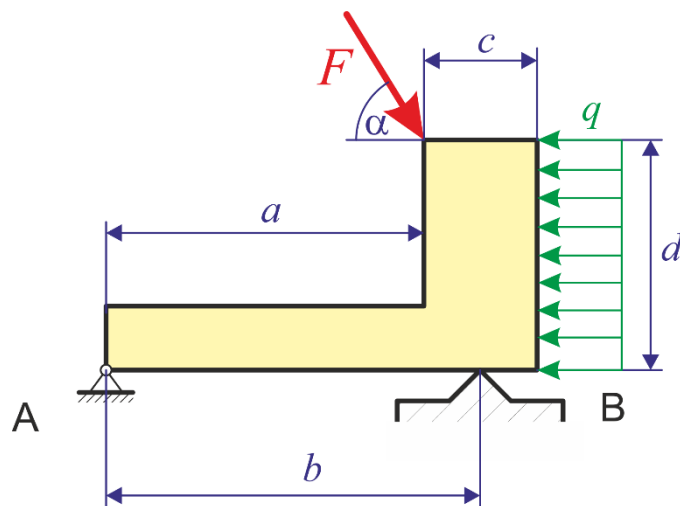


SAMPLE ENTRANCE EXAM TEST QUESTIONS - PART 2

(Mechanics: statics, kinematics, dynamics and Elasticity and strength)

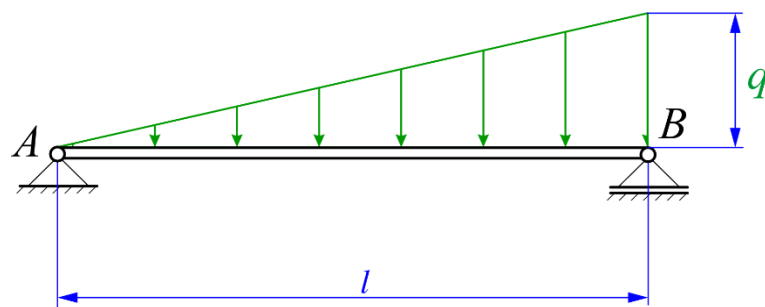
Example tasks from statics

1) The body is loaded by **force F** [N] and **distributed force q** [N/m] of rectangular shape (see figure). Load F , q and dimensions a , b , c , d and α , are given.

**Task:**

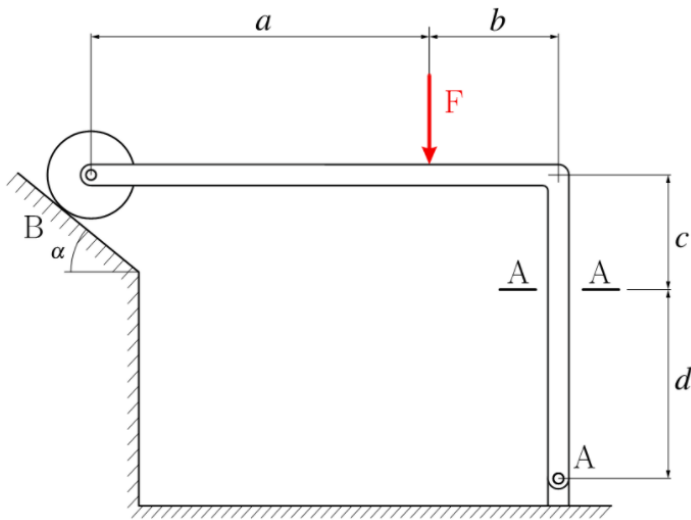
- Calculate number of DOF (degrees of freedom) of the body.
- Draw free bod diagram of the body.
- Setup the system of equations of force equilibrium of the body.
- Calculate reactions in joints A and B.

2) The beam of **length l** supported by **rotational joint A** and **simple support B**. It is loaded by **distributed force q** [N/m] of triangular shape (see figure). Length l and distributed force q are given.

**Task:**

- Calculate reactional forces in joints A and B.
- Calculate internal forces in the beam through all length of the beam.
- Draw graphs of internal forces.
- Calculate position and value of maximal internal bending moment.

3) An angle bracket is loaded and supported as shown in figure. **Force F** and **dimensions: a , b , c , d** , and **angle α** are given.

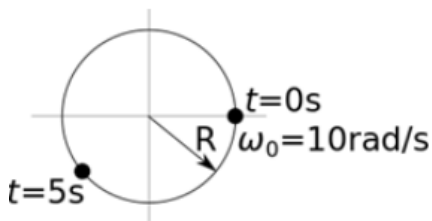


Task:

- Reactional forces in joints A and B between bracket and rigid frame.
- Internal resisting forces and moment transmitted by section **A-A** in the bracket.

Example tasks from kinematics

1) The particle is traveling along the circular path of radius $R = 1.5 \text{ m}$. The motion starts with initial angular velocity $\omega_0 = 10 \text{ rad/s}$ and slows down with **angular acceleration -1 rad/s^2** (see figure).



Task:

- What is the value of the centripetal acceleration, the tangential acceleration, the total acceleration and the velocity of the particle at time $t = 5 \text{ s}$?
- Sketch a figure with vectors of the kinematics quantities of the particle.

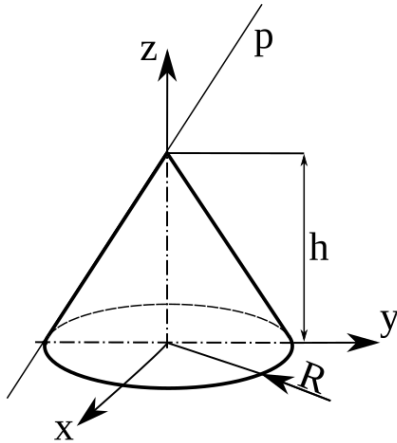
2) The position of a particle is $\vec{r}(t) = (3.0t^2\hat{i} + 5.0\hat{j} - 6.0t\hat{k}) \text{ m}$.

Task:

- Determine its velocity and acceleration as functions of time.
- What are its velocity and acceleration at time $t = 0$?

Example tasks from dynamics

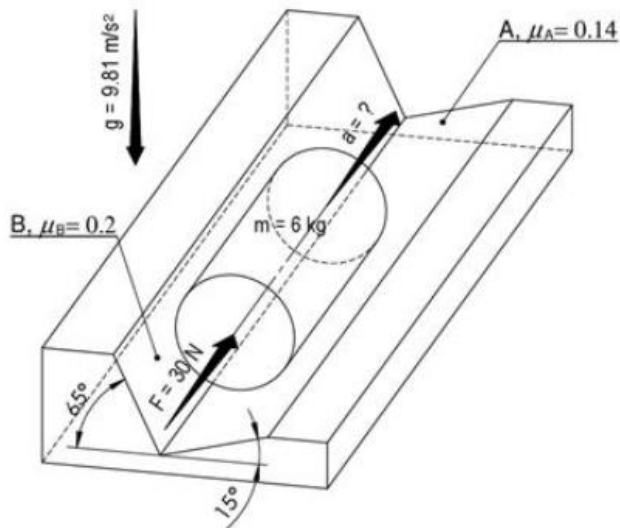
1) A cone with base radius $R = 0.2 \text{ m}$ and height $h = 0.2 \text{ m}$ (see figure) has a **density of 2000 kg/m^3** .



Task:

Calculate the moment of inertia of the body to the line p which lies on the surface of the cone.

2) A cylinder of given mass $m = 6 \text{ kg}$ lies on two planar surfaces A and B of the basic frame. The cylinder is subjected to the action of gravity force $G = m \cdot g$, $g = 9.81 \text{ m/s}^2$, and additional axial force $F = 30 \text{ N}$ (see figure).

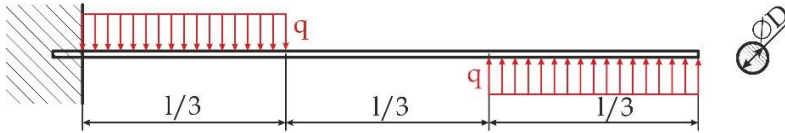


Task:

Determine acceleration (a) of the cylinder if both surfaces A and B are rough with different coefficient of friction $\mu_A = 0.14$ and $\mu_B = 0.2$.

Example tasks from elasticity and strength

1) A thin beam is rigidly clamped (fixed) at his left end and loaded with a distributed load (see figure).



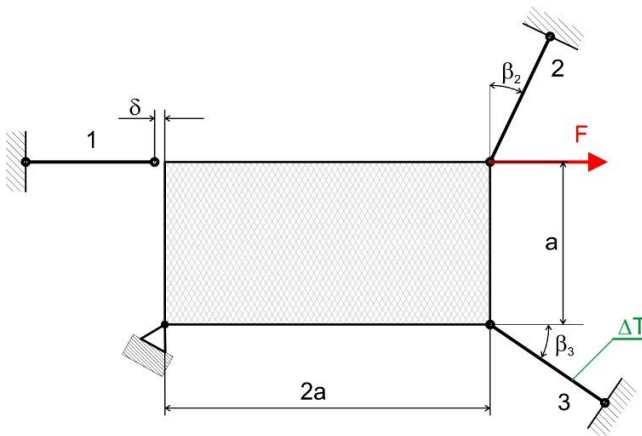
Given values:

- Length (l),
- Cross section diameter (D),
- Modulus of elasticity of the beam (E),
- Distributed load (q).

Find:

- Maximal stress in the beam.
- Maximal deflection of the beam.
- Deflection at the middle of the beam.

2) A rigid body is connected to the ground using a revolute joint and connected to three rods (see figure).



Given values:

- Dimension (a), angles (β_2), (β_3),
- Length of rods (l),
- Cross section area of rods (A),
- Modulus of elasticity of rods (E),
- Thermal expansion coefficient of rods (α_T),
- Small space (δ) before connection the rod to the body,
- Force (F),
- Temperature change (ΔT).

Find:

- Stresses in the rods: σ_1 , σ_2 , σ_3 .