Department of Mechanical Engineering

Faculty of Engineering Chulalongkorn University

Course ID: 218481 **Course Name: Automotive Engineering**

First Semester, Final Examination, Date: 7/12/2021 Time: 19.00-20.30

Name..... Student ID. .....No. in CR .....

Instructions

1. There are ...3... parts in this exam paper, with the total number of **...8....** pages.
2. **Write your Student ID, full name, and your number in CR58 in the space provided on the top of every page or on the first page of given exam papers.**
3. Your answer must only be written on the exam paper.
4. Documents, calculators, smart watches and smart phones are not allowed inside the exam room
5. Borrowing is not allowed unless it is supervised by the proctor.
6. You must not bring any part of this exam paper outside. The exam paper is a government's property. Violators will be prosecuted under a criminal court.
7. Student who wishes to leave the exam room before the end of the exam period, must raise their hand and ask for permission before leaving the room. Student must leave the room in the orderly manner.
8. Once the time is expired, student must stop writing and must remain seated quietly until the proctors collect all the exam papers or given exam booklets. Only then, the students will be allowed to leave the room in the orderly manner.
9. Any student who does not obey the regulations listed above will receive punishment under the Faculty of Engineering Official Announcement on July 27, 2017 regarding the exam regulations.

a) With implicit evidence or showing intention for cheating, student will receive an F in that subject and will receive a lower ethical behavior score.

b) With explicit evidence for cheating, student will be forced to withdraw from Chulalongkorn University, or students will an F in that subject during that semester and will be required to withdraw all subjects and receive a lower ethical behavior score.

*** No communication devices (e.g., mobile phones) are allowed during the exams. Any violators will get an F for the course and W for all other courses in the same semester and may be expelled. ***

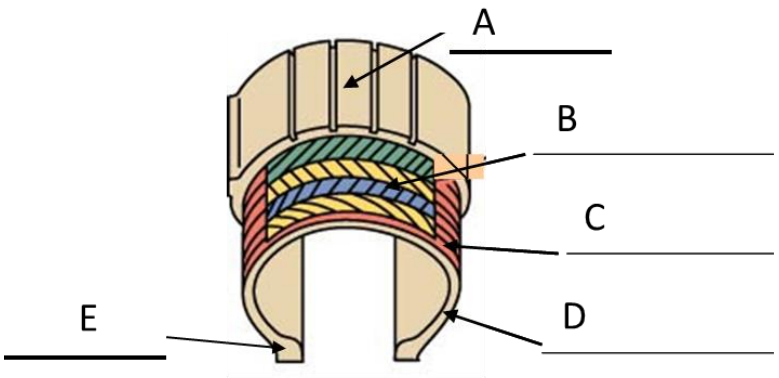
I acknowledge all instructions above. This exam represents **only my own work**. I did not give or receive help on this exam.

Signature .....

Date .....

Section 1 *Tire and suspension* (23 pts)

1.1. Specify the name of tire structure from following choices. (2.5%)

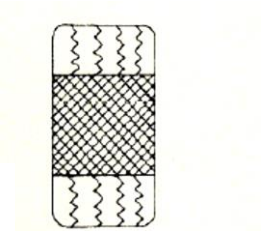
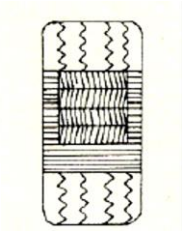


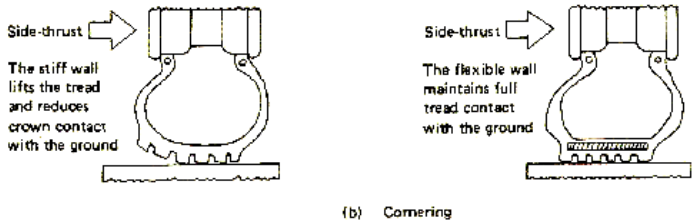
a. Edge cover
b. Side wall
c. Carcass
d. Tread
e. Bead bundle
f. Tread belts
g. Inner tube
h. Hub

1.2. "**P195/70/R15**" From this tire designation, determine the size (with unit) of tire. (1.5%)

A:Tire width:_____ B:Tire aspect ratio:_____ C:Wheel diameter:_____

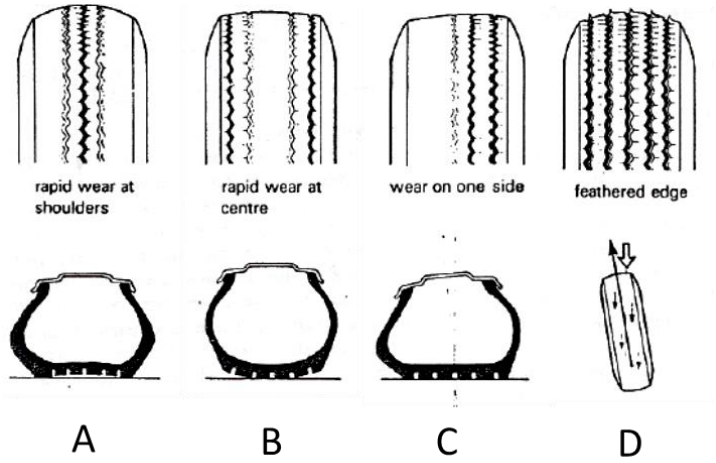
1.3 Identify type of tire in the following pictures. (2%) (Bias belt or Radial belt type?)

Tire a)  Tire b) 



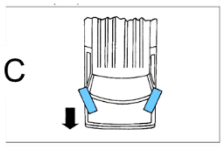
a) _____ b) _____

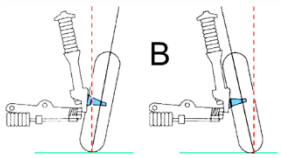
1.4. Diagnose tire wear by choosing from the following choices. (3%)



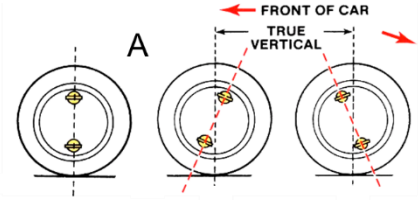
a. Over-inflation
b. Under-inflation
c. Incorrect toe misalignment
d. Steering slackness
e. Brake wear
f. Excessive camber
g. Incorrect caster

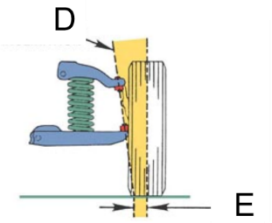
1.5. Identify name of following alignment angles and parameter (a-e). (5%)



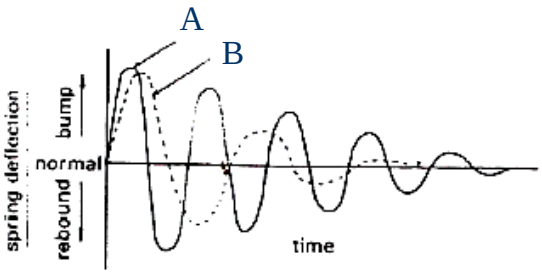


Choices:
Camber angle
Caster angle
Steering axis inclination
Toe angle
Scrub radius
Caster offset
Caster trial
Included angle
Kingpin offset





1.6. From the spring oscillation curves below, which curve is the effect of spring <u>with damper</u>? Briefly explain what is a damper and purpose of it. (3%)

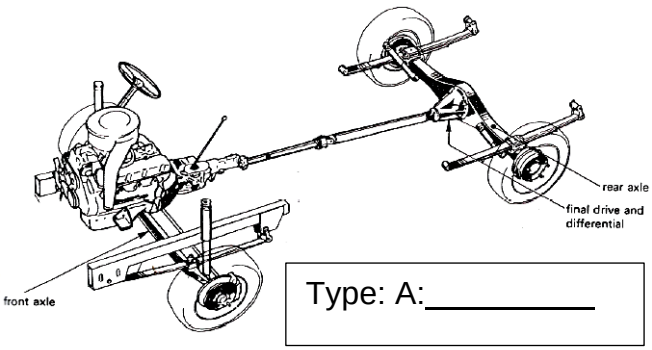


1.7 For radial tire, it should be initially rotated at 10,000 Km to equalize tire wear. Draw a diagram to show how to carry out tire rotation (Draw picture of tires as shown below in your answer sheet and draw arrows to show the direction of tire change.) (1%)

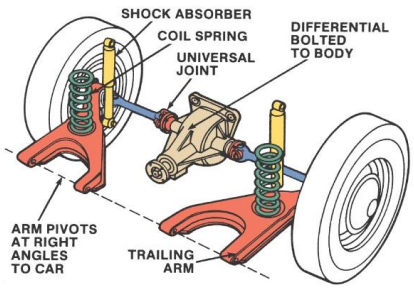
LF ▮ ▮ RF

LR ▮ ▮ RR

2.8 Identify the following suspension system that is it "**rigid axle**" or "**independent**" type and answer questions. (5%)



Type: A:_____



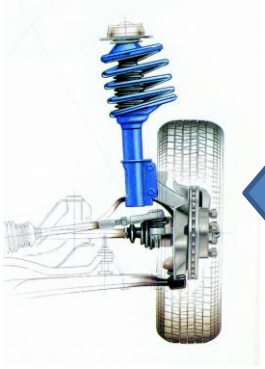
Which wheel? [Front or Rear]

ANS: B:_____

Name of this suspension:

ANS: C:_____

Type: D:_____



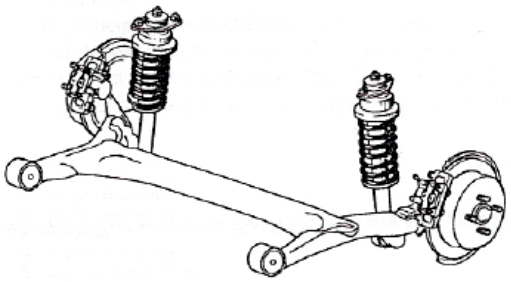
Which wheel? [Front or Rear]

ANS: E:_____

Name of this suspension:

ANS: F:_____

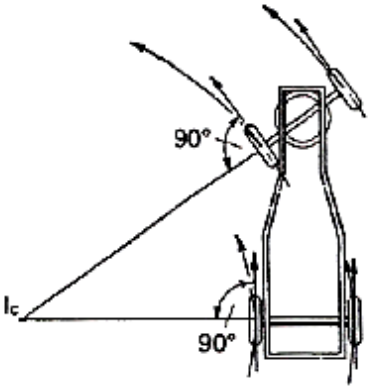
Type: G:_____

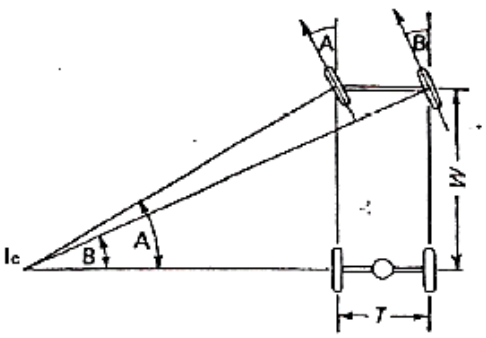


Type: H:_____

Section 2: Intro to Vehicle dynamics **(25.5%)**

2.1 From the pictures, give the name and explain the differences between these two steering systems. Which system is widely used in the car nowadays? (3.5 %)





Which system is widely used?

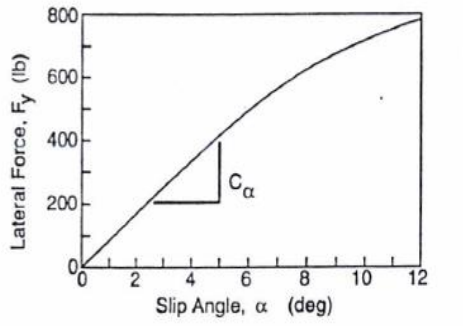
C:_____

A:_____ B:_____

D: Explain difference between A and B:

2.2 Explain the definition of tire slip angle. (3%)

2.3 From a graph below, what is the specific name of slope of the graph at small slip angle (C_α)? (1.5%)



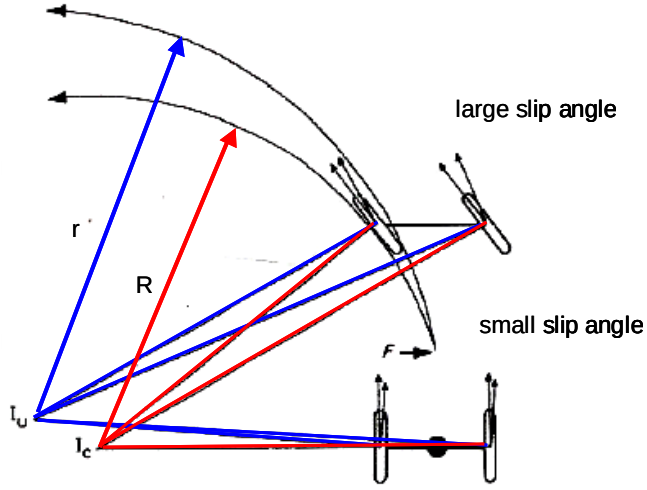
2.4 Explain behavior of driver when he drives his car on the skid pad and increase speed. How does he adjust the steering wheel input to maintain the constant turning radius on the skid pad? (Increase, decrease or not change?) (4.5%)

a) When his car is understeer:

b) When his car is neutral steer:

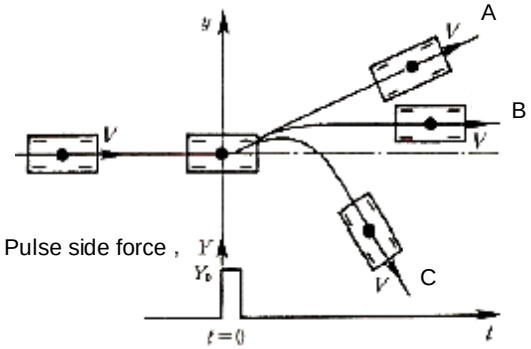
c) When his car is oversteer:

2.5 From the geometry below, what is a correct characteristic of this vehicle? Give reason to support your answer. (2 %)



(US,OS or NS)

2.6 When there is a disturbance force acting to a vehicle, vehicle path will change. From the diagram below what is the correct characteristic of vehicle A, B and C. (1%)



a) A = Oversteer, B = Neutralsteer, C = Understeer

b) A = Understeer, B = Neutralsteer, C = Oversteer

c) A = Neutral steer, B = Oversteer, C = Understeer

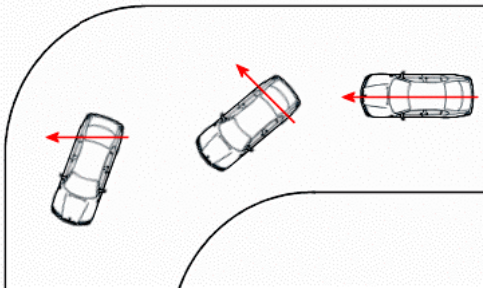
d) A = Neutralsteer, B = Understeer, C = Oversteer

2.7 What kind of car is more susceptible to rollover if involved in a single-vehicle crash? (1%)

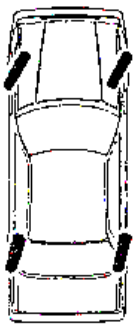
a) Super car
b) Sedan
c) SUV
d) hatchback

2.8 Vehicle in the figure trends to lose control in cornering on dry surface road. What kind of system could help driver to control vehicle in this situation? (1%)

a) ABS
b) Traction control
c) ACC
d) ESP



2.9 What is a correct mode of 4WS in this picture? (1%)



a) High speed turning mode
b) Medium speed turning mode
c) Low speed turning mode
d) Parking mode

2.10 In understeer case, what is the correct operation of ESP to help driver to turn his car properly? (1%)

a) ESP will brake outside rear wheel

b) ESP will brake inside rear wheel

c) ESP will brake outside front wheel

d) ESP will brake two front wheels

2.11 What is not a main excitation source of ride dynamics in car? (1%)

a) Road roughness
b) Tyre and wheel
c) Engine
d) Electric system

2.12 What is a sprung mass in quarter-car model? (1%)

a) Wheel and tyre
b) Suspension
c) Car body
d) Brake

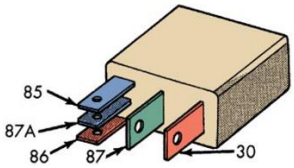
2.13 Which sentence is not correct about NVH? (1%)

a) NVH refers to Noise Vibration and Harshness.
b) An engine is not a big source of NVH.
c) There are two types of detectable noise, which are structure borne and airborne.
d) Structural vibration can be treated by damping or isolation technique.

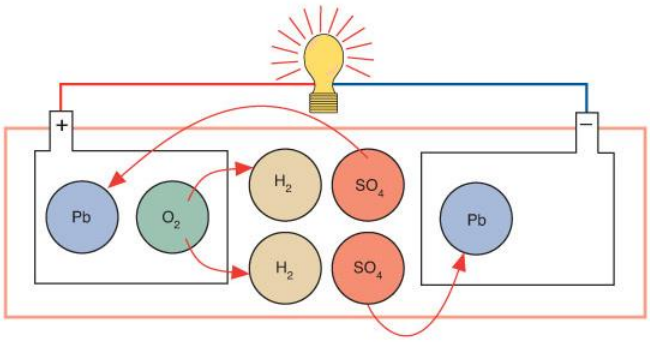
2.14 Explain how Electronic Stability Program (ESP) works. [3 %]

Section 3 Automotive Electrical System **(22.5%)**

3.1 What is relay? Explain function of it. (2%)

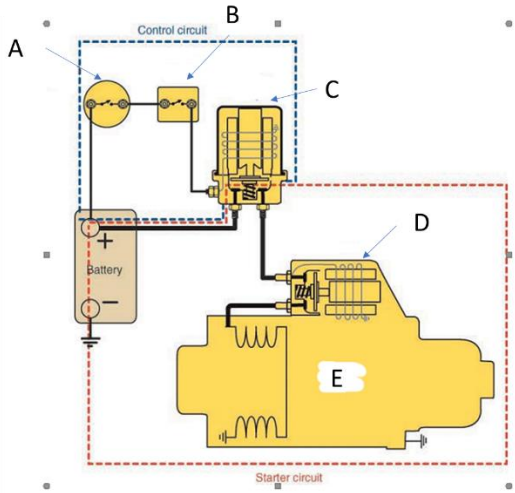


3.2 The picture below displays chemical reaction occurs inside a battery during a discharge cycle. What are the products (as a substance inside battery cell) from this chemical reaction? (3%)



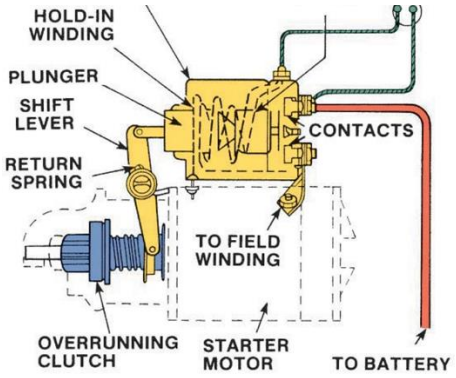
3.3 Give one examples of battery ratings. (1%)

3.4 From the given picture, choose a correct name from choices for components in starting motor circuit (A-E). (2.5%)



Choices:
(1)starter solenoid
(2)starter relay
(3)ignition switch
(4)starter motor
(5)safety switch

3.5 From the picture, explain how a pinion gear engaged to engine fly wheel when starting motor is operating. Hint: when starter motor is not operating pinion gear is not engaged to engine fly wheel. (3 %)

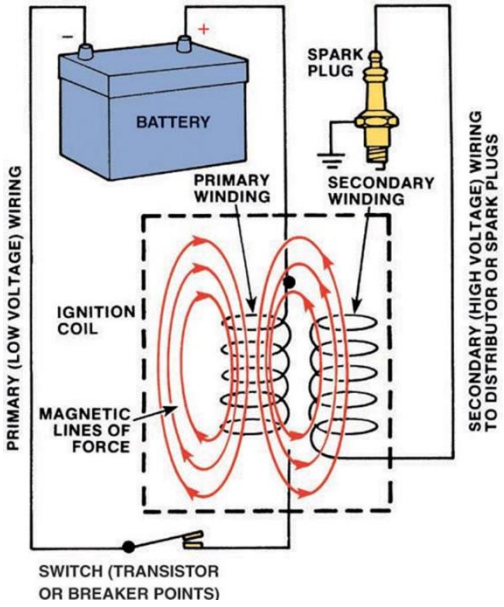


3.6 What are functions of alternator? Why does car need it? (3 %)

3.7 What is a function of rectifier in alternator? (2%)

3.8 What is <u>firing order</u> of 4 cylinders inline engine? (2%)

3.9 From picture of ignition system, explain
a) In primary wiring, it is a low voltage wiring. How many in voltage is in that wiring? (1%)
b) How to produce high voltage in the secondary wiring? (2%)



3.10 In modern internal combustion engine car, which type of Ignition system is typically used? <u>Distributor (DI) system or Distributorless (EI) system</u>? (1 %)