

UNIVERSITY OF BOLTON

**SCHOOL OF THE BUILT ENVIRONMENT &
ENGINEERING**

**BENG (HONS) AUTO ENGINEERING/BSC (HONS)
MOTOR VEHICLE STUDIES**

SEMESTER 1 EXAMINATIONS 2009/2010

MOTOR VEHICLE STUDIES 2

MODULE NO: AME2004

Date: Tuesday, 19 January 2010

Time: 2.00 – 4.00 p.m.

INSTRUCTIONS TO CANDIDATES:

There are **SIX** questions on this paper.

Answer **FOUR** questions.

All questions carry equal marks.

Marks for parts of questions are shown in brackets.

Electronic calculators may be used provided that data and program storage is cleared prior to the examination.

Density of air = 1.2 kg/m^3
 $g = 9.81 \text{ m/s}^2$

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- Q1. (a) A major manufacturer of vehicles is to make a new 2-seater sports car, code named XS-5. As part of the team with responsibility for planning the car, define TWELVE important parts of the car's specification, THREE of which should be legal requirements, THREE should relate to the manufacturing of the car, THREE should be customers' needs, and THREE should relate to the operation of the car in severe climatic conditions. Extra marks will be given for objective statements.
(12 marks)
- (b) You are now given the task of defining the drive shaft assembly of the car, as part of the XS-5 Powertrain team.

Define EIGHT requirements of the drive shaft assembly, again objective statements will be given extra marks.
(8 marks)
- (c) XS-5 is eventually specified as a front-engined, rear wheel drive sports car. Briefly discuss the advantages of such a configuration.
(5 marks)

(Total 25 marks)

Q2. A large saloon car has the following characteristics.

Drag coefficient, $C_D = 0.30$
Rolling resistance coefficient, $C_r = 0.02$
Vehicle mass = 1450 kg
Frontal area = 2.6 m^2

- (a) Using the graph paper supplied, calculate and plot the tractive effort curve for the car, on a level road, from 0 to 60 m/s. Show your calculations in the answer book.
(9 marks)
- (b) The car is fitted with an engine which produces a maximum power output of 94KW, measured at the vehicle's wheels on a chassis dynamometer. Derive graphically, or by calculation, the theoretical maximum speed of the car on a level road.
(7 marks)

Question 2 continued over page

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Question 2 continued

- (c) The car now has to tow a 1200kg mass trailer up a 3% gradient. The drag coefficient of the car/trailer combination is 0.45, the frontal area 3.5m^2 , and the rolling resistance coefficient remains 0.02.

Calculate and plot the tractive effort curve of the car and trailer from 0 to 30 m/s on the graph paper provided.

(9 marks)

(Total 25 marks)

- Q3. (a) Identify FIVE sources of noise which can be encountered on a road vehicle during high speed driving. (5 marks)

Define the meaning of the term decibels in relation to sound pressure levels, and explain the meaning of the unit dB(A). (4 marks)

- (b) Vehicle and component noise can be measured using a number of test methods. Describe using diagrams, how noise would be measured for the following :
- (i) External noise level for a car measured on a test track.
 - (ii) Engine noise in a semi-anechoic chamber (10 marks)
- (c) Show how vehicle noise varies with distance from a car, and explain why the level changes. (6 marks)

(Total 25 marks)

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- Q4. (a) Describe, with the aid of a diagram, what is meant by the terms “lift force” and “drag force” when applied to the aerodynamics of a vehicle. (2 marks)

The term “yaw angle” is used in aerodynamics, it being especially critical to study “yaw angle” effects for aircraft when landing or taking off. However, it is also important to study the effects of yaw angle on the aerodynamics of large vehicles such as trucks, buses, and vans. Explain the significance of this, again using diagrams to explain your answer. (4 marks)

- (b) A wind tunnel can be used to study the effects of air flow over a vehicle, and to help to improve the detail design of a vehicle’s aerodynamics.

Describe THREE methods used in wind tunnel testing to visualise the air flow over a vehicle, using diagrams where appropriate. (9 marks)

- (c) Describe with the aid of sketches, FOUR ways in which the aerodynamics of a truck can be improved. (8 marks)

Which of the above FOUR ways would provide the largest improvement? (2 marks)

Total 25 marks

- Q5. (a) Explain what is meant by the terms “ACTIVE SAFETY” and “PASSIVE SAFETY” in relation to vehicles. (2 marks)

Describe FOUR parts of a modern vehicle design which are passive safety features. (4 marks)

- (b) Describe, in detail, the front impact test carried out to assess vehicle structural safety, on :

- (i) A road car, and
(ii) A Formula 1 racing car (10 marks)

- (c) Explain how the TWO materials used in both of these vehicles behave under high speed impact. (9 marks)

Total 25 marks

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6. (a) Describe a typical vehicle assembly line for both :
- (i) A high volume sales saloon car, and
 - (ii) A low volume sales 8-wheel truck (10 marks)
- (b) In addition to normal track testing, manufacturers test vehicles in extreme climates. Identify FOUR tests which could be carried out on a vehicle at a HOT CLIMATE test track. (4 marks)
- Similarly, identify FOUR tests which could be carried out at a COLD CLIMATE test track. (4 marks)
- (c) Describe, in detail, how a hot climate cooling test could be carried out on a vehicle, include suitable instrumentation. (7 marks)

Total 25 marks

END OF QUESTIONS