

BINDING LINE
No answer or student information within binding edge
试卷装订线
装订线内不要答题, 不要填写考生信息
试卷装订线

Test Paper of Wuhan University of Technology (A)

2018-2019 Academic Year 2nd Semester, Course: Automobile Electric Appliances and Electronic Control Systems, Closed-book Exam

Time: 120mins, 48 class hours, 3 credits, Total Points: 100, Percent in final evaluation result: 60%, June 2019

No.	I	II	III	IV	V	VI	VII	VIII	IX	X	Total
Full score	20	42	38								100
Score	20	37	34								91

Score 20

I. Fill in the blanks (2 points * 10 = 20 points)

- Modern automobiles generally adopt three-phase synchronous alternator (三相同步交流发电机), transfer AC into DC via 三相桥式整流电路, and maintain the generator voltage steady through 调节器.
- The starter consists of 直流电动机, transmission mechanism (传动机构) and 电磁开关.
- The engine starting system is mainly composed of 起动机, 起动机 and control circuit of the starter (起动机).
- The automotive electric system is characterized by low voltage, DC, 单线制 and 负极搭铁.
- There are mainly three types of engine speed sensors: magnetic inductive, 光电式 and 霍尔效应式 engine speed sensors.
- The spark advance mechanisms of traditional contact-controlled ignition system (触点式点火系统) include 离心点火提前调节器 and 真空点火提前调节器.
- Automatic transmission (AT) shifts gear automatically according to 节气门开度 and 行驶车速.
- EPS system is classified into 转向轴助力式 pinion type electric power steering and 齿条助力式 according to the position of the power mechanism.
- ESP system integrates the basic functions of electronic brake force distribution, 防抱死系统 (ABS) and 电子控制防滑转系统 (ASR).
- Automotive electronic cruise control system uses 车速 as the feedback signal and keep the automobile speed steady by adjusting 发动机节气门开度.

Score

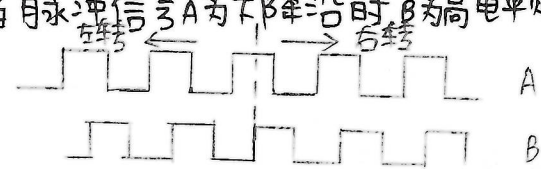
II. Short-answer questions (42 points for 6 questions)

1. What are the basic requirements of the gasoline engine ignition system? (6 points)

- 答: ① 能产生足够高的次级电压
火花塞两极板间气体电离产生电弧放电, 要使两极板间具有很高压力的气体电离产生电火花, 就必须有足够高的次级电压 (击穿电压)
- ② 有足够的点火能量
要使火花塞跳火后可燃混合气能迅速燃烧, 还需有足够的点火能量
- ③ 点火时刻适当
要使混合气燃烧功率最大, 就必须在压缩行程终了前一适当时刻点火

2. How does the photoelectric steering wheel angle sensor (光电式转向盘转角传感器) measure the steering angle and rotation direction? (6 points)

- 答: ① 光电式转向盘转角传感器有遮光盘, 遮光盘上有尺寸形状相同且均布的遮光块, 当车转动转向盘时, 会带动遮光盘一起转动, 产生相应的脉冲信号, 根据脉冲个数可计算出在转向盘转角大小
- ② 传感器中的光电耦合器产生两组脉冲信号 A、B, 两组脉冲信号的脉宽相同但相位差 90°, 当脉冲信号 A 为下降沿时 B 为高电平则为右转, B 为低电平则为左转



3. The electric fuel injection system of the automobile controls the fuel-injection quantity by controlling the fuel-injection time. How does it ensure the accuracy of fuel-injection quantity? (8 points)

- 答: 电控汽油喷射系统通过对喷油量进行修正, 保证发动机在各种工况下都能获得最佳空燃比
- ① 进气温度修正: 根据进气温度传感器对喷油量进行修正
- ② 怠速喷油量修正: 根据点火开关作出喷油量修正控制, 根据冷却液温度传感器确定喷油量修正量, 在怠速时增加喷油量, 改善怠速性能
- ③ 怠速后喷油量修正: 怠速后在基础喷油量上增加补充喷油量
- ④ 怠速暖机喷油量修正 ⑤ 加速时喷油量修正: 适当增加喷油量
- ⑥ 减速喷油量修正 ⑦ 大负荷喷油量修正 ⑧ 汽油高温喷油量修正
- ⑨ 汽油关断喷油量修正 ⑩ 蓄电池电压喷油量修正 ⑪ 混合气浓度喷油量修正

4. What are the influences of battery voltage on engine electronic control systems? (8 points)

答: ①当蓄电池电压小, 容量小时, 蓄电池内阻大, 起动力时, 电动机的端电压小, 起动力功率降低

②当蓄电池电压变化时, 喷油器电磁线圈中的励磁电流会发生变化, 喷油器开启速率会变化, 为了消除喷油器开启速率变化而引起的喷油量偏差, 需要根据蓄电池电压变化对喷油器通电时间进行修正

③蓄电池电压变化时, 点火线圈初级电流上升速率会发生变化, 故需要对点火线圈初级

5. What are the components of hydraulic-drive automatic transmission (AT) and the functions of these components? (6 points)

答: 电子控制 液力传动式自动变速器

①液力传动: 液力变矩器, 将发动机飞轮传递的力通过液力传到齿轮变速机构

②辅助变速: 由齿轮变速机构和换挡执行机构组成, 实现进一步减速增矩, 通过换挡得到不同传动比, 来提高汽车自适应能力

③自动控制: 由电子控制系和液压控制系统两部分组成, 电子控制器根据相关传感器的输入信号产生相应控制信号, 控制各电磁阀动作, 再通过控压阀及阀体中各油路转换为液压信号, 实现换挡执行机构、油压调节装置等装置

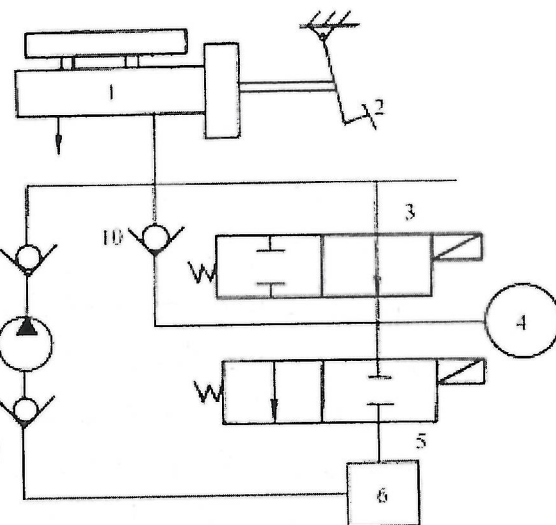
6. The figure below is the schematic diagram of circulating-flow brake pressure regulator (循环流动式制动压力调节器). What are the elements 3, 5 and 8 respectively stand for? What is the working state of pressure regulator in the figure? (8 points)

3-常开电磁阀

5-常闭电磁阀

8-回油泵

此制动压力调节器为二位三通式制动压力调节器, 图示状态为两电磁阀均不通电状态, 制动主缸与制动车轮缸直接相连, 可实现增压或普通制动



Score 34

III. Calculation (38 points)

1. (10 points) The minimum speed of an engine is 100 rpm and the transmission ratio of the retarding mechanism (减速机构) of its starting system is 10: 1,

(1) If a torque of 360Nm is required to overcome static friction, in order to start the engine, what is the minimum stall torque (the torque when the motor has a speed of zero (stalls)) required to start the motor (3 points)

$$\text{stall torque } T_s = \frac{360}{10} = 36 \text{ N}\cdot\text{m}$$

(2) If the engine has to overcome 100Nm friction torque to keep it running at the minimum speed, please calculate the driving torque when starting the motor under such status. (3 points)

$$\text{the driving Torque } T_d = \frac{100}{10} = 10 \text{ N}\cdot\text{m}$$

(3) If the efficiency of the starter is 60%, what is the input power required to start the motor, in order to keep the engine running at its lowest speed? (4 points)

$$\text{output power } P_o = \frac{M_s \cdot n_s}{9550} = \frac{100 \times 100}{9550} = 1.05 \text{ kW}$$

$$\text{input power } P_i = P_o \div 60\% = 1.75 \text{ kW}$$

2. (12 points) Gasoline consists of a number of ingredients, these are known as fractions and fall into three chemical series:

1) Paraffins, such as Octane, with a molecular formula of C_8H_{18} .

2) Napthenes, such as Cyclohexane, with a molecular formula of C_6H_{12} .

3) Aromatics, such as Benzene, with a molecular formula of C_6H_6 .

The atomic masses of various elements are known as: H-1, C-12, O-16.

姓名	朱仕卓
学号	0121628250318
专业班级	汽车工程1603
学院	国际教育学院

(1) How much oxygen is required for complete combustion of 1kg octane, cyclohexane and benzene consume, respectively? (6 points)

$2C_8H_{18} + 25O_2 = 16CO_2 + 18H_2O$
 $m(O_2) = \frac{1}{(12 \times 8 + 18)} \times \frac{25}{2} \times 32 = 3.51 \text{ kg}$ +2
 $C_6H_{12} + 9O_2 = 6CO_2 + 6H_2O$
 $m(O_2) = \frac{1}{(12 \times 6 + 12)} \times 9 \times 32 = 3.43 \text{ kg}$ +2
 $2C_6H_6 + 15O_2 = 12CO_2 + 6H_2O$
 $m(O_2) = \frac{1}{(12 \times 6 + 6)} \times \frac{15}{2} \times 32 = 3.08 \text{ kg}$ +2

(2) Air contains 23% oxygen by mass, please calculate the stoichiometric air-fuel ratios (理论空燃比) of octane and cyclohexane and benzene, respectively. (3 points)

C_8H_{18} : 理论空燃比 = $3.51 \div 23\% = 15.26$ +1
 C_6H_{12} : 理论空燃比 = $3.43 \div 23\% = 14.91$ +1
 C_6H_6 : 理论空燃比 = $3.08 \div 23\% = 13.38$ +1

(3) Suppose the gasoline has 60% octane, 20% cyclohexane and 20% benzene. what is the stoichiometric air-fuel ratio of the gasoline? (3 points)

汽油的理论空燃比 = $15.26 \times 60\% + 14.91 \times 20\% + 13.38 \times 20\%$
 $= 14.81$ +3

3. (16 points) The calculation formula of basic fuel-injection time is as follows:

$$T = \frac{120G}{CZn}$$

where G is the air flow (g/s), C is the constant related to fuel injector structure and stoichiometric air-fuel ratio (理论空燃比), Z is the number of cylinders of the engine, n is the engine speed (r/min). The speed of a four-cylinder engine is 3000r/min, and the intake air flow rate is 30g/s. Please calculate:

(1) The amount of intake air of each cylinder per cycle. (4 points)

$3000 \text{ r/min} = 50 \text{ r/s}$
 每一个循环曲轴转2圈为 $\frac{1}{25} \text{ s}$
 每缸进气量: $30 \times \frac{1}{25} \times \frac{1}{4} = 0.3 \text{ g}$ +4

(2) The basic fuel-injection quantity of each cylinder per cycle. (4 points)

每缸基本喷油量 = $\frac{0.3}{14.7} = 0.02 \text{ g}$ +4

(3) The basic fuel-injection time if the injection rate of the injector is 4g/s. (4 points)

基本喷油时间 = $\frac{0.02}{4} = 5.1 \text{ ms}$ +4

(4) The basic fuel-injection time if the EGR (废气再循环) rate is 20%. (4 points)

$EGR \text{ 率} = \frac{EGR \text{ 气体量}}{\text{吸入空气量} + EGR \text{ 气体量}} = 20\%$
 $EGR \text{ 气体量} = 0.075 \text{ g}$
 每缸喷油量 = $\frac{0.3 + 0.075}{14.7} = 0.026 \text{ g}$
 基本喷油时间 = $\frac{0.026}{4} = 6.38 \text{ ms}$ 0