 apparatus and techniques per subject

How do we assess this content?

8.3 Practical skills to be assessed in written papers

Overall, at least 15% of the marks for an A-level Biology qualification will require the assessment of practical skills.

In order to be able to answer these questions, students need to have been taught, and to have acquired competence in, the appropriate areas of practical skills as indicated in the table of coverage below.

8.3.1 Independent thinking

	Practical skill
PS 1.1	Solve problems set in practical contexts
PS 1.2	Apply scientific knowledge to practical contexts

8.3.2 Use and application of scientific methods and practices

	Practical skill
PS 2.1	Comment on experimental design and evaluate scientific methods
PS 2.2	Present data in appropriate ways
PS 2.3	Evaluate results and draw conclusions with reference to measurement uncertainties and errors
PS 2.4	Identify variables including those that must be controlled

8.3.3 Numeracy and the application of mathematical concepts in a practical context

	Practical skill
PS 3.1	Plot and interpret graphs
PS 3.2	Process and analyse data using appropriate mathematical skills as exemplified in the mathematical appendix for each science
PS 3.3	Consider margins of error, accuracy and precision of data

8.3.4 Instruments and equipment

	Practical skill
PS 4.1	Know and understand how to use a wide range of experimental and practical instruments, equipment and techniques appropriate to the knowledge and understanding included in the specification

Practical skills assessment – Biology Paper 2

0 4 A student isolated chloroplasts from spinach leaves into a solution to form a chloroplast suspension. He used the chloroplast suspension and DCPIP solution to investigate the light-dependent reaction of photosynthesis. DCPIP solution is blue when oxidised and colourless when reduced.

The student set up three test tubes as follows:

- **Tube 1** – 1 cm^3 of solution without chloroplasts and 9 cm^3 of DCPIP solution in light.
- **Tube 2** – 1 cm^3 of chloroplast suspension and 9 cm^3 of DCPIP solution in darkness.
- **Tube 3** – 1 cm^3 of chloroplast suspension and 9 cm^3 of DCPIP solution in light.

The student recorded the colour of the DCPIP in each of the tubes at the start and after the tubes had been left at 20 °C for 30 minutes.

His results are shown in **Table 1**.

Table 1

Tube	Colour of DCPIP in tube	
	At start	After 30 minutes
1	blue	blue
2	blue	blue
3	blue	colourless

0 4 . 1 The solution that the student used to produce the chloroplast suspension had the same water potential as the chloroplasts.

Explain why it was important that these water potentials were the same.

[2 marks]

Practical skills assessment – Biology Paper 2

- **N/A – 0.2%**
- **0 marks – 17.2%**
- **1 marks – 46.6%**
- **2 marks – 36%**

04.1	1. Osmosis does not occur; 2. Chloroplast/organelle does not burst/lyse/shrivel/shrink;	2	1. Accept: osmosis would occur if water potentials were not the same. 1 and 2, Accept: correct reference to osmotic lysis for **2 marks**. 2. Accept: chloroplast would burst/lyse/shrivel/shrink if water potentials were not the same. 2. Reject: 'cell bursts/shrivels' 2. Ignore: damage to chloroplasts on its own is not enough for a mark. 2. Reject: becomes turgid/flaccid.

Practical skills assessment – Biology Paper 2

- **N/A – 0.2%**
- **0 marks – 40.2%**
- **1 marks – 50.9%**
- **2 marks – 8.7%**

0 4 . 2 Explain why the student set up **Tube 1**.

[2 marks]

Tube 1 was used as the control to make sure the DCPIP solution in light stayed oxidised to prove that it is the chloroplasts that reduce it during photosynthesis. 1 1

04.2	1. To show light does not affect DCPIP; 2. To show chloroplasts are required;	2	Ignore: comparison with other tubes.

Practical skills assessment – Biology Paper 2

- **N/A – 0.3%**
- **0 marks – 17.7%**
- **1 marks – 44%**
- **2 marks – 38%**

0 4 . 3 Explain the results in **Tube 3.**

[2 marks]

The colour of DCPIP changed from blue to colourless as it had been reduced. This is because light has caused the photosystem II [1] in the thylakoids to lose electrons [1] which reduce the DCPIP

04.3	1. Reduction of DCPIP by electrons; 2. (From) chlorophyll/light dependent reaction;	2	1. Accept: hydrogen/H for electrons but not protons/hydrogen ions/H^+ on their own. 2. Accept: from chloroplasts/photosystems/water.

Practical skills assessment – Biology Paper 3

- **N/A – 1.1%**
- **0 marks – 20.7%**
- **1 marks – 20.1%**
- **2 marks – 58%**

0 4 Ecologists investigated changes in grassland communities on large islands off the coast of Scotland between 1975 and 2010. On each island, they used data from a number of sites to determine the change in mean species richness and the change in mean index of diversity.

0 4 . 1 **Table 1** shows plant species recorded at one site, on one island, in 1975.

Table 1

Species	Number of individuals
Hydrocotyle vulgaris	3
Plantago maritima	19
Ranunculus acris	3
Hieracium pilosella	3
Calliergon cuspidatum	10
Prunella vulgaris	16
Pseudoscleropodium purum	6

Calculate the index of diversity for this site using the formula:

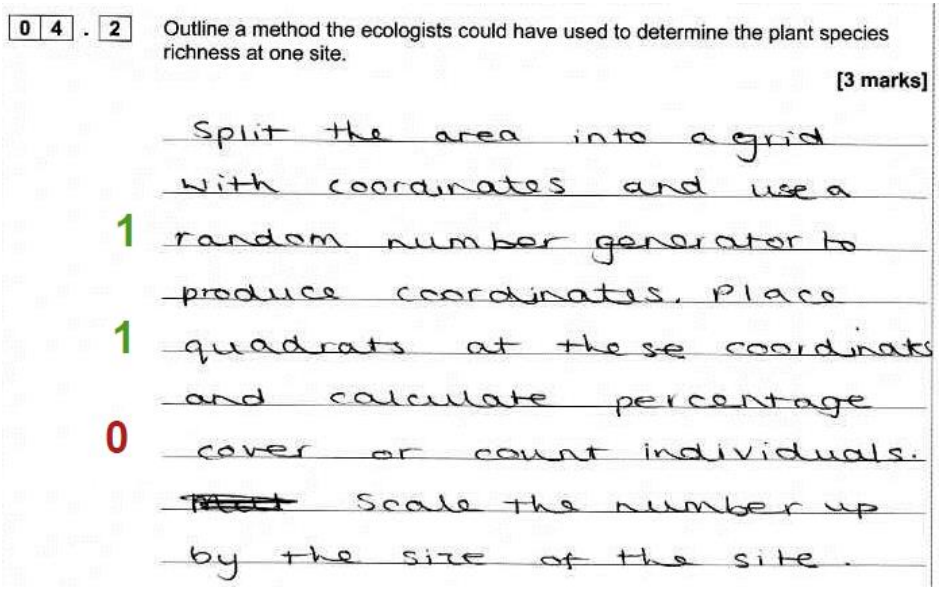
$$d = \frac{N(N-1)}{\Sigma n(n-1)}$$

[2 marks]

04.1	Correct answer of 4.92, 2 marks;; If N(N-1) = 3540, **OR** ∑n(n-1) = 720, then award 1 mark	2	Accept 4.916/4.917/4.9

Practical skills assessment – Biology Paper 3

- **N/A – 0.9%**
- **0 marks – 4.5%**
- **1 marks – 18.7%**
- **2 marks – 44.4%**
- **3 marks – 31.5%**



0 4 . 2 Outline a method the ecologists could have used to determine the plant species richness at one site.

[3 marks]

Split the area into a grid with coordinates and use a random number generator to produce coordinates. Place quadrats at these coordinats and calculate percentage cover or count individuals. ~~Meet~~ Scale the number up by the size of the site.

1

1

0

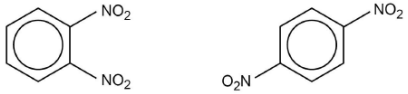
04.2	1. A method of selecting sampling sites at random; 2. Use of quadrat; 3. Identify (plant) species (at site/in each quadrat) OR Count number of (different plant) species (at site/in each quadrat);	3	1. Eg grid with coordinates selected using random number table 2. Frame or point 3. Reject refs to % cover, or counting individuals

AQA

Practical skills assessment – Chemistry Paper 2

- **N/A – 0.3%**
- **0 marks – 6.4%**
- **1 marks – 93.2%**

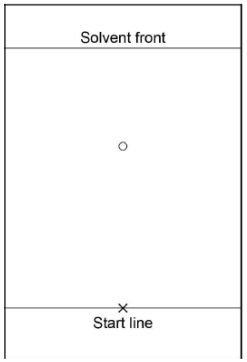
0 8 . 3 The dinitrobenzenes shown were investigated by thin layer chromatography (TLC).



In an experiment, carried out in a fume cupboard, a concentrated solution of pure 1,4-dinitrobenzene was spotted on a TLC plate coated with a solid that contains polar bonds. Hexane was used as the solvent in a beaker with a lid.

The start line, drawn in pencil, the final position of the spot and the final solvent front are shown on the chromatogram in **Figure 3**

Figure 3



Use the chromatogram in **Figure 3** to deduce the R_f value of 1,4-dinitrobenzene in this experiment.

Tick (✓) **one** box.

[1 mark]

A 0.41 ☐

B 0.46 ☐

C 0.52 ☐

D 0.62 ☐

Practical skills assessment – Chemistry Paper 2

- **N/A – 1.6%**
- **0 marks – 66.7%**
- **1 marks – 31.7%**

0 8 . 4 State in general terms what determines the distance travelled by a spot in TLC.
[1 mark]

How much of an affinity the sample has for the mobile phase or the stationary phase. 1

08.4	(Balance between) solubility in moving phase and retention by stationary phase	1	OR (relative) affinity for stationary/solid and mobile/liquid/solvent (phase)

Practical skills assessment – Chemistry Paper 2

- **N/A – 2.2%**
- **0 marks – 34.3%**
- **1 marks – 63.5%**

0 8 . 5 To obtain the chromatogram, the TLC plate was held by the edges and placed in the solvent in the beaker in the fume cupboard. The lid was then replaced on the beaker.

Give one other practical requirement when placing the plate in the beaker.

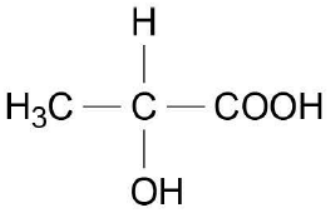
[1 mark]

The solvent should lie just beneath the start line, and not touch the start line. 1

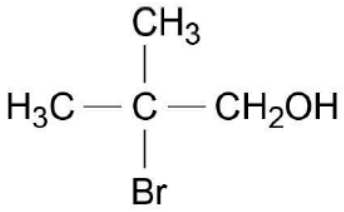
08.5	Solvent depth must be below start line	1	Ignore safety

0 7 Test-tube reactions can be used to identify the functional groups in organic molecules.

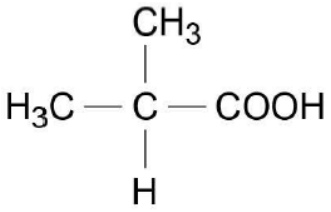
0 7 . 1 You are provided with samples of each of the four compounds.



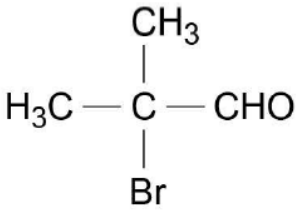
K



L



M



N

Describe how you could distinguish between all four compounds using the minimum number of tests on each compound.

You should describe what would be observed in each test.

[6 marks]

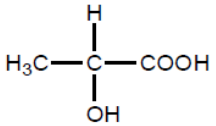
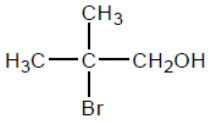
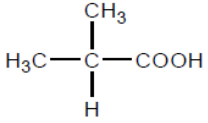
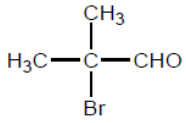
Practical skills assessment – Chemistry Paper 2

07.1	This question is marked using Levels of Response. Refer to the Mark Scheme Instructions for Examiners for guidance.		**Indicative Chemistry content** **Stage 1**: An initial test to separate into two groups (2 groups of 2 OR 1 group of 3 and 1 group of 1) **Stage 2**: An second test to distinguish within a group or to separate into two further groups **Stage 3**: A third test leads to a set of results/observations which distinguishes between all 4 compounds **Tests must include reagent and observation which identifies compound(s)** -COOH a) $NaHCO_3$ / Na_2CO_3 (or correct alternative) b) effervescence /gas turns limewater milky c) K and /or M but not L and/or N -OH and -CHO d) acidified $K_2Cr_2O_7$ e) solution turns green f) K and/or L and/or N but not M -CHO g) Fehlings OR Tollens h) red ppt OR silver mirror i) N only but not K and/or L and/or M -Br j) Silver nitrate k) cream ppt l) L and/or N but not K and/or M **Isolated tests on individual compounds - max LEVEL 2** **Isolated tests not linked to any compound – max LEVEL 1** **Penalise observation if deduction wrong, but allow observation if deduction incomplete**
	Level 3 5-6 marks	All stages are covered and each stage is generally correct and virtually complete. Answer is communicated coherently and shows a logical progression from Stage 1 to Stages 2 and 3 to distinguish all the compounds with results for all remaining compounds stated. Describing subsequent organic test on product (unnecessary) - limits to lower mark in level	
	Level 2 3-4 marks	All stages are covered but stage(s) may be incomplete or may contain inaccuracies OR two stages are covered and are generally correct and virtually complete. Answer is communicated mainly coherently and shows a logical progression from Stage 1 to Stages 2 and 3. Describing subsequent organic test on product (unnecessary) - limits to lower mark in level	
	Level 1 1-2 marks	Two stages are covered but stage(s) may be incomplete or may contain inaccuracies OR only one stage is covered but is generally correct and virtually complete. Answer includes isolated statements but these are not presented in a logical order.	
	0 mark	Insufficient correct chemistry to gain a mark.	

Practical skills assessment – Chemistry Paper 2

Alternative tests

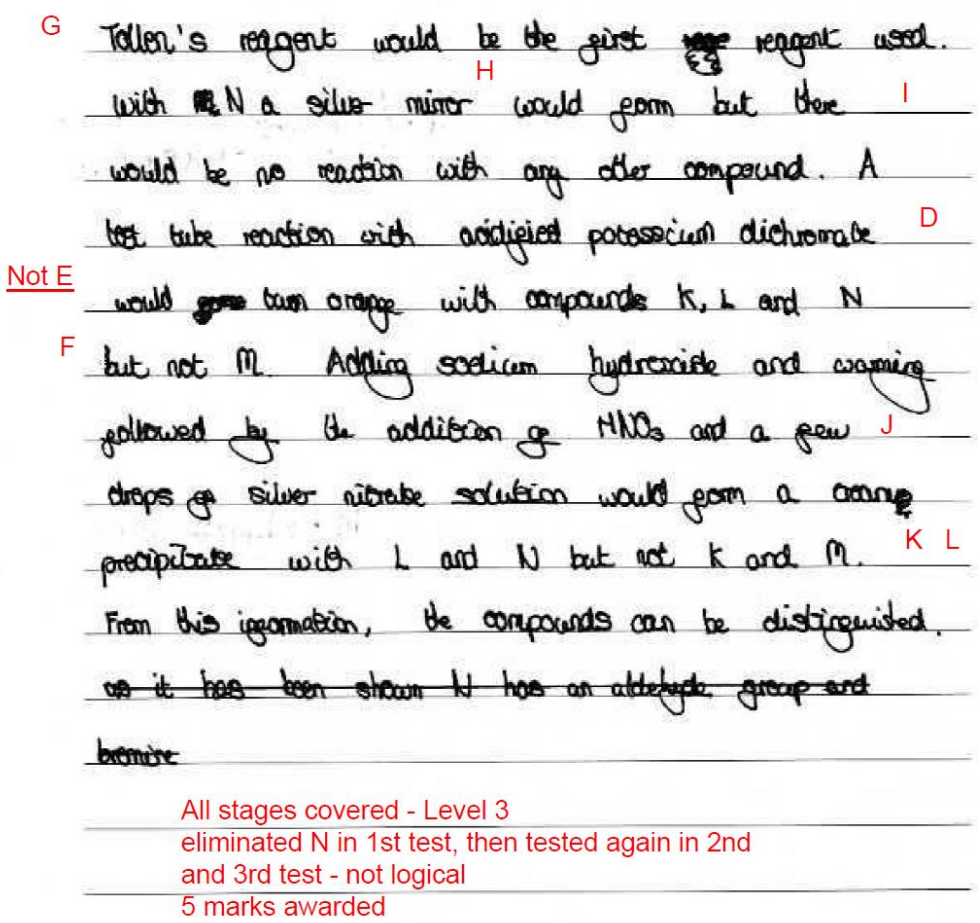
-COOH	-COOH	-OH only
a) named alcohol & H_2SO_4 b) sweet smell (of ester) c) K and /or M but not L and/or N	a) named indicator b) correct colour c) K and /or M but not L and/or N	m) named carboxylic acid & H_2SO_4 n) sweet smell (of ester) o) K and/or L but not M and /or N

					
Test	**Tests for**	**K**	**L**	**M**	**N**
a) $NaHCO_3$ / Mg / Indicator	K M	✓	×	✓	×
d) $K_2Cr_2O_7$ / H^+	K L N	✓	✓	×	✓
g) Fehlings / Tollens	N	×	×	×	✓
j) $AgNO_3$ see Note *	L N	×	✓	×	✓
a) named alcohol & H_2SO_4	K M	✓	×	✓	×
m) named carboxylic acid & H_2SO_4	K L	✓	✓	×	×

Note * allow NaOH then HNO_3, $AgNO_3$ as one test; but treat NaOH, $AgNO_3$ without acid as incomplete,so can mark on.

Practical skills assessment – Chemistry Paper 2

- N/A – 2%
- 0 marks – 4.8%
- 1 marks – 6.2%
- 2 marks – 11.2%
- 3 marks – 17.3%
- 4 marks – 22.6%
- 5 marks – 18.1%
- 6 marks – 17.7%



Practical skills assessment – Physics AS Paper 2

0 2 . 4 A student investigates the rate at which a similar pencil wears away through use.

The student measures the length of the pencil using a sliding vernier scale placed alongside a fixed scale. The fixed scale has a precision of 1 mm.

Figure 6 shows the vernier scale in the zero position.

Figure 7 shows the pencil (which is now sharpened) placed next to the fixed scale.

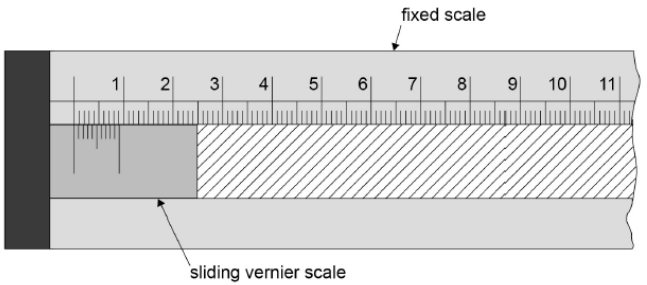
The position of the vernier scale is adjusted so that the length of the pencil can be read.

Read and record the length of the pencil shown in **Figure 7**.

[1 mark]

length of pencil = _____ mm

Figure 6



0 2 . 5 The pencil is then removed from the scale and is used to draw 20 lines on a sheet of paper. Each line has a length 25 cm.

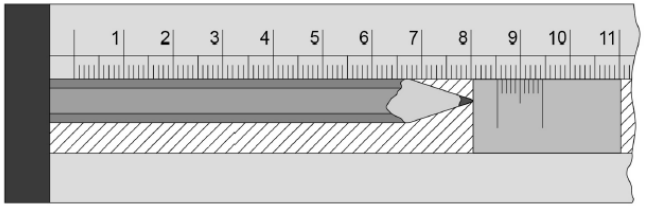
The pencil is then replaced next to the fixed scale and the vernier scale adjusted so the new length of the pencil can be read, as shown in **Figure 8**.

Read and record the new length of the pencil shown in **Figure 8**.

[1 mark]

new length of pencil = _____ mm

Figure 7

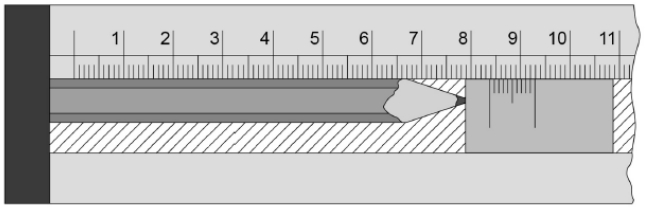


0 2 . 6 $L_{1/2}$ is the length of the line that could be drawn which would cause the original length of the pencil to be halved.

Calculate $L_{1/2}$.
Ignore any decrease in length as a result of sharpening the pencil.

[2 marks]

Figure 8



Practical skills assessment – Physics AS Paper 2

Q2.4

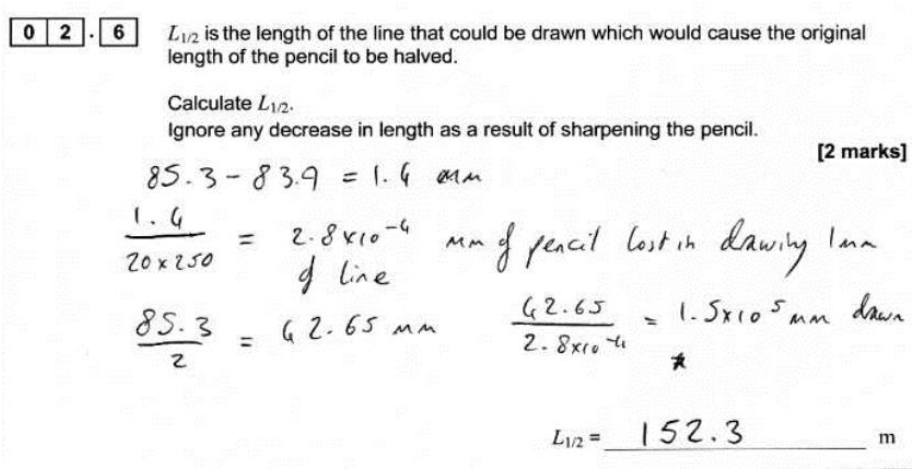
- N/A – 0%
- 0 marks – 80.8%
- 1 marks – 19.2%

Q2.5

- N/A – 0%
- 0 marks – 65.1%
- 1 marks – 34.9%

Q2.6

- N/A – 8%
- 0 marks – 31.3%
- 1 marks – 14.4%
- 2 marks – 46.3%



0 2 . 6 $L_{1/2}$ is the length of the line that could be drawn which would cause the original length of the pencil to be halved.

Calculate $L_{1/2}$.
Ignore any decrease in length as a result of sharpening the pencil. **[2 marks]**

$85.3 - 83.9 = 1.4$ mm

$\frac{1.4}{20 \times 250} = 2.8 \times 10^{-4}$ mm of pencil lost in drawing 1mm of line

$\frac{85.3}{2} = 42.65$ mm $\quad \frac{42.65}{2.8 \times 10^{-4}} = 1.5 \times 10^{5}$ mm drawn ★

$L_{1/2} =$ 152.3 m

02.6	Answers 133.43, 142.33, 152.32, 142.16 ✓✓ (Allow 2 sf or more) Allow **ECF** 1 mark can be awarded for: (Decrease in length per cm drawn found =) $\frac{\text{change in length (ans to 02.5 – ans to 02.4)}}{20 \times 25} = 2.8 \times 10^{-3}$ Or $\frac{\text{half pencil length (ans to 02.4} \div 2)}{\text{change in length (ans to 0.25 - ans to 0.24)}}$	One of these correct answers without working obtains two marks. ECF must be supported by appropriate working Allow ecf from answers to 02.4 and 02.5, condone any power of 10 errors on intermediate working seen	2

Practical skills assessment – Physics Paper 1

0 2 **Figure 1** shows an arrangement used by a student to investigate vibrations in a stretched nylon string of fixed length l. He measures how the frequency f of first-harmonic vibrations for the string varies with the mass m suspended from it.

Figure 1

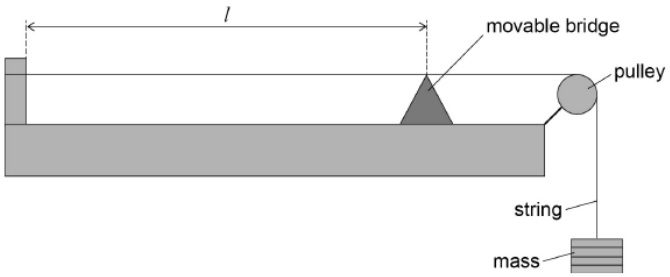


Table 1 shows the results of the experiment.

Table 1

m / kg	f / Hz
0.50	110
0.80	140
1.20	170

0 2 . 1 Show that the data in **Table 1** are consistent with the relationship

$$f \propto \sqrt{T}$$

where T is the tension in the nylon string.

[2 marks]

Practical skills assessment – Physics Paper 1

Q2.1

- **N/A – 2.1%**
- **0 marks – 43.2%**
- **1 marks – 21.5%**
- **2 marks – 33.2%**

02.1	EITHER calculate value for constant using two calculations✓ calculate value for constant using three calculations and make a comment that they have same value✓ OR calculate ratio between masses and √T for one pair of values✓ calculate ratio between masses and √T for two pair of values and make comment about same value✓ OR work out constant and use to predict one other frequency or mass✓ work out constant and use to predict two other frequencies or mass✓	need to see table to look for any working e.g. 0.5/0.8 = √110/√140 no comment needed with this alternative	2

Practical skills assessment – Physics Paper 1

Q2.2

- **N/A – 1.4%**
- **0 marks – 47.3%**
- **1 marks – 17.3%**
- **2 marks – 3.4%**
- **3 marks – 30.7%**

0 2 . 2 The nylon string used has a density of 1150 $\mathrm{kg\ m^{-3}}$ and a uniform diameter of 5.0×10^{-4} m.

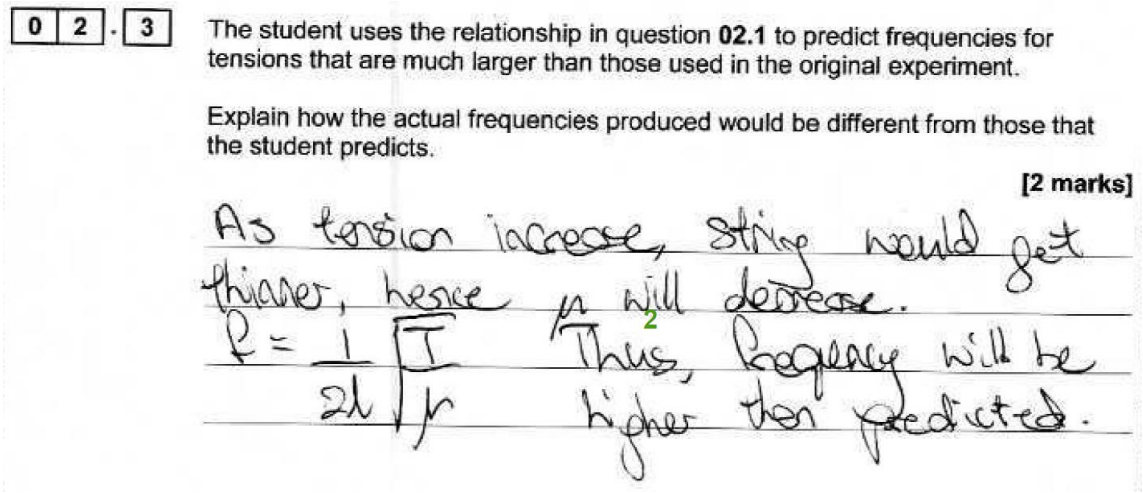
Determine the length l of the string used.

[3 marks]

02.2	$\mu = \rho A = 1150 \times \pi(5.0 \times 10^{-4}/2)^2$ $\mu = 2.258 \times 10^{-4}$ (kg m^{-1})✓ use of consistent m and f Substituted in $f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$ including g but condone powers of 10 error✓ 0.67 m✓	 Award second mark if T and f substituted correctly (ignore μ) If used diameter for radius incorrectly then lose first mark but can get third mark (answer 0.335 m)	3

Practical skills assessment – Physics Paper 1

- **N/A – 7.1%**
- **0 marks – 82.8%**
- **1 marks – 7.4%**
- **2 marks – 2.7%**



0 2 . 3 The student uses the relationship in question **02.1** to predict frequencies for tensions that are much larger than those used in the original experiment.

Explain how the actual frequencies produced would be different from those that the student predicts.

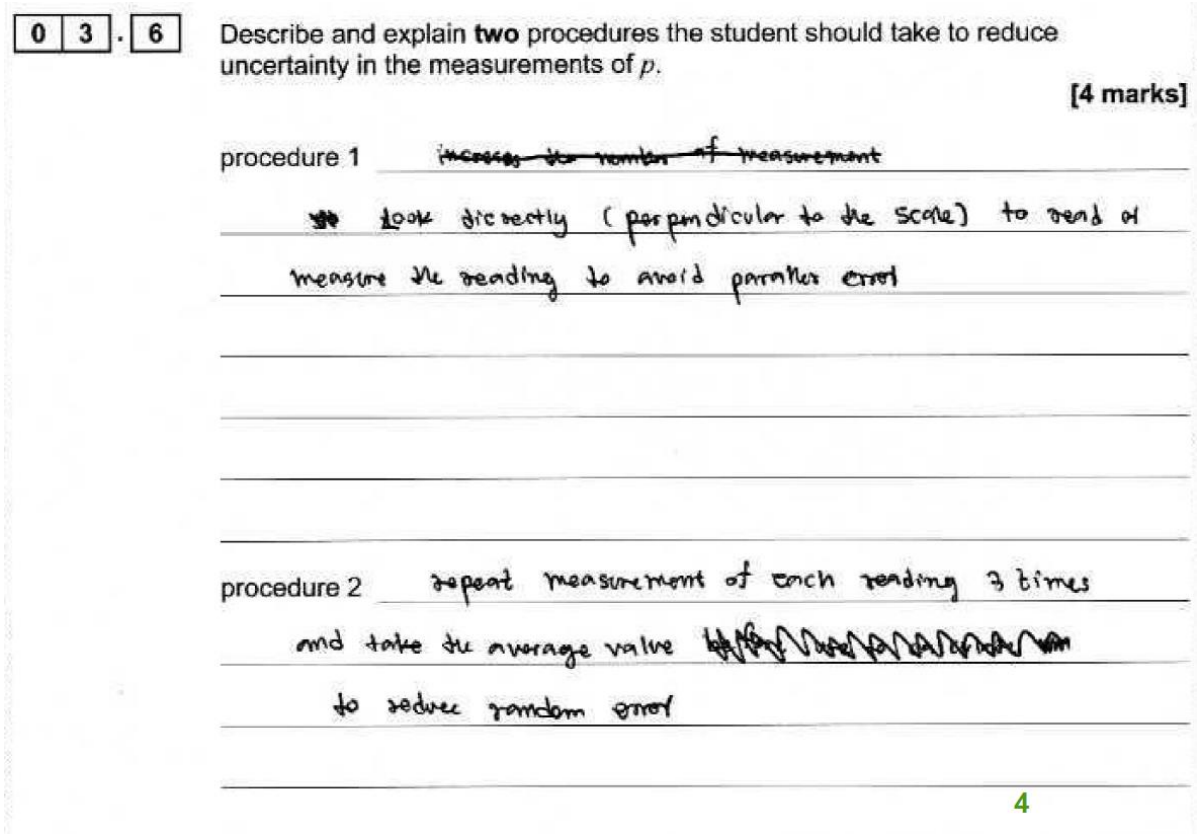
[2 marks]

As tension increase, string would get thiner, hence μ will decrease.
$f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$ Thus, frequency will be higher than predicted.
2

02.3	appreciation of reducing diameter when string is stretched.✓		2
	lower mass per unit length so (constant of proportionality and hence) frequency is higher (than would be predicted)✓		

Practical skills assessment – Physics Paper 3A

- **N/A – 2.7%**
- **0 marks – 37.4%**
- **1 marks – 31.7%**
- **2 marks – 20%**
- **3 marks – 5.7%**
- **4 marks – 2.5%**



0 3 . 6 Describe and explain **two** procedures the student should take to reduce uncertainty in the measurements of p.

[4 marks]

procedure 1 ~~increase the number of measurement~~

look directly (perpendicular to the scale) to read of measure the reading to avoid parallax error

procedure 2 repeat measurement of each reading 3 times and take the average value to reduce random error

4

Practical questions at A-level

Suggested student worksheets in the practical handbooks

- How would you improve or add to the questions?
- How do you bring the RPs into your teaching?
- How do you bring the ATs into your teaching?
- What applications and calculations could potentially be used with each RP?
- How would you set up application questions so that students that have done the practical can apply their knowledge?

How did we do?

- Please rate this session on the **Sched Conference app**.

- Using the post-its provided, please write:
  - one thing you enjoyed about our session or will take away for your teaching
  - one thing you feel could be improved.
- Stick these on the feedback poster as you leave.

Get in touch

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Thank you