

Practice questions on the semifinal exam 2016/17 I. semester

1. Microscopy I.

Theoretical background:

- types of optical lenses, parameters of them
- image formation of convex lenses
- lens laws
- image formation and magnification of microscope
- resolving power of microscope (Abbe's principle)

Quantities to be determined based on the given data:

calibration value of eyepiece scale and size of the object.

2. Refractometry

Theoretical background:

- law of light refraction, definition of index of refraction
- critical angle, total reflection
- formation of Snell circle
- factors influencing the value of index of refraction
- parts and function of Abbe-refractometer

Quantities to be determined based on the given data after proper graphical representation:

the unknown concentrations.

3. Light absorption

Theoretical background:

- derivation of Lambert-Beer law from the absorption law
- absorbance, transmittance and the relation of them
- absorption spectrum and the information available from it
- parts of absorption spectrometer
- application of absorbance measurement in laboratory diagnostics

Quantities to be determined based on the given data after proper graphical representation:

photon energy belonging to electron transition (in eV units)

4. Polarimetry

Theoretical background:

- linearly polarized, circularly polarized light and the connection between them
- definition and interpretation of optical activity
- Biot-law, specific rotation
- parts and function of polarimeter

Quantities to be determined based on the given data:

the type of given sugar and the unknown concentration.

5. Optics of the eye

Theoretical background:

- refractive media and image formation of the eye
- accommodation
- refractive disorders of eye and the way for correction of them
- limiting angle of vision, visual acuity (visus), factors influencing the visual acuity
- distribution of photoreceptors on the retina

Quantities to be determined based on the given data:

accommodation power and visual acuity.

6. Nuclear medicine

Theoretical background:

- parts of scintillation counter
- possible processes happening in the scintillation crystal
- processes happening in the photomultiplier
- signal selection, function of the discriminator, sources of noise pulses
- optimal setting of scintillation counter

Quantities to be determined based on the given data after proper graphical representation:
the optimal discrimination level.

7. Gamma-absorption

Theoretical background:

- attenuation law of radiation, attenuation coefficient, mass attenuation coefficient
- processes of attenuation on the atomic scale (photoeffect, Compton-scattering, pair production, elastic scattering)
- the dependence of mass attenuation coefficients due to different processes on the photon energy
- viewpoints of radiation protection

Quantities to be determined based on the given data after proper graphical representation:
 D , μ , μ_m , for all the absorbers and ε , τ_{mPb} , σ_{mPb} .

8. Resonance

Theoretical background:

- elastic deformation, Hooke's law
- harmonic oscillation
- undamped and damped free oscillation
- driven oscillation, resonance
- effect of external force (depending on the distance) on the driven oscillation (working principle of AFM)

Quantities to be determined based on the given data after proper graphical representation:
the spring constant.

9. Skin impedance

Theoretical background:

- definition and components of impedance
- electric model of the skin and the possible simplifications on the model
- frequency dependence of capacitive reactance, approximation of skin impedance in case of low and high frequencies
- practical applications of impedance measurement

Quantities to be determined based on the given data:
specific resistance and specific capacity of the skin.