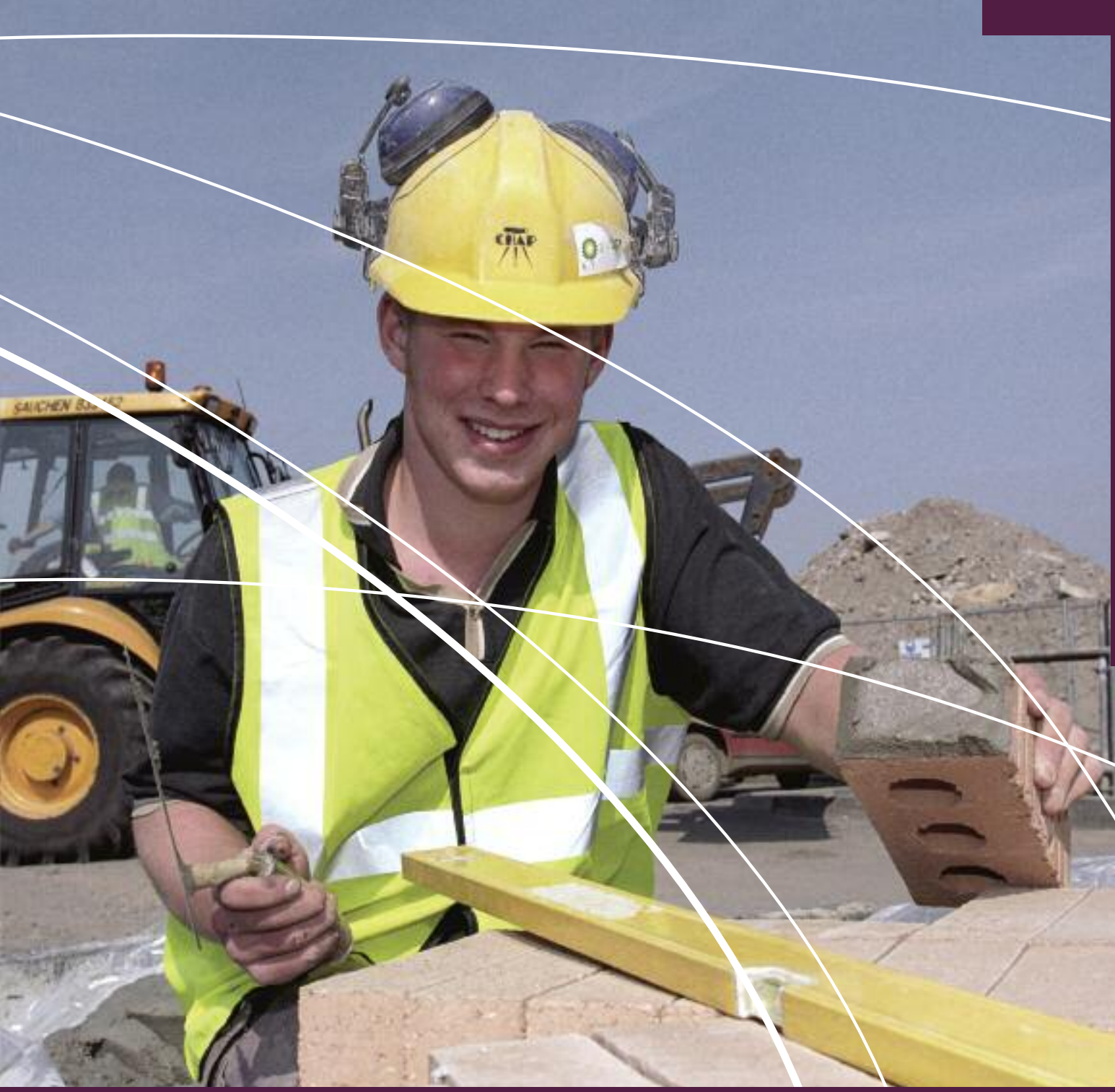

Essential Skills - Numeracy Level 2 for Experienced Construction Workers

ES LEVEL 2 RESOURCE FOR EXPERIENCED CONSTRUCTION WORKERS - JULY 2011





Acknowledgements
We would like to thank CITB-ConstructionSkills Northern Ireland who had this resource published. We also acknowledge our colleagues in the construction departments of South Eastern Regional College and South West College for their advice in our research prior to preparing this resource. We have also benefited from the expertise of many friends within the industry.

Aims
This resource should be used in the context of appropriately planned and structured Essential Skills programmes and should be used and adapted appropriately within that context.

Guidance for Using Resource
It is not intended that these materials should be used as a fixed programme of learning but as a resource which tutors can use to aid them in the planning and delivery of programmes suited to the needs of their particular groups of learners.

It is envisaged that tutors will bring their own ideas to these materials and extend and enhance them in order to keep activities refreshed and dynamic for learners.

Essential Skills tutors should ensure that they read and understand the following publication before they develop programmes: ESSENTIAL SKILLS GOOD PRACTICE: THE ASSESSMENT PROCESS. DEL NI, July 2007.

All information on this page is current and up to date at the time of printing (July 2011).

Authors: William Smyth and Paula Philpott

Disclaimer
The contents of this resource are fictional. No actual person, company, or event, is depicted.

Essential Skills Numeracy

This booklet will help you practice the skills you will need to achieve your level 2 in Numeracy.
When you see this symbol you may use a calculator to answer the question.

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MEASURE, SHAPE AND SPACE

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TASK 1 - MONEY MATTERS

In this task we will explore some important points about borrowing money as this is very likely something you will have to do in the future in your career and/or personal life. You may well need to borrow money to purchase a vehicle, tools, equipment or property.

If you have ever heard or had a discussion on loans or borrowing you will be aware of the term “Interest” or “Interest rate”. Interest is a charge a lender makes to a borrower: it is the cost of borrowing or the price of money!

You may wish to purchase something but don’t have the cash available to do so. Some institutions (e.g. bank/building society/Credit Union) may lend you the money to make the purchase meaning you can have the goods immediately. You agree to pay the money back over a given period of time, usually months or years. The lender has taken a risk in giving you their money as something may happen that means you find it difficult to pay it back. In financial arrangements lenders expect some reward for taking this risk and the reward is that they will get back more than they gave you in the first place – that’s Interest!

For instance suppose you borrowed £500 for a certain period of time. A lender may choose an interest rate of 10%. This means that you have to pay back the original £500 plus the interest (10% of £500). The original £500 borrowed is usually referred to as Capital.

NUMBER

TASK 1 - MONEY MATTERS

1. What is the interest to be paid back on this loan?

2. What is the total amount to be paid back?

3. If the loan is to be paid back in 10 equal instalments how much will each instalment be?

4. What if you had agreed 12 equal instalments, how much would each instalment be?

NUMBER

TASK 1 - MONEY MATTERS

Alternatively you may have agreed to pay back £35 each month for instance as that was the maximum you could afford.

5. In this case how long would it take you to repay the loan in full?

In practice interest is usually expressed as a per annum (yearly) percentage rate because loans normally run over a fixed number of years such as 3yrs or 5yrs (or maybe 10-15yrs for a commercial loan or 20-30yrs as in the case of a domestic mortgage).

For example, a bank may quote their lending rate as 10% p.a. To see what this means we will consider a real loan situation. Suppose Paul wants to borrow £2500 over three years (i.e. he will pay the money back gradually over three years normally in equal monthly instalments). The lender will calculate how much Paul has to pay in the following way.

Year 1:

Outstanding amount is £2500.

Interest for Yr 1 is 10% of £2500 = 2500 ÷ 100 × 10 = £250

The interest for the year is £250. You may now be tempted to simply multiply this amount by three to find out how much interest is to be paid over three years but it does not work like that in practice. Instead, lenders add on the interest for the first year when calculating interest for the second year.

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TASK 1 - MONEY MATTERS

6. To see how this works complete the calculation below?

Year 2:
Outstanding amount from Yr 1 is £2500 + £250 = £2750

Interest for Yr 2 is 10% of £2750 = £ ☐

Year 3:
Outstanding amount from Yr 2 is £2750 + £ ☐ = £ ☐

Interest for Yr 3 is 10% of £ ☐ = ☐ ÷ 100 × 10 = £ ☐

Total to be repaid is £ ☐ + £ ☐ = £ ☐

You can check your answer with the following statement, "if you borrow £2500 over three years at an interest rate of 10% pa you will pay back £3327.50 in total".

7. How many months are there in three years?

8. How much will each equal monthly instalment be?

Write down the display on your calculator including all digits

NUMBER

TASK 1 - MONEY MATTERS

9. Round this off to an appropriate degree of accuracy.

When you are working with loans (or anything that involves percentages) it is very useful to be able to add on the interest in an efficient way. It will save time when you get used to it and can often make things easier. Here is what we mean by this…

In the example above we worked out 10% of £2500 (the interest) and then added that to the original £2500 (the capital) to get the total to be repaid for the first year of borrowing. These two steps can be done in a single multiplication which saves time. You will see how this works below but first….

You just need to brush-up on being able to write a percentage as a decimal fraction.

For example 50% = 0.5 and 25% = 0.25.

10. What is 10% as a decimal?

11. What is 75% as a decimal?

NUMBER

TASK 1 - MONEY MATTERS

12. What is 100% as a decimal?

….and back to the loan calculation!

Original capital + interest for the year

= 100% of 2500 + 10% of 2500

= 1.0 x 2500 + 0.1 x 2500

= 1.1 x 2500 (or 2500 x 1.1) = 2750

If you understood this you will now see that to increase a quantity by 10% we can multiply it by 1.1 (1.1 is the same as 110%).

In reality interest rates are not normally round figures such as 10%! Typical values might be 12.5%, 7.8%, 6.2% depending on the type of loan, etc.

13. Write each of the following percentage rates as decimals.
(some examples to start you off)

12.5% = 0.125	80% =	7.9% =
13.8% = 0.138	8% =	8.34% =
17.5% = 0.175	8.3% =	1.3% =
12.4% =	6.4% =	0.8% =

NUMBER

TASK 1 - MONEY MATTERS

Now we can look at how to use this to add on interest or just increase (or decrease) things by a certain percentage. For instance, calculate the total capital and interest one year after borrowing £500 at an interest rate of 6.5%.....

100% of 500 + 6.5% of 500

= 1.0 x 500 + 0.065 x 500

= (1.0 + 0.065) x 500

= 1.065 x 500

= £532.50

Try this one yourself!

14. Calculate the total capital and interest one year after borrowing £16500 at an interest rate of 8.4%?

In the previous calculation the number “1.084” is often called a growth factor and is very useful in percentage and interest calculations. To see how, let’s suppose the sum of money, £16,500, was borrowed over two years instead of one. The interest would have to be applied twice. We did something very similar to this in question 6 but did not use a growth factor.

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TASK 1 - MONEY MATTERS

Over two years the total capital and interest would be (to the nearest penny)

£16,500 x 1.084 x 1.084 = £16,500 x 1.084^2 = £19,388.42

Questions 15-19 are quite difficult so you can leave them out if you wish!

15. What would the total capital and interest be if this amount was borrowed over three years instead of two (interest rate is still 8.4%)?

Use '2 years' to help you: £16,500 x 1.084 x 1.084 = £16,500 x 1.084^2 = £19,388.42

John is a contractor who has just successfully tendered for a new development and needs to add to his existing fleet of diggers. He visits a website to see what his options are for borrowing £16,500 to finance the digger you see here.

He wants to consider a couple of important aspects of the loan: the interest rate and the loan repayment term (i.e. how long does he takes to pay the money back).

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TASK 1 - MONEY MATTERS

Obviously he wants to pay as low an interest rate as possible but it is not always as simple as that. For instance, sometimes to get a lower interest rate you may need to choose a shorter loan period and this then makes the monthly payment higher.

John has narrowed the loan options down to just two. One option is to borrow the money over 4 years at 8.4% p.a. (p.a. stands for per annum) and the other is to borrow it over 3 years at 7.5% p.a. John has also considered his financial circumstances and feels that the maximum monthly payment he could afford is £500. In the space below calculate the monthly repayment for John and help him decide which loan option to take.

16. John borrows £16,500 over 4 years @ 8.4% p.a.?

Use growth factors to help and don't forget there are 48 months in 4 years!

17. John borrows £16,500 over 3 years @ 7.5% p.a.?

Again use a growth factor to help…

NUMBER

TASK 1 - MONEY MATTERS

18. Which loan option will John take based on the maximum monthly payment he can afford?

19. What is the main disadvantage for John in taking this loan option? In your answer give a reason and a number!

In the examples so far we have looked at interest on loans where the interest is applied each year. Often in practice it is applied each month. We can look at how a loan would be repaid over a one year period with the interest calculated each month. Breaking down a loan in this way is called 'amortising' by banks and it is useful to see how interest really works!

Peter is a self-employed joiner who borrowed £1000 to take advantage of an on-line sale on tools and equipment from a trade supplier.

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TASK 1 - MONEY MATTERS

Complete the loan breakdown below for his loan of £1000 charged at an interest rate of 1% per month. Read the information carefully before completing the table.

The balance in any given month is the difference between the balance and capital reduction from the previous month.

Monthly repayment is the repayment amount that will result in the loan being paid off after the agreed number of months. In this case it is fixed at £88.84

Interest is a fixed percentage (in this case 1%) of the balance each month.

Capital reduction is the difference between the monthly repayment and Interest.

20. The first half of the table has been completed for you. (You may consider completing this table by making use of spreadsheet software!)

** Look at how to calculate the interest for month 3. It is 1% of £841.53 which is £8.4153. When rounding this to 2 decimal places you would naturally end up with £8.42. However lenders cannot overcharge on interest which means they would have to round this down to £8.41.*

You can use this space for rough work!

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TASK 1 - MONEY MATTERS

Mth	Balance	Interest	Monthly repayment	Capital reduction
1	1000.00	10.00	88.84	78.84
2	921.16	9.21	88.84	79.63
3	841.53	8.41	88.84	80.43
4	761.11	7.61	88.84	81.23
5	679.87	6.79	88.84	82.05
6	597.82	5.97	88.84	82.87
7				
8				
9				
10				
11				
12				
13				

An extra row has been included in the table just in case you find that the capital reduction in month 12 does not exactly clear all the outstanding balance!

21. If you have needed to put an entry in for balance in Month 13 explain below why you think this is and what do you think will happen to this amount?

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TASK 1 - MONEY MATTERS

22. How much did Peter pay back in total?

23. What do you notice about the amount of interest each month as the loan progresses?

24. How would you explain capital reduction to someone who didn't know what it was?

NUMBER

TASK 2 - NUTS AND BOLTS

James works for a large construction firm and one of his duties is to source structural steel components and fasteners (rivets, screws and bolts). His company has just won a contract for a very large development and he has set about sourcing the construction fasteners needed for the job.

Keeping costs to a minimum is very important and the lead civil engineer has asked James to investigate the possibility of sourcing these fasteners in the United States.

After some searching James has located a supplier who can provide the type of nuts and bolts required. Here is a table containing some data James has been given on a range of hex head bolts. As is often the case in US Imperial units have been used for length and diameter.

Code	Length (inches)	Diameter (inches)	Steel grade
A	3/4	½	10.9
B	1	¼	12.9
C	1 ½	3/8	11.9
D	1 ½	11/8	11.9
E	1 ½	5/16	12.9
F	2	9/16	10.9
G	2	7/16	11.9
H	2 ½	1 ¼	6.8
I	2 ½	3/4	7.9
J	4	17/16	10.9

NUMBER

TASK 2 - NUTS AND BOLTS

1. Complete the table below for the selection of bolts above in terms of increasing shaft diameter. The first row is already completed?

Code	Diameter (inches)	Length (inches)	Steel grade
B	¼	1	12.9

2. What is the average (mean) length of the 10.9 grade fasteners?

Total length of 10.9 grade fasteners:

Mean length of 10.9 grade fasteners:

The Steel grade indicates the tensile strength of the steel used and is obviously of critical importance. Assume the grade numbers used (10.9, 11.9 etc) are direct measures of strength (in other words steel with a grade of 12.9 would be exactly twice as strong as steel with a grade of 6.45). A structural engineer has informed James that any fasteners of grade 6.8 and 7.9 are to be replaced by ones at least 40% stronger.

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TASK 2 - NUTS AND BOLTS

3. Which grades could be used to replace fasteners at the lower strength grades (6.8 and 7.9)?

You can tick more than one option if appropriate

6.8 grade fasteners: Replaced by:	7.9	10.9	11.9	12.9
7.9 grade fasteners: Replaced by:	10.9	11.9	12.9	

In order to compare these US fasteners with specifications provided by colleagues using metric measurements, James must convert the data for length and diameter into metric units. For the particular application in mind the precise diameter of these fasteners is critical. Accuracy in converting length is important but not critical. Therefore James has decided to adopt a different approach to making the conversion for diameter than for length.

4. To convert the lengths of the fasteners he decides to use the conversion 1 inch = 2 ½ cm. He doesn't use a calculator for this and not all Codes are used. Complete the table?

Code	Length (inches)	Length (cm)	
		Fraction	Decimal
	¼	¼ x 2 ½ = ¼ x 5/2 = 5/8	5/8 = 0.625
B			
C			
F			
H			

NUMBER

TASK 2 - NUTS AND BOLTS

5. To convert the diameters he uses the conversion 1 inch = 25.4 mm as he needs to have this correct to the nearest ½ mm?

Code	Diameter (inches)	Diameter (metric)	
		mm	cm
A	½	½ = 0.5 0.5 x 25.4 = 12.7 = 12.5mm	12.5mm = 1.25cm
B	¼		
F	9/16		
H	1 ¼		
I	¾		

Following consultation with other construction professionals James concludes that almost 60000 fasteners will be required for this job. The job will require a mixture of Type A, B, C and J fasteners and the nature of the job indicates that they will be needed in the ratio 2:4:1:5.

6. Determine how many of each fastener is required?

Code	A	B	C	J
Ratio	2	4	1	5

Total number of fasteners = 60,000

Number of each type of fastener:

A = B = C = J =

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TASK 2 - NUTS AND BOLTS

7. Use the previous answer together with the original table (summarised below) to determine the ratio of fasteners ordered in terms of Steel grade?

Code	A	B	C	J
Grade	10.9	12.9	11.9	10.9

Find the Steel grade ratio **grade10.9:grade11.9:grade12.9** for the 60000 fasteners required.

Now that James has decided on the number of fasteners of each type required he needs to get a price for the order.

8. The supplier has the following table for pricing: use it to determine the cost of his order of 60,000 fasteners?

CODE	ORDER SIZE ($ PER 100)			
	<1000	*1000-4999*	*5000-19999*	*20000 or more*
A	N/A	8.95	7.50	6.95
B	10.50	9.95	8.50	7.95
C	12.50	11.95	10.50	9.95
J	24.50	22.95	20.50	18.95

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TASK 2 - NUTS AND BOLTS

James now needs to determine the carriage cost for this order which will be determined by its weight. All fasteners come in boxes of 100 and the weight (mass) of each box is given in the table. Note the units used are lbs (pounds).

9. Determine the total weight of the order in lbs. Ignore the weight of any extra packaging as it will only be a tiny fraction of the total?

Code	A	B	C	J
Mass (lb)	4.3	6.5	9.2	10.5

James is going to use a courier located in the UK to bring the order home. On their website he needs to enter the weight of the order in kg.

10. Convert the previous answer to kg using 1kg = 2.2lb. Give your answer to the nearest kg?

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TASK 2 - NUTS AND BOLTS

The order will be loaded onto pallets for delivery from US to UK. The courier charges 25p per kg and there is a Customs administration charge of £47.50 placed on all orders.

11. In the space below calculate the carriage costs of the load using this courier?

12. Find out what the current $:£ exchange rate is and use it to price the entire order in Sterling (£) (remember the cost of the order is in $ but the carriage is in £)

Before completing the order one of the company directors asks James to double the size of the order as they have just won a second similar contract.

13. How will this impact on the cost of carriage? Will it also double? Answer this in the space below and explain your findings.

NUMBER

TASK 3 - LEVELS AND FORCES

The use of negative numbers in construction is generally related to temperature (see task called Temperature) and finances (see task called Bank Statement). They are also very useful when working with distance above or below certain levels in surveying or the direction of forces that act in beams, columns, frames etc.

In this task we will consider some situations where negative numbers are used in surveying levels and when working with forces.

Concrete hollow core floor units have a natural pre-camber when they are pre-stressed during manufacture.

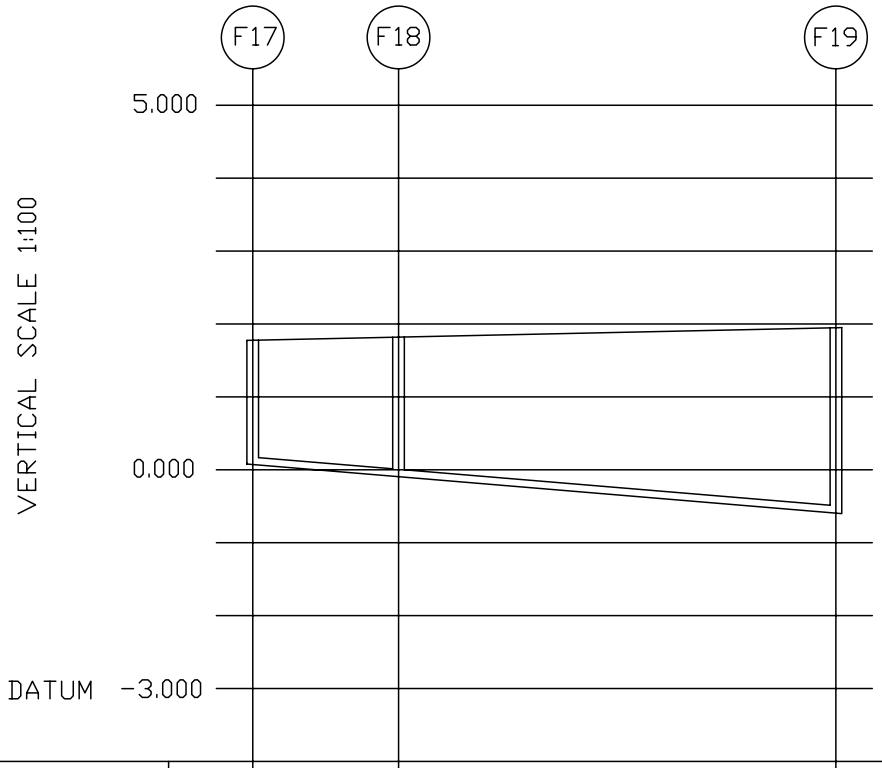
A hollow core slab spanning 7.0m has a pre-camber of -4.5mm. When a certain dead load is applied in use the slab deflects downwards from the pre-stressed position by 5.3mm.

1. In the space below produce a sketch to describe the situation. Include a vertical number line and mark the before (unloaded) and after (loaded) positions.

NUMBER

TASK 3 - LEVELS AND FORCES

The diagram below shows invert levels and cover levels of foul sewer through a site for a new leisure complex. Measurements have been taken between points F17, F18 and F19 on the site. All quoted levels are in metres and you do not need to take any scale measurements from the drawing, just use the values in the table.



FOULWATER COVER LEVEL	1.620	1.687	1.912	
FOULWATER INVERT	0.099	-0.084	-0.681	
FOULWATER DETAILS		Dia 150 Type uPVC 1 in 60	Dia 150 Type uPVC 1 in 60	
FOULWATER LENGTHS		10.964	35.742	

HORIZONTAL SCALE 1:500

LONGITUDINAL SECTION OF FOUL SEWER F17-F19

NUMBER

TASK 3 - LEVELS AND FORCES

2. What is the difference in the invert level between grid F17 and F18?

3. What is the difference in depth between the foul water cover level and the foul water invert level at location F18?

4. What depth has the foul water invert level dropped between F18 and F19?

NUMBER

TASK 3 - LEVELS AND FORCES

The internal ground floor level of a house has been set at 0.00m. External ground level is 0.15m below internal ground floor level. Internal basement level is 2.60m below internal ground floor level. The height of the eaves level is 5.20m above internal ground floor level. Mark on the diagram below the missing levels and calculate

5. The difference in height between external ground level and eaves level?

6. The total height from basement floor to eaves level?

7. How far is the basement floor level below external ground level?

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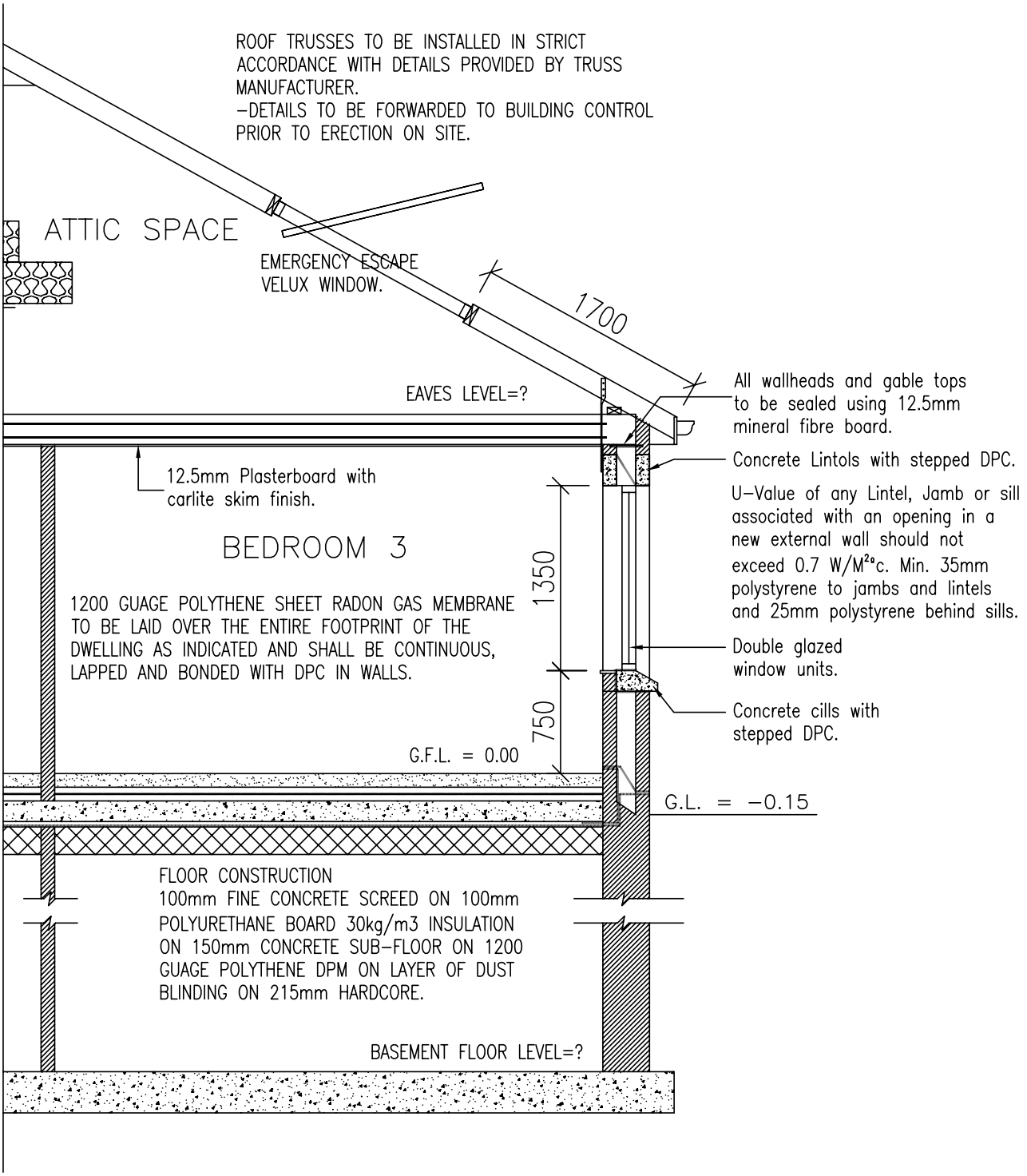
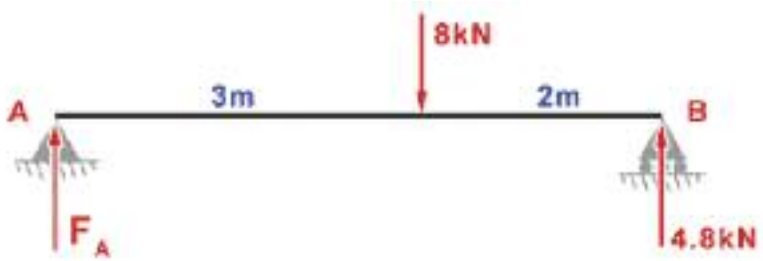
TASK 3 - LEVELS AND FORCES



NUMBER

TASK 3 - LEVELS AND FORCES

The diagram below shows the forces present in a beam. A simply supported beam is supported at each end as shown and there are often forces (loads) acting on the beam itself between the supports. In the diagram there is a force of 8kN acting as shown. As a result there will be upwards forces acting at each of the support points A and B. The force at B is given as 4.8kN.



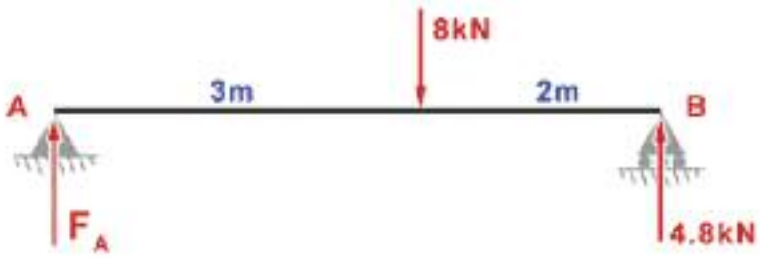
In order for this beam to be stable, certain conditions must hold. These are called equilibrium conditions and one condition is that the forces must all add up to zero! Forces are considered positive or negative depending on which direction they act. In this task we will take upwards forces as positive with downwards forces as negative.

For the beam in the diagram we can work out the unknown force FA as follows:

$F_A + 4.8 - 8 = 0$

$F_A - 3.2 = 0$

$F_A = 3.2$ kN



As a check we can sum positive forces and negative forces separately to see if the totals are equal.

For the beam above this would give:

Total positive forces = 3.2 + 4.8 = 8kN

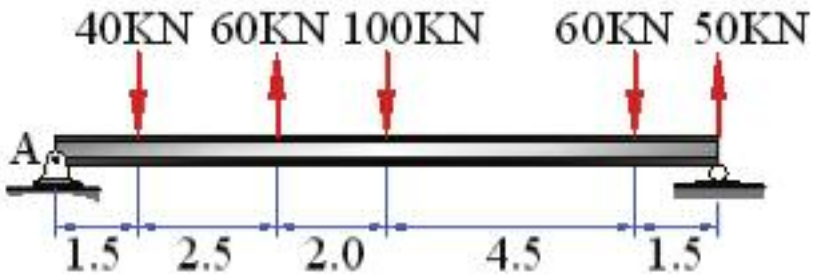
Total negative forces = 8kN

NUMBER

TASK 3 - LEVELS AND FORCES

Apply what you have learned in this example to the following problem (ignore the distances between the forces in the diagram).

8. Draw in the direction of the missing force at A



9. Use the method above of summing forces to equal zero to help you work out the size of the force at A?

10. Finally check your answer using the method of positive and negative totals?

NUMBER

TASK 4 - BANK STATEMENT

Here is the bank statement for a local building contractor for the month of November. The contractor wants to take a detailed look at the statement and get an overview of his account. You can help with this by answering the following questions.

Mid-Ulster Bank **Statement of Account**

St. Swithin's Branch
Broad Street
Magherafelt
Co. Londonderry

Tel: 02886712345

Sort: 09-59-01
A/C 657362142
Date 12.12.10

A N Other, Main street, Belfast

Date	Details	Debits	Credits	Balance
01 Nov	Opening Balance			1836.51
02 Nov	Direct Debit 043121	2248.07		
03 Nov	Cheque 234174	2192.83		
05 Nov	Transfer a/c 61152309		1500.00	
09 Nov	Cheque 234017	5877.30		
10 Nov	Cheques paid in		4540.50	
10 Nov	Standing order 0021972	1466.45		
16 Nov	Cash paid in		8340.18	
20 Nov	Cheques for salary	7840.37		
25 Nov	JR Materials (refund)		2540.34	
27 Nov	Cheque paid in		12277.45	11409.96
29 Nov	Direct Debit	3480.32		7929.64
30 Nov	Closing Balance			

NUMBER

TASK 4 - BANK STATEMENT

1. Fill in the balance column as far as 29th November. The balance on 29th November should be £7929.64, allowing you to check your answer. Use the space below as well if you need to.

2. Use an alternative method to arrive at the balance on 29th November.

Hint: Total the Debit and Credit columns separately and then combine your answer with the figure for opening balance on 01 Nov.

3. On 2nd Nov Direct Debit 043121 was debited from the account leaving a balance that day of -£411.56 What does the negative sign mean?

NUMBER

TASK 4 - BANK STATEMENT

4. On which day was the account at its lowest point and how much did he have in the bank on that date?

Date:

Amount owed:

The contractor has an agreed overdraft of £5000 on this account for which he pays £80 per month. The £80 is applied on the last day of the month and is applied if the account was 'in the red' for even one day in the month. He does not pay the fee for any month in which the account remained 'in the black' at all times.

5. Will he have to pay the £80 fee for the month of November?

The contractor also has an emergency reserve overdraft on the account of £2000. This means that if he exceeds his agreed overdraft of £5000 the bank will continue to honour any drawings on the account up to an extra £2000 (i.e. allowing a balance up to -£7000). However the bank has stipulated two conditions on this emergency reserve if it is used:

- A charge of 1.5% of the minimum balance will be applied at the end of the month
- The account needs to be brought back into the agreed overdraft limit immediately at the end of the month.

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TASK 4 - BANK STATEMENT

6. Did he use his emergency reserve in November?

7. If he did use the emergency reserve determine the charge that will be applied for using it?

NB: if you need to round off a calculator display figure to the nearest penny remember a bank will have to round down so as not to overcharge!

There was no additional activity on the account on 29th and 30th November.

8. Complete the statement up to and including Nov 30th by applying any fees or charges due? Use the space below to do any additional calculation you need to.

NUMBER

TASK 4 - BANK STATEMENT

The table below contains details on the account over the previous four months. In particular you will see the closing balance each month and the minimum balance for that month.

Month (2010)	Closing Balance Balance (before fees / charges)	Minimum Balance	Overdraft fee	Emergency reserve charge
July	3144.44	2469.46		
August	-6183.86	-6492.08		
September	1064.99	-2845.91		
October	1836.51	493.67		

9. Complete the table by entering an overdraft fee and an emergency reserve charge each month where appropriate. You may find it useful to read the instructions above again about how and why fees/charges are applied to this account. Use the space below for any working out you need to do?

At the end of one month the contractor had to lodge money into his account to bring the balance back to within the agreed overdraft limit (£5000).

10. Which month was that and how much did he have to lodge? Don't forget that the closing balance figure in the table above has NOT had any charges or fees applied. These will need to be added in before the final closing balance for the month is known.

NUMBER

TASK 5 - TEMPERATURE

Negative numbers are numbers to the left (or below) zero on a number line. The use of negative numbers in construction is generally related to temperature, finances (see task called Bank Statement), height above or below certain levels in surveying or the direction of forces and sense of moments (clockwise or anti-clockwise) that act in beams, columns, frames etc.

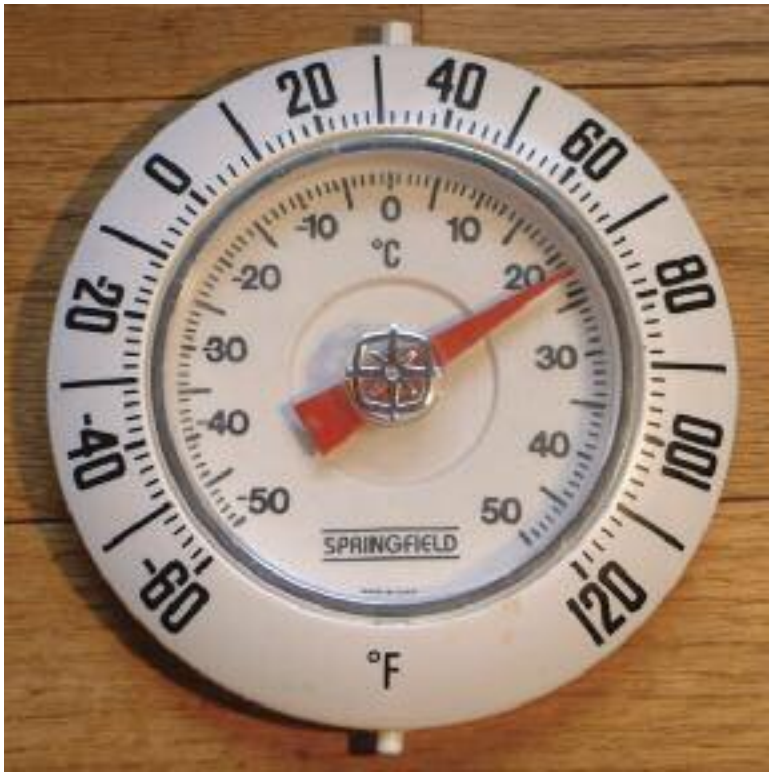
In this task we will look at some examples of how negative numbers can crop up when working with temperature.

There are two temperature scales you need to be aware of and indeed be able to convert temperatures from one scale to the other. Nowadays the Celsius temperature scale is more popular but Fahrenheit is still used quite frequently.

In the Celsius temperature scale 0°C represents the freezing point of water. Be careful, it does not mean there is no heat energy present. It just means there isn't enough heat present for water to exist in liquid form so it freezes. A negative value on the Celsius scale indicates a temperature lower than 0°C where there is less heat energy present and so it feels colder.

The boiling point of water is defined as 100°C on the Celsius scale but is 212°F on the Fahrenheit scale.

The picture below contains a dial from which you can read temperature in either scale.



NUMBER

TASK 5 - TEMPERATURE

1. What is the temperature according to the dial in °C to the nearest degree?

2. What is the dial reading in Fahrenheit (°F)? Try to estimate this to the nearest Fahrenheit degree and later you can use a formula to check.

In the text above you were told that two key points on the Celsius scale are 0°C and 100°C (this portion of the Celsius scale is sometimes referred to as the Centigrade scale because it has a range of 100 degrees). It was also stated above that the boiling point of water corresponds to 212°F.

3. What is the freezing point of water on the Fahrenheit scale? Use the dial and the information already given.

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Two workers, Jake and Paul, are having a discussion about the usefulness of this dial.

Jake said, ***"This dial cannot be used to convert 60°C to Fahrenheit (°F)"***
Paul said, ***"Yes it can, you could just find out what 30°C converts to and double it!"***
This made Jake think as he wondered if Paul was correct. To reinforce his point Paul added,
"If someone is 1 metre tall then that makes them 3' 3" tall so if someone else is 2m tall they will be 6' 6" tall – you just double it"

4. Produce some evidence from the dial gauge above to settle the discussion one way or another?

5. In the space below to explain why Paul is correct when he says "If someone is 1 metre tall then that makes them 3' 3" tall so if someone else is 2m tall they will be 6' 6" tall" but he is wrong when he attempts to apply this argument to the temperature scales of Celsius and Fahrenheit?

You may wish to include the following words in your answer or use them to help structure your answer: "direct proportion", "one quantity is zero when the other is zero", "0°C is not 0°F", "doubling one temperature did not make the other temperature double", "if you increase one quantity by a certain percentage the other increases by the same percentage"

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TASK 5 - TEMPERATURE

You will not always have access to a dial (or other device) to help you make a conversion from one temperature scale to another. Even if you had the dial above it could only help you with temperatures in the range shown as the above discussion has demonstrated.

For instance you could not use the dial to convert 60°C to °F! For this you could make use of a formula which works for all temperatures and conversion formula are very useful for this reason. We will consider two formulae in this section that can be used to convert from one temperature scale to the other depending on which direction conversion is needed.

Before doing this it will be helpful to recap on some number facts. Consider the two numbers 5/9 and 9/5.

6. One number is a proper fraction – which one is it? Give your answer in numbers and words.

7. Write the other number as a mixed number, again using numbers and words?

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TASK 5 - TEMPERATURE

8. Convert each number (5/9 and 9/5) to a decimal fraction. Use your calculator and simply record the screen display in the space provided?

5/9:

9/5:

9. Now put each of the above answers into words?

Hint: for 0.45 you would write “zero point four five” or for 7.3636363636 you could write “seven point three six repeating”

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TASK 5 - TEMPERATURE

When using temperature conversion formula you will need to use the above numbers (sometimes as fractions (5/9 or 9/5), sometimes as decimals (0.55 and 1.8)) in multiplications. This will be easy if you have a calculator but sometimes you may not and there are some useful properties of these numbers which may be helpful.

We can look at 1.8 first.

1.8 = 2 - 0.2 so multiplying a number by 1.8 is the same as multiplying the number by 2 and by 0.2 and then subtracting the two answers.

At first glance this may not seem to be much of an advantage but if you notice that

0.2 = 2 ÷ 10

then the advantage becomes clear as it is easy to divide by 10. Follow the examples below and then attempt the multiplications that follow.

Any multiplications involving negative numbers are optional!

eg 1: **45 x 1.8**
We can see that

45 x 2 = 90

and

45 x 0.2 = 9.0 (because 90 ÷ 10 = 9)

Which means…

45 x 1.8 = 90 – 9 = 81

eg 2: **6.4 x 1.8**

6.4 x 1.8

Again we can see that

6.4 x 2 = 12.8

and

6.4 x 0.2 = 1.28 (because 12.8 ÷ 10 = 1.28)

Which means…

6.4 x 1.8 = 12.8 – 1.28 = 11.52

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TASK 5 - TEMPERATURE

10. In the space below complete the multiplications without using your calculator?

23 x 1.8	-37 x 1.8

Now we will look at how to work with **0.55.**

The first thing to note is

0.55 = 0.5 + 0.05

then make use of two simple number facts

- 0.5 is the decimal form of the fraction ½.
- 0.05 = 0.5 ÷ 10.

So, to multiply something by 0.55 you could

"first of all find one half of the number you are multiplying, then divide that number by 10, finally add these two answers together".

To make this clear we can look at an example

eg: **48 x 0.55**

- Half of 48 is 24
- One tenth of 24 id 2.4

So **48 x 0.55 = 24 + 2.4 = 26.4**

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Sometimes you may need to multiply by 0.555 instead of 0.55 depending on how accurate you want your answer to be.

11. In the space below set out a method you could use as a convenient way to multiply by 0.555 without using a calculator or doing an actual multiplication sum?

Hint: 0.555 = 0.5 + 0.05 + 0.005!

12. Put your chosen method to use below?

48 x 0.555

13. Round the previous answer to 1 decimal place?

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14. Compare your previous answer to the answer given above to 48 x 0.55. Which is closer to the exact answer to 48 x 5/9 and why?

Sometimes when multiplying by 5/9 it will actually be easier to do a fraction multiplication than firstly converting the fraction to a decimal. For instance consider the multiplication 36 x 5/9.

15. In the space below calculate the answer to this multiplication using fractions?

16. What property has the number 36 that made it easier to do the above calculation with 5/9 as a fraction instead of a decimal?

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17. If instead the multiplication was 36 x 9/5 which approach would be easier – using 9/5 as a fraction or as a decimal? To help you decide do the multiplication both ways in the space below.

36 x 9/5:

36 x 1.8:

18. Without doing any calculations give a reason indicating which approach (fraction or decimal) you feel would be easier to do the multiplication 25 x 9/5?

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TASK 5 - TEMPERATURE

We can now look at the actual temperature conversion formula. As mentioned earlier there are two formulae depending on whether you need to convert from Celsius (°C) to Fahrenheit (°F) or the other way around.

If you are converting temperature from Celsius (°C) to Fahrenheit (°F) then use this formula

$$C = \frac{5}{9}(F - 32)$$

C represents Celsius temperature and F represents Fahrenheit temperature.

19. Indicate which of the following statements correctly describes how to apply this formula?

A: multiply the Fahrenheit temperature by five ninths and then subtract thirty-two.

B: subtract thirty-two from the Fahrenheit temperature and then multiply by five ninths

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If instead you need to convert from Fahrenheit (°F) to Celsius (°C)you should use this formula

$$F = \frac{9}{5}\,\mathrm{C} + 32$$

again C represents the Celsius temperature and F represents the Fahrenheit temperature.

20. In the space below use words to describe how to correctly apply this formula?

Now we can look at an actual construction situation where you will have the opportunity to use these formulae and apply what you have learned earlier in the section.

During a cold spell temperature on site is monitored as freezing conditions can cause problems with materials and machinery. The health and safety of employees is also a top priority. In order to know whether certain precautions are necessary the temperature is recorded as shown in the table below.

Site temperature at 8am (1st to 14th November 2010)														
Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Temp(°C)		4			-5		-10	-7	-3	4	1		4	
Temp (°F)	50	39	30					19	27	39	34			41

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TASK 5 - TEMPERATURE

Each morning the temperature may be taken by a different individual with the result that on some mornings the temperature has been recorded in Celsius, some mornings in Fahrenheit and some mornings it has been recorded it in both formats.

On 1st, 3rd and 14th November temperature has been recorded in Fahrenheit degrees.

21. Use the appropriate formula to convert these temperatures to Celsius and record the answers in the table. Round to the nearest °C if necessary?

Before each calculation decide whether it is easier to use five ninths in fraction format (5/9) or in decimal format (0.55)!

1st:

3rd:

14th:

NUMBER

TASK 5 - TEMPERATURE

On 5th, 7th and 13th temperature has been recorded in Celsius degrees.

22. Use the appropriate formula to convert these temperatures to Fahrenheit and record the answers in the table. Round to the nearest °F if necessary?

Before each calculation decide whether it is easier to use nine fifths in fraction format (9/5) or in decimal format (1.8)!

5th:

7th:

13th:

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TASK 5 - TEMPERATURE

Temperatures for 4th, 6th and 12th are not shown in the table. The images below show the temperatures for these dates measured in Celsius.

23. Make each temperature reading and record the result in the table?

4th December **6th December** **12th December**

24. Use the conversion dial shown earlier to record the temperatures for 4th, 6th and 12th in Fahrenheit to the nearest degree. As an exercise you may wish to test how well you have used the dial by checking your answers with the conversion formula?

25. Now that the table is complete you should use the space below to determine the mean temperature over the two week period, firstly in Celsius and then in Fahrenheit?

Celsius:

	4			-5		-10	-7	-3	4	1		4	

Fahrenheit:

50	39	30					19	27	39	34			41

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TASK 5 - TEMPERATURE

26. Without doing an actual calculation how might you perform a check on your previous answers?

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TASK 1 - MONEY MATTERS ANSWERS

In this task we will explore some important points about borrowing money as this is very likely something you will have to do in the future in your career and/or personal life. You may well need to borrow money to purchase a vehicle, tools, equipment or property.

If you have ever heard or had a discussion on loans or borrowing you will be aware of the term “Interest” or “Interest rate”. Interest is a charge a lender makes to a borrower: it is the cost of borrowing or the price of money!

You may wish to purchase something but don’t have the cash available to do so. Some institutions (e.g. bank/building society/Credit Union) may lend you the money to make the purchase meaning you can have the goods immediately. You agree to pay the money back over a given period of time, usually months or years. The lender has taken a risk in giving you their money as something may happen that means you find it difficult to pay it back. In financial arrangements lenders expect some reward for taking this risk and the reward is that they will get back more than they gave you in the first place – that’s Interest!

For instance suppose you borrowed £500 for a certain period of time. A lender may choose an interest rate of 10%. This means that you have to pay back the original £500 plus the interest (10% of £500). The original £500 borrowed is usually referred to as Capital.

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TASK 1 - MONEY MATTERS ANSWERS

1. What is the interest to be paid back on this loan?

£50

2. What is the total amount to be paid back?

£500 + £50 = £550

3. If the loan is to be paid back in 10 equal instalments how much will each instalment be?

£550 ÷ 10 = £55

4. What if you had agreed 12 equal instalments, how much would each instalment be?

£45.83

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TASK 1 - MONEY MATTERS ANSWERS

Alternatively you may have agreed to pay back £35 each month for instance as that was the maximum you could afford.

5. In this case how long would it take you to repay the loan in full?

(16 months): 15 payments of £35 followed by a single payment of £25

In practice interest is usually expressed as a per annum (yearly) percentage rate because loans normally run over a fixed number of years such as 3yrs or 5yrs (or maybe 10-15yrs for a commercial loan or 20-30yrs as in the case of a domestic mortgage).

For example, a bank may quote their lending rate as 10% p.a. To see what this means we will consider a real loan situation. Suppose Paul wants to borrow £2500 over three years (i.e. he will pay the money back gradually over three years normally in equal monthly instalments). The lender will calculate how much Paul has to pay in the following way.

Year 1:

Outstanding amount is £2500.

Interest for Yr 1 is 10% of £2500 = 2500 ÷ 100 × 10 = £250

The interest for the year is £250. You may now be tempted to simply multiply this amount by three to find out how much interest is to be paid over three years but it does not work like that in practice. Instead, lenders add on the interest for the first year when calculating interest for the second year.

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TASK 1 - MONEY MATTERS ANSWERS

6. To see how this works complete the calculation below?

Year 2:
Outstanding amount from Yr 1 is £2500 + £250 = £2750

Interest for Yr 2 is 10% of £2750 = £ **275**

Year 3:
Outstanding amount from Yr 2 is £2750 + £ **275** = £ **3025**

Interest for Yr 3 is 10% of £ **3025** = **3025** ÷ 100 × 10 = £ **302.50**

Total to be repaid is £ **3025** + £ **302.50** = £ **3327.50**

You can check your answer with the following statement, "if you borrow £2500 over three years at an interest rate of 10% pa you will pay back £3327.50 in total".

7. How many months are there in three years?

12 × 3 = 36

8. How much will each equal monthly instalment be?

Write down the display on your calculator including all digits

3327.50 ÷ 36 = 92.43055556

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TASK 1 - MONEY MATTERS ANSWERS

9. Round this off to an appropriate degree of accuracy.

£92.43

When you are working with loans (or anything that involves percentages) it is very useful to be able to add on the interest in an efficient way. It will save time when you get used to it and can often make things easier. Here is what we mean by this…

In the example above we worked out 10% of £2500 (the interest) and then added that to the original £2500 (the capital) to get the total to be repaid for the first year of borrowing. These two steps can be done in a single multiplication which saves time. You will see how this works below but first….

You just need to brush-up on being able to write a percentage as a decimal fraction.

For example 50% = 0.5 and 25% = 0.25.

10. What is 10% as a decimal?

0.10

11. What is 75% as a decimal?

0.75

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TASK 1 - MONEY MATTERS ANSWERS

12. What is 100% as a decimal?

1.00

….and back to the loan calculation!

Original capital + interest for the year

= 100% of 2500 + 10% of 2500

= 1.0 x 2500 + 0.1 x 2500

= 1.1 x 2500 (or 2500 x 1.1) = 2750

If you understood this you will now see that to increase a quantity by 10% we can multiply it by 1.1 (1.1 is the same as 110%).

In reality interest rates are not normally round figures such as 10%! Typical values might be 12.5%, 7.8%, 6.2% depending on the type of loan, etc.

13. Write each of the following percentage rates as decimals.
(some examples to start you off)

12.5% = 0.125	80% = **0.80**	7.9% = **0.079**
13.8% = 0.138	8% = **0.08**	8.34% = **0.0834**
17.5% = 0.175	8.3% = **0.083**	1.3% = **0.013**
12.4% = **0.124**	6.4% = **0.064**	0.8% = **0.008**

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TASK 1 - MONEY MATTERS ANSWERS

Now we can look at how to use this to add on interest or just increase (or decrease) things by a certain percentage. For instance, calculate the total capital and interest one year after borrowing £500 at an interest rate of 6.5%.....

100% of 500 + 6.5% of 500

= 1.0 x 500 + 0.065 x 500

= (1.0 + 0.065) x 500

= 1.065 x 500

= £532.50

Try this one yourself!

14. Calculate the total capital and interest one year after borrowing £16500 at an interest rate of 8.4%?

1.0 x 16,500 + 0.084 x 16,500

(1.0 + 0.084) x 16,500

1.084 x 16,500

= £17,886

In the previous calculation the number “1.084” is often called a growth factor and is very useful in percentage and interest calculations. To see how, let’s suppose the sum of money, £16,500, was borrowed over two years instead of one. The interest would have to be applied twice. We did something very similar to this in question 6 but did not use a growth factor.

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TASK 1 - MONEY MATTERS ANSWERS

Over two years the total capital and interest would be (to the nearest penny)

£16,500 x 1.084 x 1.084 = £16,500 x 1.084^2 = £19,388.42

Questions 15-19 are quite difficult so you can leave them out if you wish!

15. What would the total capital and interest be if this amount was borrowed over three years instead of two (interest rate is still 8.4%)?

Use '2 years' to help you: £16,500 x 1.084 x 1.084 = £16,500 x 1.084^2 = £19,388.42

£16,500 x 1.084 x 1.084 x 1.084 = £16,500 x 1.084^3 = £21,017.05

John is a contractor who has just successfully tendered for a new development and needs to add to his existing fleet of diggers. He visits a website to see what his options are for borrowing £16,500 to finance the digger you see here.

He wants to consider a couple of important aspects of the loan: the interest rate and the loan repayment term (i.e. how long does he takes to pay the money back).

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TASK 1 - MONEY MATTERS ANSWERS

Obviously he wants to pay as low an interest rate as possible but it is not always as simple as that. For instance, sometimes to get a lower interest rate you may need to choose a shorter loan period and this then makes the monthly payment higher.

John has narrowed the loan options down to just two. One option is to borrow the money over 4 years at 8.4% p.a. (p.a. stands for per annum) and the other is to borrow it over 3 years at 7.5% p.a. John has also considered his financial circumstances and feels that the maximum monthly payment he could afford is £500. In the space below calculate the monthly repayment for John and help him decide which loan option to take.

16. John borrows £16,500 over 4 years @ 8.4% p.a.?

Use growth factors to help and don't forget there are 48 months in 4 years!

£16,500 x 1.084 x 1.084 x 1.084 x 1.084 = £16,500 x 1.084^4 = £22,782.48

£22,782.48 ÷ 48 = £474.63

17. John borrows £16,500 over 3 years @ 7.5% p.a.?

Again use a growth factor to help…

£16,500 x 1.075 x 1.075 x 1.075 = £16,500 x 1.075^3 = £20,497.89

£20,497.89 ÷ 36 = £569.38

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TASK 1 - MONEY MATTERS ANSWERS

18. Which loan option will John take based on the maximum monthly payment he can afford?

John will have to take the loan of £16,500 over 4 years @ 8.4% p.a.

19. What is the main disadvantage for John in taking this loan option? In your answer give a reason and a number!

By taking this loan John will have to make loan payments for 4 years instead of 3 years and will pay back an extra £2284.59 over the other loan.

In the examples so far we have looked at interest on loans where the interest is applied each year. Often in practice it is applied each month. We can look at how a loan would be repaid over a one year period with the interest calculated each month. Breaking down a loan in this way is called 'amortising' by banks and it is useful to see how interest really works!

Peter is a self-employed joiner who borrowed £1000 to take advantage of an on-line sale on tools and equipment from a trade supplier.

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TASK 1 - MONEY MATTERS ANSWERS

Complete the loan breakdown below for his loan of £1000 charged at an interest rate of 1% per month. Read the information carefully before completing the table.

The balance in any given month is the difference between the balance and capital reduction from the previous month.

Monthly repayment is the repayment amount that will result in the loan being paid off after the agreed number of months. In this case it is fixed at £88.84

Interest is a fixed percentage (in this case 1%) of the balance each month.

Capital reduction is the difference between the monthly repayment and Interest.

20. The first half of the table has been completed for you. (You may consider completing this table by making use of spreadsheet software!)

** Look at how to calculate the interest for month 3. It is 1% of £841.53 which is £8.4153. When rounding this to 2 decimal places you would naturally end up with £8.42. However lenders cannot overcharge on interest which means they would have to round this down to £8.41.*

You can use this space for rough work!

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TASK 1 - MONEY MATTERS ANSWERS

Mth	Balance	Interest	Monthly repayment	Capital reduction
1	1000.00	10.00	88.84	78.84
2	921.16	9.21	88.84	79.63
3	841.53	8.41	88.84	80.43
4	761.11	7.61	88.84	81.23
5	679.87	6.79	88.84	82.05
6	597.82	5.97	88.84	82.87
7	**514.95**	**5.14**	**88.84**	**83.70**
8	**431.25**	**4.31**	**88.84**	**84.53**
9	**346.72**	**3.46**	**88.84**	**85.38**
10	**261.34**	**2.61**	**88.84**	**86.23**
11	**175.11**	**1.75**	**88.84**	**87.09**
12	**88.02**	**0.88**	**88.84**	**87.96**
13	**0.06**			

An extra row has been included in the table just in case you find that the capital reduction in month 12 does not exactly clear all the outstanding balance!

21. If you have needed to put an entry in for balance in Month 13 explain below why you think this is and what do you think will happen to this amount?

Because of the rounding down during the loan breakdown not all the interest gets paid off. This 6p will be written off by the bank and will not have to be paid by Peter.

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TASK 1 - MONEY MATTERS ANSWERS

22. How much did Peter pay back in total?

12 x £88.84 = £1066.08

23. What do you notice about the amount of interest each month as the loan progresses?

It decreases because the interest applied in any month depends on the balance (amount outstanding) at the beginning of that month. As this is decreasing the interest charged also decreases.

24. How would you explain capital reduction to someone who didn't know what it was?

Each month a loan payment is made. Some of this payment goes towards covering the interest for that month. The rest is used to reduce the amount owed to the bank (i.e. the balance). The amount by which the balance is reduced each month is the capital reduction.

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TASK 2 - NUTS AND BOLTS ANSWERS

James works for a large construction firm and one of his duties is to source structural steel components and fasteners (rivets, screws and bolts). His company has just won a contract for a very large development and he has set about sourcing the construction fasteners needed for the job.

Keeping costs to a minimum is very important and the lead civil engineer has asked James to investigate the possibility of sourcing these fasteners in the United States.

After some searching James has located a supplier who can provide the type of nuts and bolts required. Here is a table containing some data James has been given on a range of hex head bolts. As is often the case in US Imperial units have been used for length and diameter.

Code	Length (inches)	Diameter (inches)	Steel grade
A	3/4	½	10.9
B	1	¼	12.9
C	1 ½	3/8	11.9
D	1 ½	11/8	11.9
E	1 ½	5/16	12.9
F	2	9/16	10.9
G	2	7/16	11.9
H	2 ½	1 ¼	6.8
I	2 ½	3/4	7.9
J	4	17/16	10.9

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TASK 2 - NUTS AND BOLTS ANSWERS

1. Complete the table below for the selection of bolts above in terms of increasing shaft diameter. The first row is already completed?

Code	Diameter (inches)	Length (inches)	Steel grade
B	¼	1	12.9
E	**5/16**		
C	**3/8**		
G	**7/16**		
A	**½**		
F	**9/16**		
I	**¾**		
J	**1 1/16**		
H	**1 ¼**		
D	**1 3/8**		

2. What is the average (mean) length of the 10.9 grade fasteners?

Total length of 10.9 grade fasteners:

¾ + 2 + 4 = 6 ¾

Mean length of 10.9 grade fasteners:

6 ¾ ÷ 3 = 27/4 ÷ 3 = 9/4 = 2 ¼ or 6 ¾ ÷ 3 = 27/4 ×1/3 = 9/4 = 2 ¼

The Steel grade indicates the tensile strength of the steel used and is obviously of critical importance. Assume the grade numbers used (10.9, 11.9 etc) are direct measures of strength (in other words steel with a grade of 12.9 would be exactly twice as strong as steel with a grade of 6.45). A structural engineer has informed James that any fasteners of grade 6.8 and 7.9 are to be replaced by ones at least 40% stronger.

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TASK 2 - NUTS AND BOLTS ANSWERS

3. Which grades could be used to replace fasteners at the lower strength grades (6.8 and 7.9)?

You can tick more than one option if appropriate

6.8 grade fasteners: Replaced by:	7.9	**10.9**	**11.9**	**12.9**
7.9 grade fasteners: Replaced by:	10.9	**11.9**	**12.9**	

In order to compare these US fasteners with specifications provided by colleagues using metric measurements, James must convert the data for length and diameter into metric units. For the particular application in mind the precise diameter of these fasteners is critical. Accuracy in converting length is important but not critical. Therefore James has decided to adopt a different approach to making the conversion for diameter than for length.

4. To convert the lengths of the fasteners he decides to use the conversion 1 inch = 2 ½ cm. He doesn't use a calculator for this and not all Codes are used. Complete the table?

Code	Length (inches)	Length (cm)	
		Fraction	Decimal
–	¼	¼ x 2 ½ = ¼ x 5/2 = 5/8	5/8 = 0.625
B	**1**	**1 x 2 ½ = 2 ½**	**2 ½ = 2.5**
C	**1 ½**	**1 ½ x 2 ½ = 3 ¾**	**3 ¾ = 3.75**
F	**2**	**2 x 2 ½ = 5**	**5**
H	**2 ½**	**2 ½ x 2 ½ = 6 ¼**	**6 ¼ = 6.25**

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TASK 2 - NUTS AND BOLTS ANSWERS

5. To convert the diameters he uses the conversion 1 inch = 25.4 mm as he needs to have this correct to the nearest ½ mm?

Code	Diameter (inches)	Diameter (metric)	
		mm	cm
A	½	½ = 0.5 0.5 x 25.4 = 12.7 = 12.5mm	12.5mm = 1.25cm
B	¼	**¼ = 0.25** **0.25 x 25.4 = 6.35 = 6.5mm**	**6.5mm = 0.65cm**
F	9/16	**9/16 = 0.5625** **0.5625 x 25.4 = 14.3 = 14.5mm**	**14.5mm = 1.45cm**
H	1 ¼	**1¼ x 25.4 = 31.75 = 31.5 or 32.0**	**31.5mm = 3.15cm** **32.0mm = 3.20cm**
I	¾	**¾ x 25.4 = 19.05 = 19.0**	**19.0mm = 1.90cm**

Following consultation with other construction professionals James concludes that almost 60000 fasteners will be required for this job. The job will require a mixture of Type A, B, C and J fasteners and the nature of the job indicates that they will be needed in the ratio 2:4:1:5.

6. Determine how many of each fastener is required?

Code	A	B	C	J
Ratio	2	4	1	5

Total number of fasteners = 60,000

2+4+1+5 = 12 parts. 60000 ÷ 12 = 5000. 1 part = 5000 fasteners

Number of each type of fastener:

A = **2 x 5000 = 10000** B = **4 x 5000 = 20000** C = **1 x 5000 = 5000** J = **5 x 5000 = 25000**

NUMBER

TASK 2 - NUTS AND BOLTS ANSWERS

7. Use the previous answer together with the original table (summarised below) to determine the ratio of fasteners ordered in terms of Steel grade?

Code	A	B	C	J
Grade	10.9	12.9	11.9	10.9

Find the Steel grade ratio **grade10.9:grade11.9:grade12.9** for the 60000 fasteners required.

Method 1
grade10.9 (A+J=10000+25000= 35000)
grade11.9 (C=5000)
grade12.9 (B=20000)

35000:5000:20000 = 7:1:4

Method 2 (from table in question 6)

A&J:C:B = (2+5):1:4 = 7:1:4

Now that James has decided on the number of fasteners of each type required he needs to get a price for the order.

8. The supplier has the following table for pricing: use it to determine the cost of his order of 60,000 fasteners?

CODE	ORDER SIZE ($ PER 100)			
	<1000	*1000-4999*	*5000-19999*	*20000 or more*
A	N/A	8.95	7.50	6.95
B	10.50	9.95	8.50	7.95
C	12.50	11.95	10.50	9.95
J	24.50	22.95	20.50	18.95

Code A: 10000 fasteners. This means $7.50 per 100 = 7.50 x 100 = $750
Code B: 20000 fasteners. This means $7.95 per 100 = 7.95 x 200 = $1590
Code C: 5000 fasteners. This means $10.50 per 100 = 10.5 x 50 = $525
Code J: 25000 fasteners. This means $18.95 per 100 = 18.95 x 250 = $4737.50

Total = 750 + 1590 + 525 + 4737.50 = $7602.50

NUMBER

TASK 2 - NUTS AND BOLTS ANSWERS

James now needs to determine the carriage cost for this order which will be determined by its weight. All fasteners come in boxes of 100 and the weight (mass) of each box is given in the table. Note the units used are lbs (pounds).

9. Determine the total weight of the order in lbs. Ignore the weight of any extra packaging as it will only be a tiny fraction of the total?

Code	A	B	C	J
Mass (lb)	4.3	6.5	9.2	10.5

Code A: 4.3 x 100 = 430 lb
Code B: 6.5 x 200 = 1300 lb
Code C: 9.2 x 50 = 460 lb
Code J: 10.5 x 250 = 2625 lb

Total = 430 + 1300 + 460 + 2625 = 4815 lb

James is going to use a courier located in the UK to bring the order home. On their website he needs to enter the weight of the order in kg.

10. Convert the previous answer to kg using 1kg = 2.2lb. Give your answer to the nearest kg?

4815 ÷ 2.2 = 2189 kg (to nearest kg)

NUMBER

TASK 2 - NUTS AND BOLTS ANSWERS

The order will be loaded onto pallets for delivery from US to UK. The courier charges 25p per kg and there is a Customs administration charge of £47.50 placed on all orders.

11. In the space below calculate the carriage costs of the load using this courier?

Pallet cost = 2,189 kg x 25 p/kg = 54,725 p = £547.25

Carriage cost = Pallet cost + Customs charge = £547.25 + £47.50 = £594.75

12. Find out what the current $:£ exchange rate is and use it to price the entire order in Sterling (£) (remember the cost of the order is in $ but the carriage is in £)

depends on exchange rate

Before completing the order one of the company directors asks James to double the size of the order as they have just won a second similar contract.

13. How will this impact on the cost of carriage? Will it also double? Answer this in the space below and explain your findings.

Doubling order means it weighs 4,378kg instead of 2,189kg

Pallet cost = 4,378 kg x 25 p/kg = 109,450 p = £1,094.50
Carriage cost = Pallet cost + Customs charge = £1,094.50 + £47.50 = £1,142

The carriage cost has not exactly doubled. This is because of the customs charge which does not depend on the weight of the order. The presence of the customs charge means the relationship between carriage cost and weight are not in direct proportion. You will probably have noticed that the pallet cost doubled as this cost is in direct proportion to the weight of the order.

NUMBER

TASK 3 - LEVELS AND FORCES ANSWERS

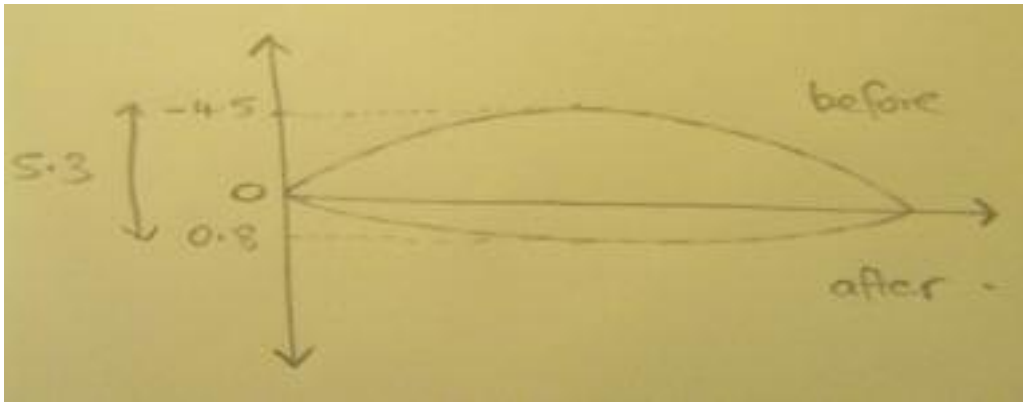
The use of negative numbers in construction is generally related to temperature (see task called Temperature) and finances (see task called Bank Statement). They are also very useful when working with distance above or below certain levels in surveying or the direction of forces that act in beams, columns, frames etc.

In this task we will consider some situations where negative numbers are used in surveying levels and when working with forces.

Concrete hollow core floor units have a natural pre-camber when they are pre-stressed during manufacture.

A hollow core slab spanning 7.0m has a pre-camber of -4.5mm. When a certain dead load is applied in use the slab deflects downwards from the pre-stressed position by 5.3mm.

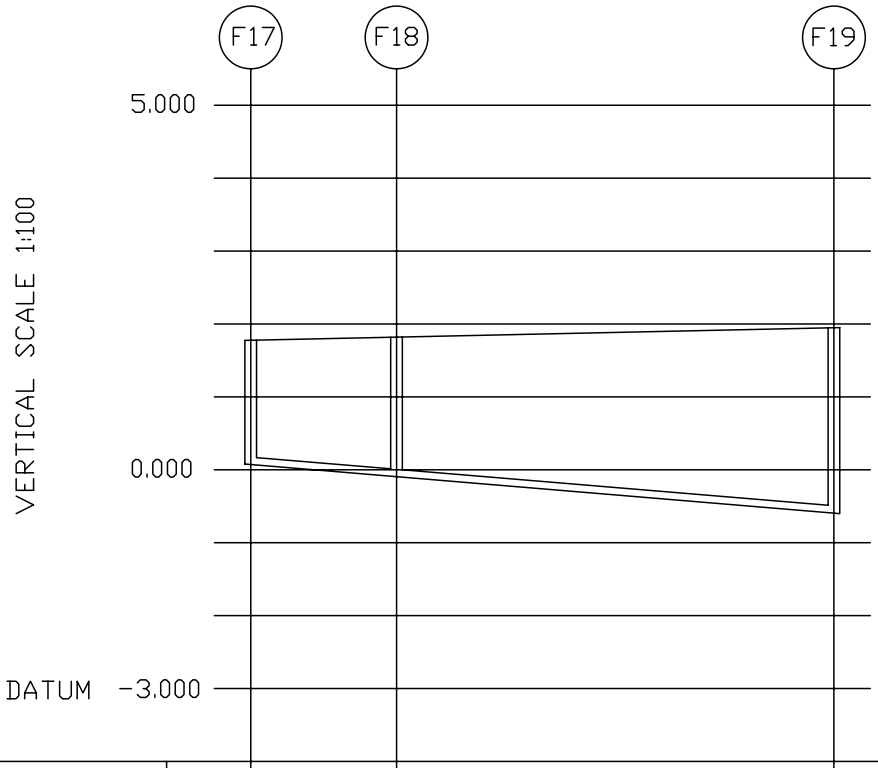
1. In the space below produce a sketch to describe the situation. Include a vertical number line and mark the before (unloaded) and after (loaded) positions.



NUMBER

TASK 3 - LEVELS AND FORCES ANSWERS

The diagram below shows invert levels and cover levels of foul sewer through a site for a new leisure complex. Measurements have been taken between points F17, F18 and F19 on the site. All quoted levels are in metres and you do not need to take any scale measurements from the drawing, just use the values in the table.



FOULWATER COVER LEVEL	1.620	1.687	1.912	
FOULWATER INVERT	0.099	-0.084	-0.681	
FOULWATER DETAILS		Dia 150 Type uPVC 1 in 60	Dia 150 Type uPVC 1 in 60	
FOULWATER LENGTHS		10.964	35.742	

HORIZONTAL SCALE 1:500

LONGITUDINAL SECTION OF FOUL SEWER F17-F19

NUMBER

TASK 3 - LEVELS AND FORCES ANSWERS

2. What is the difference in the invert level between grid F17 and F18?

The difference is the distance along the number line from one number to the other. Since the values here are 0.099 and -0.084 (one positive and one negative) the difference will be 0.099 + 0.084 = 0.183m (183mm)

3. What is the difference in depth between the foul water cover level and the foul water invert level at location F18?

Again one negative value and one positive value so the difference is

0.084 + 1.687 = 1.771m (1771mm)

4. What depth has the foul water invert level dropped between F18 and F19?

As these are both negative values the difference between -0.084 and -0.681 is equal to the difference between 0.084 and 0.681 which is 0.681 – 0.084 = 0.597m (597mm)

NUMBER

TASK 3 - LEVELS AND FORCES ANSWERS

The internal ground floor level of a house has been set at 0.00m. External ground level is 0.15m below internal ground floor level. Internal basement level is 2.60m below internal ground floor level. The height of the eaves level is 5.20m above internal ground floor level. Mark on the diagram below the missing levels and calculate

5. The difference in height between external ground level and eaves level?

5.20 + 0.15 = 5.35m (5350mm)

6. The total height from basement floor to eaves level?

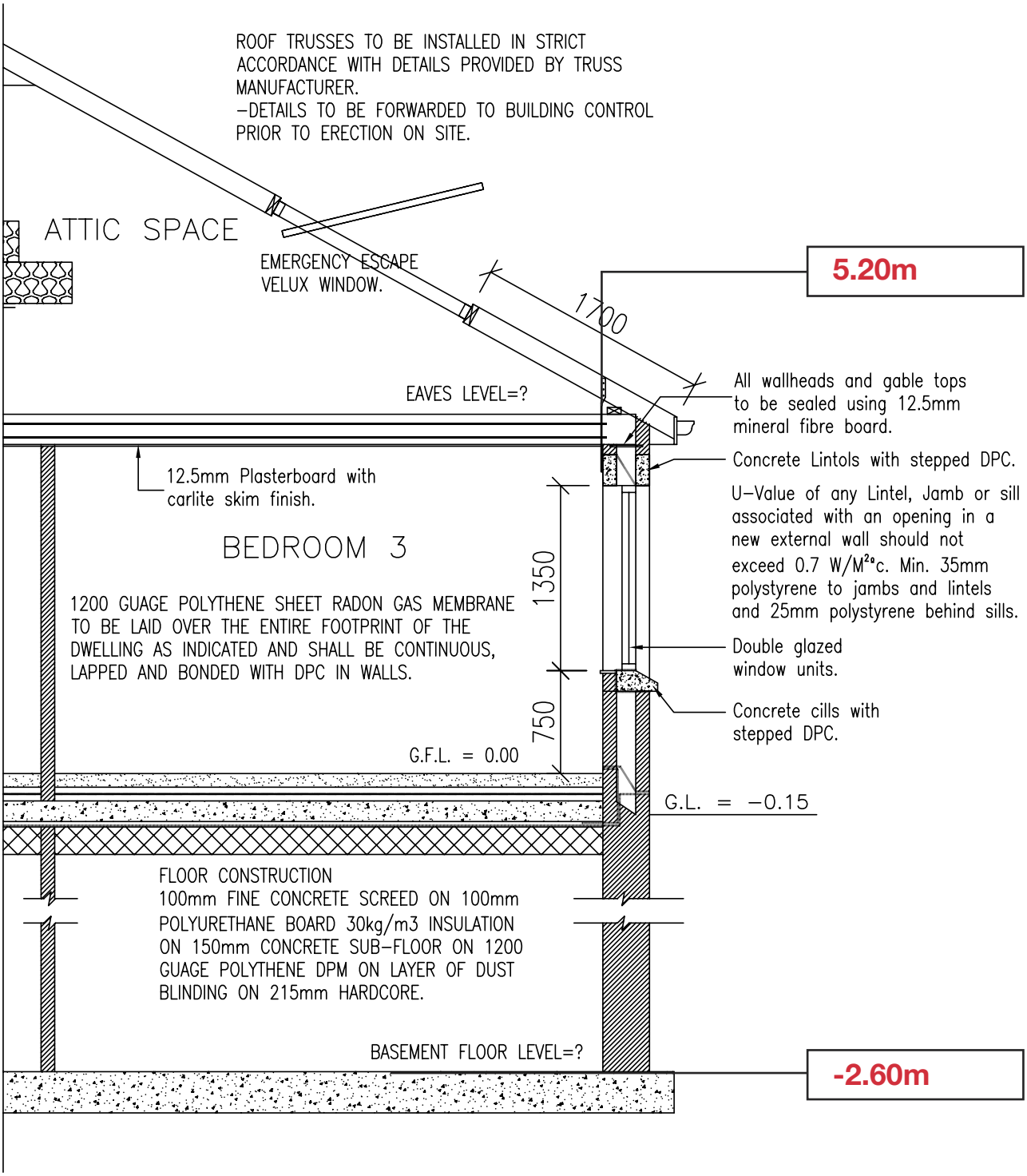
5.20 + 2.60 = 7.80m (7800mm)

7. How far is the basement floor level below external ground level?

Difference between two negative numbers -0.15 and -2.60 is equal to the difference between 2.60 and 0.15 which equals 2.60 – 0.15 = 2.45m (2450mm)

NUMBER

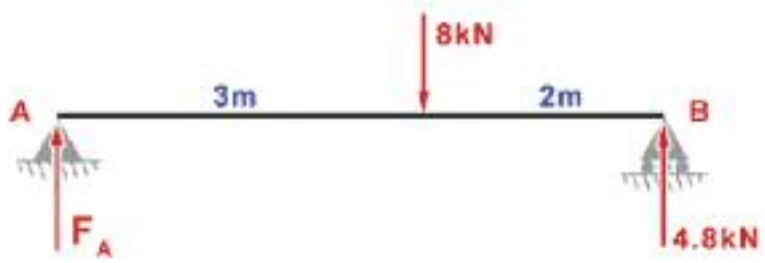
TASK 3 - LEVELS AND FORCES ANSWERS



NUMBER

TASK 3 - LEVELS AND FORCES ANSWERS

The diagram below shows the forces present in a beam. A simply supported beam is supported at each end as shown and there are often forces (loads) acting on the beam itself between the supports. In the diagram there is a force of 8kN acting as shown. As a result there will be upwards forces acting at each of the support points A and B. The force at B is given as 4.8kN.



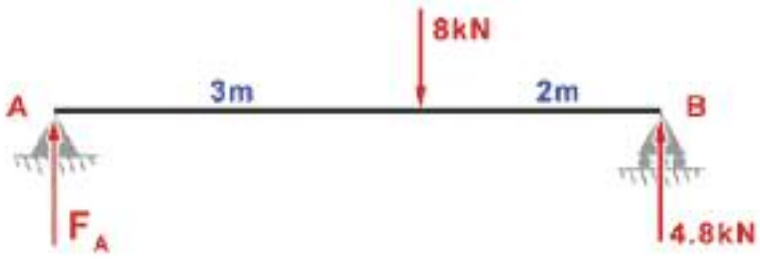
In order for this beam to be stable, certain conditions must hold. These are called equilibrium conditions and one condition is that the forces must all add up to zero! Forces are considered positive or negative depending on which direction they act. In this task we will take upwards forces as positive with downwards forces as negative.

For the beam in the diagram we can work out the unknown force FA as follows:

$F_A + 4.8 - 8 = 0$

$F_A - 3.2 = 0$

$F_A = 3.2$ kN



As a check we can sum positive forces and negative forces separately to see if the totals are equal.

For the beam above this would give:

Total positive forces = 3.2 + 4.8 = 8kN

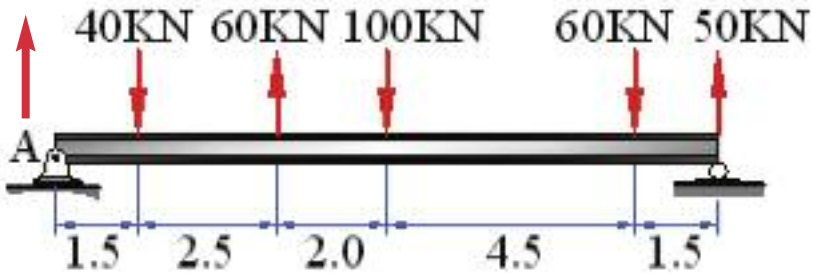
Total negative forces = 8kN

NUMBER

TASK 3 - LEVELS AND FORCES ANSWERS

Apply what you have learned in this example to the following problem (ignore the distances between the forces in the diagram).

8. Draw in the direction of the missing force at A



9. Use the method above of summing forces to equal zero to help you work out the size of the force at A?

F +60 + 50 – 40 – 100 – 60 = 0

F + 110 – 200 = 0

F -90 = 0 so F = 90kN

10. Finally check your answer using the method of positive and negative totals?

Total Positive forces = 90 +60 + 50= 200kN

Total Negative forces = 40 + 100 + 60 = 200kN

NUMBER

TASK 4 - BANK STATEMENT ANSWERS

Here is the bank statement for a local building contractor for the month of November. The contractor wants to take a detailed look at the statement and get an overview of his account. You can help with this by answering the following questions.

Mid-Ulster Bank **Statement of Account**

St. Swithin's Branch
Broad Street
Londonderry

Tel: 02886712345

A/C 657362142 Magherafelt

Sort: 09-59-01
Date 12.12.10 Co.

A N Other, Main street, Belfast

Date	Details	Debits	Credits	Balance
01 Nov	Opening Balance			1836.51
02 Nov	Direct Debit 043121	2248.07		**-411.56**
03 Nov	Cheque 234174	2192.83		**-2604.39**
05 Nov	Transfer a/c 61152309		1500.00	**-1104.39**
09 Nov	Cheque 234017	5877.30		**-6981.69**
10 Nov	Cheques paid in		4540.50	**-2441.19**
10 Nov	Standing order 0021972	1466.45		**-3907.64**
16 Nov	Cash paid in		8340.18	4432.54
20 Nov	Cheques for salary	7840.37		**-3407.83**
25 Nov	JR Materials (refund)		2540.34	**-867.49**
27 Nov	Cheque paid in		12277.45	11409.96
29 Nov	Direct Debit	3480.32		7929.64
30 Nov	**Overdraft fee**	**80.00**		7849.64
30 Nov	**Emergency reserve**	**104.72**		7744.92
30 Nov	Closing Balance			7744.92

NUMBER

TASK 4 - BANK STATEMENT ANSWERS

1. Fill in the balance column as far as 29th November. The balance on 29th November should be £7929.64, allowing you to check your answer. Use the space below as well if you need to.

2. Use an alternative method to arrive at the balance on 29th November.

Hint: Total the Debit and Credit columns separately and then combine your answer with the figure for opening balance on 01 Nov.

Debit total = £23,105.34

Credit total = £29,198.47

Credit – Debit = £6,093.13

balance = opening balance + Credit – Debit

= £1,836.51 + £6,093.13 = £7,929.64

3. On 2nd Nov Direct Debit 043121 was debited from the account leaving a balance that day of -£411.56 What does the negative sign mean?

It means the account holder owes the bank money, £411.56 to be exact.

NUMBER

TASK 4 - BANK STATEMENT ANSWERS

4. On which day was the account at its lowest point and how much did he have in the bank on that date?

Date:	**9th November**
Amount owed:	**£6,981.69**

The contractor has an agreed overdraft of £5000 on this account for which he pays £80 per month. The £80 is applied on the last day of the month and is applied if the account was 'in the red' for even one day in the month. He does not pay the fee for any month in which the account remained 'in the black' at all times.

5. Will he have to pay the £80 fee for the month of November?

Yes

The contractor also has an emergency reserve overdraft on the account of £2000. This means that if he exceeds his agreed overdraft of £5000 the bank will continue to honour any drawings on the account up to an extra £2000 (i.e. allowing a balance up to -£7000). However the bank has stipulated two conditions on this emergency reserve if it is used:

- A charge of 1.5% of the minimum balance will be applied at the end of the month
- The account needs to be brought back into the agreed overdraft limit immediately at the end of the month.

NUMBER

TASK 4 - BANK STATEMENT ANSWERS

6. Did he use his emergency reserve in November?

Yes

7. If he did use the emergency reserve determine the charge that will be applied for using it?

NB: if you need to round off a calculator display figure to the nearest penny remember a bank will have to round down so as not to overcharge!

1.5% of £6,981.69 = 0.015 x 6981.69 = 104.72535 = £104.72

There was no additional activity on the account on 29th and 30th November.

8. Complete the statement up to and including Nov 30th by applying any fees or charges due? Use the space below to do any additional calculation you need to.

Overdraft fee of £80 plus emergency reserve charge of £104.72

NUMBER

TASK 4 - BANK STATEMENT ANSWERS

The table below contains details on the account over the previous four months. In particular you will see the closing balance each month and the minimum balance for that month.

Month (2010)	Closing Balance Balance (before fees / charges)	Minimum Balance	Overdraft fee	Emergency reserve charge
July	3144.44	2469.46	**N / A**	**N / A**
August	-6183.86	-6492.08	**80.00**	**97.38**
September	1064.99	-2845.91	**80.00**	**N / A**
October	1836.51	493.67	**N / A**	**N / A**

9. Complete the table by entering an overdraft fee and an emergency reserve charge each month where appropriate. You may find it useful to read the instructions above again about how and why fees/charges are applied to this account. Use the space below for any working out you need to do?

At the end of one month the contractor had to lodge money into his account to bring the balance back to within the agreed overdraft limit (£5000).

10. Which month was that and how much did he have to lodge? Don't forget that the closing balance figure in the table above has NOT had any charges or fees applied. These will need to be added in before the final closing balance for the month is known.

Month: **August**

Closing balance (after fees/charges applied):

-6,183.36 – 80.00 – 97.38 = £6,361.24

Amount to be lodged to restore account:

6,361.24 – 5,000 = £1,361.24

NUMBER

TASK 5 - TEMPERATURE ANSWERS

Negative numbers are numbers to the left (or below) zero on a number line. The use of negative numbers in construction is generally related to temperature, finances (see task called Bank Statement), height above or below certain levels in surveying or the direction of forces and sense of moments (clockwise or anti-clockwise) that act in beams, columns, frames etc.

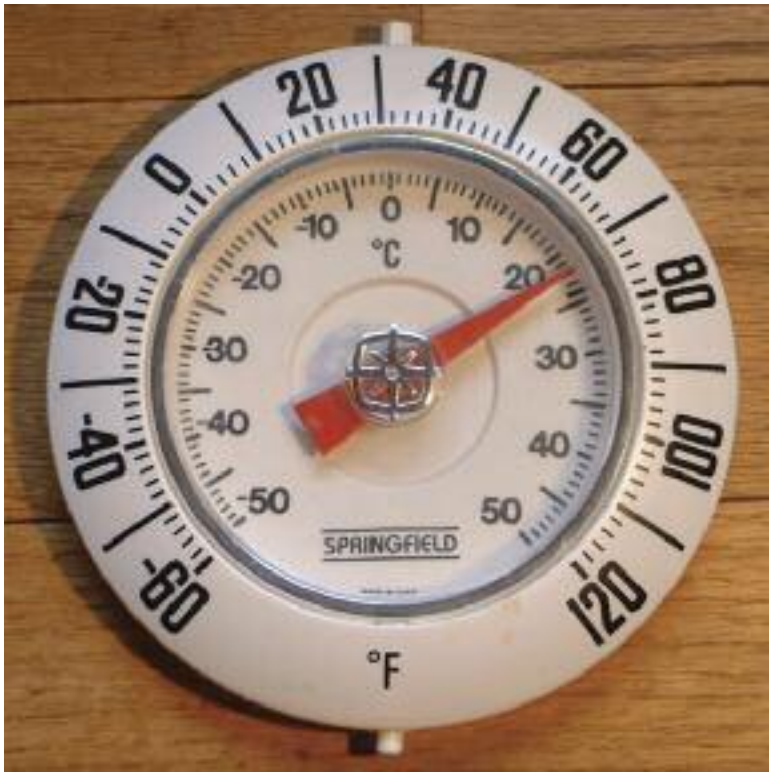
In this task we will look at some examples of how negative numbers can crop up when working with temperature.

There are two temperature scales you need to be aware of and indeed be able to convert temperatures from one scale to the other. Nowadays the Celsius temperature scale is more popular but Fahrenheit is still used quite frequently.

In the Celsius temperature scale 0°C represents the freezing point of water. Be careful, it does not mean there is no heat energy present. It just means there isn't enough heat present for water to exist in liquid form so it freezes. A negative value on the Celsius scale indicates a temperature lower than 0°C where there is less heat energy present and so it feels colder.

The boiling point of water is defined as 100°C on the Celsius scale but is 212°F on the Fahrenheit scale.

The picture below contains a dial from which you can read temperature in either scale.



NUMBER

TASK 5 - TEMPERATURE ANSWERS

1. What is the temperature according to the dial in °C to the nearest degree?

22°C

2. What is the dial reading in Fahrenheit (°F)? Try to estimate this to the nearest Fahrenheit degree and later you can use a formula to check.

72°F

In the text above you were told that two key points on the Celsius scale are 0°C and 100°C (this portion of the Celsius scale is sometimes referred to as the Centigrade scale because it has a range of 100 degrees). It was also stated above that the boiling point of water corresponds to 212°F.

3. What is the freezing point of water on the Fahrenheit scale? Use the dial and the information already given.

32°F

NUMBER

TASK 5 - TEMPERATURE ANSWERS

Two workers, Jake and Paul, are having a discussion about the usefulness of this dial.

Jake said, ***"This dial cannot be used to convert 60°C to Fahrenheit (°F)"***
Paul said, ***"Yes it can, you could just find out what 30°C converts to and double it!"***
This made Jake think as he wondered if Paul was correct. To reinforce his point Paul added,
"If someone is 1 metre tall then that makes them 3' 3" tall so if someone else is 2m tall they will be 6' 6" tall – you just double it"

4. Produce some evidence from the dial gauge above to settle the discussion one way or another?

22°C = 72°F but 44°C ≠ 144°F 0°C = 32°F

5. In the space below to explain why Paul is correct when he says "If someone is 1 metre tall then that makes them 3' 3" tall so if someone else is 2m tall they will be 6' 6" tall" but he is wrong when he attempts to apply this argument to the temperature scales of Celsius and Fahrenheit?

You may wish to include the following words in your answer or use them to help structure your answer: "direct proportion", "one quantity is zero when the other is zero", "0°C is not 0°F", "doubling one temperature did not make the other temperature double", "if you increase one quantity by a certain percentage the other increases by the same percentage"

The units of measure for height (metres and feet) are in direct proportion – when one is zero the other is zero, for instance a distance of 0m is also 0ft. Also the relation 1m = 3.25ft means if you double a length in metres you also double it in ft.

For two quantities to be in direct proportion one should be zero when the other is zero and if you double one the other should double as well. This is true for length (in metres and feet) as just discussed but it is not true for converting temperature from Celsius to Fahrenheit as the answer to the previous question shows.

NUMBER

TASK 5 - TEMPERATURE ANSWERS

You will not always have access to a dial (or other device) to help you make a conversion from one temperature scale to another. Even if you had the dial above it could only help you with temperatures in the range shown as the above discussion has demonstrated.

For instance you could not use the dial to convert 60°C to °F! For this you could make use of a formula which works for all temperatures and conversion formula are very useful for this reason. We will consider two formulae in this section that can be used to convert from one temperature scale to the other depending on which direction conversion is needed.

Before doing this it will be helpful to recap on some number facts. Consider the two numbers 5/9 and 9/5.

6. One number is a proper fraction – which one is it? Give your answer in numbers and words.

5/9 (five ninths)

7. Write the other number as a mixed number, again using numbers and words?

9/5 = 1 4/5 (one and four fifths)

NUMBER

TASK 5 - TEMPERATURE ANSWERS

8. Convert each number (5/9 and 9/5) to a decimal fraction. Use your calculator and simply record the screen display in the space provided?

5/9: **0.555555555**

9/5: **1.8**

9. Now put each of the above answers into words?

Hint: for 0.45 you would write “zero point four five” or for 7.3636363636 you could write “seven point three six repeating”

zero point five repeating or zero point five recurring for 0.555555555

one point eight for 1.8

NUMBER

TASK 5 - TEMPERATURE ANSWERS

When using temperature conversion formula you will need to use the above numbers (sometimes as fractions (5/9 or 9/5), sometimes as decimals (0.55 and 1.8)) in multiplications. This will be easy if you have a calculator but sometimes you may not and there are some useful properties of these numbers which may be helpful.

We can look at 1.8 first.

1.8 = 2 - 0.2 so multiplying a number by 1.8 is the same as multiplying the number by 2 and by 0.2 and then subtracting the two answers.

At first glance this may not seem to be much of an advantage but if you notice that

0.2 = 2 ÷ 10

then the advantage becomes clear as it is easy to divide by 10. Follow the examples below and then attempt the multiplications that follow.

Any multiplications involving negative numbers are optional!

eg 1: **45 x 1.8**
We can see that

45 x 2 = 90

and

45 x 0.2 = 9.0 (because 90 ÷ 10 = 9)

Which means…

45 x 1.8 = 90 – 9 = 81

eg 2: **6.4 x 1.8**

6.4 x 1.8

Again we can see that

6.4 x 2 = 12.8

and

6.4 x 0.2 = 1.28 (because 12.8 ÷ 10 = 1.28)

Which means…

6.4 x 1.8 = 12.8 – 1.28 = 11.52

NUMBER

TASK 5 - TEMPERATURE ANSWERS

10. In the space below complete the multiplications without using your calculator?

23 x 1.8

23 x 2 = 46 and

23 x 0.2 = 4.6 (because 46÷ 10 = 4.6)

which means…

23 x 1.8 = 46 – 4.6 = 41.4

-3.7 x 1.8

3.7 x 1.8 (ignore minus for now)

3.7 x 2 = 7.4 and

3.7 x 0.2 = 0.74 (because 7.4÷ 10 = 0.74)

which means…

3.7 x 1.8 = 7.4 – 0.74 = 6.66

now replace minus to give - 6.66

Now we will look at how to work with **0.55.**

The first thing to note is

0.55 = 0.5 + 0.05

then make use of two simple number facts

- 0.5 is the decimal form of the fraction ½.
- 0.05 = 0.5 ÷ 10.

So, to multiply something by 0.55 you could

"first of all find one half of the number you are multiplying, then divide that number by 10, finally add these two answers together".

To make this clear we can look at an example

eg: **48 x 0.55**

- Half of 48 is 24
- One tenth of 24 id 2.4

So **48 x 0.55 = 24 + 2.4 = 26.4**

NUMBER

TASK 5 - TEMPERATURE ANSWERS

Sometimes you may need to multiply by 0.555 instead of 0.55 depending on how accurate you want your answer to be.

11. In the space below set out a method you could use as a convenient way to multiply by 0.555 without using a calculator or doing an actual multiplication sum?

Hint: 0.555 = 0.5 + 0.05 + 0.005!

"first of all find one half of the number you are multiplying, then divide that number by 10, then divide that number by 10 also, finally add the three answers together".

12. Put your chosen method to use below?

48 x 0.555

(0.5) 1/2 of 48 = 24

(0.05) 24 ÷ 10 = 2.4

(0.05) 2.4 ÷ 10 = 0.24

48 x 0.555 = 24 + 2.4 + 0.24 = 26.64

13. Round the previous answer to 1 decimal place?

26.64 = 26.6 (to 1 decimal place)

NUMBER

TASK 5 - TEMPERATURE ANSWERS

14. Compare your previous answer to the answer given above to 48 x 0.55. Which is closer to the exact answer to 48 x 5/9 and why?

48 x 0.55 = 26.4

48 x 0.555 = 26.6

The exact answer to 48 x 5/9 is 26 2/3 which is 26.7 (to 1 decimal place). This shows that 48 x 0.555 is closer to the exact answer than 48 x 0.55 and the reason is that 0.555 is a better approximation to 5/9 than 0.55.

Sometimes when multiplying by 5/9 it will actually be easier to do a fraction multiplication than firstly converting the fraction to a decimal. For instance consider the multiplication 36 x 5/9.

15. In the space below calculate the answer to this multiplication using fractions?

36 x 5/9 = 36/1 x 5/9 = 4/1 x 5/1 (cancel 9 and 36) = 20/1 = 20

16. What property has the number 36 that made it easier to do the above calculation with 5/9 as a fraction instead of a decimal?

36 is a multiple of 9

NUMBER

TASK 5 - TEMPERATURE ANSWERS

17. If instead the multiplication was 36 x 9/5 which approach would be easier – using 9/5 as a fraction or as a decimal? To help you decide do the multiplication both ways in the space below.

36 x 9/5:

36 x 9/5 = 36/1 x 9/5 = 324/5
(as no common factors to cancel) = 64 4/5 = 64.8

36 x 1.8:

36 x 1.8 = 72 – 7.2 = 64.8 (this was less work!)

18. Without doing any calculations give a reason indicating which approach (fraction or decimal) you feel would be easier to do the multiplication 25 x 9/5?

As 5 is a factor of 25 it would definitely be easier to use fractions here

NUMBER

TASK 5 - TEMPERATURE ANSWERS

We can now look at the actual temperature conversion formula. As mentioned earlier there are two formulae depending on whether you need to convert from Celsius (°C) to Fahrenheit (°F) or the other way around.

If you are converting temperature from Celsius (°C) to Fahrenheit (°F) then use this formula

$$C = \frac{5}{9}(F - 32)$$

C represents Celsius temperature and F represents Fahrenheit temperature.

19. Indicate which of the following statements correctly describes how to apply this formula?

A: multiply the Fahrenheit temperature by five ninths and then subtract thirty-two.

B: subtract thirty-two from the Fahrenheit temperature and then multiply by five ninths

NUMBER

TASK 5 - TEMPERATURE ANSWERS

If instead you need to convert from Fahrenheit (°F) to Celsius (°C)you should use this formula

$$F = \frac{9}{5}\,\mathrm{C} + 32$$

again C represents the Celsius temperature and F represents the Fahrenheit temperature.

20. In the space below use words to describe how to correctly apply this formula?

Multiply the Celsius temperature by nine fifths and then add thirty-two

Now we can look at an actual construction situation where you will have the opportunity to use these formulae and apply what you have learned earlier in the section.

During a cold spell temperature on site is monitored as freezing conditions can cause problems with materials and machinery. The health and safety of employees is also a top priority. In order to know whether certain precautions are necessary the temperature is recorded as shown in the table below.

Site temperature at 8am (1st to 14th November 2010)														
Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Temp(°C)	10	4	-1	-2	-5	-6	-10	-7	-3	4	1	0	4	5
Temp (°F)	50	39	30	28	23	21	14	19	27	39	34	32	39	41

NUMBER

TASK 5 - TEMPERATURE ANSWERS

Each morning the temperature may be taken by a different individual with the result that on some mornings the temperature has been recorded in Celsius, some mornings in Fahrenheit and some mornings it has been recorded it in both formats.

On 1st, 3rd and 14th November temperature has been recorded in Fahrenheit degrees.

21. Use the appropriate formula to convert these temperatures to Celsius and record the answers in the table. Round to the nearest °C if necessary?

Before each calculation decide whether it is easier to use five ninths in fraction format (5/9) or in decimal format (0.55)!

1st: **F-32 = 50-32 = 18. As 18 is a multiple of 9 it will be easier to use five ninths in fraction format.**

C = 5/9 x 18 = 5/9 x 18/1 = 5/1 x 2/1 = 10

3rd: **F-32 = 30-32 = -2. As 2 is not a factor of 9 it will be easier to use five ninths in decimal format.**

C = 0.55 x 2 =1 +0.1 = 1.1 = 1 to nearest degree. Now put the minus sign back to give -1.

14th: **F – 32 = 41 – 32 = 9. Obviously easier to use fraction form of five ninths**

C = 5/9 x 9 = 5/9 x 9/1 = 5/1 = 5

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TASK 5 - TEMPERATURE ANSWERS

On 5th, 7th and 13th temperature has been recorded in Celsius degrees.

22. Use the appropriate formula to convert these temperatures to Fahrenheit and record the answers in the table. Round to the nearest °F if necessary?

Before each calculation decide whether it is easier to use nine fifths in fraction format (9/5) or in decimal format (1.8)!

5th: **As C = -5 it will be easier to use five ninths in fraction format. 9/5 x -5 = 9/5 x -5/1 = -9/1 = - 9. And -9 + 32 = 23**

7th: **As above = 9/5 x -10 = 9/5 x -10/1 = -9/1 x 2/1 = -18/1 = -18. And -18 +32 = 14.**

13th: **As 4 is not a factor of 5 it will be easier to use decimal format 1.8. 4 x 1.8 = 8 – 0.8 = 7.2. And 7.2 + 32 = 39.2 = 39 to nearest degree.**

NUMBER

TASK 5 - TEMPERATURE ANSWERS

Temperatures for 4th, 6th and 12th are not shown in the table. The images below show the temperatures for these dates measured in Celsius.

23. Make each temperature reading and record the result in the table?

4th December **6th December** **12th December**

24. Use the conversion dial shown earlier to record the temperatures for 4th, 6th and 12th in Fahrenheit to the nearest degree. As an exercise you may wish to test how well you have used the dial by checking your answers with the conversion formula?

25. Now that the table is complete you should use the space below to determine the mean temperature over the two week period, firstly in Celsius and then in Fahrenheit?

Celsius:

10	4	-1	-2	-5	-6	-10	-7	-3	4	1	0	4	5

10 + 4 + (-1) + (-2) + (-5) + (-6) + (-10) + (-7) + (-3) + 4 + 1 + 0 + 4 + 5 = -6 -6 ÷ 14 = -0.43°C

Fahrenheit:

50	39	30	28	23	21	14	19	27	39	34	32	39	41

50 + 39 + 30 + 28 + 23 + 21 + 14 + 1 + 27 + 39 + 34 + 32 + 39 + 41 = 436 436 ÷ 14 = 31.1°F

NUMBER

TASK 5 - TEMPERATURE ANSWERS

26. Without doing an actual calculation how might you perform a check on your previous answers?

Use the conversion formula on one of the answers to see if it converts to match the other one! Bear in mind though that any rounding off when completing the table may result in the conversion not being exact. However it should be close enough to make you feel sure your calculations for the mean have been correct.