



IMI & VOLKSWAGEN APPRENTICESHIP GROUP MATHS - STUDENT PACK

About the industry

The automotive industry influences everyone, from delivering goods on time to commuters travelling to work and emerging services being able to respond to crisis, the motor industry helps keep the country moving.



About The IMI

The Institute of The Motor Industry is the professional body for individuals working in the motor industry and the authoritative voice of the retail automotive sector. The IMI's aim is to ensure that the automotive retail sector has a skilled, competent and professional workforce that is fully equipped to keep pace with the demands of new technology and changing markets. A key part of business for manufacturers and dealers is to encourage the best and brightest people to join their business in a variety of roles.



About Volkswagen Apprenticeship Group

The future of Volkswagen ultimately depends upon our commitment to people. Our business success will only be achieved through having highly skilled people within our Retailers supported by training and development. Throughout Volkswagen we have a rigorous commitment to quality and excellence. Our products are highly acclaimed, our processes for distribution and support services are world class and we have some of the most technologically advanced resources in any industry.

The Volkswagen Advanced Apprenticeship Programme is designed to train and develop apprentices to keep pace with advancing technology and high levels of customer service. The Programme provides apprentices with an exciting and challenging opportunity to receive formal qualifications through extensive product training whilst in full-time employment.

Via its network of UK retailers, Volkswagen offers a comprehensive three-year Programme that consists of a variety of workplace and block release training at the Volkswagen Group Apprentice Training Centre. You can choose the area in which you would like to train: Service Technician, Parts Advisor or Product Host.

Every apprentice is encouraged to demonstrate initiative and to contribute his or her own ideas for improving customer service or developing the business. But this approach requires a special type of person. You must have the ambition to succeed in a fast-paced environment and to aim to be the best in everything you do.

To find out more about our Advanced Apprenticeship Programme,

- <http://www.volkswagen.co.uk/about-us/careers/advanced-apprenticeship-programmes>
- <http://www.volkswagen-apprentice.co.uk/index.html>

VOLKSWAGEN
GROUP APPRENTICE PROGRAMME

INTRODUCTION

All lessons are based on real life activities with the motor industry as a backdrop, encompassing sub-sectors such as motorsport, motorcycle, heavy vehicle, motor parts, paint and finishing and sales as well as green issues such as vehicle emissions. The rationale behind “Indicate” is to a) introduce students to the various aspects of the motor industries b) allow students to demonstrate a fluency and confidence in a range of “real life” mathematical techniques and processes in an unfamiliar context.

Further, these lessons will allow students to select the most appropriate way to communicate mathematics both orally and in writing and allow them to understand and interpret mathematics that is presented in a range of forms.

Students will have the opportunity to become familiar with a range of resources and tools to enable them to achieve their objectives, coupled with the opportunity to explore and use mathematical concepts (equivalence, proportional thinking, relationships and proof operations).

These lessons will allow students to pose questions: they should be able to adopt a questioning approach to mathematical activity.

They are designed to provide a helpful context based around the motor industry. Teachers may want to use all or just some of the lesson ideas. They may also want to decide whether some of the tasks in these lessons are undertaken by an individual student or in small group. There will also be flexibility for the teacher to decide the level of difficulty they wish to set, depending on the abilities of their students.

Finally, within each lesson plan in this teacher pack are some notes for further guidance as well as a comprehensive list of website links.





Lesson overview

Lesson 1 **P**

Module: Sales

Topic: Statistics/Data analysis

Lesson 2 **P**

Module: Buying a car

Topic: Finance & Money

Lesson 3 **P**

Module: Designing a race circuit

Topic: Shape, Space & Measure

Lesson 4 **P**

Module: Car emissions

Topic: Sequences and functions

Lesson 5 **P**

Module: F1 Lap times

Topic: Compound Measures

Lesson 6 **P**

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Module: Off Road

Topic: Angles

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Module: Parts

Topic: Statistics/Data analysis

Lesson 12 **P**

Module: Buying a motorbike

Topic: Statistics/Data analysis

Lesson 1

Topic: Statistics/Data analysis

Module: Sales

Learning Objectives:

- To be able to analyse and interpret data
- To be able to present data in different formats

Task

The UK retail car industry is made up of many car manufacturers selling vehicles. You work in the Corporate Division at Jaguar Land Rover (JLR) and you have been asked (using the attached data) to provide information for a presentation by your manager to the Board of VW, illustrating sales of all VW vehicles and the sales performance of other car manufacturers who are your competitors.

Your closest competitors in this market are Mercedes Benz, Audi, Volvo and BMW. Using the raw data, develop some different ways and methods of presenting this. Use pictograms, bar charts and pie charts to support your findings and to make it easier for your manager to explain to the Board.



New car data sheet

<i>Car Manufacturer</i>	<i>No of Cars sold in 2010</i>
Audi	88,355
Bentley	891
BMW	92,083
Citroen	64,183
Fiat	47,405
Ford	246,770
Honda	55,421
Hyundai	54,872
Jaguar	13,939
Jeep	1718
Kia	50,278
Land Rover	32,654
Lexus	5629
Mazda	40,113
Mercedes-Benz	64,187
MG	266
MINI	36,003
Nissan	77,113
Peugeot	95,529
Porsche	5568
Renault	83,286
SEAT	28,235
Skoda	35,360
Smart	6730
Suzuki	18,627
Toyota	77,231
Vauxhall	214,593
Volkswagen	151,025
Volvo	33,112



Lesson 2

Topic: Finance/Money

Module: Buying a car

Learning Objectives:

- To prepare a cash-flow forecast.
- To understand the importance of cash flow and how to improve it.

Task 1

You are buying a Ford Fiesta 1.3L car on a finance plan for £5795. Your parents have agreed to give you the £2000 deposit but you must fund the rest out of your Apprenticeship salary of £320 per month (after tax and National Insurance). Fill in the cash-flow plan taking account of the following:

- Monthly car repayments are £96.20 (from the second month, no payment for the first month)
- You need to tax the car as soon as you get it which costs £130 for the year.
- You insure the car - £185 for the first month and £85 per month for the rest of the year.
- You will need to allow £40 per month for fuel.
- On your Birthday in July, you get £100 in cash.
- Your car needs an MOT in July which costs £50.
- Your car has to be serviced in September which costs £150.
- You get a flat tyre in November and pay £55 for a new one.
- You ask for money for Christmas and get given £200
- You have a major engine problem in January and split the cost of repair over January and February. You pay £410 in January and £270 in February.

Remember the closing balance each month is your total income less your total payments plus whatever you had left in the bank from the month before.

Task 2

Produce a table (attached template) detailing what other monthly expenses you would expect to have as an apprentice and realistically how much you can expect to have at the end of the year. From October to February, your repayment will rise by 10% - add this in to your forecast.



Cash flow chart

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Income												
Deposit form parents												
Salary												
Extra cash												
Total Income												
Payments												
Deposit on car												
Monthly repayments												
Insurance												
Fuel												
Tax												
MOT												
Service												
Unexpected expenses												
Total payments												
Closing balance each month												

Lesson 3

Topic: Shape/Space/Measure

Context: Designing a race circuit

Learning Objectives:

- To be able to use shapes (2D and 3D) and appreciate/understand surface areas and volumes.
- To be able to appreciate scale – making sense of plans, diagrams and construction kits.

Task

Motor sport is an ever growing popular pastime and new circuits and tracks are needed. You have been asked to develop plans and layout for a new track in the middle of England. You have sufficient budget to design what you want. Draw to scale and use relevant ICT to design the layout. You can decide the layout of the track. Once you have developed and constructed the race track, you will need to consider seating for spectators and where you are going to locate stands. You will have a limited area of space to work in (5000 m²) and you need to fit in all the requirements in the space that has been allocated.





Lesson 4

Topic: Sequences and functions

Module: Car emissions

Learning Objectives:

- To communicate mathematics effectively
- Identify and classify patterns

Task

You have been asked to produce a short report to outline the costs and efficiencies of various different models of cars in terms of what they cost in road tax. The rate of tax will depend on both engine size and CO₂ emissions. Find out the CO₂ emissions, engine size, miles per gallon, car tax bracket code and actual car tax cost for the following cars and present your findings in the form of a table – format will be provided. You will be directed to the internet to ascertain the data you need.

1. Ford Focus Model Year Pre 2010 ¼ - Diesel 1.6 Duratorq TDCi (90PS) 5 door saloon.
2. Peugeot 3008 (from October 2009 onwards) – Petrol 1.6 THP (156 bhp) Energy Saver Tyres
3. Audi Q7 – Petrol 4.2 V8 TDI 340PS Quattro 8 speed triptronic
4. Ferrari – Petrol 599 Aperta
5. Toyota Prius MY2010 – Alternative Fuel, T Spirit 1.8 VVTi hybrid E-CVT

Discussion

What is the relationship between engine size, CO₂ emissions, mpg and car tax code? Can you draw any conclusions from this? If you were to advise somebody wishing to buy a car that would result in lower costs, what advice would you give them about CO₂ emissions and engine sizes? What car would you recommend to someone who wanted low car tax costs and why?

From your home, work out how far you can get on one tank of fuel in each of these cars.

Table 1 shows the rates by car band

This table is taken from the DirectGov website “Find New Car Details” hyperlink below (Feb 2012):

<http://carfueldata.direct.gov.uk/search-new-or-used-cars.aspx>

Standard rates

The following table contains the rates of vehicle tax for already registered cars.

Petrol car (TC48) and diesel car (TC49)

Band	CO2 emission (g/km)	12 months rate	6 months rate
A	Up to 100	£0.00	Not available
B	101-110	£20.00	Not available
C	111-120	£30.00	Not available
D	121-130	£95.00	£52.25
E	131-140	£115.00	£63.25
F	141-150	£130.00	£71.50
G	151-165	£165.00	£90.75
H	166-175	£190.00	£104.50
I	176-185	£210.00	£115.50
J	186-200	£245.00	£134.75
K*	201-225	£260.00	£143.00
L	226-255	£445.00	£244.75
M	Over 255	£460.00	£253.00

Table 2

Table of results matching your filter section

Table of results for new cars matching your filter selection							
Manufacturer	Model	Description	Gearbox	Engine size (cc)	Fuel type	CO2	Tax band
ABARTH	500	Abarth	M5	1368			
ABARTH	500	500C	SAT5	1368			
ABARTH	Punto Evo	1.4 16v Turbo MultiAir 165	M6	1368			
ALFA ROMEO	159, 2011 onwards	1750 TBi 200 bhp	M6	1742			
ALFA ROMEO	159, 2011 onwards	2.0 JTDm 16v 170 bhp	M6	1956			
ALFA ROMEO	159, 2011 onwards	2.0 JTDm 16v 136 bhp	M6	1956			
ALFA ROMEO	159 Sportwagon, 2011 onwards	2.0 JTDm 16v 170 bhp	M6	1956			
ALFA ROMEO	159 Sportwagon, 2011 onwards	2.0 JTDm 16v 136 bhp	M6	1956			
ALFA ROMEO	159 Sportwagon, 2011 onwards	1750 TBi 200 bhp	M6	1742			
ALFA ROMEO	Brera, 2011 onwards	2.0 JTDm	M6	1956			
ALFA ROMEO	Brera, 2011 onwards	1750 TBi	M6	1742			
ALFA ROMEO	Giulietta	1.4 TB 120 bhp	M6	1368			
ALFA ROMEO	Giulietta	1750 TBi 235 bhp	M6	1742			
ALFA ROMEO	Giulietta	1.4 TB MultiAir 170 bhp	M6	1368			

Lesson 5

Topic: Compound Measures

Module: F1 Lap Times

Learning Objectives:

- To be able to make sense of information involving compound measures and present data using graphs and other diagrams/tables

Task

In F1 there are many practice laps before the actual race. This allows both the drivers and mechanics to test the cars and the engines as well as getting used to new parts and the track. With the information provided, represent the lap times for the first ten practice laps for three drivers (Laps 3 to 13): Vettel, Webber and Hamilton. Plot the times on the same graph as a way of comparison. You decide the scale and the titles of the graph's axes. Data will be provided.

Lap times for the three drivers are provided:

<i>Driver</i>	<i>S. Vettel</i>	<i>M. Webber</i>	<i>L. Hamilton</i>
Lap Times	1:17.493	1:17.350	1:16.404
	1:14.667	1:19.362	1:15.078
	1:16.387	1:18.687	1:23.681
	1:14.575	1:15.645	1:14.503
	1:17.085	1:14.766	1:21.725
	1:14.445	1:14.040	1:14.296
	1:21.311	1:19.122	1:27.215
	1:14.025	1:14.055	1:13.961
	1:22.008	1:14.443	1:14.938
	1:14.511	1:24.411	1:19.697
	1:16.812	1:17.175	1:13.963

Lesson 6

Topic: Budgeting

Module: Drag Racing

Learning Objectives:

- This exercise allows the student to “play” with variable factors, to achieve the best result possible. It should introduce them to ideas of trade off and value for money.

Task

You have been asked to design and build a drag racing car at the world famous Santa Pod raceway. You have been given a specific budget to spend and you have several options available to choose to build and develop a specification for the car. You need to have all seven parts to ensure the car will race properly plus one compulsory part (the parachute) at a fixed cost.

You will not have enough budget to always buy the best parts, so you will have to make a judgement and look at the relative value of each part. Each part has an associated financial value and point's total. Your objective is to achieve the highest number of points within budget.

Drag Racing parts table

Budget is £10,000.....what is the maximum number of points you can achieve?

Part	High	Points	Medium	Points	Low	Points
	Cost		Cost		Cost	
Engine	2500	10	1500	7	1000	5
Body	1000	10	750	5	400	5
Suspension	1000	10	750	7	200	3
Wheels	800	10	600	8	300	3
Tyres (four)	1800	10	1200	7	800	4
Weight reduction kit	2000	10	1500	7	1000	5
Supercharger	1500	10	1200	7	1000	5
Fuel	2500	10	2000	7	1500	4
Parachute (fixed cost)	300		300		300	

Lesson 7

Topic: Measures

Module: Motorcycle trip

Learning Objectives:

- Making sense of and understanding information involving compound measures, for example fuel consumption, speed and acceleration.
- To understand the importance of varying factors and trade off (e.g. speed over fuel consumption).

Task

You are planning a holiday. You are going to travel from Lands End to John O’Groats from the SW of England to the NE of Scotland, on a motorbike. The total journey is 1580.2 kilometers and will take about eight days with overnight stops and meal breaks. You will be riding a Honda NC700 and details about the bike that you need to know to be able to complete this task, will be given to you. Look at the weblink below to get some more information:

<http://www.honda.co.uk/motorcycles/adventure/#!/nc700x/specifications/>

The journey is broken up into 8 days of travel which are detailed in the handout sheet.

Your task is to work out:

- What is the total mileage of the trip? Convert kilometres to miles to get an understanding of distance in Imperial measure.
- How much fuel will you use? Find out the mpg for the specific model of motorbike and convert to MPL.
- How much the whole trip will cost? You will be given a set of data to assist in this process and some assumptions (i.e. cost of fuel and accommodation)

Table 1 – Chart for completion by student (completed for teacher pack)

Day	Point	Mileage	KMS	Cum Mileage	Cum KMS	MPG	KPG	MPL	KPL
1	Land's End	0	0	0	0				
1	Bath	214							
2	Stratford upon Avon	87							
3	Nottingham	68							
4	Blackpool	124							
5	Gretna Green	111							
6	Loch Lomond	116							
7	Fort William	78							
8	John O'Groats	184							

Table 2 – Motorbike itinerary

- On day 1 you set off from Land's End in Cornwall and drive to Bath and stay overnight.
- On day 2 you drive from Bath to Stratford upon Avon and stay overnight.
- On day 3, you drive from Stratford upon Avon to Nottingham
- On day 4 you drive from Nottingham to Blackpool and stay overnight.
- On day 5 you drive from Blackpool to Gretna Green and stay overnight.
- On day 6 you drive from Gretna Green to Loch Lomond and stay overnight.
- On day 7 you drive from Loch Lomond to Fort William and stay overnight.
- On day 8 you drive from Fort William to John O'Groats and stay overnight and your trip is complete.

Lesson 8

Topic: Automotive Finishing/Paint

Module: Paint job

Learning Objectives:

- Calculate accurately, selecting mental methods or calculating devices as appropriate.
- Record methods, solutions and conclusions.
- Estimate, approximate and check working

Task 1

You have bought a car and you have decided that you wish to both re-spray it to have a new colour and you wish to add some car art detail that you have seen advertised.

- To obtain the colour you want, you are going to have to mix paints (red, white & blue) in the following ratio 1:2:4. Your car has the following measurements:
- Length – 4961mm, Width – 2053mm and Height – 1460mm
- Assume the surface area of the car is $H \times W \times L$. Also assume that to paint one metre square (m^2) you will need 0.30 (300ml) litre of paint.
- How much of each colour are you going to need?

Task 2

Once the car has been re-sprayed, you decide that you want add some further colour to the sides of the cars by creating a flame effect.

- Black, red and orange
- Total amount of paint is 1.35 litres.
- How much of each colour do you need?

Lesson 9

Topic: Geometry and Measure

Module: Heavy Vehicle

Learning Objectives:

- Perimeters, areas, surface areas, weights and volumes

Task 1

You work in a distribution centre that loads car parts onto lorries for distribution across the country. Your company has just bought a new Scania truck with a curtain slider trailer (the truck pulls the trailer).

The trailer is 13.6 meters in length and 3.048 high. The width of the trailer 2.743. What is the cubic capacity of the trailer?

If the boxes of parts that you send out to clients are uniform and are sized 0.5 x 0.5 x 0.75, how many boxes will you be able to fit as a maximum in the trailer?

Task 2

Once the truck and trailer have departed with their cargo, they need to visit a weighbridge to ascertain the weight of the load. Assume that each box weighs 7.5 kgs, what is the weight of the load?



Lesson 10

Topic: Angles and gradients

Module: Off road

Learning Objectives:

- To get an appreciation of how angles and gradients apply to off road vehicle activity.

Task

This lesson is set in the context of vehicles undertaking extreme driving in terms of going off road, looking at some of the limits that such vehicles have in tackling climbs and descents with a focus on angles and gradients. Students can research data via manufacturers' website and other promotional material about the abilities and limitations of such vehicles to cope with such angles and gradients.

Task 2

Choose a 4x4. Given the data that you have uncovered in Task 1 about individual vehicle's ability to deal with angles and gradients, design a short test track that incorporates such challenges that your chosen vehicle can complete. You could include going up and down a certain gradient, looking at the angle the vehicle could achieve without rolling over, looking at the clearance levels for the vehicle going through water etc..





Lesson 11

Topic: Parts

Module: Calculations and manipulation with numbers

Learning Objectives:

- Using mental and written methods to make sense of everyday situations, including financial statements and transactions.

Task 1

You work in a car parts retailer and you have responsibility for pricing. You buy in car parts at a certain price (trade price) and you are then responsible for adding a 17.5% mark up on those items. You will be given a table of ten items and their cost price. You must work out what their mark-up price will be.

Task 2

Your employer has now expanded into the global market via internet sales and is offering parts all over the world. Orders are coming in from several countries but they want to know what your prices are in their currency.

Task 3

Nominal weights have been given to each item. Research the cost of sending all the items on an individual basis to the USA (New York).

Use the Post Office's online facility to enter the destination and weight for each part to obtain a cost. Nominal weights for each item are given on the student handout sheet.

<http://www.postoffice.co.uk/price-finder>



Part type	Trade price	(17.5 %)	USD	Euro	HKD	Nominal weight of item	Postage costs (£) Choose one country from US, HK or Europe	Total cost (£)
Tyre	37.20					5 kg		
Synthetic Oil (2 litres)	12.37					3.2 kg		
5 litre diesel oil	33.00					7.5 kg		
65 piece socket set	24.75					3.7 kg		
2 ton ratchet axel stands	19.79					47 kg		
Advanced Trolley Jack	74.24					22 kg		
Bodywork Shampoo/Conditioner	6.59					325g		
Easy fit wiper blade set	12.78					150g		
Turtle wax concentrate	3.29					400g		
Dynamic Jump starter	49.49					6.7kg		
55W H7 car Bulb	7.01					15g		

Lesson 12

Topic: Finance/Money

Learning Objectives:

- To prepare a cash-flow forecast.
- To understand the importance of cash flow and how to improve it.

Task 1

You are buying a motorbike – a Honda CBF 125 on a finance plan for £2,500. You have saved a £1000 deposit but you must fund the remaining £1,500 from your earnings - £400 per month (after tax and National Insurance). Fill in the cash-flow plan taking account of the following:

- Monthly bike repayments are £68.40 (after the third month, no payments for the two months)
- The bike was taxed when you purchased it.
- Your insurance for the bike is £400 per year – you pay by direct debit on a monthly basis (split evenly across the 12 months).
- You also need to spend £300 on a helmet and protective clothing for riding the bike.
- You will need to allow £32 per month for fuel.
- In August you get a bonus at work of £100.
- Your bike has to be serviced in September which costs £150.
- You get a flat tyre in November and pay £55 for a new one.
- You ask for money for Christmas and get given £150
- You have a major exhaust problem in January and split the cost of repair over January and February. You pay £200 in January and £170 in February.

Remember the closing balance each month is your total income less your total payments plus whatever you had left in the bank from the month before.

Task 2

Produce a table (attached template) detailing what other monthly expenses you would expect to have as an apprentice and realistically how much you can expect to have at the end of the year. From October to February, your repayment will rise by 10% - add this in to your forecast.



Cash flow chart

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Income												
Deposit you have saved												
Salary												
Extra cash												
Total Income												
Payments												
Deposit on bike												
Monthly repayments												
Insurance												
Helmet and protective clothing												
Fuel												
Service												
MOT												
Unexpected expenses												
Total payments												
Closing balance each month												

ANNEX C

Website Resources

- <http://www.plansmotorsport.com/track/>
- <http://www.trackdesigns.co.uk/>
- http://www.trackdays.co.uk/tracks/tockwith_motorsports_centre.htm
- http://www.wilsonmotorsport.com/public_html/code/maps.htm
- http://en.wikipedia.org/wiki/Formula_One_car
- http://www.fia.com/en-GB/mediacentre/f1_media/Pages/timing.aspx
- <http://www.halfords.com>
- <http://www.theaa.com/>
- <http://www.rac.co.uk/>
- <http://www.contourtraining.com/index.php?page=4x4-off-road-driving-course-content>
- <http://www.funbrain.com/osa/index.html>
- <http://www.coolmath-games.com/0-crazy-taxi-m12/index.html>
- <http://www.mathschallenge.co.uk/>
- http://www.mathschallenge.co.uk/online-resources/documents/jmc_2012.pdf
- <http://www.mathschallenge.co.uk/>
- http://www.fia.com/en-GB/mediacentre/f1_media/Pages/timing.aspx
- <http://en.wikipedia.org/wiki/Weighbridges>
- <http://retexa.co.uk/node/15>
- <http://www.direct.gov.uk/en/Motoring>
- <http://www.postoffice.co.uk/price-finder>
- http://www.clipartguide.com/search_terms/graph.html
- <http://www.santapod.co.uk/index.php>

All websites are external and the IMI is not responsible for any content.