

武汉理工大学考试试卷 (A 卷)

2018 ~2019 学年 1 学期 汽车排放与噪声控制 课程 开卷

时间 120 分钟, 32 学时, 2 学分, 总分 100 分, 占总评成绩 70 % 年 月 日

题号	一	二	三	四	五	六	七	八	九	十	合计	任课教师
满分	10	10	10	10	10	10	10	10	10	10	100	
得分	8	7	6	7	7	4	5	5	5	8	62	

得分 8

I. What is the definition of environmental pollution? What is the environmental pollution related to automobiles? How to restore the polluted environment to a non-polluting state without influence on human health? (10 points)

环境污染指人类活动对大气、水、土壤造成的有害排放。
与汽车相关的环境污染有：汽车排放污染和噪声污染。
恢复被人类污染的环境的方法有：控制和隔离污染源，等待环境自然恢复，对已造成的污染进行治理，对恢复过程进行人工干预。

得分 7

II. The carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NOx) and soot are the main pollutants discharged by the automobiles, please briefly describe their formation mechanism and explain why the nitrogen oxides (NOx) and soot emitted by diesel engines are usually higher than that of gasoline engines. (10 points)

1. 一氧化碳是局部缺氧或低温条件下烃的不完全燃烧产生的。

碳氢化合物、未燃和未完全燃烧的燃油、润滑油及其裂解产物和部分氧化物。

氮氧化物是高温燃烧中剩余的氧与氮化合成的产物。

2. 与汽油机相比，柴油机燃烧温度高，使氮氧化物排放多，工作粗暴，燃烧更不完全，故碳烟排放多。

得分 6

III. What kind of exhaust pollution of automobiles is the main target of the exhaust gas recirculation of gasoline engine? What are the two types of such purification technology? Of which, what is the principle of exhaust gas purification of the external exhaust gas recirculation? What are the control strategies according to different working conditions? (10 points)

1. 废气再循环是针对柴油机的氮氧化物的净化技术，分为外部废气再循环和内部废气再循环。

2. 外部废气再循环是将燃烧过的废气引入进气，降低燃烧温度从而降低温度，减少氮氧化物生成的技术。

3. 高负荷、启动时降低EGR率或停止EGR，低负荷时加大EGR率。

得分 7

IV. What are the main factors to be considered in the optimal design of the combustion system for reducing emissions of pollutants? Briefly describe the design basis or principles. (10 points)

1. 紧凑的燃烧室形状, 降低面容比, 加大燃烧深度, 降低CO与HC排放
2. 改善气流运动, 加快油气混合, 保证完全燃烧
3. 合理提高压缩比
4. 提高进气量
5. 减少不参与燃烧的缝隙容积

得分 7

V. What are the structural components of the Three-way catalytic converter for gasoline engines? What are the purification principles? Briefly describe the performance indexes of the catalytic converter. (10 points)

- 结构部分有: 壳体、减振层、载体和催化剂涂层四部分
- 原理为: 使用氧化型、还原型等催化剂加快尾气中有害气体转化
- 催化剂性能指标主要有: 转化效率、起燃温度特性、空燃比特性、空速特性、流动特性和耐久性等
- 失活机理:

得分 4

VI. Please briefly describe the working principle of the non-dispersive infrared absorption analyzer (NDIR) for CO and CO₂ tests. (10 points)

- 原理基于大多数非对称气体分子能吸收特定波长段红外线的特性, 根据其吸收程度计算气体浓度
2. 由入射光强度、出射光强度、待测气体厚度, 计算气体浓度

得分 5

VII. Engine noise is a main source of automobile noise, please describe the classification of the engine noise and the evaluation contents? (10 points)

1. 发动机噪声主要分为表面噪声和空气动力噪声, 表面噪声包含燃烧噪声和机械噪声, 空气动力噪声包含进排气噪声、排气噪声和风扇噪声
2. 低转速时, 燃烧噪声占主导, 高转速时, 机械噪声占主导, 但二者密切相关难以分开

0

ersive infrared

波长段
度
度, 计

se describe the

声, 表西
盒, 箱

箱, 木架

得分

5

VIII. The gear transmission is widely applied in drive system of automobiles.

Please briefly describe the generation mechanism of automobile gear noise. (10 points)

齿轮噪声是由齿与齿之间撞击产生振动及曲轴扭震破坏正常啮合关系造成的。

主要分为低频噪声和高频噪声, 高频噪声由基节偏差引起的, 低频误差是由齿距累积误差引起的。

得分

5

IX. What is the subjective measure of noise? How to understand the concept of

loudness and the meaning of the equal loudness curve? (10 points)

噪声主观量度是考虑了人耳接受主观客观声压与频率后产生的主观感觉与客观不一致的响度评价量度。

响度是人对客观声音的主观感觉

等响度曲线是统一不同频率下人耳听到的主、客观量的曲线, 曲线上每点给人带来的主观响度等级是一样的。

得分

8

X. There are three different automobile assemblies (i.e. A, B and C) for a

benchmarking automobile. Each automobile assembly has 2 noise sources. The sound pressure levels of 2 noise sources of A assembly are: 100dB(A) and 93dB(A); the sound pressure levels of 2 noise sources of B assembly are: 100dB(A) and 90dB(A); and the sound pressure levels of 2 noise sources of C assembly are 97dB(A) and 93dB(A); Please calculate the total sound pressure level of three different vehicle assemblies (i.e. A, B and C) respectively. What are the important enlightenments that we can get from the calculation results from the perspective of noise reduction? (10 points)

$$\begin{aligned} 12: & 100 \text{ dB} \text{ 与 } 93 \text{ dB} \\ & L_{p2} = 100 + 10 \times \lg(1 + 10^{\frac{100-93}{10}}) \\ & = 100.8 \end{aligned}$$

$$\begin{aligned} 13: & 100 \text{ dB} \text{ 与 } 90 \text{ dB} \\ & L_{p2} = 100 + 10 \times \lg(1 + 10^{\frac{100-90}{10}}) \\ & = 100.4 \\ 14: & 97 \text{ dB} \text{ 与 } 93 \text{ dB} \\ & L_{p2} = 97 + 10 \times \lg(1 + 10^{\frac{97-93}{10}}) \\ & = 98.5 \end{aligned}$$

启示: 对于有不同声压级的噪声源的噪声时, 降低噪声应主要考虑声压级大的一方, 声压级小的一方的降低作用不大。