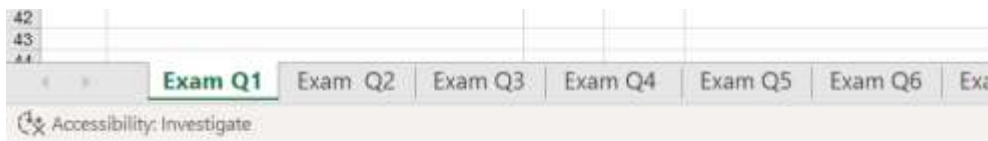


Mock Exam

Guidance

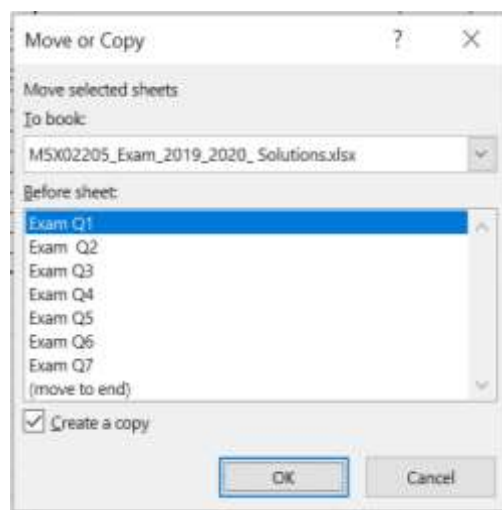
- Use the spreadsheet you developed in the first term as the starting point for this exam. Start by saving your spreadsheet as 'YourName_Exam'
- Each question will ask you to modify the spreadsheet by changing or finding certain values.
- When you have completed a question save the spreadsheet, then create a copy of the current worksheet. Change the name of that copy to the next question number.
- For example - for Exam Q1 when you have completed the question, name the worksheet by changing the name on the tab to Exam Q1 by right clicking on the tab and then entering the new name.



- To generate the worksheet for Exam Q2 right click on the worksheet tab and then left click on Move or Copy



- Check the create or copy box and then OK



- A worksheet called Exam Q1(2) will be created
- Rename the new worksheet tab from Exam Q1 (2) to Exam Q2

- Answer Exam Q2 starting with this new worksheet (which is the same as your final version of the Exam Q 1 worksheet) and then create the next worksheet in the same way. As before.

Mock Examination

Exam Q1

Open the initial spreadsheet you have already developed and, after changing lateral acceleration to 9m/s^2 , save it as instructed

Accel		7 m^2
Measured Suspension Data		
MR fl	Motion Ratio Front Left	1
MR fr	Motion Ratio Front Right	1
MR rl	Motion Ratio Rear Left	1
MR rr	Motion Ratio Rear Right	1
M fl	Front Left total measured static corner mass [kg]	250
M fr	Front Right measured static corner mass [kg]	250
M rl	Rear Left total measured static corner mass [kg]	250
M rr	Rear Right total measured static corner mass [kg]	250
Mus fl	Front Left unsprung mass [kg]	25
Mus fr	Front Right total unsprung mass [kg]	25
Mus rl	Rear Left unsprung mass [kg]	25
Mus rr	Rear Right unsprung mass [kg]	25
Ks fl	Front Left Spring rate [lb/in]	250
Ks fr	Front Right Spring rate [lb/in]	250
Ks rl	Rear Left Spring rate [lb/in]	250
Ks rr	Rear Right Spring rate [lb/in]	250
Tf	Front Track [m]	1.5
Tr	Rear track [m]	1.5
L	Wheel base [m]	2.5
Rrf	Rolling Radius front [m]	0.275
Rrr	Rolling Radius rear [m]	0.275
Htot	Height of CG of total mass above ground [m]	0.4
Hs	Height of CG of sprung mass above ground [m]	
hf	Height of Front roll centre above ground [m]	0.1
hr	Height of Rear roll centre above ground [m]	0.2

- Highlight the cell for the calculated value of Hs (10 Marks)
- Add the following three rows with the relevant calculations for front split, rear split and FRLSD in the cells at the bottom of the final column of the spreadsheet.

(10 Marks)

Front Split	
Rear Split	
FRLSD	

- Create a Total Rear WT percentage of Total Weight transfer calculation with the equation

$$= \text{WTr} / \text{Total WT} * 100 \quad \text{and put this below the previous 3 rows}$$

Rear WT percentage [%]	
------------------------	--

Save, and then Copy worksheet to generate Exam Q2

Exam Q 2 (Based on worksheet Exam Q1)

- Replace the basic input data with the data detailed in the table below.
Highlight the cell containing the result for weight transfer at the rear of the car due to the sprung mass acting about the roll axis [WTsr] .

Accel		12 m ²
Measured Suspension Data		
MR fl	Motion Ratio Fronbt Left	0.87
MR fr	Motion Ratio Fron Right	0.82
MR rl	Motion Ratio Rear Left	0.98
MR rr	Motion Ratio Rear Right	0.98
M fl	Front Left total measured static corner mass [kg]	195.8
M fr	Front Right measured static corner mass [kg]	216.2
M rl	Rear Left total measured static corner mass [kg]	208.8
M rr	Rear Right total measured static corner mass [kg]	229.2
Mus fl	Front Left unsprung mass [kg]	24
Mus fr	Front Right total unsprung mass [kg]	24
Mus rl	Rear Left unsprung mass [kg]	32
Mus rr	Rear Right unsprung mass [kg]	32
Ks fl	Front Left Spring rate [lb/in]	215
Ks fr	Front Right Spring rate [lb/in]	212
Ks rl	Rear Left Spring rate [lb/in]	336
Ks rr	Rear Right Spring rate [lb/in]	337
Tf	Front Track [m]	1.5
Tr	Rear track [m]	1.55
L	Wheel base [m]	2.6
Rrf	Rolling Radius front [m]	0.32
Rrr	Rolling Radius rear [m]	0.32
Htot	Height of CG of total mass above ground [m]	0.41
Hs	Height of CG of sprung mass above ground [m]	
hf	Height of Front roll centre above ground [m]	0.06
hr	Height of Rear roll centre above ground [m]	0.09

Save and Copy the worksheet to generate Exam Q3

(10 Marks)

Exam Q3 (Based on worksheet Exam Q2)

The rear spring rates are changed. Input this data into your spreadsheet.

Ks rl	Rear Left Spring rate [lb/in]	285
Ks rr	Rear Right Spring rate [lb/in]	285

Highlight these changed cells in your spreadsheet

(5 marks)

Answer the following questions below the spreadsheet in a lightly shaded section to make it clear .

Q3.i Would this car be expected to understeer more or less than the car in Q2 when turning right? (5 Marks)

Q3. ii Justify your answer to the previous question by reference to the load splits, proportion of rear weight transfer and typical tyre performance characteristics.

(5 Marks)

Q3.iii **Do not make this change on your spreadsheet!** If the front right lower spring pan was wound up to increase the wheel load on that corner by 30 kg what change would occur at the other 3 corners ?

(5 Marks)

Save and then copy worksheet to generate Exam Q4

Exam Q4 (Based on worksheet Exam Q3)

Delete the answers to the previous question from this worksheet

Make the following data changes.

hr	Height of Rear roll centre above ground [m]	0.12
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Answer the following question underneath the spreadsheet. Highlight the area they are in to make it clear where you have put them.

5i) Using the Formula Dependents function trace though the effect of the change through the spreadsheet by highlighting each of the cells affected by this simple change (5 marks)

5ii) Explain, in real terms, what has happened to the car's overturning moment, roll angle, weight transfer distribution load splits and overall handling balance produced by just raising the roll centre height. (5 marks)

5iii) If the car had a double wishbone suspension system suggest one way in which such a change could be achieved. (5 mark)

Save and then copy the worksheet. To generate Exam Q5

Exam Q5 (Based on worksheet Q4)

Use the spread sheet to find two equal front spring rates that would need to be used to achieve equal front and rear WT.

Save and then copy the worksheet. To generate Exam Q6 (10 Marks)

Exam Q6 (Based on worksheet Q5)

Delete the answers to the previous question from this worksheet

Q6i) Change the front spring rates to these values:

Ks fl	Front Left Spring rate [lb/in]	275
Ks fr	Front Right Spring rate [lb/in]	275

Note the rear WT proportion and the FRLSD values (5 Marks)

Q6ii) Now change the static loads for the car to these values

M fl	Front Left total measured static corner mass [kg]	230.8
M fr	Front Right measured static corner mass [kg]	181.2
M rl	Rear Left total measured static corner mass [kg]	173.8
M rr	Rear Right total measured static corner mass [kg]	264.2

Answer the following questions:

- What has happened to the Rear WT proportion?
- What has happened to the FRLSD?
- How will the car behave in comparison to the car in Q6i ? (5 Marks)

You have completed the Mock Exam!

If you email your completed spreadsheet to me roger.dowden@uwtsd.ac.uk I can check that you have understood how to do the exam and give some feedback. Remember in the exam proper you will be submitting the exam to the Moodle Exam Submission point.