

LOCATION: SWANSEA

LLEOLIAD: ABERTAWE

LEVEL 4

LEFEL 4

MODULE CODE:
M4X00394 Vehicle Technology

TIME: 2 HOURS + 30 MINUTES SUBMISSION ALLOWANCE

ANSWER 4 QUESTIONS FROM 5

Equipment or materials required – Calculator

THIS IS AN OPEN BOOK EXAMINATION FOR ONLINE SUBMISSION

The examination will be uploaded to Moodle at 13:00Hrs on the 14th of May 2020.

You have 2 hours to complete the paper and a further 30 minutes to prepare your submission.

Submission: You are required to take legible, clear digital photographs of your answers and workings which you must then upload these to the submission folder on Moodle.

If you have any issues with your submission you should email tim.tudor@uwtsd.ac.uk within the allotted time with a contact phone number so that I can contact you with further instructions.

Assume acceleration due to gravity 'g' = 9.81 m/s².

ANSWER 4 QUESTIONS FROM 5

QUESTION ONE (SUSPENSION AND CHASSIS SYSTEMS)

Define the following terms (use diagrams where appropriate) and explain how these effect the performance of a suspension system

- i) Camber (2 marks)
- ii) Caster Angle (2 marks)
- iii) Instant centre (3 marks)
- iv) Roll centre (3 marks)

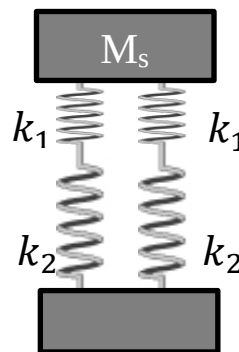
QUESTION TWO (TYRES AND WEIGHT TRANSFER)

A vehicle of mass 915Kg drives around a 130m radii corner at 25m/s. If the vehicle has a centre of gravity height of 0.375m an average track of 1.16m and a wheelbase of 2.65m.

- i) Show that the lateral acceleration of the vehicle is 4.81m/s^2 . (2 marks)
- ii) Calculate the lateral load transfer which would be experienced by the vehicle during the turn. (3 marks)
- iii) Explain why load transfer has a detrimental impact on the overall available grip for a vehicle. (3 marks)
- iv) With the aid of a diagram explain what is meant by the term 'Slip Angle' (2 marks)

QUESTION THREE (SPRINGS AND DAMPING)

The front suspension for a Dakar Rally vehicle may be modelled as a system of springs in series and parallel as shown below.



M_s	Sprung Mass = 215 Kg
K_1	Helper Spring Rate = 13 000 N/m
K_2	Main Spring Rate = 28 000 N/m

- i) Calculate the overall spring rate of the suspension system. (3 Marks)
- ii) Calculate the natural frequency of the suspension system. (2 Marks)
- iii) Comment on the natural frequency of the suspension system with reference to its suitability to an off road vehicle. (2 Marks)
- iv) Draw a diagram to show the response of a spring mass damper system when undamped, overdamped and underdamped. (3Marks)

QUESTION FOUR (BRAKES)

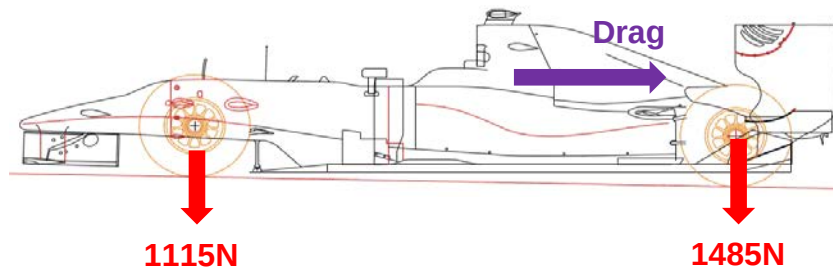
A vehicle of total mass 875 kg must decelerate at 7.5 m/s^2 when its disc brakes are applied. If as a worst case scenario of 100% longitudinal weight transfer is assumed, calculate;

- i) The deceleration force required to be produced by the front brake system. (2 Marks)
- ii) The pedal force required if the brake system specification is as follows; (8 Marks)

Pedal Ratio	4:1
Master Cylinder Piston Diameter	15.875 mm
Slave Cylinder Piston Area Diameter	44.45 mm
Number of Slave Cylinders	2
Effective Pad Radius	0.15m
Pad Coefficient of Friction	0.42
Rolling Radius	0.285m

QUESTION FIVE (AERODYNAMICS)

A single seater race car with frontal area 1.1 m^2 is tested in the wind tunnel at 35 m/s and found to produce aerodynamic forces measured at the wheels as shown below. Take the density of air to be 1.223 Kg/m^3



- i) Explain how the velocity of air around the vehicle relates to the pressure acting on the vehicle surface. (3 Marks)
- ii) Calculate the total downforce produced and the corresponding coefficient of lift for the car. (3 Marks)
- iii) Calculate the drag force which would be produced if the coefficient of drag for the vehicle is 0.67 (2 Marks)
- iv) Calculate the centre of pressure (%) for the vehicle. (2 Marks)