Q1.

What are the main factors affecting the fatigue strength of mechanical components?

应力集中、零件尺寸(尺寸越大，疲劳强度越低)、表面状态(表面粗糙度和表面处理情况)、环境介质、加载顺序和频率等。

Q2.

How many ways to achieve fluid friction? What are their characteristics?

There are three ways to achieve fluid friction, which are hydrodynamic lubrication, elasto-hydrodynamic lubrication and hydrostatic lubrication.

Their characteristics are as follows:

Hydrodynamic lubrication:

1)Internal liquid friction is the principal cause of friction resistance.

2)The morphology and material properties of the two surfaces have no effect on the friction characteristics, which are mainly determined by the liquid or gas's viscosity.

3)The friction coefficient are extremely low. For example, surface protection, cleansing, cooling, and rust prevention are all benefits of the oil film.

Elasto-hydrodynamic lubrication:

1)High contact stress.

2)The fluid lubrication film is formed due to the occurrence of elastic deformation in the contact region and the increasing viscosity of lubricating fluid.

Hydrostatic lubrication:

1)A lubricating film can form even when the two surfaces are moving at the same speed. The short service life resulting from dry friction during the starting and low speed stages is overcome.

2) It has beneficial motion precision and can be employed at a variety of speeds.

3) Good vibration resistance and high rigidity.

Q3.

What properties do R_m, R_{eH}, HBW, and HRC represent respectively?

R_m: 抗拉强度(tensile strength)是指材料在断裂或破坏前承受的最大应力值，应力-应变曲线最高点。

R_{eH}: 屈服强度(yield strength)是指材料在受力过程中发生塑性变形的临界点，即材料开始发生塑性变形时所承受的最大应力。

HBW: 布氏硬度（Brinell hardness），是一种衡量材料硬度的机械性能指标。它是通过测量一个硬化钢球在标准负载下压入材料时留下的压痕直径来确定的，“载荷 P 与压痕表面积 F 的比值即为布氏硬度值，记作 HB”[1]。HBW 值越高，表示材料的硬度越大，抗压能力越强。

HRC: 洛氏硬度（Rockwell hardness），是一种衡量材料硬度的机械性能指标。它是通过标准负载下金刚石或碳化钨压头进入材料的深度来确定的。HRC 值越高，表示材料越硬，抗磨损性能越好。“HRC 是采用 150Kg 载荷和钻石锥压入器求得的硬度，用于硬度较高的材料”[2]。

Q4.

What are the types of wear? Please give some examples.

1) 磨粒磨损(Abrasive wear): 制动器摩擦片和制动盘之间发生磨粒磨损
2) 粘着磨损(adhesive wear): 螺杆与螺套发生粘着磨损导致失效
3) 疲劳磨损(fatigue wear): 钢轨受频繁通过的列车的线接触应力导致表面的疲劳磨损
4) 腐蚀磨损(corrosive wear): 海底管道因海水中的氯离子和其他化学物质出现腐蚀磨损

Q5.

Please explain what is clearance fit(间隙配合), transition fit(过渡配合) and interference fit(过盈配合).

[1] https://baike.baidu.com/item/%E5%B8%83%E6%B0%8F%E7%A1%AC%E5%BA%A6/3708064
[2] https://baike.baidu.com/item/%E6%B4%9B%E6%B0%8F%E7%A1%AC%E5%BA%A6/3708083

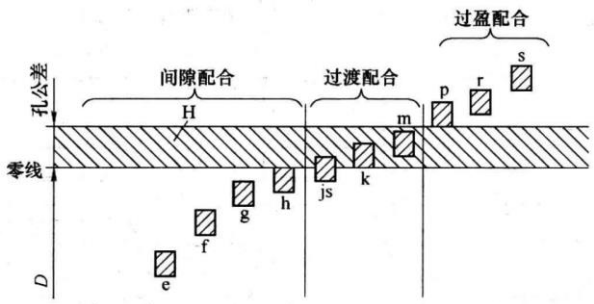

图 9-11　基孔制配合

clearance fit(间隙配合):

孔＞轴，孔与轴之间存在间隙的配合，此时，孔的公差带在轴的公差带之上，不存在重叠。这种配合的两个零件之间有一定的空隙或间隙，它们能够相对自由地移动或旋转，动联接。

transition fit(过渡配合):

孔＞轴 or 孔＜轴，孔的公差带与轴的公差带发生重叠时的配合，两个零件之间存在一定的紧密度。

interference fit(过盈配合):

孔＜轴，此时，孔的公差带在轴的公差带之下，不存在重叠。

这种配合的两个零件之间存在一定的压力或压合，需要施加一定的力才能将它们拆开或装上，静联接。

Q6.

For a material, if $\sigma_{-1} = 180\ MPa, m = 9, N_0 = 5 \times 10^6$, what is the corresponding finite life fatigue limit when N= 7000, 25000, 620000 ?

$$\sigma_{-1\,N=7000} = \sigma_{-1}\sqrt[m]{\frac{N_0}{N}} = 180 \times \sqrt[9]{\frac{5 \times 10^6}{7000}} = 373.57MPa$$

$$\sigma_{-1\,N=25000} = \sigma_{-1}\sqrt[m]{\frac{N_0}{N}} = 180 \times \sqrt[9]{\frac{5 \times 10^6}{25000}} = 324.30MPa$$

$$\sigma_{-1\,N=620000} = \sigma_{-1}\sqrt[m]{\frac{N_0}{N}} = 180 \times \sqrt[9]{\frac{5 \times 10^6}{620000}} = 226.99MPa$$