**IMI LESSON PLANS**

**MATHS – TEACHER 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.

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*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.

**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 & support materials*

**Lesson 1** - Topic: Statistics/Data analysis Context: New Car Sales

*A data sheet on the sales of new cars in the UK for a selected month and any associated information needed to complete this topic is provided.*

**Lesson 2** - Topic: Finance & Money Context: Buying a Car

**Lesson 3** - Topic: Shape, Space & Measure Context: Designing a Race Circuit

*None.*

**Lesson 4** - Topic: Sequences and functions Context: Car Emissions

*Detailed information (two data tables) and a further handout table provided (for student to complete).*

**Lesson 5** - Topic: Compound Measures Context: F 1 Lap Times

*A table of F1 lap times for three drivers provided.*

**Lesson 6** - Topic: Budgeting Context: Drag Racing

*Support material is provided in the form of a table that lists parts and their relative values depending on their quality (high, medium or low).*

**Lesson 7** - Topic: Measures Context: Motorcycle Trip

*3 supporting data sheets that includes journey itinerary, journey mileage/kms, motorbike technical details (mpg etc).*

**Lesson 8** - Topic: Shape, Space and Measure Context: Paint Job

*None.*

**Lesson 9** - Topic: Geometry and Measure Context: Heavy Vehicle

*None.*

**Lesson 10** - Topic: Angles and Gradients Context: Off Road

*Technical specifications on 4x4 vehicles included*

**Lesson 11** - Topic: Statistics/Data analysis Context: Vehicle Parts

*Prepared tables have been produced for students to present their findings and compare tasks*

**Lesson 12** - Topic: Statistics/Data analysis Context: Buying a Motorbike

*A cash flow chart has been produced for this task for the students to complete*

**LESSON 1**

*Topic: Statistics/Data analysis*

Context: New Car Sales

Learning Objectives:

By the end of this lesson(s), students should:

* be able to analyse and interpret data
* be able to present data in different formats

Possible areas covered:

* The handling data cycle: representing (specifying the problem and planning), representing and analysing (collecting data), analysing ( processing and presenting the data) and interpreting and evaluating (interpreting and discussing the results).
* Presentation and analysis of grouped and ungrouped data, including time series and lines of best fit.
* Spread
* Probabilities

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 JLR, illustrating sales of all Jaguar and Land Rover vehicles and the sales performance of other car manufacturers who are your competitors.
* Your closest competitors in this market are Mercedez 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.

Teacher notes:

In this lesson, we are providing the students with a host of data and information. We want them to develop and use their analytical skills to interpret the data and present in different formats. This will give them the perfect opportunity to see maths being used in the workplace. This scenario could also be linked with other lessons in the curriculum. The task can be completed either individually or in groups. There are also opportunities for teachers to decide how straightforward or complex they want to make the task, given the abilities of their students. This lesson will allow the student to see data and how it can be used in a real work scenario. They will see how data is collected and organised and displayed. using a combination of pictograms, bar charts and/or pie charts. Data is provided by the IMI for new car sales for 2010 for the purposes of this exercise.

Further notes:

This exercise may provide a theme for other lessons in other parts of the curriculum and may allow for team work and presentation skills to be utilised.

Support Materials:

New Car Sales Data Sheet

|  |  |
| --- | --- |
| *Car Manufacturer* | *No of Cars sold in 2010* |
| 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*

Context: Buying a car

Learning Objectives:

* To be able 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 Apprentice 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 Powerpoint presentation 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.

Teacher notes:

This task gives students some experience of forecasting and can be used to explain why companies use a cash-flow forecast. There will be the opportunity to cover the types of costs and expenditure that students might see on a cash flow forecast and to become familiar with relevant key terms and phrases.

Support materials:

A cash flow plan template is provided in each student pack.

**Notes**

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*Lesson 2 – Buying a car*

*Cash flow chart*

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb |
| **Income** |  |  |  |  |  |  |  |  |  |  |  |  |
| Deposit from 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)
* Introduction to/further development of constructions, loci and bearings
* Similarity, including the use of scale

Possible areas covered:

* Properties of 2D and 3D shapes (including circles and shapes from cuboids)
* Constructions, loci and bearing (includes constructing mathematical figures using both straight edge and compasses and ICT
* Pythagoras’ theorem
* Transformations
* Similarity, including the use of scale (this includes making sense of plans, diagrams and construction kits).
* Points, lines and shapes in 2D coordinate systems
* Units, compound measures and conversions
* Perimeters, areas, surface areas and volumes (this includes 3D shapes based on prisms).

Task 1

Motorsport 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. You should include bends and corners of varying degrees of difficulty. 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.

Teacher notes:

This exercise will allow the student to explore 2D and 3D shapes and give some thought and understanding to the mathematical concepts of constructions, loci and bearings, including construction of figures (the track and the stands) using ICT where possible. Depending on the students’ ability (and available ICT), this task can be a straightforward mapping to scale, producing a 2D model of the track and stands. Alternatively, for those students with more ability and/or those students who wish to explore the use of ICT further, a 3D mapping project could be undertaken. Varying difficulties and challenges could be introduced depending on the level of ability of the student. For more able students, gradients and slopes could feature. This lesson could either be undertaken by a student individually or by a group of students together as a team.

Support materials:

Our resource section provides a huge amount of links to both existing tracks and new track designers. There is an opportunity here for teachers to cover shapes, scale, plans and diagrams for either a single lesson or a project over a series of lessons

**Notes**

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**LESSON 4**

*Topic: Sequences and functions*

Context: Car emissions

Learning Objectives:

* To communicate mathematics effectively
* Identify and classify patterns

Possible areas covered:

* A range of sequences and functions based on simple rules and relationships.

Task 1

You have been asked to produce a short report to outline the costs and efficiencies of various different models of cars (specified) in terms of what they cost in road tax. The rate of tax will depend on both engine size and C02 emissions. Find out the C02 emissions, miles per gallon, car tax bracket code and actual cost for the following cars and present your findings in the form of the table on the next page. You will be directed to the internet to find 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

Optional Task 2

Students could be set a quiz using the data available on the DirectGov website to ascertain which car(s) are/have:

* The highest CO2 emissions
* How many are in Band M (over 255 CO2 g/km)
* Biggest engine size (cc)
* Models of petrol compared to diesel

Teachers notes:

Students will firstly need to be made aware (if they are not already) of the myriad of car manufacturers and models. Guidance will need to be given in some circumstances to ensure that they are looking at the data of the correct model of car. This lesson(s) will rely on information published on the DirectGov website.

In this task, students are asked to think about the relationship between two variable factors (vehicle emissions and car tax). As well as thinking about the relationship, they should be able to think and predict about possible outcomes using some of the evidence provided e.g. larger engines generally have a higher tax bracket. Using information and resources provided, they will be able to interpret and predict patterns and sequences. Look at the different engine sizes of cars and look at their comparative CO2 emissions. See the relationship between the CO2 emissions and the car tax that the owner of the car has to pay. Present findings.

Teacher discussion point – work out how far you could go on a full tank in a car in the highest and lowest car tax brackets, using available data. Contextualise the distance for the students according to their locality e.g. if 120 miles, then Birmingham to London.

Support Materials:

<http://www.direct.gov.uk/en/Motoring/BuyingAndSellingAVehicle/AdviceOnBuyingAndSellingAVehicle/CalculatethefuelconsumptionCO2andtaxcosts/DG_195357> (Feb 2012)

The next pages contain relevant information and a table has been created for use by the teacher with the answers to the specific questions asked of the students.

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 shows detailed information of manufacturer, model, description, gearbox, engine size, fuel type, CO2 emissions and tax bands**

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>

Showing 1 - 100 of 3823 results

| 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](http://carfueldata.direct.gov.uk/search-new-or-used-cars.aspx?vid=22735)  | M5  | 1368  | Petrol  | 155  | G  |
| ABARTH  | 500  | [500C](http://carfueldata.direct.gov.uk/search-new-or-used-cars.aspx?vid=26263)  | SAT5  | 1368  | Petrol  | 151  | G  |
| ABARTH  | Punto Evo  | [1.4 16v Turbo MultiAir 165](http://carfueldata.direct.gov.uk/search-new-or-used-cars.aspx?vid=26264)  | M6  | 1368  | Petrol  | 142  | F  |
| ALFA ROMEO  | 159, 2011 onwards  | [1750 TBi 200 bhp](http://carfueldata.direct.gov.uk/search-new-or-used-cars.aspx?vid=27061)  | M6  | 1742  | Petrol  | 189  | J  |
| ALFA ROMEO  | 159, 2011 onwards  | [2.0 JTDm 16v 170 bhp](http://carfueldata.direct.gov.uk/search-new-or-used-cars.aspx?vid=27062)  | M6  | 1956  | Diesel  | 139  | E  |
| ALFA ROMEO  | 159, 2011 onwards  | [2.0 JTDm 16v 136 bhp](http://carfueldata.direct.gov.uk/search-new-or-used-cars.aspx?vid=27063)  | M6  | 1956  | Diesel  | 134  | E  |
| ALFA ROMEO  | 159 Sportwagon, 2011 onwards  | [2.0 JTDm 16v 170 bhp](http://carfueldata.direct.gov.uk/search-new-or-used-cars.aspx?vid=27064)  | M6  | 1956  | Diesel  | 142  | F  |
| ALFA ROMEO  | 159 Sportwagon, 2011 onwards  | [2.0 JTDm 16v 136 bhp](http://carfueldata.direct.gov.uk/search-new-or-used-cars.aspx?vid=27065)  | M6  | 1956  | Diesel  | 137  | E  |
| ALFA ROMEO  | 159 Sportwagon, 2011 onwards  | [1750 TBi 200 bhp](http://carfueldata.direct.gov.uk/search-new-or-used-cars.aspx?vid=27069)  | M6  | 1742  | Petrol  | 194  | J  |
| ALFA ROMEO  | Brera, 2011 onwards  | [2.0 JTDm](http://carfueldata.direct.gov.uk/search-new-or-used-cars.aspx?vid=27067)  | M6  | 1956  | Diesel  | 142  | F  |
| ALFA ROMEO  | Brera, 2011 onwards  | [1750 TBi](http://carfueldata.direct.gov.uk/search-new-or-used-cars.aspx?vid=27070)  | M6  | 1742  | Petrol  | 189  | J  |
| ALFA ROMEO  | Giulietta  | [1.4 TB 120 bhp](http://carfueldata.direct.gov.uk/search-new-or-used-cars.aspx?vid=25689)  | M6  | 1368  | Petrol  | 149  | F  |
| ALFA ROMEO  | Giulietta  | [1750 TBi 235 bhp](http://carfueldata.direct.gov.uk/search-new-or-used-cars.aspx?vid=25690)  | M6  | 1742  | Petrol  | 177  | I  |
| ALFA ROMEO  | Giulietta  | [1.4 TB MultiAir 170 bhp](http://carfueldata.direct.gov.uk/search-new-or-used-cars.aspx?vid=25691)  | M6  | 1368  | Petrol  | 134  | E  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Car** | **Model/Year** | **Fuel type** | **Description** | **Fuel consumption (Imperial combined) MPG** | **Engine size (cc)** | **CO2 emissions (g/km)** | **Tax band** |
| Ford Focus | Model Year Pre 2010 ¼ | Diesel | 1.6 Duratorq TDCi (90PS) 5 door saloon | 62.8 | 1560 | 119 | C |
| Peugeot 3008 | from October 2009 onwards | Petrol | 1.6 THP (156 bhp) Energy Saver Tyres | 39.7 | 1598 | 167 | H |
| Audi Q7 |  | Petrol | 4.2 V8 TDI 340PS Quattro 8 speed triptronic | 30.7 | 4134 | 242 | L |
| Ferrari |  | Petrol | 599 Aperta | 16.0 | 5999 | 411 | M |
| Toyota Prius | MY2012 | Alternative Fuel | T Spirit 1.8 VVTi hybrid E-CVT | 70.6 | 1798 | 92 | A |

**Table 3 – template for answers (completed for teacher pack)**

**LESSON 5**

*Topic: Compound Measures*

Context: 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: 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.

Teachers note

This is an opportunity for students to look at (interesting) data relating to F1 lap times for three drivers and how to present information and findings in a graphical format. By introducing some real life scenarios from F1 racing, we hope this will enthuse students to embrace the value of data and how to represent it. We have selected three drivers for this lesson(s). If you wanted to further develop the lesson, you could introduce further drivers or use the data for a lesson on mean, median and mode.

Support materials

Lap times for the three drivers are provided

|  |  |  |  |
| --- | --- | --- | --- |
| DRIVER | S. Vettel | M. Webber | L. Hamilton |
| 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*

Context: 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 (£10,000) and you have several options available to choose from 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. Use your budgeting skills and weigh up the relative values of the parts, thinking about trade off and value for money.

Teachers note

Students are given the opportunity to “spec” their drag racer. They will need to appreciate that they won’t be able to purchase the most expensive part for each of the categories so they are asked to think about the relationships between varying factors in the car’s set up and how changing one factor may have an implication to the car. They will also be able to make value judgements about which parts offer best value for money. To enthuse the students in this area, there are links to Santa Pod raceway and other drag racing sites that might be used to contextualise the exercise. This topic could also link into other lessons as part of the curriculum.

Support materials

A table has been developed that offers students the opportunity to spend a budget of £10,000 on various parts. The spend is weighted to quality and the higher quality items attract the higher number of points. This affords the student the opportunity to look at the cost implications of certain purchases and their relative values and to look at alternatives.

Drag Racing parts table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Part** | **High** |  | **Medium** |  | **Low** |  |
|  | **Cost** | **Points** | **Cost** | **Points** | **Cost** | **Points** |
| 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 |  |
|  |  |  |  |  |  |  |

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

Notes

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**LESSON 7**

*Topic: Measures*

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 kilometres 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 web link 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 miles.
* How much fuel will you use? Find out the miles per gallon (mpg) for the specific model of motorbike and convert to miles per litre (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)

Teachers note

This is an opportunity for students to start to gain or develop an appreciation of distance and speed and time taken to travel. It makes full use of the mathematical process of conversion. Teachers may also want to consider if they wish to develop this unit further for students with a greater ability – this could include looking at other possible routes, varying journey speeds etc.

Support materials

Full support materials accompany this lesson, including the trip itinerary, required technical information about the bike, including fuel consumption and a table for teachers that include all the required information to complete the task. Note that students will be given the same table but without the completed data.

**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 | 78.8 | 126.8 | 20.82 | 27.92 |
| 1 | Bath | 214 | 344.4 | 214 | 344.4 |  |  |  |  |
| 2 | Stratford upon Avon | 87 | 140.0 | 301 | 484.4 |  |  |  |  |
| 3 | Nottingham | 68 | 109.5 | 369 | 593.9 |  |  |  |  |
| 4 | Blackpool | 124 | 199.5 | 493 | 793.4 |  |  |  |  |
| 5 | Gretna Green | 111 | 178.6 | 604 | 972 |  |  |  |  |
| 6 | Loch Lomond | 116 | 186.7 | 720 | 1158.7 |  |  |  |  |
| 7 | Fort William | 78 | 125.5 | 798 | 1284.2 |  |  |  |  |
| 8 | John O’Groats | 184 | 296.1 | 982 | 1580.3 |  |  |  |  |

**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.

* What is the total mileage of the trip? Convert kilometres to miles to get an understanding of distance in miles. 982 miles = 1580.3 kms.
* How much fuel will you use? Find out the miles per gallon (mpg) for the specific model of motorbike (78.8) and convert to miles per litre (20.82).
* How much the whole trip will cost in fuel? You will be given a set of data to assist in this process and some assumptions (i.e. cost of fuel is £1.357 per litre) 1580.3 km divided by 27.92 km per litre (kpl) = 56.60 litres x £1.357 = £76.80

**LESSON 8**

*Topic: Measure*

Context: Paint Job

Learning Objectives:

* Apply concepts of ratio and proportion
* 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 HxWxL. Also assume that to paint one metre square (m2) you will need 0.30 (300ml) litre of paint.
* How much of each colour are you going to need?

ANSWER:

Total volume is 14.87m requiring a total of 4.46 litres of paint

0.64 litres of red

1.28 litres of white

2.56 litres of blue

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. This is made up of three colours to a ratio of 1:2:8 (Black, red and orange, in that order).

Total amount of paint is 1.35 litres. How much of each colour do you need?

ANSWER:

122.7 ml of black

245.5 ml of red

981.8 ml of orange

Teacher note

This lesson is an opportunity to look at surface areas, volumes and ratios. No support materials are provided but students could do some basic research on spraying a car and adding artwork, with a focus on what amounts of paint are needed. If some students are struggling, an alternative might be to re-spray a straightforward part of the car e.g. the bonnet or the roof with the teacher giving the student a nominal surface area.

NOTES

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**LESSON 9**

*Topic: Geometry and Measure*

Context: 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 meters in length and 3 meters high. The width of the trailer is 3 meters. What is the cubic capacity of the trailer?

ANSWER: 117m3

If the boxes of parts that you send out to clients are uniform and are sized 1.5m x 1.5m x 1.5m, how many boxes will you be able to fit as a maximum in the trailer?

ANSWER: 34.6 (34)

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 total weight of the load?

ANSWER: 255kg

Teacher note

This lesson is an opportunity to look at weights and volumes. There are links provided to the curtain slider trailer and weighbridges.

**LESSON 10**

*Topic: Angles and gradients*

Context: Off road

Learning Objectives:

* To get an appreciation of how angles and gradients apply to off road vehicle activity, including the gradient properties of parallel and perpendicular lines.

Task 1

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 by make and model. 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.

Teacher note

Students are asked to think about the relationships between the 4x4 and its ability to climb, descend and manoeuvre. Much information is provided on manufacturers’ websites about the vehicles’ capabilities. Again, students can be enthused in this topic by looking at some video footage of off road capabilities of specific 4x4 models and also by the variety of tracks/courses available. Some links have been provided.

**LESSON 11**

*Topic: Calculations and manipulations with numbers*

Context: Parts

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 trade price. You must work out what their mark up price will be. Put your answers in to the table.

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. Add in to the table the prices of the marked up parts (not the trade price) in US dollars, Euros and Hong Kong dollars. Teachers can either give their students the three exchange rates or ask their students to find this information out via the internet.

Task 3

The weight of each item has been listed in the table. Research the cost of sending all the items on an individual basis to the USA (New York) to arrive within five days and add this information into the table.

Use the Post Office’s online facility to enter the destination and weight for each part to obtain a cost.

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

Teacher note:

Students are asked to think about the relationships between a trade price and a retail price to give them some understanding or feeling towards mark up and profit. The introduction of foreign currencies and postage costs in tasks 2 & 3, reflect the use of mathematics in day to day business life. A support sheet is provided for both the teacher and student. These tasks can be undertaken by an individual student or in groups.

**Task 2 – Template for completion by student (use internet to obtain currency rates for day of exercise)**

Resource:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | 43.71 |  |  |  | 5 kg |  |  |
| Synthetic Oil (2 litres) | 12.37 | 14.99 |  |  |  | 3.2 kg |  |  |
| 5 litre diesel oil | 33.00 | 39.99 |  |  |  | 7.5 kg |  |  |
| 65 piece socket set | 24.75 | 29.99 |  |  |  | 3.7 kg |  |  |
| 2 ton ratchet axel stands | 19.79 | 23.99 |  |  |  | 47 kg |  |  |
| Advanced Trolley Jack  | 74.24 | 89.99 |  |  |  | 22 kg |  |  |
| Bodywork Shampoo/Conditioner | 6.59 | 7.99 |  |  |  | 325g |  |  |
| Easy fit wiper blade set | 12.78 | 15.49 |  |  |  | 150g |  |  |
| Turtle wax concentrate | 3.29 | 3.99 |  |  |  | 400g |  |  |
| Dynamic Jump starter | 49.49 | 59.99 |  |  |  | 6.7kg |  |  |
| 55W H7 car Bulb | 7.01 | 8.50 |  |  |  | 15g |  |  |

**LESSON 12**

*Topic: Finance/Money*

Context: Buying a Motorbike

Learning Objectives:

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

Possible areas covered:

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 first two months)
* The bike was taxed when you purchased it.
* You 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.

Teachers note

This is a similar lesson to lesson 2 but now in the context of a buying a motorbike with some new scenarios and figures added. Teachers may want to use this as a lesson in isolation or to use as a follow up/re-enforcement of the earlier lesson 2 (with all or some of their students).

This task therefore gives students some experience of forecasting and can be used to explain why companies use a cash-flow forecast. This gives students the opportunity to cover the types of costs and expenditure that they might encounter whilst owning a vehicle.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 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 & Protective Clothing |  |  |  |  |  |  |  |  |  |  |  |  |
| Fuel |  |  |  |  |  |  |  |  |  |  |  |  |
| Service |  |  |  |  |  |  |  |  |  |  |  |  |
| Unexpected Expenses |  |  |  |  |  |  |  |  |  |  |  |  |
| **Total Payments** |  |  |  |  |  |  |  |  |  |  |  |  |
| **Closing Balance each month** |  |  |  |  |  |  |  |  |  |  |  |  |

**ANNEX A**

|  |  |  |
| --- | --- | --- |
| **Lesson** | **Topic** | **Student support material provided** |
| 1 | Statistics/Data analysis | Car sales data sheet |
| 2 | Finance & Money | Cash flow chart |
| 3 | Shape, Space & Measure | None |
| 4 | Sequences and functions  | Detailed information and table provided for student to complete |
| 5 | Compound Measures | Table of F1 lap times |
| 6 | Budgeting | Table of drag racer parts |
| 7 | Measures | Motorbike Land’s End to John O’Groats materials |
| 8 | Measures | None |
| 9 | Statistics/Data analysis  | None |
| 10 | Angles | Vehicle information provided |
| 11 | Statistics/Data analysis | Parts price list and possible template. |
| 12 | Finance & Money | Cash flow chart |

**ANNEX B**

*Useful weblinks and resources by lesson:*

**Lesson 1 -** Topic: Statistics/Data analysis

IMI have provided data on the sales of new cars.

**Lesson 2 -** Topic: Finance & Money

A cash flow chart has been produced for this task for the student to complete.

**Lesson 3 -** Topic: Shape, Space & Measure

* <http://www.apexcircuitdesign.co.uk/>
* <http://en.wikipedia.org/wiki/Brands_Hatch>
* <http://en.wikipedia.org/wiki/List_of_A1_Grand_Prix_circuits>
* <http://en.wikipedia.org/wiki/List_of_Formula_One_circuits>
* <http://en.wikipedia.org/wiki/Monaco_Grand_Prix>
* <http://en.wikipedia.org/wiki/Nardo_Ring>
* <http://en.wikipedia.org/wiki/Silverstone_Circuit>
* <http://en.wikipedia.org/wiki/Australian_Grand_Prix>
* <http://nurburgring.org.uk/>
* <http://www.silhouet.com/motorsport/tracks/monza.html>
* <http://www.wilsonmotorsport.com/public_html/code/maps.htm>

**Lesson 4 -** Topic: Sequences and functions

Detailed information and table provided for student to complete

* <http://www.direct.gov.uk/en/Motoring/BuyingAndSellingAVehicle/AdviceOnBuyingAndSellingAVehicle/CalculatethefuelconsumptionCO2andtaxcosts/DG_195357>

**Lesson 5 -** Topic: Compound Measures

Table of lap times provided

**Lesson 6 -** Topic: Budgeting

Support material is provided

* <http://www.santapod.co.uk/index.php>

**Lesson 7 -** Topic: Measures

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

**Lesson 8 -** Topic: Statistics/Data analysis

None

**Lesson 9 -** Topic: Statistics/Data analysis

* <http://www.rothdean.com/vehicle/1856/2009_Wilson_Trailer_Co.html>
* <http://retexa.co.uk/node/15>
* <http://en.wikipedia.org/wiki/Weighbridges>

**Lesson 10 -** Topic: Angles

* <http://www.contourtraining.com/index.php?page=4x4-off-road-driving-course-content>

**Lesson 11 -** Topic: Statistics/Data analysis

Prepared tables have been produced for students to present their findings and complete the tasks.

**Lesson 12 -** Topic: Statistics/Data analysis

A cash flow chart has been produced for this task for the student to complete.

**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.