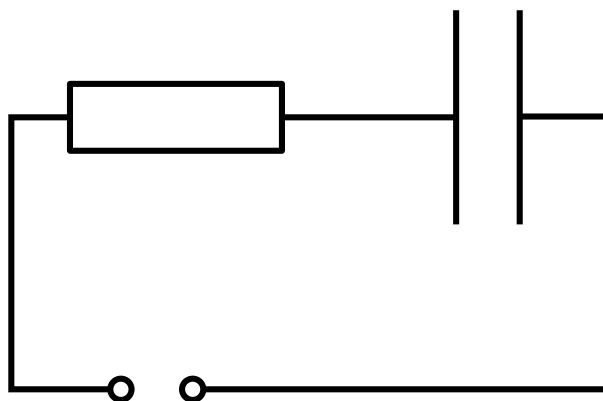NTF FIZIKA 2 − 1. THEORY EXAM

Student ID: _____

Study programme: _____

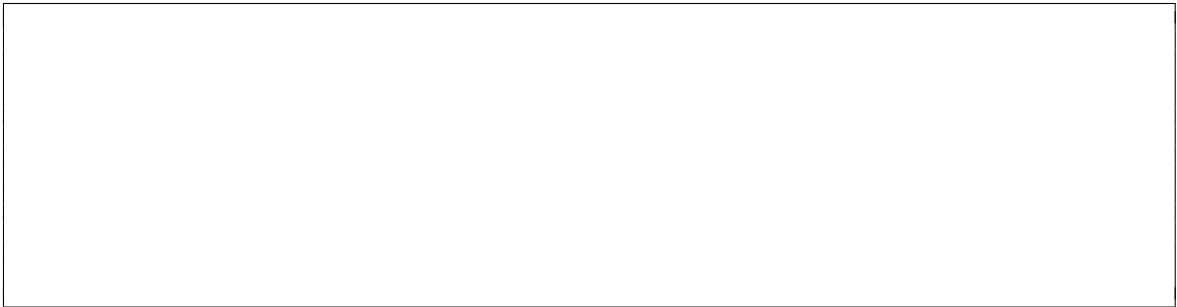1. In the following circuit of a capacitor C and resistor R,

(a) (6 %) sketch a graph of charge on capacitor vs. time, if the capacitor starts empty, then the circuit is connected to a positive voltage U_0 for a time equal RC, then the wires are connected without a voltage source.

(b) (5 %) We replace the capacitor so that it has twice the capacitance. What is the ratio between the charge at $t = RC$ now, compared to the one in the first part of the task?

2. A bathroom heater consists of a heating wire with resistance $20\,\Omega$, in series to a pontentiometer (variable resistor).

   (a) (4 %) On the lowest setting the potentiometer resistance is $95\,\Omega$. What is the power of the heater?
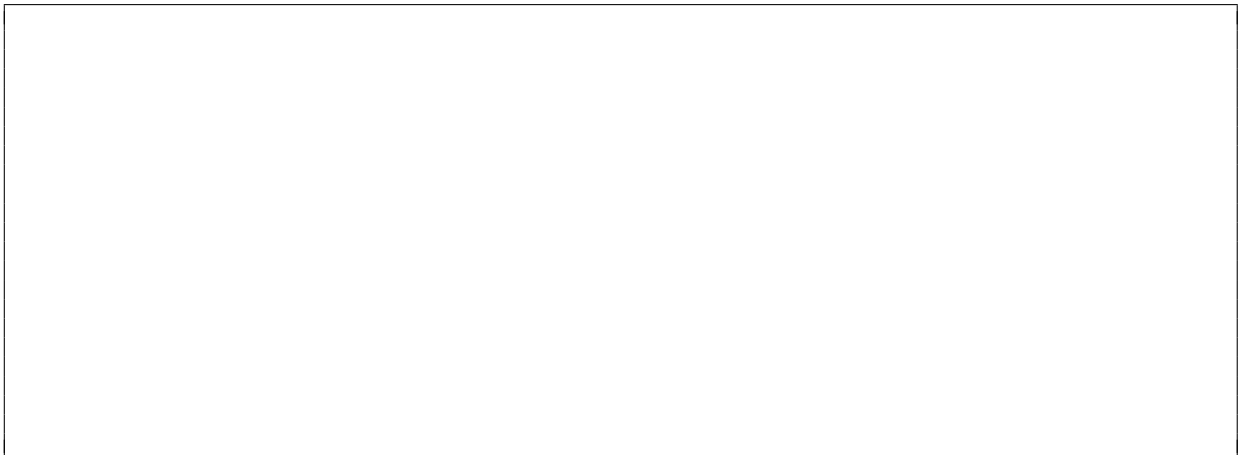
   (b) (4 %) What is the resistance of the potentiometer on the highest setting, when the power is $1\,\mathrm{kW}$?

3. (4 %) The breakdown electric field in the air is $3\,\mathrm{MV/m}$. The electrical network of Slovenian railways works at $3\,\mathrm{kV}$. When the locomotive raises its pantograph towards the wires, at which distance does a spark form?

4. (5 %) A straight wire of current is placed in a magnetic field. Express the force on the wire in relation to the relevant quantities. Name and explain the quantities. How must the wire be oriented to maximize the force? Draw a sketch.

5. (a) (5 %) Sketch a telescope made of two convex lenses and include the paths of parallel rays entering the telescope at an angle. Choose the focal lengths to achieve magnification 4×.
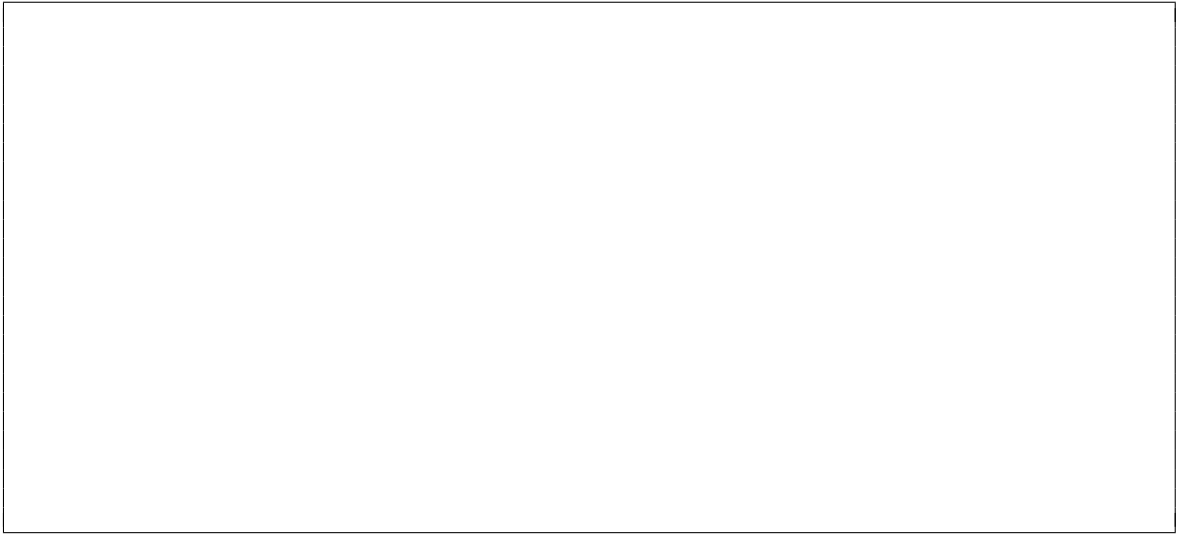
(b) (5 %) Through the telescope, we observe the church tower on top of a hill, at the angle of view 2°. How far is the tower, if its real size is 9 m?
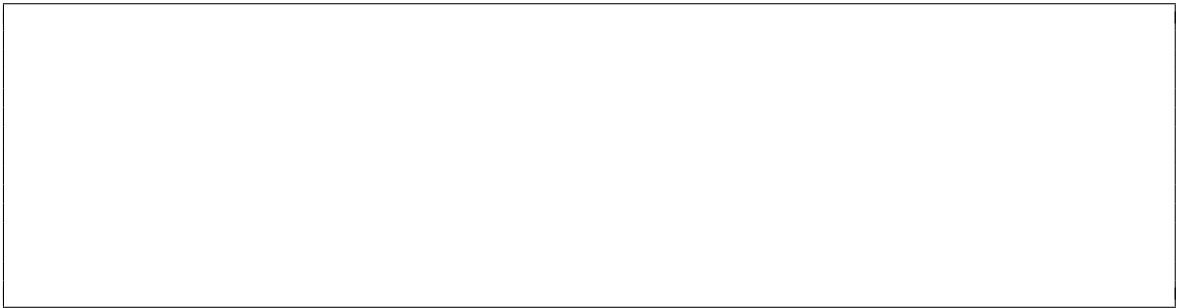
6. (6 %) An oldfashioned projector has the slide width 35 mm, put near the focus of a convex lens. The lens focal length is 10 cm. Determine the width of the image, projected onto a screen 10 m away from the lens.
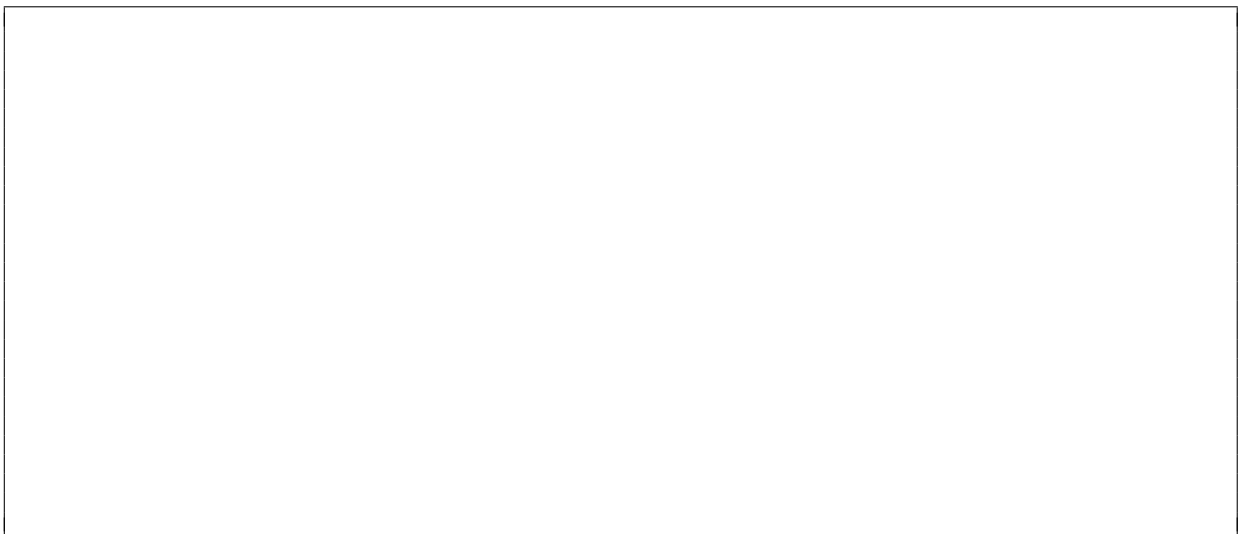
7. (7 %) For each of the images, specify if the main cause of the phenomenon is *interference*, *refraction* or *scattering* of light. Explain your reasoning. If you feel more than one effect is important, specify which and why.

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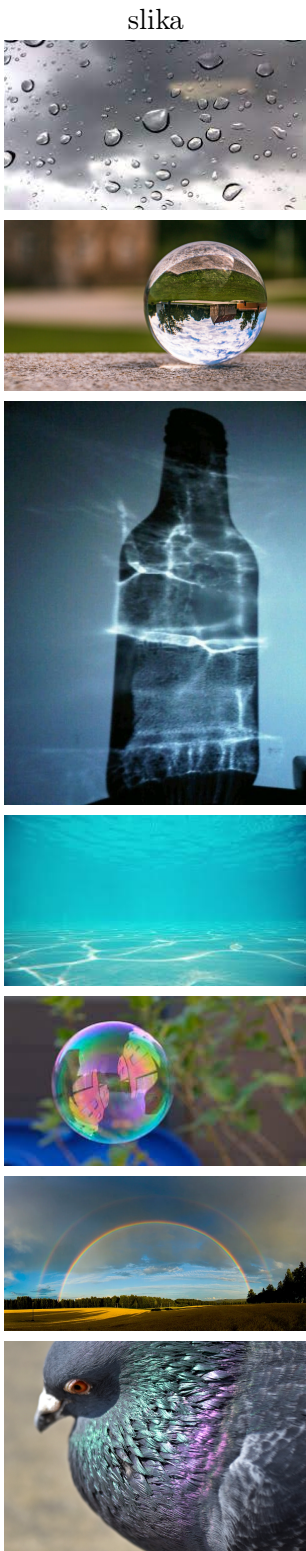
8. A cubic metre of hot air above a road is lifting due to buoyancy. At the road level, air temperature is $50\,°\mathrm{C}$.

   (a) (7 %) What is the air temperature at the height, where pressure falls to 0.75 of the pressure at the road level? Express the result symbolically and explain all the quantities.

   (b) (7 %) What determines whether the water vapour at this altitude condenses into a cloud? Describe, which laws and quantities you would need for the calculation.

9. (a) (6 %) Determine the largest efficiency that can be achieved by a heat engine operating between a reservoir in an ice bath, and an open tank where water boils at 1 bar external pressure.

(b) (8 %) Describe what happens to the efficiency of this heat engine, if we seal the boiler to be air-tight, and still heat it enough for the water to boil? Describe your reasoning and physical facts that you need for describing the phenomenon.

10. (10 %) At an online forum, someone is stating that Earth atmosphere is closed in a dome, because vacuum cannot exist next to the atmosphere without sucking it out.

How would you explain to that person where his mistake was and support your statement with physical arguments?

11. (6 %) Write down the expression for exchanged heat and work for an ideal gas during an isobaric process. Name the used quantities, including which correspond to the initial and which to the final state.

12. (5 %) Zapiši zvezo med temperaturno razliko med stranicama ravne plošče in toplotnim tokom, ki teče skoznjo. Poimenuj vse uporabljene količine in navedi njihove enote.