

姓名 Name	王强
学号 Student ID	0216284510
专业班级 Class	机械1603
学院 School	机械学院

Test Paper of Wuhan University of Technology (A)

2018~2019 Academic Year 2st Semester, Course: Manufacturing Technology of Automobile and Engine, Closed-book exam

Time: 120mins, class hours, credits, Total Points: 100, Percent in final evaluation

result: %, Date:

No.	I	II	III	IV	V	VI	VII	VIII	IX	X	Total
Full score	23	28	26	23							100
Score	17	16	15	16							64

Score 17

QUESTION I (23 Points)

1. What is the production process of automobiles? What is the manufacturing process of automobile production? (4 points)

答: 汽车的生产过程是指将原材料转变为汽车产品的全过程。

工艺过程是指生产过程中改变生产对象形状、尺寸、相对位置和材料性质等使其成为成品或半成品的过程。

2. What are the three types of auto parts production? (3 points)

答: 汽车的生产类型分为大量生产、成批生产、单件生产三种。

3. Briefly introduce the methods for obtaining workpiece dimension. (4 points)

答: 工件尺寸的获得方法包括: 试切法、定尺寸刀具法、调整法、主动测量法。

4. What is operation? Describe the arrangement principles of machining operation (6 points)

答: 工序是指一个(组)工人,在一个工作地(机床设备)对一个或同时对几个工件所连续完成的那部分工艺过程。工序是组成工艺过程的基本单位。
机械加工工艺安排原则: 先粗后精, 先主后次, 先基准后其他。

5. What is machining allowance? What are the main factors influencing machining allowance? (6 points)

答: 加工余量是指加工过程中, 加工表面上的加工层厚度。

加工余量是指每一个工序对工件加工时留下的余量, 以便进一步精加工。

影响加工余量的主要因素包括: 加工工序, 加工工艺, 被加工材料。

Score 16

QUESTION II (28 Points)

6. Figure 1 shows the positioning condition of transmission case 1. The positioning element consists of two taper pins 2 both movable from top to bottom and from left to right, bearing plate 3 and bearing nail 4. Please analyze (12 points):

(1) What is the over-positioning?

(2) The degree to which the freedom is restricted by the positioning elements in the figure.

(3) Decide whether there exists over-positioning.

答: (1) 正定位是指定位元件对工件的自由度进行了完全定位。

(2) 支承板 3 限制 2 个自由度 Z, Y
轴承销 2 限制 2 个自由度 X, Z
支承钉 4 限制 1 个自由度 X
共限制 6 个自由度。

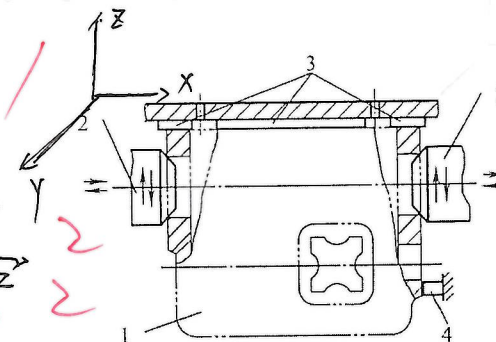


Figure 1

(3) 存在正定位现象, 自由度又被轴承销和支承板完全定位。

7. Figure 2 is a machining and positioning diagram of piston and pin hole. The piston has a full height of $106_{-0.1}^0$ mm, pin hole position of 56 ± 0.08 mm and symmetry requirement of 0.2mm. Please analyze (16 points):

- (1) What is positioning error? What are the main reasons for positioning error?
- (2) Please calculate the positioning error of process size 56 ± 0.08 mm.
- (3) Assuming that the coaxiality error between the seam allowance and the piston skirt is zero, please calculate the positioning error of the symmetry and determine whether it meets the processing requirement.

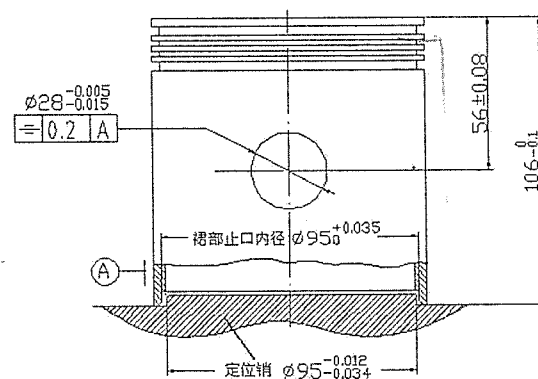


Figure 2

1/3: (1) 定位误差是指由于定位不准导致工序基准偏离理想位置引起
工序尺寸变化的加工误差。

2 定位误差产生的原因包括基准不重合误差与基准位移误差。
2 其中,基准不重合误差是由于工序基准与定位基准不重合而产生的误差。
基准位移误差是由于定位副制造误差而引起定位基准的位移。

(2) 对于工序尺寸 56 ± 0.08 mm

$$\Delta j.b = \frac{0.16}{2} = 0.08 \text{ mm}$$

$$\Delta j.y = 0$$

$$\Delta d = \Delta j.b + \Delta j.y = 0.08 \text{ mm}$$

(2) 对于对称度

∵ 内止孔与活塞裙部同轴度误差为 0 ∴ $\Delta j.y = 0$

∴ $\Delta j.b = 0$ $\Delta j.y = 0.069$

$$\Delta d = \Delta j.b + \Delta j.y = 0 \text{ mm} < 0.2 \text{ mm}$$

满足要求。

8. Figure 3 is the assembly diagram of the first principle axis journal of the crankshaft and the bearing pedestal. 1 is the crankshaft, 2 and 4 are thrust washers, 3 is the mainshaft bearing of the cylinder and 5 is the timing gear. Design requirements: the assembly gap between the journal and shoulder of the first principle axis and the thrust washer is $A_0 = 0.05 \sim 0.25\text{mm}$. Design requirements: $A_1 = 43.5\text{mm}$; $A_2 = A_4 = 2.5\text{mm}$; $A_3 = 38.5\text{mm}$. The assembly method of complete interchange is to be used, to ensure assembly precision. (20 points)

- (1) Please explain the principle of shortest dimension chain.
- (2) Set up assembly dimension chain and determine increasing and decreasing links with circuit method.
- (3) Solve and calculate the dimensional tolerances and limit deviations of the related parts.

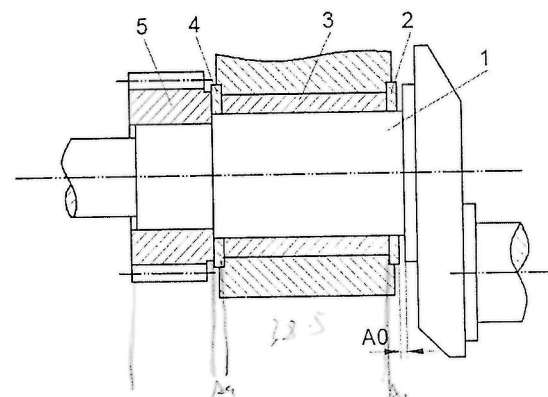
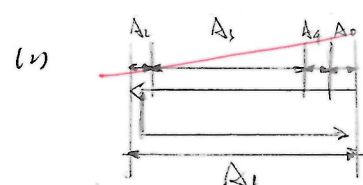


Figure 3

Standard tolerance (from GB/T 1800.3-1998)

Basic dimensions (mm)		≤3	>3~6	>6~10	>10~18	>18~30	>30~50
Tolerance grade (μm)	IT8	14	18	22	27	33	39
	IT9	25	30	36	43	52	62
	IT10	40	48	58	70	84	100

答: 尺寸链最短原则是指组成环越少, 尺寸链精度越高。
定义的尺寸链的



根据回路法, 增环 A_1
减环 A_2, A_3, A_4

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

(3) 完全互换法, 用极限法求解。

$$A_0 = A_1 - A_2 - A_3 - A_4 = 43.5 - 38.5 - 2.5 - 2.5 = 0\text{mm}$$

$$A_0 = 0 \quad T_0 = 0.25 - 0.05 = 0.2\text{mm}$$

$$T_{av} = \frac{T_0}{n-1} = 0.05\text{mm}$$

因 $A_1 = 43.5\text{mm}$, $A_3 = 38.5\text{mm}$, IT8级, 对应 $T_1 = 0.039\text{mm}$, $T_3 = 0.039\text{mm}$

$$T_2 = T_4 = \frac{T_0 - T_1 - T_3}{2} = 0.07\text{mm}$$

因 $A_2 = A_4 = 2.5\text{mm}$, 对应 IT9级, $T_2 = T_4 = 0.025\text{mm}$

$T_1 + T_2 + T_3 + T_4 = 0.128\text{mm}$, 满足完全互换法原则。

$$T_0' = T_1 + T_2 + T_3 + T_4 = 0.128\text{mm}$$

$$T_0' < T_0 = 0.2\text{mm}$$

BINDING LINE No answer or student information within binding edge

试卷装订线

9. Describe the advantages and disadvantages of the assembly methods of complete interchange and incomplete interchange and the application occasions of such methods. (6 points)

答: 完全互换装配法的优点在于①装配简单, 成本低②工件之间有互换性, 因生产时能严格保证③能够实施工厂的互用, 便于调换工作④产品更利于维修, 零件更换更方便
缺点在于无法用于精度要求较高, 组成环数较多的装配。
适合应用于精度要求较低, 组成环数少的产品。
不完全互换装配法的优点在于①能够适当放大公差, 降低成本②装配简单效率高
缺点在于会存在少量不合格产品, 但该类产品易于返工后
期的检验方法剔除或更换。
适合应用于大量大批, 精度较高, 组成环数较多的产品。

Score 16

QUESTION IV (23 Points)

10. As shown in Figure 4, the slender axis workpiece (a and b in Figure 4) and thin-wall cylindric workpiece (c in Figure 4) are cut after being clamped with different fixtures on the machine tool. And different machining errors in dimension and shape occur in the machined parts. Please analyze reasons for the machining errors of the workpieces (6 points)

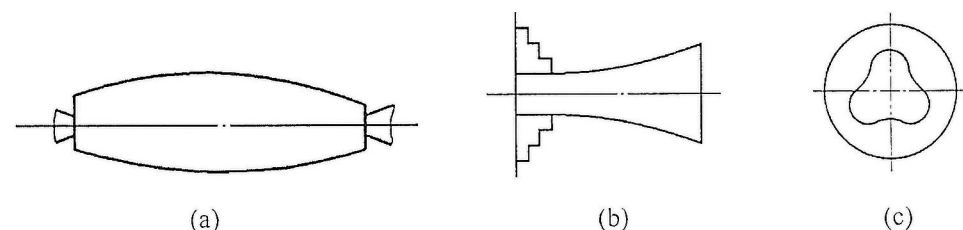


Figure 4

答：对细长轴工件a

因其长度较长，两端夹紧固定，因工件刚度不足，刀具运动至工件中间时，工件出现较大弯曲变形，导致刀具仅切削掉表面一层，而中间弯曲变形较小，正常切削，待加工完成后，工件即变为图a中的腰鼓形。

对细长轴工件b

因其长度较长，一端由夹生固定，长度较小，不易变形，而远离固定端因工件刚度不足，在刀具作用下弯曲变形，仅切下较薄一层，故加工完成后呈此腰鼓形。

对薄壁筒形工件，其内外圆刚度都较差，在盘式固定装

置固定夹紧后，出现变形，向内弯曲；呈图c形状，后因在切削加工时，将弯曲凸出部分同样切削掉，造成在加工完后，工件变形消除，内部被多切去了一部分。

11. Machine separately two batches of workpieces on the machine tool with static adjustment method. The dimension distribution curves obtained are shown as A and B in Figure 5. Δ is the dimension distribution range; ΔL is the deviation of the distribution center of the two batches of workpieces and T is the process tolerance of the workpiece. Please analyze: (11 points)

- (1) What is the 6 σ principle? What does it mean in the manufacturing process?
- (2) Please determine the nature of the machining error leading to the change in the dimension distribution curves of the two batches of workpieces and describe how to eliminate the machining error.
- (3) Please provide the condition for ensuring that there is no rejected part in the two batches of workpieces.

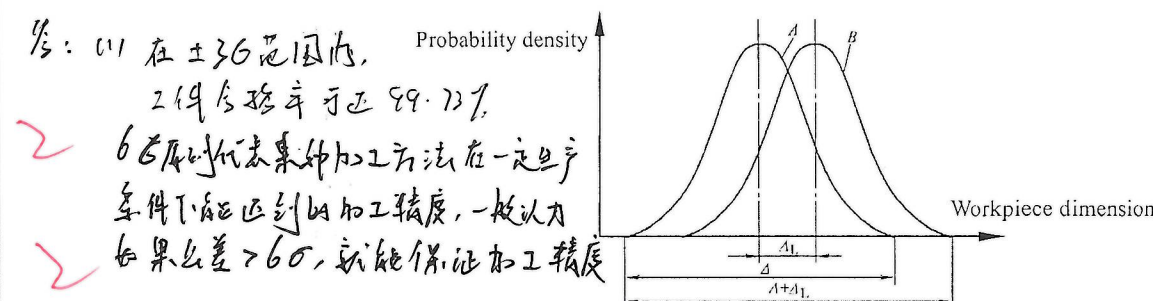


Figure 5

造成两批工件尺寸分布曲线变化的加工误差

属于系统误差，误差的大小，方向不变。

可以通过使用更高精度的机床，根据更细的磨料等来消除该误差。

(2) 当 $\Delta + \Delta L < 6\sigma$ ，则能够保证不出废品

12. Analyze the influences of cutting heat on residual stress on the machined surface of the workpiece in the cutting process, at the end of cutting and when the workpiece is completely cooled in the machining process based on Figure 6. Here, t_H representing room temperature when the workpiece has high plasticity and t_p refers to the temperature; $+\sigma$ and $-\sigma$ represent tensile stress and compressive stress, respectively; 1, 2 and 3 represent three layers of metal at different distances from the workpiece surface, respectively. (6 points)

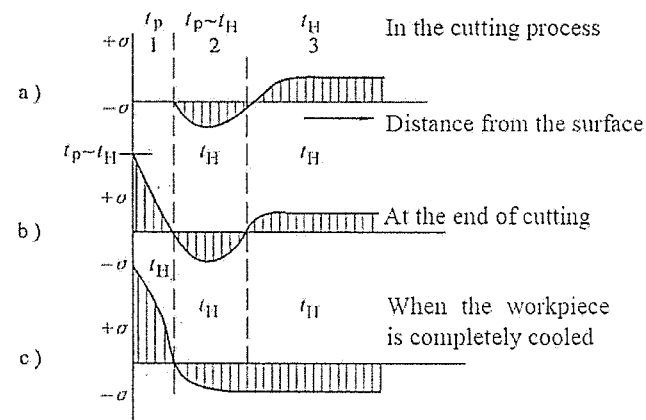


Figure 6

1/3: 切削时使工件表层内应力呈表压内拉状态。
残余

在切削时，切削力使工件应力状态为表压内拉
随着切削时间变长，切削热影响变大，
工件内应力慢慢向表压内压的状态转换，
最后在结束之后，残余内应力为表压内压。