

Tribology course: mid-term evaluation

Name of student: _____

Sciper: _____

Question 1

An emergency guiding system of a high-speed underground train consists of a carbon/graphite reinforced PTFE polymer block sliding against a flat steel rail. This system is supposed to guide the vehicle during the emergency braking distance of 120 m in length (braking time 6 s). The polymer block has a cubic form with the edge length of 10 cm. The polymer contact face is pressed against the steel rail with a force of 3000 N. This guiding system is supposed to be able to operate for at least 5 emergency brakings with a total thickness loss of 1 cm on the contacting face of the polymer block. Calculate the maximum allowable wear coefficient for the polymer block.

Answer: 0,278 $\text{mm}^3 \text{N}^{-1} \text{m}^{-1}$

Question 2

A steel ball ($E = 210 \text{ GPa}$, Poisson ratio 0.3) of 12.7 mm diameter is loaded against a ceramic (silicon carbide, $E = 410 \text{ GPa}$, Poisson ratio 0.14) flat with a force of 10 N. The contact is supposed to be elastic. Calculate the area of contact and the maximum contact pressure.

Area of contact: $1,47 \cdot 10^{-2}$ mm^2 Contact pressure: 1020,53 MPa

Question 3

Calculate the area of contact in the case of a hard indenter loaded with 9 N against a soft metal (hardness 0.9 GPa, Young's modulus 115 GPa). A perfectly plastic contact is assumed.

Answer: 0,01 mm^2

Question 4

Despite the rather poor mechanical strength with respect to steel and ceramics, polymers are widely used in tribological applications. Choose (fill one circle) the most appropriate reason for that from the following statements.

- Polymers are cheap, easy to form materials
- Polymers are intrinsically self-lubricating materials and thus reduce friction in contacts
- Polymers accommodate load by elastic deformation thus enabling lower contact pressure compared to other materials.
- Polymers are not prone to adhesion and thus exhibit low wear rates.

Question 5

The hydrodynamic fluid film thickness established between a perfectly smooth plane and a cylinder in an oil-lubricated contact is 107 nm. What is the maximum admissible roughness for the cylinder in order to have full contact separation by the fluid film? Choose (fill in the circle) the appropriate response from the following values.

- R_q = 0 μm
- R_q = 0.025 μm
- R_q = 0.030 μm
- R_q = 0.310 μm

Question 6

Which of the following correctly describe lubricants? Choose (fill in the circle) the most appropriate response from the following statements.

- Decrease friction
- Decrease the extent of wear
- Are always liquids
- Separate the contact surfaces and prevent formation of asperity junctions

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Answer: 0.218 mm³ N⁻¹ m⁻¹

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