Medical and biological physics (sample questions with answers). Module 3

1. When voltage of X-ray tube increases:
A. the power of X-radiation decreases
B. **the power of X-radiation increases**
C. the power doesn't changed
D. hardness of X-ray decreases
E. the energy distribution in the spectrum is not changed

2. Let **d** be a distance from the object to the lens, let **f** be a distance from the lens to the image, and **F** be a lens focal length. Thin lens formula is
A. 1/F = 1/d + 1/f
B. F = d + f
C. F = d - 1/f
D. F = 1/(d + f)
E. F = 1/d + 1/f

3. According to the law of light refraction (Snell's law) (where α is angle of incidence, β is angle of refraction, n is relative index of refraction)
A. 2 sin α / sin β = n
B. sin α · sin β = n
C. sin α + sin β = n
D. sin α – sin β = n
E. **sin α /sin β = n**

4. Retina is
A. light conducting system of eye
B. **light perceiving system of eye**
C. light refractive system of eye
D. light reflective system of eye
E. protective coat of eye

5. Electrosleep is the physiotherapeutic method based on use of:
A. alternating current
B. direct current
C. **pulse current**
D. direct electric field
E. direct magnetic field

6. An area of the retina where the optic nerve enters the eyeball is called
A. eye optical center
B. yellow spot
C. **blind spot**
D. iris
E. pupil

7. Duration of phosphorescence is of the order of
A. 10^{-1} s
B. 1 min
C. 1 s
D. 10^{-8} s
E. 10^{3} s

8. To obtain achromatic polarized light they use

A. Nicol prism
B. optically active substance
C. optically isotropic medium
D. light absorbed medium
E. light scattering medium

9. Maximal concentration of rods is
A. in the blind spot
B. in the yellow spot
C. **on the retina periphery**
D. in that area where the optic nerve enters the eyeball
E. in the crystalline lens

10. If monochromatic absorption factor (α) of the body at all wavelength is equal to unity at any temperature, then this body is called:
A. white
B. grey
C. **black**
D. green
E. invisible

11. Let F_{ob} be the focal lengths of the objective, L be the optical length of the microscope drawtube Magnification M_{ob} of the objective is calculated by the formula
A. $M_{ob} = L / F_{ob}$
B. $M_{ob} = L \cdot F_{ob}$
C. $M_{ob} = L - F_{ob}$
D. $M_{ob} = L + F_{ob}$
E. $M_{ob} = F_{ob} / L$

12. The power flux (F) of X-ray tube can be calculated by the formula (where U is the voltage, I is the current in the X-ray tube, Z is the atomic number of the anode material, and $k = 10^{-9} \cdot W^{-1}$ is the proportionally coefficient):
A. $F = kZI^2U$
B. $F = kZ^2IU$
C. **$F = kZIU^2$**
D. $F = kZI/U$
E. $F = kU/ZI$

13. To characterize the radiobiological effect of different radiations next notion is introduced:
A. absorbed dose
B. **equivalent dose**
C. radiation dose rate
D. permissible dose
E. expose dose

14. Let n_2 be an absolute refractive index for material of lens and n_1 be an absolute refractive index for the environment. Double convex or plane-convex lens is
A. diverging lens if $n_2 > n_1$
B. converging lens if $n_2 < n_1$
C. negative lens if $n_2 > n_1$
D. **converging lens if $n_2 > n_1$**
E. positive lens if $n_2 < n_1$

15. An atom at stationary state

A. emits quanta of electromagnetic waves
B. absorbs quanta of electromagnetic energy steadily
C. absorbs electromagnetic waves steadily
D. emits electromagnetic waves uninterruptedly
E. doesn't emit electromagnetic energy

16. Relative refractive index (n) of two mediums (second medium with respect to first one) is calculated by the formula (c is velocity of electromagnetic wave in vacuum, v_1 is velocity of electromagnetic wave in the first medium, v_2 is velocity of electromagnetic wave in the second medium)
A. $n=v_2/v_1$
B. **$n=v_1/v_2$**
C. $n=c/v_1/v_2$
D. $n=c/(v_1+v_2)$
E. $n=(v_1+v_2)/c$

17. At absolute zero temperature any body:
A. gets red color
B. radiates electromagnetic waves
C. **doesn't radiate electromagnetic waves**
D. radiates thermal radiation
E. is self-destructing

18. Numerical value of relative refractive index (n) of two mediums may be equal to
A. n>1 or n<1
B. n>1
C. n<1
D. n=1
E. n=0

19. Out-system unit of measurement of equivalent dose is:
A. rad
B. roentgen
C. sievert
D. **rem**
E. Grey

20. Critical angle of total internal reflection corresponds to angle of refraction
A. 180 degree
B. 0 degree
C. **90 degree**
D. 270 degree
E. 45 degree

21. The emission spectra are referred to as the dependence of:
A. energy emitted by substance on wavelength or frequency
B. energy absorbed by substance on wavelength
C. wave function on wavelength
D. coherent radiation intensity on frequency
E. forced radiation intensity on frequency radiation causing it

22. The complex QRS on ECG shows:
A. excitation of auricle muscles
B. enervation of ventricle muscles
C. **excitation of ventricles muscles**

D. enervation of article muscles
E. relaxation of the myocardium

23. The unit of the radiation flux is:
A. Kelvin (K)
B. watt per square meter (W/m^2)
C. volt (V)
D. ampere (A)
E. **watt (W)**

24. What direct current voltage is used in electroplating and electrophoresis?
A. **60 - 80 V**
B. 200 - 400 V
C. 600 - 1000 V
D. 10 - 30 V
E. 1 V

25. Nuclei, which has the same nuclear charge number Z (different A), is called:
A. **isotopes**
B. nucleons
C. isobars
D. ions
E. subisotopes

26. Focal power of normal crystalline lens at rest is equal to
A. 70 dptr
B. 30 dptr
C. 63-65 dptr
D. **20 dptr**
E. 40 dptr

27. Value of exposure dose is a measure of:
A. activity of radionuclide
B. efficiency of any kind irradiation in comparison with X-rays irradiation
C. energy be taken up by unit of mass of irradiated substance
D. relative efficiency of irradiation with X-rays or gamma-rays
E. **ionizing action of X-rays or gamma-radiation on dry air**

28. The number of protons in a nucleus is called:
A. activity of the given nucleus
B. mass number
C. quantity of the given nucleus
D. **charge number**
E. number of the given nucleus

29. The dipole moment (D) of the current dipole is calculated by the formula (where J is current strength, l is an arm of current dipole):
A. $D=J \cdot l^2$
B. **$D=J \cdot l$**
C. $D=J/l$
D. $D=J^2 \cdot l$
E. $D=l/J$

30. Thermal radiation of any body has:

A. continuous spectrum
B. line spectrum
C. spectrum coinciding with hydrogen radiation spectrum
D. spectrum coinciding with oxygen radiation spectrum
E. continuous spectrum in temperature range from 0°C to 10°C, and line spectrum at all other temperatures

31. In the Stefan-Boltzmann law $R = \sigma T^4$ the quantity T is:
A. time
B. **absolute temperature**
C. absorption factor
D. radiance
E. radiation flux

32. Electrographic diagnostic methods are based on:
A. **irritation of excitable tissues**
B. introducing of medical substances to human organism through skin under the action of direct current
C. investigating peripheral blood circulation
D. measuring and recording slow oscillations of complete resistance
E. registration of an electric potential differences between various points of an organism

33. Device for measuring of refractive index is called
A. saccharimeter (polarimeter)
B. photocolorimeter
C. spectrometer
D. **refractometer**
E. Nicol prism

34. Speed of ions movement under the action of an electric field is $v = 3 \cdot 10^{-5} \frac{m}{s}$. Electric field intensity is $E = 300 \frac{V}{m}$. Calculate ions mobility (b).
A. $1 \cdot 10^5$ m^2/sV
B. 100
C. $1 \cdot 10^{-7}$ m^2/sV
D. $1 \cdot 10^{-5}$ m^2/sV
E. $2 \cdot 10^{-5}$ m^2/sV

35. X-radiation dose is D=100 rad. Calculate equivalent dose in SI units and in off-system units.
A. 1 R, 100 rem
B. 1 Sv, 100 rem
C. 100 R, 1 Sv
D. 10 Sv, 100 rem
E. 10 rem, 0.1 Sv

36. The body with mass m=60 kg absorbed ionizing radiation energy E=1 J during 6 hours. Calculate radiation dose (D) and dose rate ($\dot{D}$) in units of SI and in off-system units.
A. D = 0.0167 Gy, D = 1.67 rad, $\dot{D}$ = 0.28 · 10^{-2} rad/hour, $\dot{D}$ = 0.28 · 10^{-2} Gy/hour
B. D = 0.05 Gy, D = 1.5 rad, $\dot{D}$ = 0.01 · 10^{-2} rad/hour, $\dot{D}$ = 0.01 · 10^{-2} Gy/hour
C. D = 0.1 Gy, D = 1.35 rad, $\dot{D}$ = 0.2 · 10^{-2} rad/hour, $\dot{D}$ = 0.2 · 10^{-2} Gy/hour

D. D = 0.011 Gy, D = 1.33 rad, $\dot{D} = 0.33 \cdot 10^{-2}$ rad/hour, $\dot{D} = 0.33 \cdot 10^{-2}$ Gy/hour

E. D = 0.021 Gy, D = 1.52 rad, $\dot{D} = 0.12 \cdot 10^{-2}$ rad/hour, $\dot{D} = 0.12 \cdot 10^{-2}$ Gy/hour

37. Calculate the critical angle of total internal reflection (α_{cr}) for mediums diamond-air. Absolute index of refraction for diamond is $n = 2.42$.
A. 54°
B. 41°
C. π/4
D. 24°
E. 70°

38. Focal distance of the eyepiece equals 1 cm. Magnification of the objective lens is 30. What is the total magnification of the microscope?
A. 1500
B. 500
C. 750
D. 150
E. 75

39. Hoorweg – Weiss – Lapicque equation describes dependence of:
A. specific conductivity upon tissue resistance
B. tissue resistance upon threshold current
C. dielectric permittivity upon frequency of alternating current
D. **threshold current upon pulse duration**
E. tangent of dielectric loss angle upon specific resistivity

40. Absolute refractive index (n) of medium is calculated by the formula (c is velocity of electromagnetic waves in vacuum, v is velocity of electromagnetic waves in medium)
A. n = c – v
B. n = c · v
C. n = c + v
D. **n = c/v**
E. n = v/c

41. According to Einthoven Theory the heart is:
A. a point electric dipole in infinity conductor medium
B. **a point current dipole in infinity conducting medium**
C. a source of direct current
D. an aggregate of positive charged particles
E. an aggregate of negative charged particles

42. Eye's light conducting system does not include
A. cornea
B. **retina**
C. aqueous humour of the anterior chamber
D. crystalline lens
E. vitreous body

43. Optical resonance absorption spectroscopy studies
A. electron levels structure of atoms and molecules at energy emission producing
B. adsorption spectra of atoms and molecules
C. structures of stationary electron states of atoms and molecules

D. adsorption energies of ionization only
E. energies of excitation of atoms and molecules

44. An oval area in the centre of the retina (where cones are mainly located) is called
A. yellow spot
B. blind spot
C. eye optical center
D. iris
E. pupil

45. Half-life period T of radioactive material (if λ is decay constant) is equal to
A. $T = \ln 2 \cdot \lambda$
B. **$T = \ln 2/\lambda$**
C. $T = \lambda^2/\ln^2$
D. $T = 1/2\lambda$
E. $T = \ln\lambda$

46. The human eye pupil takes part in the process of
A. accommodation
B. **dark adaptation**
C. binocular vision
D. achromatic vision
E. color vision

50. To observe phenomenon of rotation of the polarization plane of the polarized light it is necessary to transmit the light through the
A. optically isotropic medium
B. optically anisotropic medium
C. **optically active medium**
D. light absorbing medium
E. light scattering medium

51. Let F_{ob} and F_e be the focal lengths of the objective and the eyepiece respectively; L be the optical length of the microscope drawtube, and a be the distance of the best vision. Magnification (M) of the microscope is calculated by the formula
A. $M = L \cdot a / F_{ob} / F_e$
B. $M = L / a / F_{ob} / F_e$
C. $M = L \cdot a \cdot F_{ob} \cdot F_e$
D. $M = L \cdot a / (F_{ob} - F_e)$
E. $M = L \cdot a / (F_{ob} + F_e)$

52. The duration of fluorescence is of the order of
A. 10^{-1} s
B. 10^3 s
C. 1 s
D. 10^{-8} s
E. 1 min

53. The value of the monochromatic absorption factor (α_λ) is:
A. within 0 to 1
B. greater than 1
C. equal to 0 always
D. equal to 10 always
E. less than 0

54. The electric field intensity E is determined by formula (where F is the force exerted by the field on a stationary test charge q placed at the point of the field being considered):
A. $E=F \cdot q$
B. **$E=F/q$**
C. $E=q/F$
D. $E=F/q^2$
E. $E=q^2/F$

55. Dynamic radionuclide methods are used for:
A. definition the maximum allowable radiation dose
B. spatial distribution of the radiopharmaceutical preparations in organ
C. accumulation radionuclides in organs and systems
D. destroying malignant tumor cells
E. **functional diagnostics by registration radiation flux vs. time dependence**

56. Linear braking capacity S equals (dn is the number of ions formed by particle which passed distance dl, dE is energy lost by the particle)
A. dl/dE
B. dn/dl
C. **dE/dl**
D. dn
E. dE

57. Absolute refractive index (n) of medium takes the following numerical values
A. n>1
B. n<1
C. n=1
D. n=0
E. n>1 or n<1

58. If temperature of a black body increases in 2 times, then its radiance:
A. increases in 16 times
B. decreases in 2 times
C. is equal to zero
D. increases in 2 times
E. decreases in 4 times

59. Ultra-violet rays are electromagnetic waves with wavelength
A. 380 – 760 nm
B. > 760 nm
C. **< 380 nm**
D. 380 nm
E. 760 nm

60. According to Einthoven's theory at the first lead the electric potential difference is measured between:
A. left hand - left foot
B. right hand - left foot
C. left hand - right foot
D. **right hand - left hand**
E. right foot - left foot