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Shipley College

LEEDS CITY COLLEGE

Does semantics in Mathematics affect attainment of GCSE resit learners?

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About CfEM

Centres for Excellence in Maths (CfEM) is a five-year national improvement programme aimed at delivering sustained improvements in maths outcomes for 16–19-year-olds, up to Level 2, in post-16 settings.

Funded by the Department for Education and delivered by the Education and Training Foundation, the programme is exploring what works for teachers and students, embedding related CPD and good practice, and building networks of maths professionals in colleges.

Summary

This report includes the method, results and recommendations of the Shipley College and Leeds City College action research project. Over the past couple of years when marking exams, as part of the centre assessed and teacher assessed grades, I had noticed that my learners were making mistakes on questions I was confident they were able to do. I came to the conclusion that the learners were struggling with language itself. In particular, establishing what is being asked of them. As such I decided to create a set of interventions that could address this.

The project was designed to test whether working on the language used in GCSE mathematics could improve attainment in 16-19 year old resit learners. Five action research teachers, including myself, selected 10 classes for a total of 65 learners from entry level 3 to level 2 vocational courses. Each maths exam board has a list of command words that are the keywords that will come up in the exam; ten of these words were selected to be used in the project.

The intervention was split into two cycles; cycle 1 ran from December to February and cycle 2 ran from March to May 2022. A mixture of quantitative and qualitative data was collected from both cycles.

Cycle 1 involved three matching activities based on the definitions of the selected command words to see if recall can be improved through repeated exposure. The second part of cycle 1 was concerned with applying what was learnt about the words to questions that involve the command words.

Cycle 2 involved an online google form on identifying the correct definition for each of the words, followed by in class tasks based on the words to improve application. Student and staff interviews were then held to establish the effectiveness of the interventions. Participants were then asked to answer past exam questions involving the words and finally a google form was attempted to assess the learners progress in understanding the words.

Quantitative data was collected from the matching tasks in cycle 1 and from the two google forms at the beginning and end of cycle 2 to see any improvements. Qualitative data was collected from staff and student interviews to provide depth to the findings.

It was found that repeated exposure to command words and their definitions does improve recall in resit learners. However, in order for it to be most effective, there must be the ability for the learners to apply the understanding they have gained of the words to actual maths questions to bolster understanding. This implies that if vocabulary work can be incorporated throughout the year as part of regular maths lessons, it will have a positive effect on learner attainment.

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Background

Introduction

Shipley College completed this project in conjunction with Leeds City College as one of their network partners. Shipley College is a small college located in Saltaire, Bradford. We have approximately 2500 learners undertaking various courses and approximately 350 GCSE maths enrolments. Learners undertake English and Maths from entry level 2 to GCSE alongside their vocational courses depending on ability; the learners will complete functional skills maths entry level 2 and 3 if they have no other qualifications. At Shipley College, maths is mainly taught to learners on 16-19 full time courses, but it also offers functional skills to adults and core maths to those who want to further their maths studies. Contact time for English and Maths is 3 hours per week, split into two hour and a half sessions.

As a college we regularly undertake CPD through CfEM and are engaged in research and delivery of maths mastery. We have assisted Leeds City College in action research data collection over the past 2 years and had the opportunity this year to undertake this research project in partnership with Leeds City College.

The past couple of years were unprecedented with formal exams not going ahead; the use of centre and teacher assessed grades are where our current learners' grades have come from. This year will be the first time some learners are sitting a formal examination. As such it highlights the need and importance of undertaking research into how we, the teachers, can develop our practice and understanding to improve the attainment of resit learners. Last year's national pass rate for grade 5 and above was 51.9%, which was an increase of 8.7% from the 2019 exams (Gov.uk, 2021). This shows that, on the whole, the country seemed to have more success in the pandemic years. However, due to these grades being decided by the institutions and not in a formal examination situation, the learners will need extra training on how to tackle an exam. This coupled with education taking place online for two years, means that this year's cohort are at a disadvantage compared to previous years; maths mastery is especially important for these learners as they have gaps in knowledge that aren’t immediately visible. This highlights the need for this research further; what can we do to better prepare our learners and encourage understanding?

Shipley College

At Shipley College we strive to provide an institution that encourages success and supports the needs of our learners. Shipley College is quite a small institution and has been active since 1969 as a college, located in the world heritage site of Saltaire.

The college has four main core values: inspirational culture of collaboration and partnership, aspiration, professionalism and achievement, responsiveness and equality and respect. These values underpin what we do at Shipley College and provide a great setting for our learners to succeed.

Shipley College’s demographic comes from inner-city Bradford and surrounding areas and as such students come from a variety of backgrounds and are of various ages. We also tend to get many learners that have not had the greatest educational experience or have not been in mainstream education for many years, which can mean they haven’t spent much time in a classroom setting; we aim to enthuse an interest in learning in these learners and

strive to help them get a step up into the career they would like to follow. We also have a dedicated essential skills department that provides a starting point for those that need extra support due to SEN needs or need a place to begin their educational journey.

As a maths department, we teach GCSE across all of the sectors; we have classes of learners on entry level 3 courses as well as those undertaking their level 3 vocational subjects with university in mind. In order for us to provide the best service to our learners, we ensure that we are constantly developing our own practice and finding new ways to motivate and engage our learners whilst teaching them the understanding they require.

Research Aim

As a teacher, I have taught both GCSE Maths and English and have always found it fascinating when learners are quite passionately declaring that they dislike maths or prefer English. It always seems to be maths that is disliked the most. This highlights an attitude towards the topic that will be a barrier before they even begin to learn.

Both topics are quite different in many ways, however this made me think about the ways in which they are the same and how each subject could support the other. One of the similarities between them is that of language; maths is a sort of language in itself, but uses the English language to establish what is being asked of the learner. This made me think back to when I was marking the centre and teacher assessed grades of the previous years; learners were making mistakes on questions that I was confident that they knew quite well. I noticed that it was the actual question itself that was causing them to falter; their literacy ability is being tested as opposed to just their mathematical knowledge alone. There is a tendency in my lower level learners that if they have low maths attainment, then they also have low literacy levels, which further shows that the barriers to learning may not just be mathematical method related. The thought process was that if the learners can recognise key mathematical words in an exam, then they will be better equipped to establish what is being asked of them and have more confidence in answering the question. The literacy we were testing was specifically maths command word: a list of keywords that each exam board provides, that identifies which maths centric words will be presented in the exam. We use AQA as an exam board, so the words were chosen from their list of command words. There are only slight differences between words used between exam boards and this research is therefore relevant for any of them. The choice was made to only use AQA words as these are the specific words that the learners would come across in the exam.

At Shipley College, the Maths team consists of 9 teachers, 5 of which (including myself) were involved in the project. As a group we planned and executed the research cycles collecting results. Each of the participating teachers had groups from different areas of the college, so would be able to see if the research topic affects those on higher level courses as well as the lower ones. By the end of the project we were aiming to see if we could improve understanding and attainment through repeated exposure to the language used in maths.

Literature Review

1. Introduction

Maths is a subject that requires a vast array of skills to be acquired and large amounts of information to be retained and then applied in an exam situation. Learning the skills required is a major part of having success in the exam, but the actual understanding of the topics themselves is, in itself, more important than just remembering the methods. Maths mastery aims to put the focus on understanding rather than just remembering information and it is through this that the project will aim to improve attainment through the improvement of vocabulary related to key terms and definitions found in the GCSE Maths exam.

Over the past couple of years education has had to adapt quickly to changing situations due to the global pandemic; with this there have been many difficulties that have had a detrimental effect on the learners themselves. According to an Ofqual study, mathematical attainment has dropped to the same level it was in 2017 when the new style of exams were introduced (Lough 2021). This presents a greater need for ways to improve attainment than in previous years and highlights the impact the pandemic has had on maths education.

This review will be split into three sections:

- Research Question Background
- Maths and Language
- Conclusions

2. Research Question Background

Through my experience as a Maths teacher and experiences of undertaking centre assessed and teacher assessed grades over the past couple of years, I have noticed there are other factors that affect success alongside just maths expertise. Whilst marking my learners' exam papers I found that many of them were missing out on marks due to their understanding of the language used in the questions; they knew the correct method but did not use it as they could not establish what the question was asking them to do. This informed my research question formation. I decided to focus on improving vocabulary to see if this can boost the success of my GCSE resit learners.

Maths vocabulary can be split into three main areas: technical, specialist and everyday. "Technical" refers to specific terms only used in maths like 'equilateral'. "Specialist" terms are words which have a certain meaning in maths like 'factor' and covers words that have a different meaning in maths than they do in everyday life (Barwell 2011). This highlights the difficulty when it comes to the semantics of maths; students have to learn mathematical terms whilst also attempting to attach different meanings to certain words on a situational basis.

This was examined in the research of Newham College over the last two years action research projects; Newham College undertook research into how language affects attainment in ESOL learners who are taking GCSE Maths through the use of keyword specific interventions (Rahman et al 2021). They developed a list of keywords related to the part of the scheme of work they were currently using, which was algebra and geometry. The words chosen were created from the Pearson command words, National Centre for

Excellence in the Teaching of Mathematics and through personal choice related to their learners

Through examining their projects, I decided to base my word choice for my first research cycle on ten of the Pearson Command words that I felt were most misunderstood by my learners (none of the chosen words are the same as the ones chosen by Newham College). I chose AQA as this is the exam board that Shipley college uses for GCSE Mathematics, so the words are relevant to the exam that will be sat in June.

The participants in Newham College's projects were mainly ESOL learners, but they did use some non-ESOL learners as they thought it would be of benefit to them also. I chose to involve learners who are all aiming for a grade 4, but come from a variety of educational backgrounds and have varying abilities when it comes to Mathematics. I did this to enable an insight into the experiences and abilities of all demographics and how previous experience may affect maths attainment.

2.1 Maths and Language

Maths is a subject in which there are multiple skills that have to be employed to gain success. There is the mathematical understanding of the topic, the ability to apply it and the level of literacy required to extract the method required. The literacy required is where many problems arise. Palmer (2019) highlights three main areas in which literacy causes issues in mathematical learning: application of vocabulary strategies to word problems, wider vocabulary understanding and variation in language used by different teachers. All three of these present problems with language understanding; the first being a problem with the understanding of the syntax of a question, two questions may be phrased differently, but be asking the same thing. The second difficulty, according to Palmer (2019), is that the breadth of regular language used in maths relies on understanding that the learner may not have, thus holding them back due to their own understanding of the English language rather than their understanding of words specific to maths.

Language variation can also be of detriment in this type of situation as language in maths can take a somewhat synonymous nature; 'multiply' can mean 'product of' or 'times'. There are more synonyms of a singular method the higher the level in which the maths is being taught. So not only are the learners attempting to learn a topic, they are also having to attach multiple words to one meaning. The third language difficulty is directly linked to an individual's literacy level and is where I am going to be basing my research. A common question which has shown this is being asked to provide a 'criticism' of an example graph or table; I knew that my learners could spot what was wrong with the example, but many of them could not answer the question due to not knowing what 'criticism' meant. These language issues become especially prevalent when learners encounter problem solving tasks. NCTM (2000) states that problem solving is a task in which the method is not known in advance, which in the context of literacy, would create great difficulty in establishing what a question is asking a learner to do.

As Bay-Williams et al (2009) states: "Nearly all mathematics lessons include concepts that students have previously learned. This prior knowledge and its related vocabulary are essential to building new mathematical concepts".This reflects in the difficulties learners have with language; in order to attain the vocabulary understanding and build upon it, there must be a basis to build upon. Each topic has terms and skills that rely on previous knowledge, so if there are gaps in understanding, then there will be problems in being able to make the connection between how a specific language will relate to a method.

As stated earlier, Newham College undertook their research in relation to ESOL learners where English is a second language, however they also included non-ESOL learners too so they could examine the difference in attainment; they found that the interventions they ran had benefit to both groups of learners (Rahman et al 2021). This finding highlights that maths vocabulary acquisition is a problem for learners that have English as their first language also. Literacy levels have a direct correlation to maths success (Beal et al 2010); learners with higher reading levels do better in maths tests. I will also be looking at this relationship in my research; participants are to state their English target as well as their maths to examine how this relates to vocabulary understanding.

When looking at the relationship between English and maths, it is easy to draw conclusions that when English reading skills are higher, maths results will be, but this doesn't take into account misconceptions. Beckett (2011) speaks about error patterns; common mistakes where learners apply what they know about one topic to another, for example using the same process for multiplying fractions when dividing them. The misconceptions were then practised multiple times to see if they could be improved. It was found that repeated exposure to these problems and practice enabled the learners to stop making the mistakes. The same could be applied to maths language; repeated exposure to the terms and practice with them in context specific environments could enable the learners to embed the knowledge.

Lesham and Markovitz (2013) undertook a small study involving looking at the similarities between English and maths through interviews with teachers. They were presenting mathematics as a language in itself and trying to establish the teacher's views on how the subjects relate. They found that there were common views that they are both distinctly different subjects, however after the interviews had been concluded the teachers were starting to think along the lines of how collaboration could benefit their own subject. This thought process of looking at maths in a similar light as English could have great applications for the action research question; I teach both and hear from my learners that one is better than the other, so by blurring the lines between them being completely different things, then each subject could support the other. This study did have a very small sample size so may not be representative of the greater population, but in terms of improving literacy in maths could help improve it. As I have stated previously, exposure or experience with a term may improve recall when required.

3. Conclusions

Finding ways in which to improve results in resit learners is especially important as the last couple of years have had a detrimental effect on the outcomes of GCSE maths learners. As Riccomini (2015) states "Students' mathematical vocabulary learning is a very important part of their language development and ultimately mathematical proficiency".

Through examining the literature, I have decided that the research project going forward will have a focus on both the key terms that are Maths specific and also include ubiquitous terms that are commonly misinterpreted. The first cycle of the research project involved the learners practising with 10 key words from the AQA maths command words list over the course of four weeks; they will have questions involving the specific words in the first and the last week to see if they have made an improvement; in between they will be practising the terms using match up activities including definitions. Words that are misunderstood consistently will be carried over into the second cycle and words that the learners have great success with will be replaced.

Methods

Research Design

The research was split into two cycles spread across the academic year. The decision was made to only run two cycles as opposed to three to give more time for data collection and address any absentees or other issues. Both quantitative and qualitative data was collected to ensure we had detailed quality data to analyse.

Cycle 1 consisted of establishing a starting point for the learners (a survey) and then the collection of iterative quantitative data; this cycle was designed to specifically test whether or not repeated exposure to a command word could help with recall when presented with a question involving said word. The tasks were designed to focus on the word definition to begin with before introducing tasks involving said words. The findings from the first cycle informed how we implemented cycle 2. Cycle 1 was designed to highlight the need for research and explore whether or not repeated exposure to a word improves recall in a preliminary form. Two questions were used as a basis for this cycle - does the method work and are the learners gaining anything from it?

In between the cycles, the action research group met to discuss successes and challenges of the first cycle and what amends we would need to do before commencing the second cycle.

Cycle 2 was implemented in a different way from what we had found in cycle 1; the format of the tasks was changed to make the experience more user friendly. The collection methods of cycle 2 involved both quantitative and qualitative data, with an emphasis on collecting more qualitative data. In this cycle the data was collected in a more natural way; instead of repeated tasks in which the learners were doing the same thing over time, we decided to let the teachers themselves work the tasks into their lessons where they saw fit. This was done to encourage language work in maths as a normal part of a lesson, rather than as a separate entity. We interviewed the teachers and learners involved to get their perspectives on the project and the teachers also recorded their own reflections on how the cycle was progressing as they are the best judges of effectiveness as they know their learners the best.

Ethical considerations

All involved participants signed a consent form as part of their initial survey and were aware of how their data would be used. This was not a compulsory project so the learners had the choice to take part or not. Nothing was asked of the learners about their lives outside of their name, knowing their previous English and maths grades and what course they are on. Names have been taken off interview transcripts to provide anonymity and any quotes that are used have a denotation of Student or Teacher followed by a letter. None of the named data collected will be used outside the organisation.

Barriers

The learners that have taken part in this project have spent the last two years learning online and have not sat a formal exam in that time. Some may not have ever sat a GCSE examination. This has been a barrier to their learning as it has left many with gaps in knowledge that would have been really hard to identify during online teaching unless identified through a task or by the learner themselves. Another barrier that has been

prevalent this year is the learner experience of a classroom; being used to being by yourself learning on a screen is completely different than being in a class full of peers. As such some learners have found it difficult to return to a classroom situation. There are many anxieties involved with being back face to face in college and with sitting a formal exam. This year's cohort have had a lot to deal with on top of trying to succeed at college and this has been prevalent through the research project.

Research Objectives

These objectives are the four aims are what we are going to achieve with this project:

- **RO1** To research previous literature related to language and mathematics to see what methodologies have been trialled and how attainment has been improved.
- **RO2** To analyse whether or not language practice boosts attainment through repeated use of command words.
- **RO3** To create and implement a set of questions that develop understanding of maths command words.
- **RO4** To analyse and share findings to inform future schemes of work.

Results and Discussion

Intervention

This research project was split into two cycles, each designed to test the theory of whether vocabulary work can improve attainment in GCSE resit learners.

Five teachers including myself picked the classes we wanted to run the project with; a mixture of entry level 3, level 1 and level 2 classes were picked as we decided that it tends to be the lower levels that have more difficulty with literacy. We included level 2 groups to see if the problem does extend to higher level learners. Altogether we had 10 classes consisting of 65 learners.

Once the question had been created and as an action research group we knew what we were testing, we planned how we could specifically see how continued practice of words can improve recall. From the AQA list of command words used in their exams we picked 10 words that we felt, as teachers, are commonly misunderstood; the words that were picked all had specialist mathematical definitions, but some also had meanings outside of maths. The chosen command words were:

- Compare
- Calculate
- Simplify
- Product
- Factorise
- Estimate
- Describe
- Significant
- Sensible
- Plot

All of the first cycle tasks were designed around these words. We decided that the first cycle needed to have focus on the specific definitions to get the learners used to the words and see if they have any success with recall.

We created an initial short survey in order to gain learners' consent to participating in the project, as well as to gather background information to form a starting point (see appendix 1). This contained questions about previous grades as well as how the learners attempt exam papers.

After the survey, we created three sets of matching activities, in which learners matched the correct definition to the correct word. The three sets contained the same words and definitions, but in a different order each time to prevent rote learning. This ran over three weeks, with the task being used as a starter or a plenary (see appendix 2). The learners would mark their score out of 10 each week and it would be recorded to see if there was any improvement in their recall of the definitions.

To further aid learning, following the final match up activity, learners were provided with a glossary, providing clear definitions as well as example questions where the words were used in the correct context (see appendix 3). In the same session, they were provided with a worksheet where they were asked to explain how to answer the question, rather than finding the solution (see appendix 4). This was to see if they could demonstrateunderstanding of the

words and whether or not the repeated exposure could yield an interpretation that is internalised and conceptualised.

The final part of this cycle was completed in the 6th week, a week after the explanation questions (appendix 4). This task was a collection of questions that involved the words and they were asked to answer them properly (see appendix 5). They did have use of the definition sheet to support them and marked the questions in class.

After this task had been completed the action research group met to discuss the strength and challenges of the first cycle. From the first cycle, data was collected from the matching activities and initial survey, which was then analysed to see if there had been any improvement. During this analysis it became clear that the matching tasks needed to be amended as using a paper based activity created difficulty in establishing what the learners had matched together and was rather messy. The suggested amendments to this task are in the recommendations later in this report. There was also the consensus that the command word list needed amending as some of the words were not as misunderstood as we thought when it came to the learners answering questions involving them. Three of the words were changed: compare, plot and calculate were changed to translate, rearrange and expand. These were changed as we felt that the three new words were much more misunderstood; also we noticed that even if the learners could not match the definitions to compare, plot and calculate, they could answer questions involving the words as they are quite self explanatory. For example, the visual nature of a graph meant that the learners could plot points on the graph without necessarily truly understanding the word plot.

With cycle 1 involving purely quantitative research, we had decided that we wanted more qualitative data from cycle 2. The format of the cycle was also changed. We digitised all of the tasks as the learners seemed most comfortable with online tasks; we discussed this and it seems that due to this year's cohort having spent the last two years learning online, it has become a platform the learners are most comfortable using.

Cycle 2 was split into three main sections in which we wanted to connect the knowledge the learners had acquired of the words and let them apply to answering a question; more of a focus on connecting definitions with understanding.

A self marking google form was created in which three slightly differing definitions was presented and the learner had to pick the correct response (see appendix 6); data was collected from this task to provide a starting point for cycle 2.

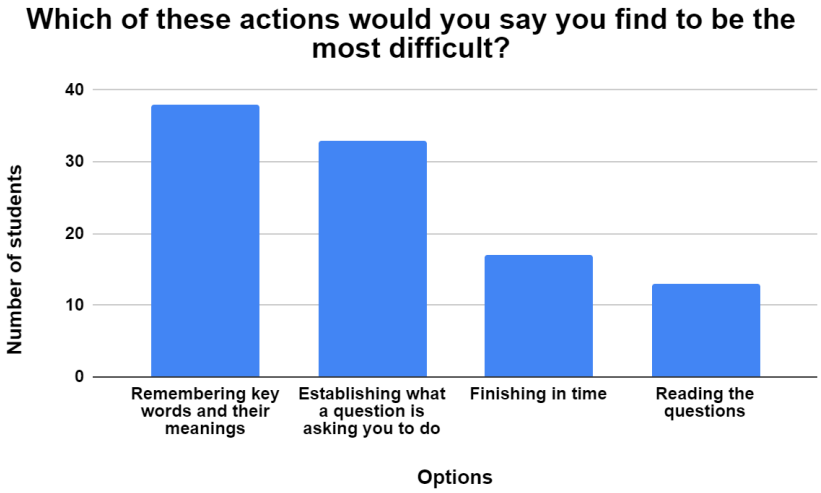
For the second part of cycle 2 we wanted the tasks to become more of a natural part of the lesson instead of a dedicated task. We decided to give each teacher the freedom to use the words as they saw fit in the lesson; they know their learners the best and know what way to present the tasks that would fit the class the best. We shared resources but used them as we saw fit. We collected the resources from a variety of sources; they came from CorbettMaths, MathsWatch, Exampro and Mathsbot. We chose these websites as they provide a fantastic variety of tasks, but also are used widely in classrooms across the country so are available to anyone that wants to recreate this project with their learners.

This ran over a three week period in which the action research group incorporated tasks involving the words into their lessons and then reflected on the successes and challenges their learners experienced. After these three weeks, the learners were given a definition sheet with a collection of questions from the sources we had been using in class (see appendix 7). These questions were selected based on them being good examples of the word in action and were not particularly challenging; we didn’t want the learners to lose

confidence as their mathematical ability is not what was being tested. We marked these in class together so the learners could identify where they may have made errors. This task ran over one week and was attempted in either one or both maths sessions of that week. In the week following the learners were presented with a set of questions taken directly from Exampro as we wanted the learners to have experience of the format of questions they would come across in the exam (see appendix 8). This task also ran for one week and was marked in class as a group. Data was not taken from these tasks as they were tasks to build knowledge and confidence ahead of the next task.

During this time the participating staff and learners were interviewed about the project to collect qualitative data based on their experiences so far (see appendix 9). After the completion of the interviews and exam style questions, the learners had one final task. This task was created to ask the learners about their own confidence levels and understanding in answering questions involving the command words (see appendix 10). The task incorporated all of the words that had been tested throughout cycle 1 and 2. It also contained questions on how useful the learners have found the tasks and whether they think that working on the definitions has been beneficial. The data from this task was compared to the first definition based google form from the start of cycle 2, to see if there has been an improvement in their understanding. The action research group then met to analyse the findings and draw conclusions from both of the cycles.

Pre-Intervention Student Questionnaire



The bar chart above shows the findings from the initial survey from the beginning of cycle 1. As you can see, the most significant difficulties identified by the learners was remembering the keywords and their meanings and establishing what is being asked of them. This highlights that this project has identified an area in which the learners themselves feel they need to work on and further supports the idea that literacy is tied to understanding of mathematical concepts.

Post-Intervention Data Analysis of Keywords

Cycle 1

Figure 1 below shows the results from the match up activities completed in cycle 1 (appendix 2). The two columns in the middle show the correct responses from match up task 1 compared to those from match up task 3. They have been listed by number of correct responses to show which words showed the most success. The percentage column represents the percentage increase from the first task to the final task. For example, 21 learners correctly matched sensible to its definition on the first task and 40 learners were correct on the final task, which means there has been a 90.48% increase in the amount of learners identifying the correct definition.

Understanding was also checked on a verbal basis in class; learners were asked why they chose a particular definition to see if they could explain why they had made that choice. This was done to prevent learners from just guessing each definition.

Key Word	Score on initial task	Score on final task	% Increase
Sensible	**21**	**40**	**90.48%**
Compare	**27**	**45**	**66.67%**
Simplify	**29**	**45**	**55.17%**
Calculate	**39**	**55**	**41.03%**
Product	**23**	**32**	**39.13%**
Factorise	**34**	**42**	**23.53%**
Plot	**36**	**44**	**22.22%**
Significant figures	**34**	**38**	**11.76%**
Describe	**36**	**37**	**2.78%**
Estimate	**37**	**38**	**2.70%**

Figure 1

As you can see the most success was with sensible, compare and simplify. After discussion, we decided that the most success was had with these words as their definitions are very similar elsewhere outside of a maths setting. In particular, compare and calculate have the same definition in an everyday meaning as well as in as a specialist maths word (Barwell 2011). Simplify has the same definition in the sense that it is to make something simple.

All the words showed an increase in attainment from the first to the last task, which presents the fact that repeated exposure does indeed improve recollection. The smallest increase was from describe and estimate; both of these words have very specific meanings in mathematics and also only come up in relation to a few topics, so do not appear as regularly as a word like simplify, which is apparent in many topics.

The decision of changing three of the words for cycle 2 was based on the action research group's experience of the learners answering questions involving the words plot, compare and calculate; the learners had great success with them when presented with a question.

Cycle 2

Key word	Score on initial task	Score on final task	% increase
Describe	**15**	**51**	**240.00%**
Rearrange	**14**	**44**	**214.29%**
Significant figures	**15**	**44**	**193.33%**
Sensible	**17**	**44**	**158.82%**
Simplify	**26**	**53**	**103.85%**
Factorise	**19**	**38**	**100.00%**
Estimate	**29**	**49**	**68.97%**
Translate	**24**	**40**	**66.67%**
Expand	**38**	**53**	**39.47%**
Product	**32**	**40**	**25.00%**

Figure 2

Figure 2 shows the results of the data collected from cycle 2. The initial task in the second column comes from the correct responses on the definition google form that was completed at the beginning of cycle 2 (appendix 6). The final task score in the third column is from the final google form given to the learners at the end of cycle 2 (appendix 10). Again, as with cycle 1, the percentage increase is shown in the final column and is the difference between the amount of participants that identified the correct answer. As you can see from the table below, there were much larger increases in understanding between the first task and the last.

What was interesting about this is the words that scored the highest. There was a completely different order to the success of each word. The biggest surprise was with describe; it ranked as one of the smallest percentage increases in the first cycle, yet was the most improved in cycle 2. This didn't seem to make sense when describe was shown to prove difficult for most to establish what is being asked of them. However, the learners had been answering questions and doing work on the definitions of describe for the whole of cycle 1. This highlighted to us that the learners had begun to conceptualise describe in a mathematical sense instead of the definition outside of maths. This also shows us that the repeated use of the word and its definition had a positive effect on recall and understanding in the learners.

All of the words had a positive increase between the first and last task. This increase however is relative to them understanding the definitions of the words and being more confident in dealing with the definitions; neither of the tasks asked them to answer a question involving the words as this was done as part of their classwork. However, it does show that the work they have done in class on tasks involving the words has had a positive influence on learner recall; the percentage were much higher in cycle 2 and cycle 2 involved the learners answering questions in between the first and last google form.

Staff and Student Interviews

Confidence with keywords

During cycle 2, the students were asked whether they felt more confident about any of the keywords used in the project. Nearly every learner interviewed confirmed that they had felt an increase in confidence about the keywords, with the most commonly identified being simplify, describe and estimate. The table below shows typical quotes regarding progression with this.

Student T	"Yes, I know how to do all of them now. I used to struggle with estimate but I can do that now."
Student R	"I think I know how to do the simplify ones now… I think I can expand as well. I think I can translate. The factorise one I need to do more work on. But I think I need more practice on them all really."

Figure 3

The teachers likewise reflected on which words the students have increased confidence in using. Teacher C advised "I noticed the most progress with simplify, expand, estimate and significant figure". However, it is worth noting that although progress has been made, learners still struggle with some of the keywords from the project. In the interviews, the students identified significant figure, estimate, and rearrange as the words they still had difficulty with. Therefore although Teacher C identified two of these words as those that had made the most progress, further intervention is required to increase the learners' understanding of them.

Preference of task

17 of the 23 learners interviewed stated that they preferred the matching card activity, suggesting that they prefer to use paper resources or that it was easier to complete than an online form. The teachers' opinion was a little more divided. Teacher A commented that she worried that learners rushed' through the match up task, whereas teacher B detailed the advantages of the google form:

> "I found that the multiple choice questions on google forms were the most effective. I am unsure if this is because they have had a lot of experience with this format due to online teaching or if there is less pressure on making a mistake; they can easily change an online answer compared with writing something on paper [...] The online tasks can also be set as homework for the next session more easily."

Continuation with project

Of the 22 students who were interviewed, 21 respondents supported the continuation of the intervention within their maths sessions:

Student W	Yes, it makes me understand when it comes to the exam what I need to do. It comes to you more naturally when you've focussed on it.
Student C	Yes, that would really help. It helps me understand exactly what it means and how to answer the questions.

Figure 4

The interviews with the teachers indicated the positive impact the intervention had had on their own teaching practice and the increased word knowledge of their students.

Teacher A	I think it has just made me very aware of this gap in my students' knowledge and made me determined to address it. I have realised how carefully I need to structure my sentences and lessons so they can recall the correct use for each terminology.
Teacher C	I did notice a real difference between the participating and nonparticipating groups. I found that when the keywords were presented to the non participants as part of their normal class tasks, they were only able to do the tasks after the teaching, then when revisited were unable to identify what to do as it had been a while since they had last had contact with the word

Figure 5

Teachers also gave suggestions for adaptations to the interventions for a future trial. Teacher C commented, 'I would vary the tasks much more to ensure the learners gain confidence when presented with keywords in multiple formats'. Other suggestions from teachers included cutting up the match-up card activities or using interactive games.

Conclusions and Recommendations

Conclusions

- There was an overall improvement in learner understanding of the keywords, however some of the keywords still proved difficult for some; more data would need to be collected to assess the improvement on these particular words.
- A clear improvement was shown with the words sensible, describe and simplify; most learners were able to correctly state definitions and apply to an example exam question. It was shown however that some learners could identify the correct meaning, but stated they would not be able to apply to an actual question. This shows a need for practical application of the meanings as opposed to just conceptualising the words.
- Significant, translate and factorise showed the least improvement overall. Estimate showed good improvement in the first cycle, but was a word that learners said they know the meaning of, but cannot complete a question involving. This highlights the need for application based tasks as well as word definitions.
- Estimate, although improved from the start of the project and there is some data to show increased confidence (question 5 student interview and question 6 teacher interview), evidence suggests that this is a word of contention for a lot of learners and would benefit from further intervention.
- The learners indicated they preferred exam style question practice involving the words, with the match up activity being the least popular. However, during the interviews it was indicated that the learners did like match up activities and the teachers said they would use these types of physical tasks in future. This could be due to the actual task I used in the intervention; the learners did not like the way I had presented it, but would find kinesthetic tasks useful.

- There is a noticeable difference in the improvements seen between cycle 1 and cycle 2; cycle 2s Google form and exam question based activities yielded a higher success rate than those from cycle 1. From this it shows that presenting the keywords in multiple formats has a greater success rate than just using one set task in session.
- Overall success with most learners, some words still found to be difficult by some learners. This could be due to their personal preference and skill. More data needed to be collected to truly test this theory.

Recommendations

- From what was found, it is recommended that the words chosen for intervention would benefit from being words which come up in only a few topics in maths as the learners would not come across them often or words that have specific meanings in a maths context that differ from their everyday meaning, for example ‘describe’ or ‘translate’. The results showed that continuous exposure to ‘describe’ yielded conceptualisation in the learners.
- The intervention should focus on only one of these types of words; using both common and specialist terms in the same intervention prevents depth from being achieved with either word type. The intervention should have focus of working on common phrases in a maths context or specific words that do not appear regularly throughout the maths topics.
- Tasks that had the most impact were the matching activities and the application exam questions. The matching activities need to be amended however as due to their design they provided too many opportunities for the learner to misunderstand where on the page the matching should be done and did not allow for mistakes. For the task to be more effective it would benefit from becoming a kinesthetic task that can be freely manipulated until the learner is happy with their answers. An example of this could be cut out words and definitions that could be placed in the correct order.
- Further research would be needed on measuring the impact of learners' exposure to words that have meanings that are different outside of a maths classroom. Learners found confusion when presented with more commonly used words, like ’compare’ or ‘describe’, when used in multiple contexts. Collaboration between english, maths and vocational topics on what commonly used words mean in each context would be beneficial. It would strive to address confusion between the settings in which the words are used.
- The sample size would need to be increased to truly test the validity of the results; we only had a sample of 65 learners so to see if this actually has an impact we would need a much larger group of participants.
- This project would benefit from being implemented with learners at level 3 as well as lower levels. This would test whether higher level learners experience the same difficulties as an entry 3 learner. The lower levels tend to have more difficulty with literacy.

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Appendix/Appendices

1. Cycle 1 Initial Survey

Student Survey for Action Research

By completing this survey, you are agreeing to the following:

Shipley College is conducting action research into the understanding of specific maths related language and whether attainment can be improved through repeated exposure to these terms with GCSE Maths resit learners.

As part of this research project, we will be collecting personal data that will be used to gauge your success with specific mathematical language. This will include your name, course and your written responses to the research materials.

Your personal data, but not your name, will be stored electronically. This project is being carried out in partnership with the Centre for Excellence in Mathematics network and your data may be shared with network partners and the ETF (Education and Training Foundation). You are free to withdraw at any point of the project by contacting your subject teacher.

1. Please complete all sections below:

Student ID:	
College:	
Vocational Course / Level:	
Target Grade for maths:	
Target Grade for english:	

2. How important is having a Grade 4 in GCSE Maths to you?
   Please choose one option.

   - Extremely important ☐
   - Important ☐
   - Of little importance ☐
   - Not important ☐

3. How many times have you taken a GCSE Maths exam?
   Please choose one option.
   - 0 ☐
   - 1 ☐
   - 2 ☐
   - 3 ☐
   - 4 ☐
   - 5 or more ☐

4. How many questions on average would you say you do not know how to answer when attempting an exam paper?
   Please choose one option.
   - No questions ☐
   - 1 - 2 ☐
   - 3 - 4 ☐
   - 5+ ☐

5. When attempting a question with a lot of words or sentences. How many of the following do you do?
   Please choose as many options as apply to you.
   - Underline important parts. ☐
   - Read it multiple times. ☐
   - Find what the question is asking you to do. ☐
   - Ignore these questions. ☐

6. What would you say you revise the most before an exam?
   - Algebra ☐
   - Ratio ☐
   - Fractions ☐
   - Other (Please state):

     ……..

7. Which of these options would you say you find the most difficult?
    - Remembering keywords and their meanings. ☐
    - Establishing what a question is asking you to do. ☐
    - Reading the questions. ☐
    - Finishing in time. ☐

8. What do you think you can do to improve your grade this year?

    - Revise more topics ☐
    - Attend more classes ☐
    - Practice exam questions ☐
    - Other (Please state):

    ……..

9. Which of these subjects do you find the most challenging?

    - English ☐
    - Maths ☐
    - Neither of them ☐

End of survey.
Thank you for taking part.

---

2. Matching Activity

Name:

Match the correct definition to the words on the left:

1	**Compare**		**Make a sensible guess of an answer using rounding to one significant figure.**
2	**Calculate**		**Use division to make the numbers as small as possible.**
3	**Simplify**		**Round the number starting from the first number that isn't 0 from the left side.**
4	**Product**		**Comment on how one thing has been changed to become another or comment on the relationship or pattern of sets of data.**
5	**Factorise**		**Examine and comment on the differences between two or more numbers, data or things.**
6	**Estimate**		**Mark the points on the axis or graph using the given data or coordinates.**
7	**Describe**		**Find the highest common factor of the numbers and place what you would multiply it by in brackets.**
8	**Significant Figure**		**Work out the answer.**
9	**Sensible**		**Is the answer you get from multiplying numbers together.**
10	**Plot**		**Check whether or not your answer makes sense by rounding the question to 1 significant figure and answering.**

Score:

_____/10

---

3. Definitions with examples

Definitions and Examples

Compare: Examine and comment on the differences between two or more numbers, data or things.

Example: Compare lines AB and CD

Answer: CD is longer than AB.

Calculate: Work out the answer.

Example: Calculate 25 x 6

Answer: 150

Simplify: Use division to make the numbers as small as possible.

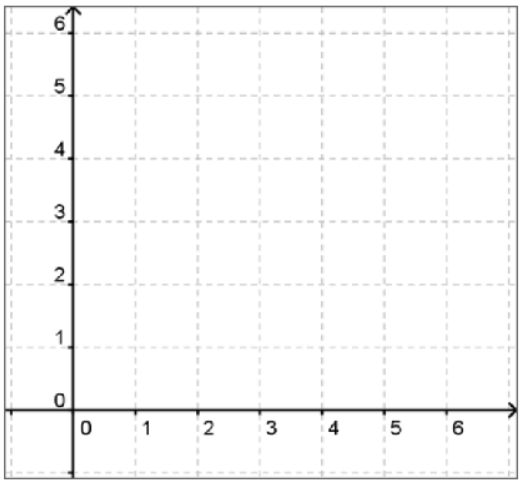
Example: Simplify the fraction $\frac{15}{20}$

Answer: Divide both the numerator and denominator by the same number.

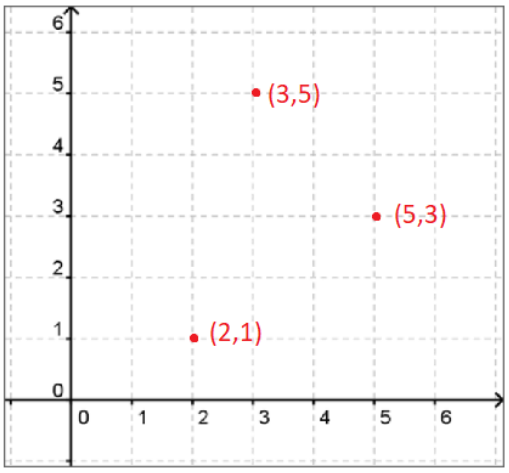
$$\frac{15}{20} \begin{matrix} \div 5 \\ \hline \\ \div 5 \end{matrix} \frac{3}{4}$$

Plot: Mark the points on the axis or graph using the given data or coordinates.

Example: Plot the points (2,1) (3,5) (5,3) on the axis.



Answer:



Significant figures: Round the number starting from the first number that isn't 0 from the left side.

Example: Round 0.00536 to 1 significant figure.
Answer: 0.005

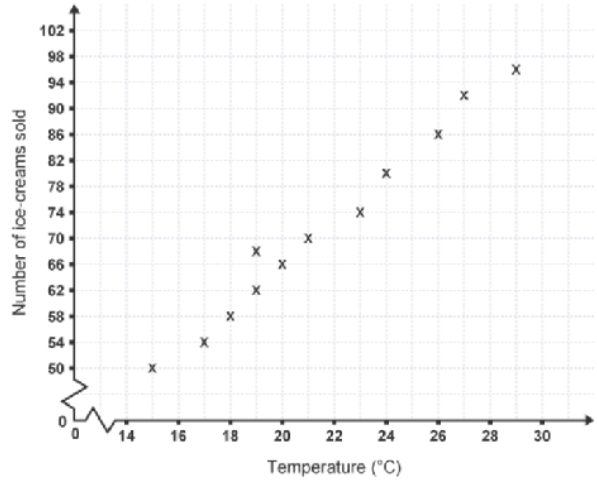
Example: Round 1253 to 2 significant figures.
Answer: 1300

Estimate: Make a sensible guess of an answer using rounding to one significant figure.

Example: Estimate the answer to 125 x 45
Answer: 100 x 50 = 5000

Describe: Comment on how one thing has been changed to become another or comment on the relationship or pattern of sets of data.

Example: Describe the relationship between temperature and number of ice-creams sold.



Answer: As the temperature goes up, there are more ice-creams sold.

Sensible: Check whether or not your answer makes sense by rounding the question to 1 significant figure and answering.

Example: 22 x 38 = 836

Check if the answer is sensible:

20 x 40 = 800

Yes the answer is sensible.

Factorise: Find the highest common factor of the numbers and place what you would multiply it by in brackets.

Example: Factorise $6x + 12$

Highest common factor of 6 and 12 is 3.

$3(2x+4)$

Product: Is the answer you get from multiplying numbers together.

Example: Find the product of 12 and 4

Answer: $12 \times 4 = 48$

---

4. Explaining what to do for each question worksheet

For each of the following, explain what the question is asking you to do to get an answer.

Do not answer the question itself.

Here is some data about the people listening to a radio station one day.

	Percentage	Mean number of hours listening	Range of number of hours listening
Aged 40 or under	21	1.2	4.5
Aged 41 or over	79	6.3	13.9

Compare the data for people aged 40 or under with the data for people aged 41 or over.

Make **three** comparisons.

[3 marks]

Explain what the question is asking you to do with the data?

(a) Simplify fully 56 : 24

[2 marks]

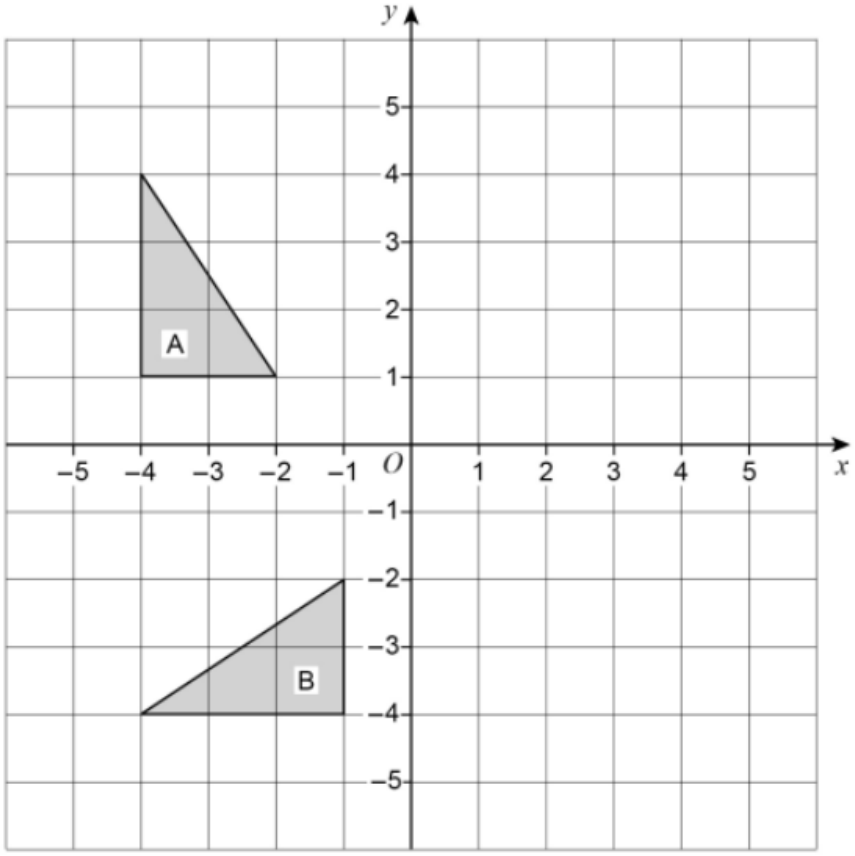
Explain what the question is asking you to do with the ratio?

Estimate the answer to 526 x 78

Explain what the question is asking you to do with 9.25 and 7.8:

15 Describe fully the **single** transformation that maps shape A to shape B.

[3 marks]



Explain what the question is asking you to do:

13 (a) Use your calculator to work out the exact value of $\frac{18\,953 \times 437}{11}$

[1 mark]

Answer _____

13 (b) Use approximations to 1 significant figure to check if your answer to part (a) is sensible.

[3 marks]

Explain what part (b) is asking you to check:

The pressure at sea level is 101 325 Pascals.

Any rise of 1 km above sea level decreases the pressure by 14%

For example,

at 3 km above sea level the pressure is 14% less than at 2 km

Work out the pressure at 4 km above sea level.

Give your answer to 2 significant figures.

[4 marks]

Explain what the question wants you to do with the answer:

(a) Factorise $x^2 - 100$

[1 mark]

Explain what the question is asking you to do to the expression:

What is the Product of 12 and 8?

Explain what the question is asking you to do with 12 and 8:

Plot the points (2,5) (4,6) and (6,9) on the axis.

Explain what you need to do with the points:

Calculate 2.35 + 5.7

Explain what you need to do with the points:

5. Cycle 1 Final Worksheet

Monthly milk production in thousands of litres												
Month	J	F	M	A	M	J	J	A	S	O	N	D
2016	51	53	55	56	64	72	70	75	64	64	62	58
2017	62	65	62	67	72	83	81	86	75	73	70	68

Nicci runs a dairy farm and records the volume of milk (in thousands of litres) produced each month by her cows.
The table shows the amount produced in two consecutive years.

Find the median and range of the milk production for each year.

Compare the milk production for the two years.

A bar of chocolate costs 84p

Calculate how many bars could be bought for £5

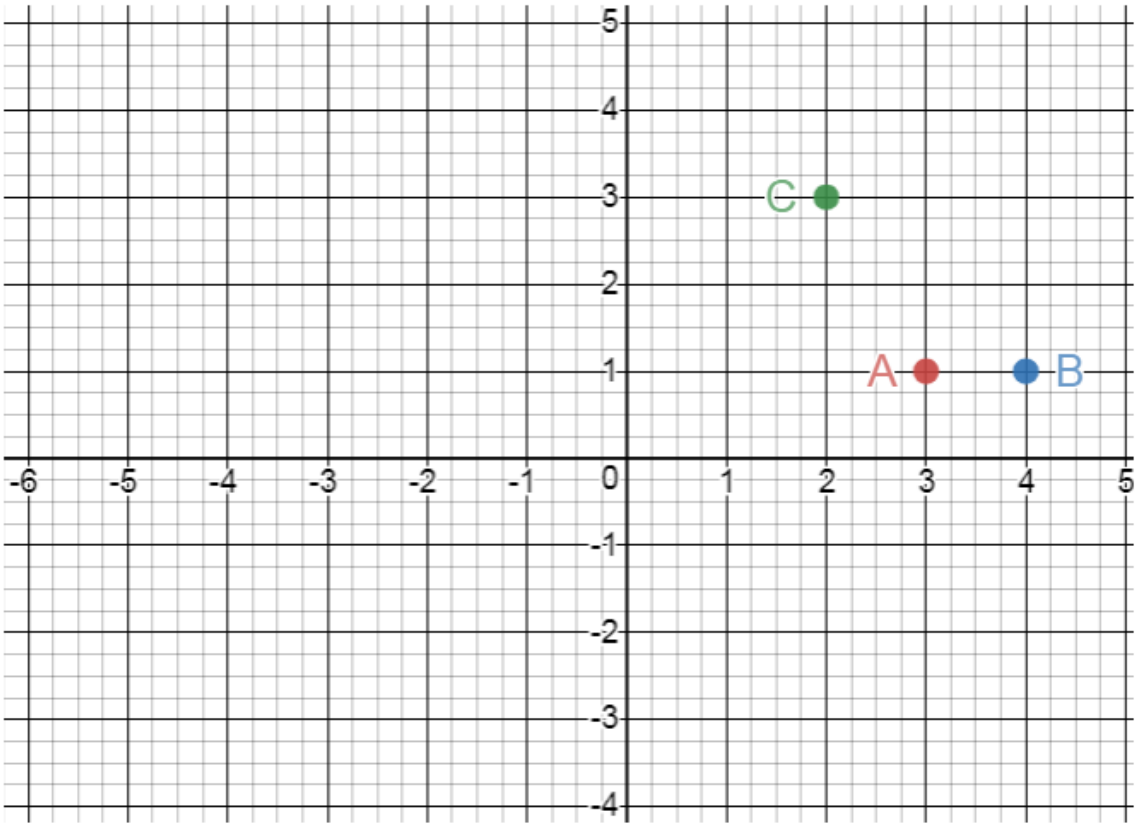
$$t = \frac{r - w}{y}$$

Work out an estimate of the value of t when

$$r = 232.5$$
$$w = 17.08$$
$$y = 0.2$$

Simplify

$$\frac{63}{105}$$



Describe the single transformation that maps triangle ABC to the coordinates A'(-2, 0), B'(-2, 1) & C'(-4, -1).

$$\frac{3.5 \times 6.125}{0.875 \div 2.8}$$

Estimate by rounding every number to 1 significant figure before calculating.

Is your answer sensible? Work out the actual answer to check

Factorise

$3x + 12$

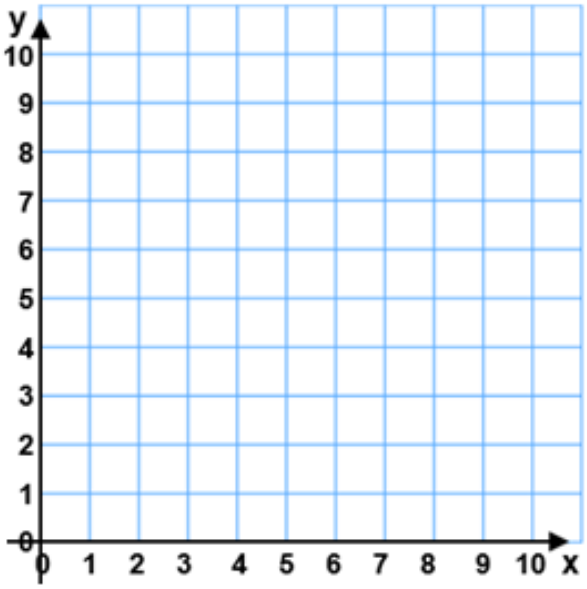
The product of two numbers is 42.

What could the two numbers be?

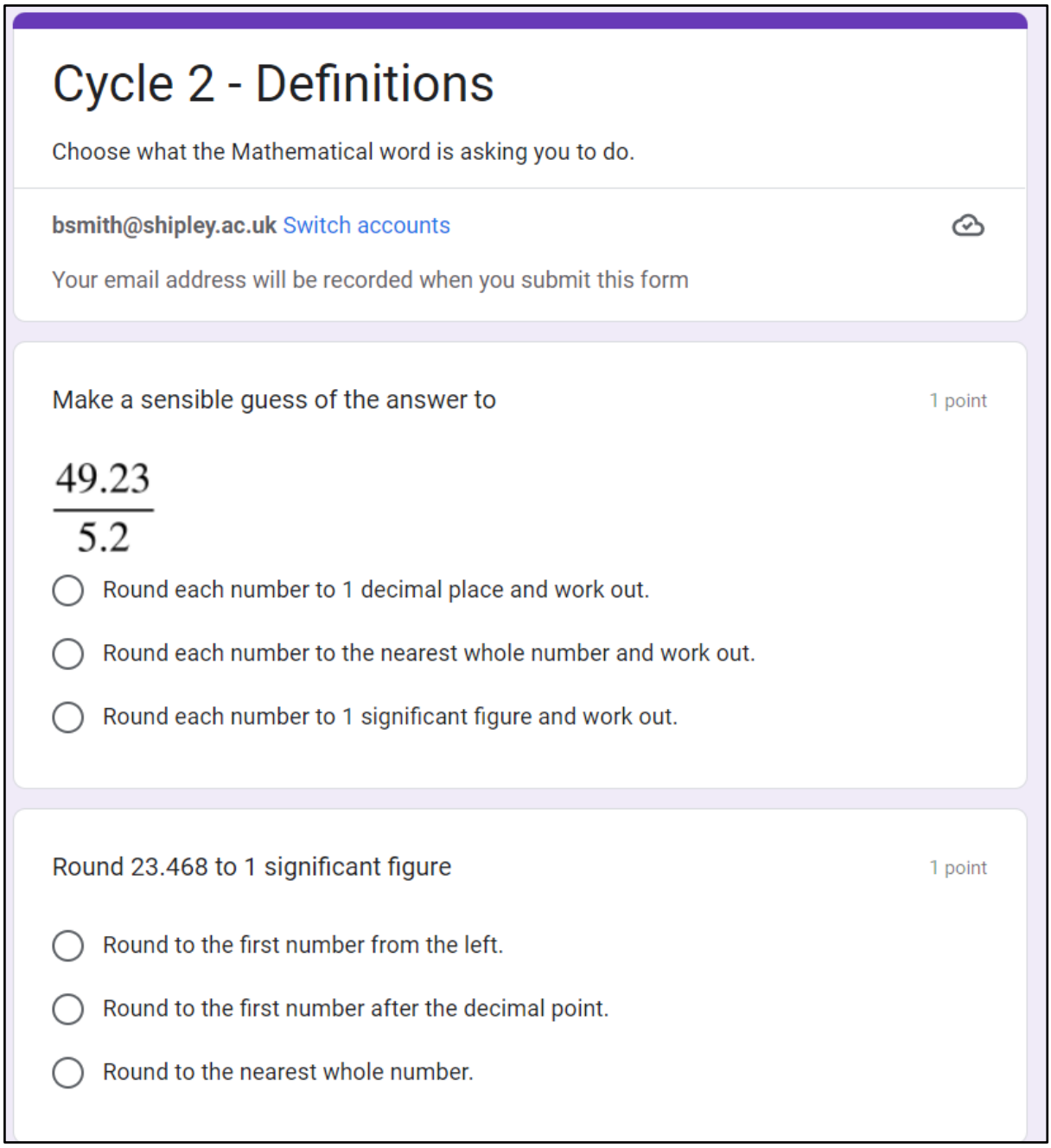
Three corners of a square are given as A(1, 5), B(4, 2) and C(7, 5).

a) Plot the three coordinates

b) Identify and plot the coordinate of the fourth corner. Label this D



6. Initial Google Form - Definitions



Cycle 2 - Definitions

Choose what the Mathematical word is asking you to do.

bsmith@shipley.ac.uk Switch accounts

Your email address will be recorded when you submit this form

Make a sensible guess of the answer to 1 point

$$\frac{49.23}{5.2}$$

- ◯ Round each number to 1 decimal place and work out.
- ◯ Round each number to the nearest whole number and work out.
- ◯ Round each number to 1 significant figure and work out.

Round 23.468 to 1 significant figure 1 point

- ◯ Round to the first number from the left.
- ◯ Round to the first number after the decimal point.
- ◯ Round to the nearest whole number.

Estimate 2.75 x 3.5 1 point

- ◯ Multiply both numbers by 100 to make them whole and answer.
- ◯ Round each number to 1 significant figure and answer.
- ◯ Round each number to 1 decimal place and answer.

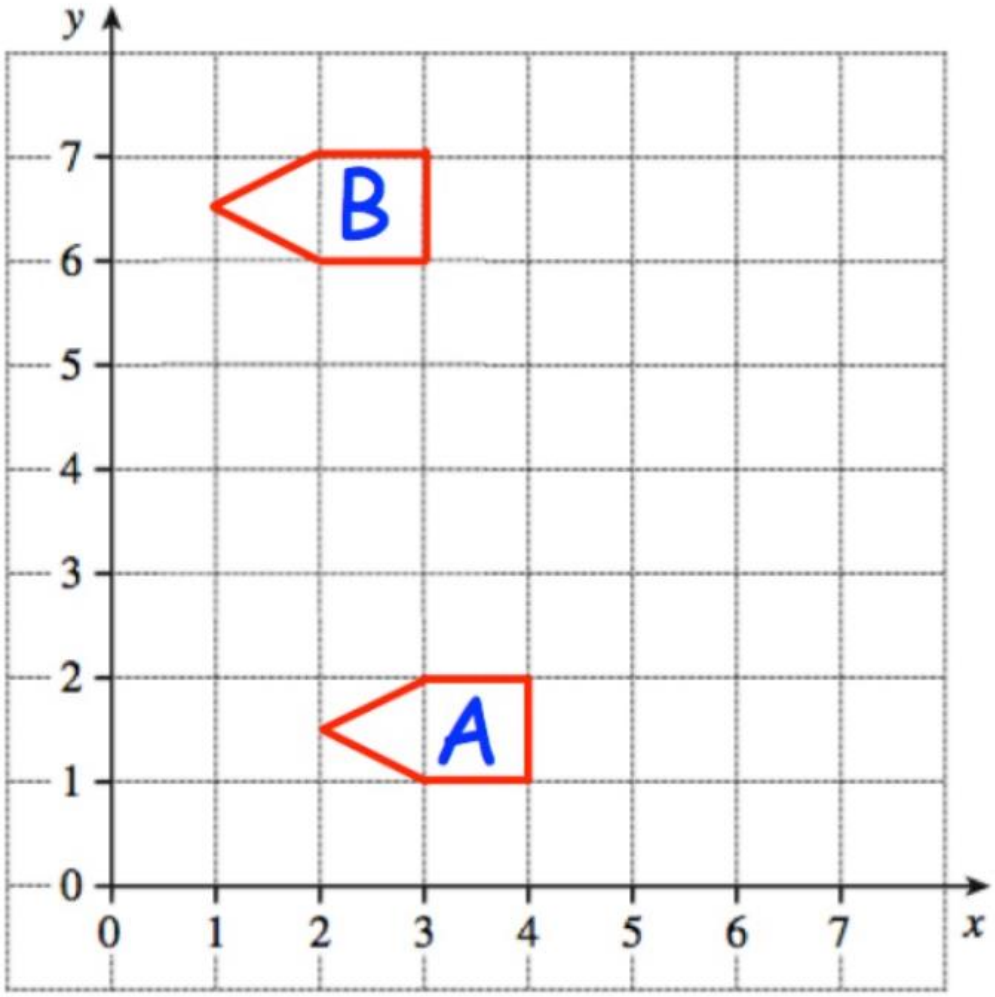
Translate triangle A by 1 point

$$\begin{pmatrix} 5 \\ 4 \end{pmatrix}$$

- ◯ Move the triangle left/right and up/down by the numbers in brackets.
- ◯ Make the triangle bigger/smaller by the numbers in brackets.
- ◯ Spin the triangle clockwise/anticlockwise by the numbers in brackets.

Describe fully the transformation that maps A onto B

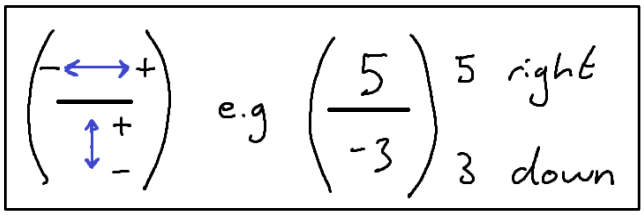
1 point



- ◯ Count how many squares are between shape A and B.
- ◯ Find the type of transformation and write how shape A became shape B.
- ◯ Find the type of transformation and write the coordinates of each shape.

7. Cycle 2 Definitions and Questions

Translate - Move a shape left/right and up/down using a vector on an axis



Rearrange - Move parts of an equation over the equals sign to leave one letter (variable) by itself.

Expand - Multiply all the numbers and letters (variables) on the inside of the brackets by what's on the outside.

Simplify - Make the numbers smaller by finding a common factor or collecting the like terms.

Product - The answers you get from multiplying two numbers.

Factorise - Opposite of expanding brackets. Find the highest common factor and put on the outside of the brackets. Put what it needs to be multiplied by on the inside.

Estimate - Make a sensible guess by rounding to 1 significant figure.

Describe - Explain how a shape has been changed or transformed.

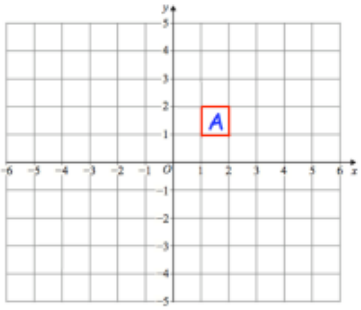
Significant - Round the number starting with the first number that isn't 0 from the left.

Sensible - Check your answer makes sense by rounding the question to 1 significant figure.

Translation

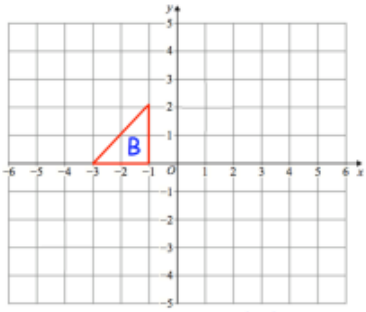
Question 3: Translate each of the shapes below as instructed.

(a)



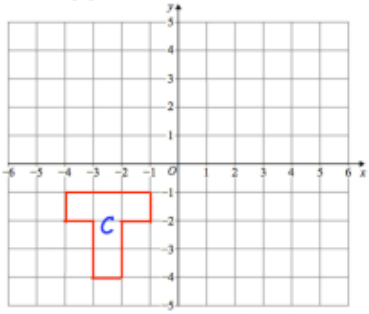
Translate A by $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$

(b)



Translate B by $\begin{pmatrix} 6 \\ 1 \end{pmatrix}$

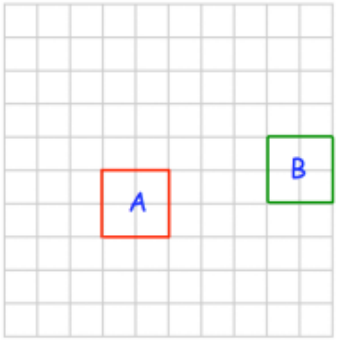
(c)



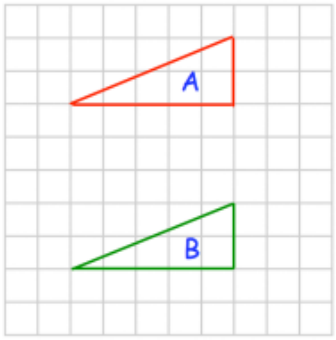
Translate C by $\begin{pmatrix} -1 \\ 5 \end{pmatrix}$

Question 2: Describe fully each translation that takes shape A to shape B

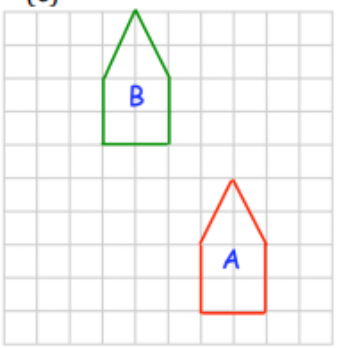
(a)



(b)



(c)



Rearrange

Question 1: Make y the subject of each of the following

(a) $y + w = c$ (b) $y - p = m$ (c) $m + y = s$

(d) $y - 2g = n$ (e) $3y = c$ (f) $ay = w$

(g) $\frac{y}{c} = w$ (h) $\frac{y}{a} = 2c$ (i) $a = y + p$

(j) $c = y - k$ (k) $y^2 = s$ (l) $y^3 = x$

(m) $\sqrt{y} = g$ (n) $\pi y = c$ (o) $n - y = t$

(p) $ry = c$ (q) $4\pi y = b$ (r) $y + 7t = c + r$

(s) $\frac{r}{y} = w$ (t) $y^2 = k + x$ (u) $A = xy$

Expand

Question 1: Expand the following brackets

(a) $5(y + 3)$ (b) $4(a + 2)$ (c) $8(w + 10)$ (d) $3(x - 7)$

(e) $9(s - 1)$ (f) $2(8 - t)$ (g) $7(4 + h)$ (h) $10(a + 2b + 3c)$

(i) $4(3y + 2)$ (j) $5(2p - 1)$ (k) $3(7a + 2)$ (l) $9(2x - 5)$

(m) $5(4 + 3t)$ (n) $7(9 - 2c)$ (o) $8(3w + 1)$ (p) $9(1 - 4p)$

(q) $11(2k - 5)$ (r) $20(6a + 5c)$ (s) $3(15w - 7)$ (t) $3(9 - 2a)$

Simplify

Question 1: Simplify fully

(a) $\frac{2}{4}$ (b) $\frac{6}{9}$ (c) $\frac{6}{8}$ (d) $\frac{5}{15}$ (e) $\frac{4}{6}$ (f) $\frac{9}{12}$

Question 2: Simplify the following ratios

(a) 4 : 6 (b) 14 : 8 (c) 15 : 10 (d) 6 : 15

(e) 30 : 10 (f) 12 : 16 (g) 6 : 18 (h) 45 : 10

(i) 12 : 28 (j) 24 : 36 (k) 25 : 60 (l) 27 : 63

Product

Question 1: Write each of these numbers as the product of their prime factors.

(a) 10 (b) 12 (c) 20 (d) 18 (e) 16 (f) 30 (g) 100

(h) 26 (i) 24 (j) 27 (k) 42 (l) 33 (m) 38 (n) 64

Factorise

Question 1: Factorise the following expressions

(a) $4x + 6$ (b) $15x + 20$ (c) $9y - 12$ (d) $5x + 15$

(e) $6x - 3$ (f) $4x + 8$ (g) $5y - 25$ (h) $8w + 24$

(i) $10y + 15$ (j) $14w + 21$ (k) $20y - 30$ (l) $27x + 18$

Estimate

Question 1: Work out an estimate to each of the following

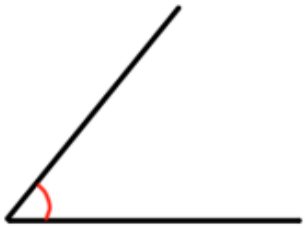
(a) $906 + 397$ (b) $578 + 720$ (c) $912 - 114$ (d) $4998 - 592$

(e) $1965 - 370$ (f) $8.31 + 9.74$ (g) $50.6 - 5.25$ (h) $44.34 + 98.101$

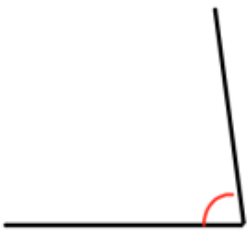
Question 1: Estimate the size of each of these angles

(a)

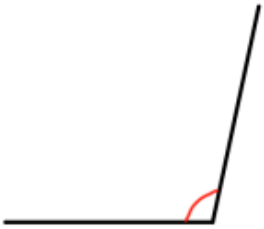
(b)



(c)



(d)



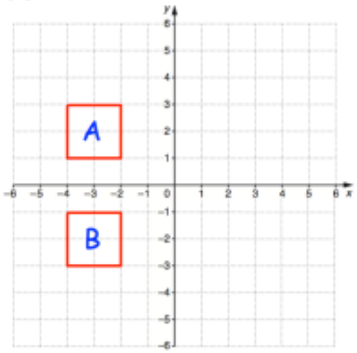
(e)

(f)

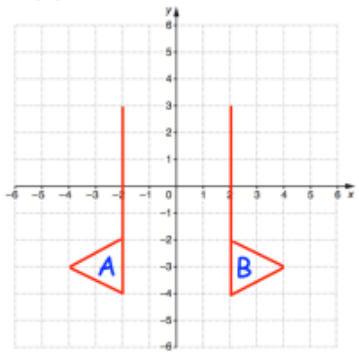
Describe

Question 7: Describe fully the single transformation that takes shape A to shape B.

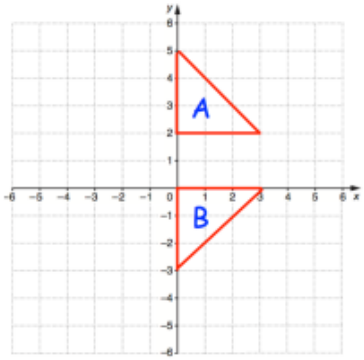
(a)



(b)

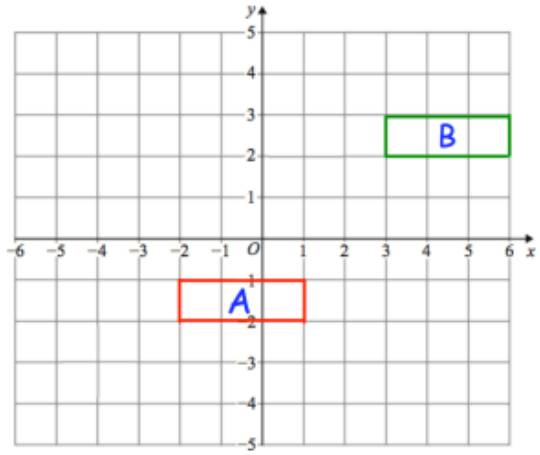


(c)

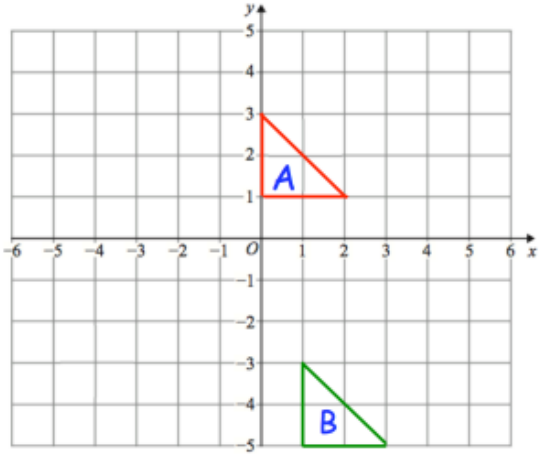


Question 4: Describe fully the single transformation that takes shape A to shape B

(a)



(b)



Significant

Question 1: Round each of the following numbers to 1 significant figure

(a) 36 (b) 22 (c) 83 (d) 68 (e) 97 (f) 120 (g) 519

(h) 260 (i) 741 (j) 888 (k) 408 (l) 650 (m) 148 (n) 972

Question 4: Round each of the following numbers to 1 significant figure

(a) 0.54 (b) 0.86 (c) 0.161 (d) 0.048 (e) 0.0943 (f) 0.0071 (g) 0.0038

(h) 0.06482 (i) 0.8835 (j) 0.00064 (k) 0.00098 (l) 0.00002789

Sensible

Question 1: For each of the following, circle the most appropriate estimate.

	Length of a pencil	**15mm**	**1.5cm**	**15cm**	**1.5m**
	Thickness of a key	**3mm**	**3cm**	**3m**	**3km**
	Height of a man	**1.8m**	**1400cm**	**100cm**	**0.15m**
	Length of a running track	**400cm**	**400m**	**4km**	**40m**

---

8. Exam Questions

Q1.

The vector $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$ translates A to B.

Circle the vector that translates B to A.

$\begin{pmatrix} -2 \\ 3 \end{pmatrix}$ $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$ $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$ $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$

(Total 1 mark)

Q2.

(a) Use your calculator to work out the exact value of $\frac{18953 \times 437}{11}$

Answer _____

(1)

(b) Use approximations to 1 significant figure to check if your answer to part (a) is sensible.

_____

_____

_____

_____

_____

_____

_____

_____

_____

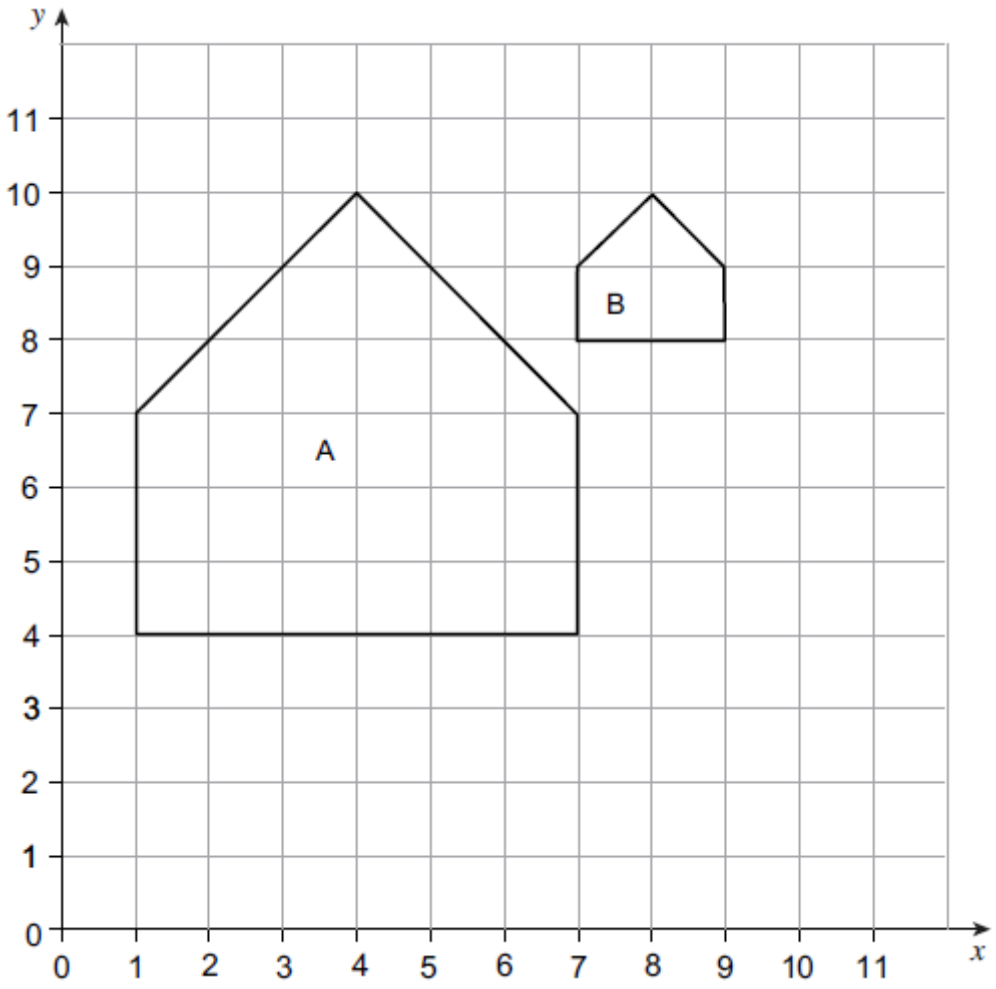
_____

(3)

(Total 4 marks)

Q3.

Describe fully the **single** transformation that maps shape A to shape B.



(Total 3 marks)

Q4.

Use approximations to estimate the value of $\frac{37 \times 304}{58}$

_____
_____

_____
_____

Answer _____

(Total 2 marks)

Q5.

Expand $x(x + 3)$
Circle your answer.

$2x + 3$ $x^2 + 3$ $x^2 + 3x$ $3x^2$

(Total 1 mark)

Q6.

Rearrange $y = 3x - 2$ to make x the subject.

Circle your answer.

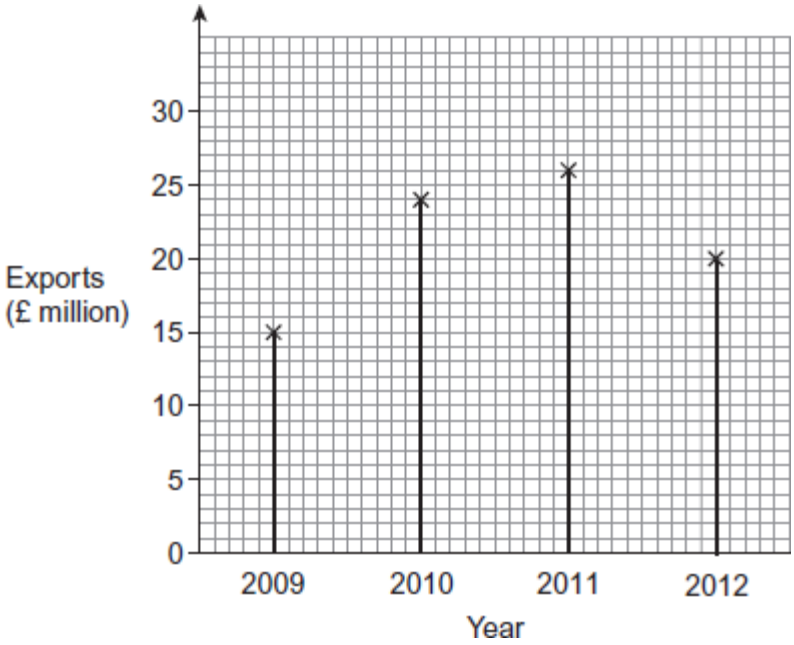
$x = \frac{y}{3} - 2$ $x = \frac{y+2}{3}$ $x = \frac{y-2}{3}$ $x = \frac{y}{3} + 2$

(Total 1 mark)

Q7.

The diagram shows information about the exports of a company.

Exports



(a) Write the value of the exports in 2011 to 1 significant figure.

_____

Answer £_____million

(1)

Q8.

Write 36 as a product of prime factors.

Give your answer in index form.

Answer _____

(Total 3 marks)

Q9.

(a) Simplify fully $4a - 3a + 2b - 8b$

_____

_____

_____

_____

_____

Answer _____

(2)

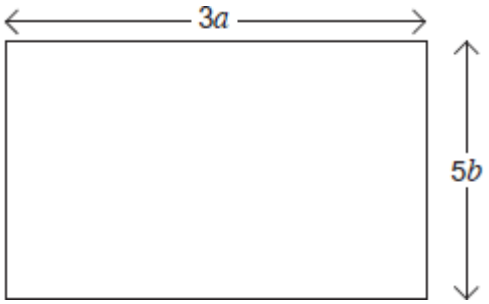
(b) Factorise $m^2 - 2m$

Answer _____

(1)

Q10.

The diagram shows a rectangle.



(a) Write down an expression for the **perimeter** of the rectangle.

Simplify your answer.

_____

_____

Answer _____

(2)

(b) Write down an expression for the **area** of the rectangle.

Simplify your answer.

_____

_____

Answer _____

(2)

TOTAL MARKS - _____ / 23

9. Staff and Learner Interview Questions

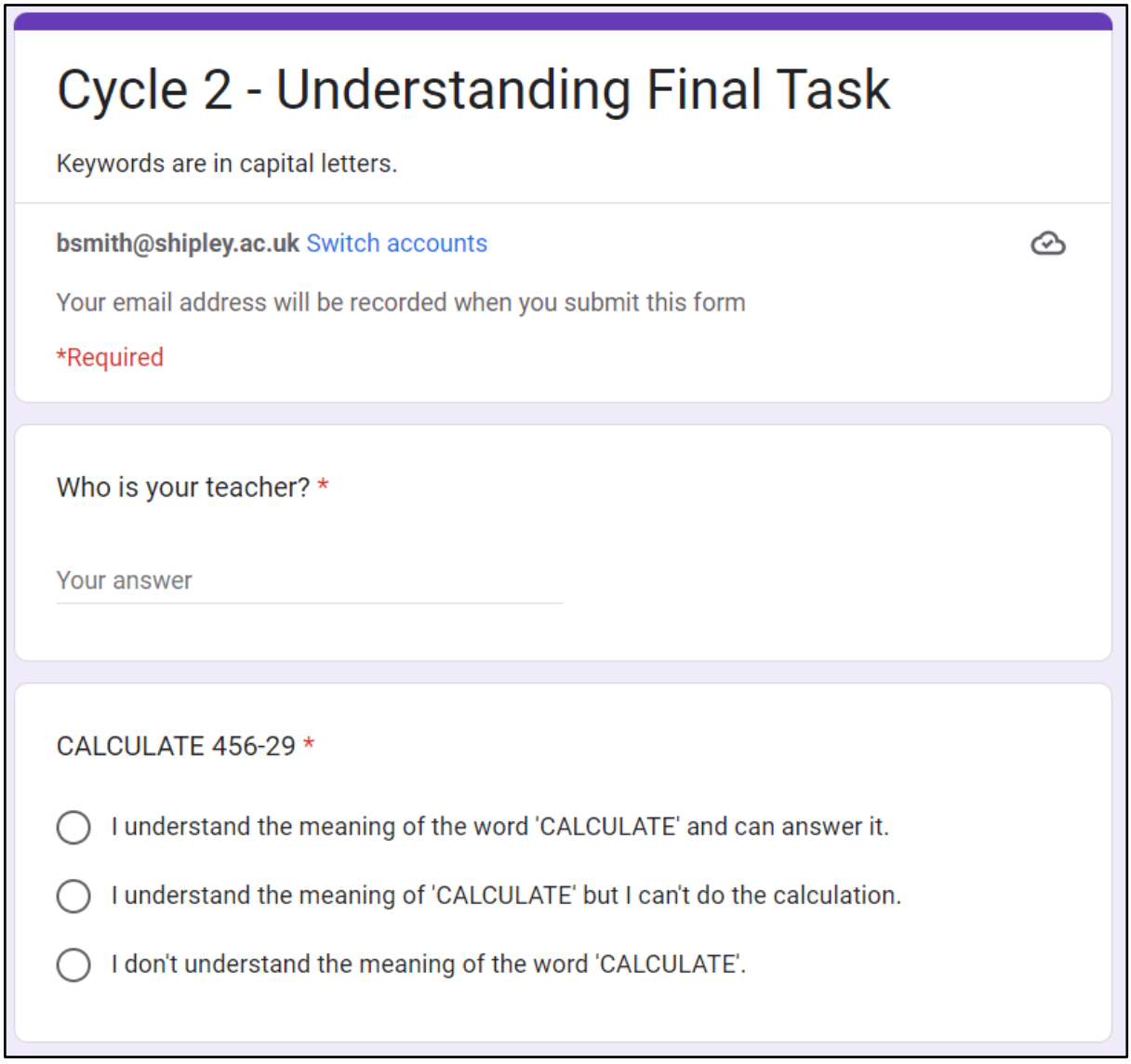
Student questions

1. What is your opinion on GCSE English and Maths? Do you have any preference?
2. How do you feel about your upcoming maths exam?
3. If you were asked to do this maths paper, what questions would you attempt first?
4. How do you approach a maths question with a lot of words, i.e. 4-6 marks question? *[Show an example to the learner and let them explain].*
5. Here is a list of the keywords that we have been using in this project; are there any words from this list that you feel more confident about?
6. Are there any particular words that you are still struggling with from this list?
7. Have you done any similar tasks before in terms of helping you understand the maths keywords?
8. Would you like your teacher to continue using the maths keyword based tasks in your session? Give a reason for your answer.
9. Which did you prefer: the matching card activity or the google form with the maths keywords? What is your reason behind your answer?
10. Is there any other way your teacher can help you with the understanding of these maths keywords?

Teacher questions

1. Have you tried maths keyword based interventions before? Can you explain a bit more about those in detail?
2. How are the learners engaging with the keywords intervention? Is there a difference in confidence between your participating and non-participating groups?
3. What impact has the keyword intervention had on your teaching practice with your participating groups and as a whole?
4. Which task did you think was more beneficial; the matching card activity or the google form with the maths keywords? What is your reason behind your answer?
5. What strategies have you used with your learners previously when solving a 4-6 marks question?
6. Are there any specific words that your students have increased confidence in using and any words that they are still struggling to use?
7. After the project is complete, would you still like to use the keywords intervention with your learners?
8. What has been the key moment for you so far in this project?
9. Is there anything that you would like to change if you ran this project again?
10. Based on your experience so far, what advice would you give to any new teachers wanting to trial this intervention?

10. Cycle 2 Final Understanding Task - Google Forms



Cycle 2 - Understanding Final Task

Keywords are in capital letters.

bsmith@shipley.ac.uk Switch accounts

Your email address will be recorded when you submit this form

*Required

Who is your teacher? *

Your answer

CALCULATE 456-29 *

- I understand the meaning of the word 'CALCULATE' and can answer it.
- I understand the meaning of 'CALCULATE' but I can't do the calculation.
- I don't understand the meaning of the word 'CALCULATE'.

COMPARE *

The table shows the number of diners at each table in a hotel at 8 pm on Monday night and 8 pm on Friday night.

8 pm Monday night		
Number	Frequency	
0	18	
1	2	
2	3	
3	1	
4	1	
6	0	

8 pm Friday night		
Number	Frequency	
0	0	
1	0	
2	16	
3	2	
4	5	
6	2	

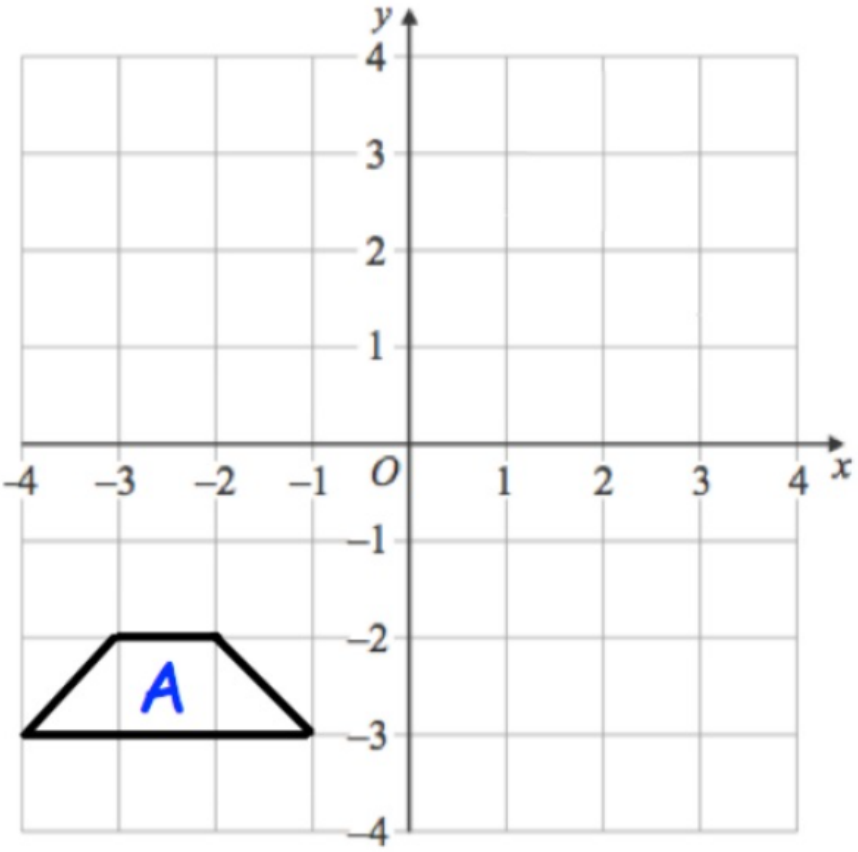
Compare the numbers of diners at each table on these nights.

- ◯ I understand the meaning of the word 'COMPARE' and can answer it.
- ◯ I understand the meaning of the word 'COMPARE' but I can't do the calculation.
- ◯ I don't understand the meaning of the word 'COMPARE'.

ESTIMATE 2.75 x 3.5 *

- ◯ I understand the meaning of the word 'ESTIMATE' and can answer it.
- ◯ I understand the meaning of the word 'ESTIMATE' but I can't do the calculation.
- ◯ I don't understand the meaning of the word 'ESTIMATE'.

TRANSLATION *



Translate trapezium A by the vector $\begin{pmatrix} 0 \\ 4 \end{pmatrix}$

- ◯ I understand the meaning of the word 'TRANSLATE' and can answer it.
- ◯ I understand the meaning of the word 'TRANSLATE' but I can't do the calculation.
- ◯ I don't understand the meaning of the word 'TRANSLATE'.

REARRANGE x = 2y + 4 to make y the subject. *

- ◯ I understand the meaning of the word 'REARRANGE' and can answer it.
- ◯ I understand the meaning of the word 'REARRANGE' but I can't do the calculation.
- ◯ I don't understand the meaning of the word 'REARRANGE'.

EXPAND *

$$2(x+5)$$

- ◯ I understand the meaning of the word 'EXPAND' and can answer it.
- ◯ I understand the meaning of the word 'EXPAND' but I can't do the calculation.
- ◯ I don't understand the meaning of the word 'EXPAND'.

SIMPLIFY fully *

$$\frac{12}{36}$$

- ◯ I understand the meaning of the word 'SIMPLIFY' and can answer it.
- ◯ I understand the meaning of the word 'SIMPLIFY' but I can't do the calculation.
- ◯ I don't understand the meaning of the word 'SIMPLIFY'.

Find the PRODUCT of 157 and 22 *

- ◯ I understand the meaning of the word 'PRODUCT' and can answer it.
- ◯ I understand the meaning of the word 'PRODUCT' but I can't do the calculation.
- ◯ I don't understand the meaning of the word 'PRODUCT'.

FACTORISE *

$6x + 24$

- ◯ I understand the meaning of the word 'FACTORISE' and can answer it.
- ◯ I understand the meaning of the word 'FACTORISE' but I can't do the calculation.
- ◯ I don't understand the meaning of the word 'FACTORISE'.

Round 23.468 to 1 SIGNIFICANT figure *

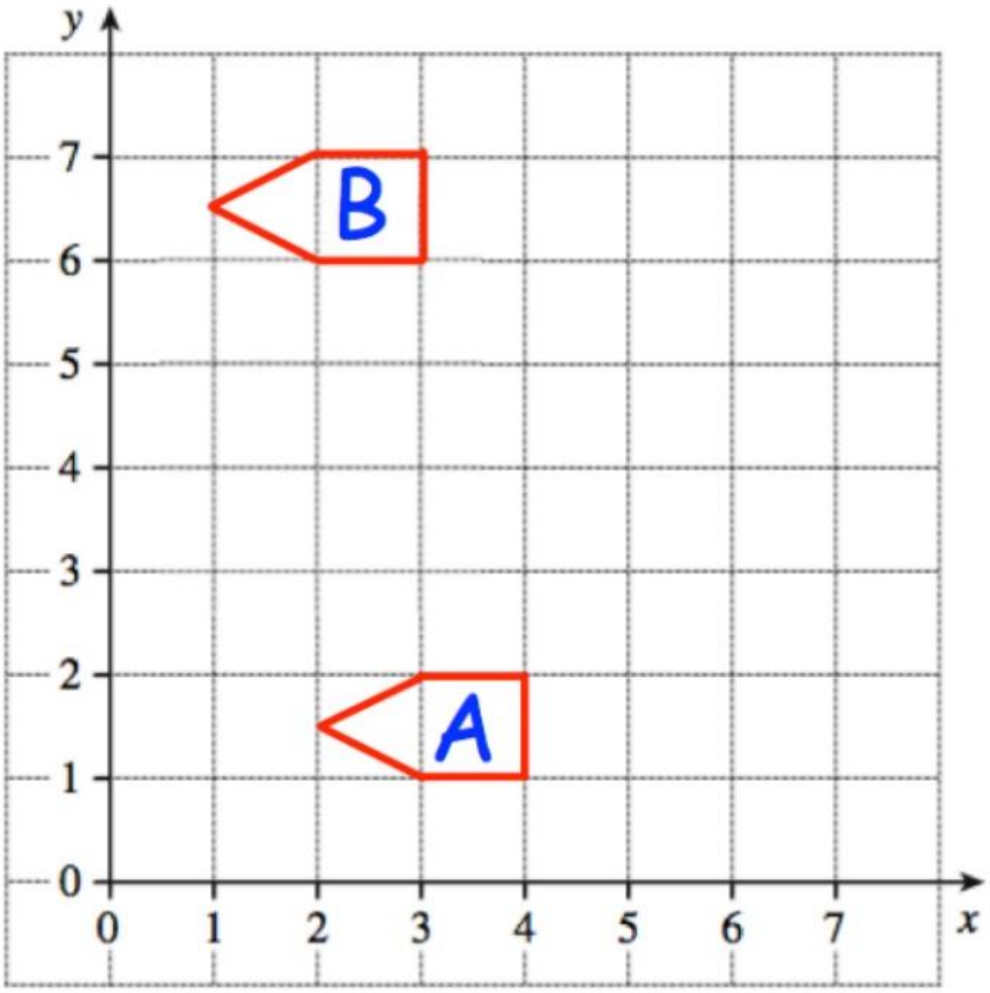
- ◯ I understand the meaning of the word 'SIGNIFICANT' and can answer it.
- ◯ I understand the meaning of the word 'SIGNIFICANT' but I can't do the calculation.
- ◯ I don't understand the meaning of the word 'SIGNFICICANT'.

Make a SENSIBLE guess of the answer to *

$$\frac{49.23}{5.2}$$

- ◯ I understand the meaning of the word 'SENSIBLE' and can answer it.
- ◯ I understand the meaning of the word 'SENSIBLE' but I can't do the calculation.
- ◯ I don't understand the meaning of the word 'SENSIBLE'.

DESCRIBE fully the transformation that maps A onto B *



- ◯ I understand the meaning of the word 'DESCRIBE' and can answer it.
- ◯ I understand the meaning of the word 'DESCRIBE' but I can't do the calculation.
- ◯ I don't understand the meaning of the word 'DESCRIBE'.

Knowing the definitions / meanings of the keywords helped me to understand the topics more and attempt more of the questions. *

	1	2	3	4	5	
Strongly Agree	○	○	○	○	○	Strongly Disagree

Which of these tasks was the MOST useful / helpful? *

- ○ Exam style questions
- ○ Match up word definitions
- ○ Starter/plenary questions
- ○ Word definitions google form

Please explain why you have chosen this task as the most useful / helpful? *

Your answer

Please explain why you have chosen this task as the most useful / helpful? *

Your answer

Which of these tasks was the LEAST useful / helpful? *

- ◯ Exam style questions
- ◯ Match up word definitions
- ◯ Starter/plenary questions
- ◯ Word definitions google form

Please explain why you have chosen this task as the least useful / helpful? *

Your answer

Submit Clear form