The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:	Diploma in Technology/Bachelor of Technology (Engineering)
Name of the Examination	:	Final Examination
Course Code and Title	:	**MEX6332 Vehicle Dynamics and Design of Automotive Components**
Academic Year	:	2012/13
Date	:	22 nd August 2013
Time	:	0930 hrs. – 1230 hrs.
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of two parts, A and B. Part A consists of two (02) questions and part B consists of six (06) questions. You are required to answer only five (05) questions selecting at least one (01) question from part A.
3. All questions carry equal marks.

PART A

QUESTION 01

A motor car with a total mass of 1500 kg was tested on a chassis dynamometer and typical data obtained are given in Fig. Q1. The testing revealed that the rolling resistance (R_r) and the aerodynamic drag resistance (R_a) are given by

$R_r = (155 + 0.35V)$ N and $R_a = 0.11\ V^2$ N,

where V is the speed of the vehicle in km/h. The road wheel diameter is 0.8 m. The vehicle was tested in the top gear and the maximum speed reached was 150 km/h.

Determine:

(a) Overall gear ratio

(b) Overall transmission efficiency

(c) Acceleration at the maximum torque condition

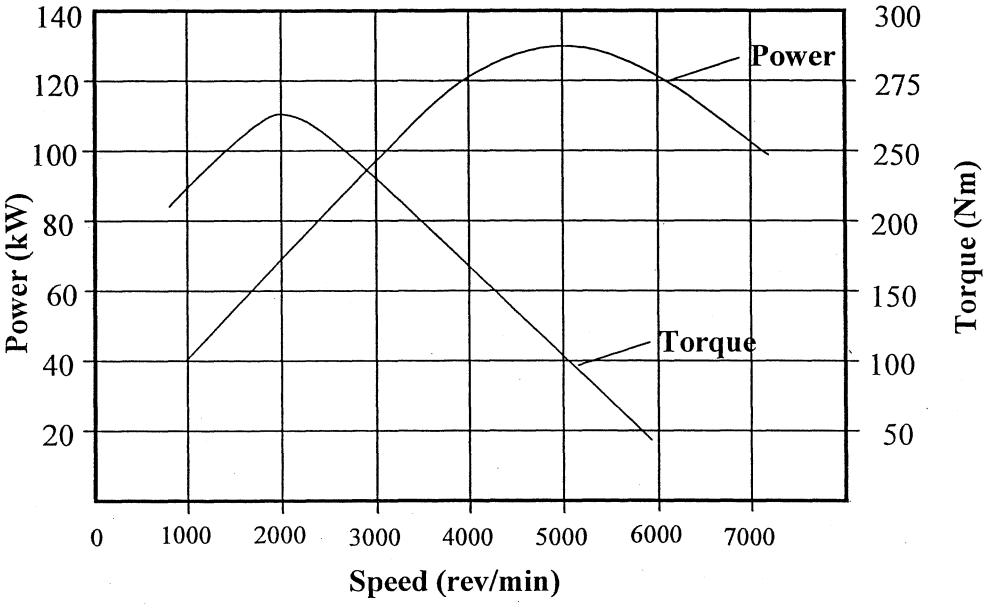


Fig. Q1

QUESTION 02

(a) A typical fuel consumption map is shown in Fig. Q2. Explain how this can be effectively used to increase the fuel efficiency in hybrid vehicles.

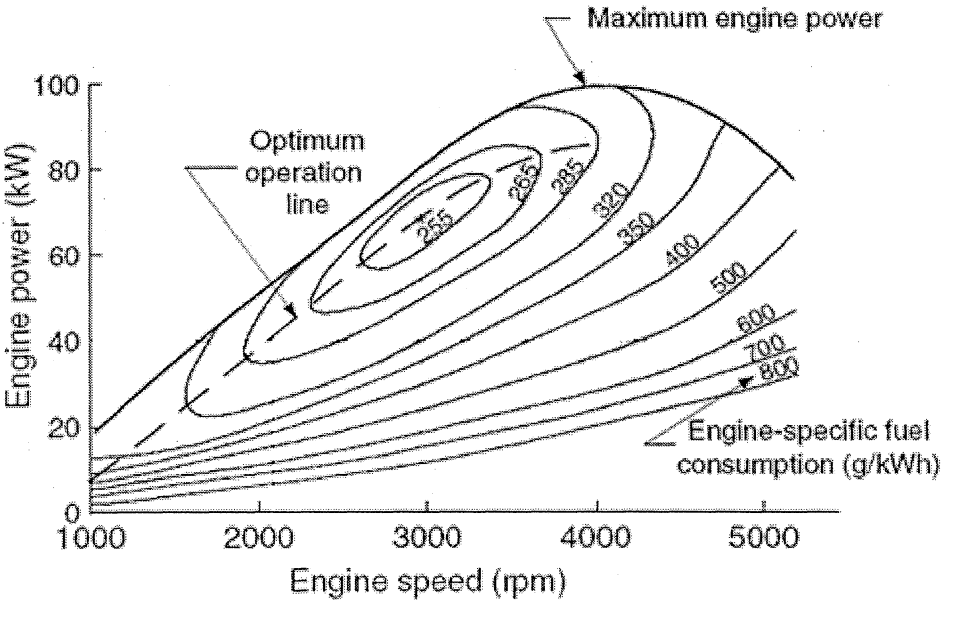


Fig. Q2

(b) Compare the fuel efficiency of the Hybrid sedan and the small standard car, using the data tabulated in Table 2. Assume that the IC engine of the hybrid vehicle consumes 10% more energy to charge the main battery system and it is shut off for 10 min. per hour.

Table 2

Paramenter	Unit	Hybrid Sedan	Small Car
Total distance travelled	km	1000	1000
Density of air	kg/m^3	1.25	1.25
Coefficient rolling resistance		0.1	0.1
Gross weight	kg	1325	730
Average no. of passengers		4	4
Weight of a passenger	kg	75	75
Average speed	km/h	100	90
Frontal projected area	m^2	1.2	0.85
Aerodynamic drag coefficient		0.2	0.3
Specific fuel consumption of the engine	kg/kWh	0.255	0.32

PART B

QUESTION 03

Design parameters of two different vehicles are given in Table 3. The Car 1 is fitted with brakes only for the front wheels and the Car 2 is fitted with brakes for rear wheels only. Compare the stopping distances of Car 1 and Car 2.

Table 3

	Car 1	Car 2
Speed of the vehicle (km/h)	80	80
Wheel base (m)	3	2.2
Height of the center of gravity above ground (m)	0.5	0.3
Distance from the rear axle to the center of gravity (m)	2	1.2
Coefficient of friction between tyre and the road	0.4	0.4

QUESTION 04

Determine the maximum gradient uphill a vehicle whose specifications are given in Table 4, can negotiate when the vehicle is,

(a) front wheel driven
(b) rear wheel driven, separately.

Table 4

Mass of the car (kg)	2400
Static weight distribution on axles	1:1
Wheel base (m)	2.8
Height of the center of gravity above ground (m)	0.52
Coefficient of friction on the highway	0.75

QUESTION 05

(a) Starting from fundamentals show that the velocity of a piston in a reciprocating engine is given by

$$v_P = \omega r\left(\sin\theta + \frac{\sin 2\theta}{2n}\right)$$

(b) Determine the maximum allowable rotational speed of the engine, if the linear speed of the piston is not to exceed 22 m/s. You may assume that, the crank radius is 80 mm and the length of the connecting rod is 230 mm.

QUESTION 06

(a) Explain the boundary layer of a fluid passing over a surface by drawing its velocity gradient.
(b) Discuss the aerodynamic effect on the dynamic performance of an automobile.
(c) Explain the function of a rear spoiler in a sports car with the aid of a sketch.
(d) The graph shown in Fig. Q6 represents the variation of rolling resistance and aerodynamic drag with the vehicle speed for two trucks; A and B. Both trucks have the same engine power and the same overall transmission efficiency. If both are being driven on the same flat road, which truck has the best fuel economy at 40 km/h? Explain your answer analytically. What can you say about the fuel economy of the two trucks at speeds lower than 4 km/h?

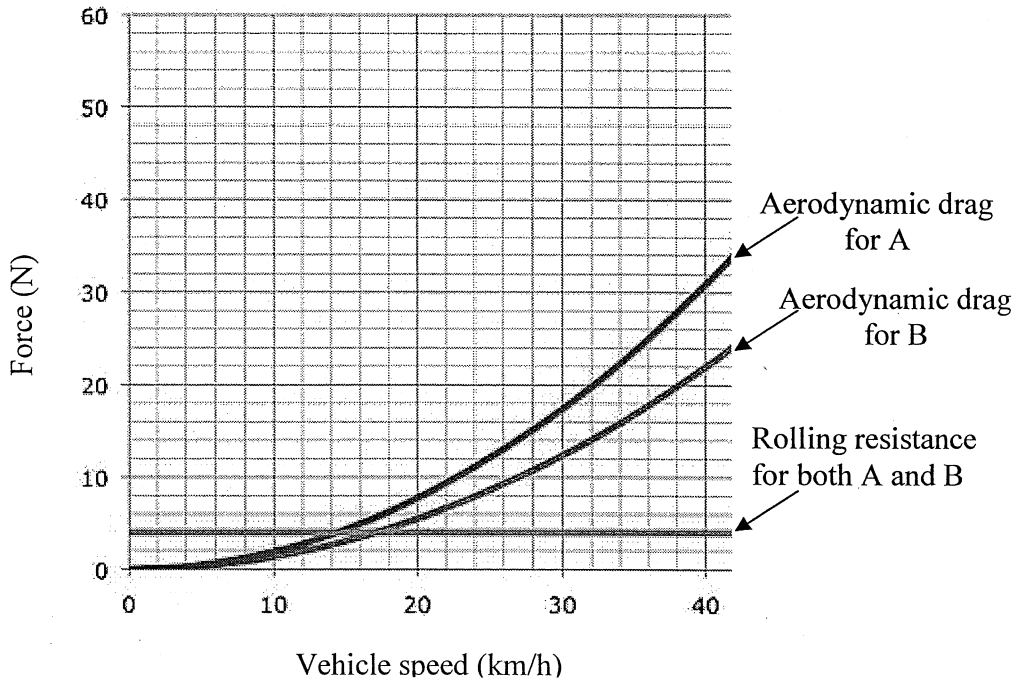


Fig. Q6

QUESTION 07

(a) Briefly explain the terms 'Riding comfort' and 'Handling'.

(b) Explain the following with the aid of sketches.

(i) Generation of forces in an accelerating tyre.

(ii) Generation of forces in a braking tyre.

(c) Discuss the effect of tyre inflation pressure on the rolling resistance of a pneumatic tyre and state the other factors that influence the rolling resistance.

QUESTION 08

(a) Explain the following terms.

(i) Indicated power

(ii) Indicated mean effective pressure

(iii) Indicated thermal efficiency

(iv) Brake power

(v) Brake mean effective pressure

(vi) Brake thermal efficiency

(vii) Volumetric efficiency

(viii) Specific fuel consumption

(b) Explain why multi cylinder engines are designed rather than a single cylinder large engine, when higher power rating is required from an engine. What are the factors to be considered and the practical difficulties to be overcome in designing and manufacturing such a large single cylinder engine?

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