Probleme II

1. Reactia de producere a ozonului din oxigen in atmosfera (la cca 25km in stratosfera) este:

$$O_2 + h\nu \rightarrow O + O$$
$$O_2 + O + h\nu \rightarrow O_3 + M \quad (M=N_2)$$

Actiunea protectoare a ozonului din atmosfera provine din absorbtia radiatiei din domeniul 230-290nm. Carui domeniu spectral ii apartin aceste lungimi de unda. Care este energia unui foton si energia unui mol de fotoni din acest domeniu. Cu cate grade se poate incalzi o cantitate de 1 litru de apa daca primeste aceasta energie (c_{apa}=4,180J/mol.K, N_A=6,023.10^{23}fotoni /mol)

2. Clorofila absoarbe lumina care are energia fotonilor de 3,056.10^{-19}J si de 4,41410^{-19}J . Care este frecventa, lungimea de unda si culoarea acestor fotoni.

3. Fara a efectua calcule in detaliu, aranjati urmatoarele radiatii in ordinea cresterii energiei per foton: a) 662nm; 2,1.10^{-5} cm; c) 3.58μm; d) 4,1.10^{-6}m

4. Fara a efectua calcule in detaliu, aranjati urmatoarele radiatii in ordinea cresterii energiei unui mol de fotoni: a) radiatia cu ν=3.$10^{-15}s^{-1}$; b) o lampa de incalzit cu infrarosii; c) radiatia cu λ=7000A^o; razele folosite la radiografiile dentare.

5. Lampile cu vapori de sodiu la presiune inalta sunt folosite la iluminatul strazilor. Cele mai intense linii din spectrul sodiului sunt la 589,00 si 589,59nm. Care este diferenta de energie per foton ale radiatiilor corespunzatoare celor doua linii.

6. Frecventa de prag fotoelectric pentru un catod de indiu este 9,96.$10^{14}s^{-1}$. Care este energia si lungimea de unda a fotonilor acestei radiatii. Se va produce efect fotoelectric daca indiul este iradiat cu radiatie UV?dar IR? Explicati.

7. Semnalele radio emise de nava Voyager I lansata in anul 1970 aveau frecventa de 8,4GHz. Pe Pamant, aceasta radiatie era receptionata de o antena care trebuia sa fie capabila sa detecteze semnale de minim 4.10^{-21}W. Cati fotoni pe secunda reprezinta aceasta limita de detectie.

8. Un laser emite pulsuri de lumina care au energia de 2,46.10^{-16}J la frecventa de 3,25.10^{14}Hz. Cati fotoni se afla in acest puls.

9. Care este lungimea de unda a luminii ce ilumineaza o suprafata de bariu daca frecventa prag a bariului este 6,07.10^{14}Hz, iar energia cinetica a electronilor emisi este de 1,31.10^{-18} J.

10. O bila de litiu cu raza de 5cm emite electroni, daca este iluminata cu radiatie monocromatica cu lungimea de unda de 232nm. Stiind ca lucrul de extractie este de 5,29 eV, sa se arate ca la un moment dat emisia inceteaza si sa se calculeze numarul maxim de electroni emisi.

11. O placa de zinc este iluminata cu o radiatie care are lungimea de unda de 300nm. Pana la ce distanta de suprafata placii se indeparteaza electronii daca sunt franati de un camp electric omogen de 10 V/m. care este fracvanta prag. Se cunoaste lucrul de extractie al zincului de 3,74eV.

12. Prin racirea unui corp cu temperatura de 2000K datorita radiatiei, lungimea de unda a maximului spectral se deplaseaza cu 5000A^o. Care este noua temperatura a corpului.

13. Intr-o explozie termonuclera, temperatura gazelor atinge 10^7K. Care este lungimea de unda a maximului spectral si carui domeniu ii apartine.

14. Cunoscand masa Soarelui de 2.10^{30}kg si raza sa de 7.10^{8}m si stiind ca la suprafata are o temperatura de 6150K sa se calculeze masa pierduta de Soare prin radiatie in interval de o secunda. In cat timp masa Soarelui scade cu 1%.

15. Un fascicul de electroni este accelerat la o tensiune de 5V. Care este lungimea de unda de Broglie a electronilor. La ce tensiune ar trebui accelerati pentru a avea o lungime de unda in domeniul: a) raze X ($1A^o$); b) vizibil ($6000A^o$); raze gamma ($10^{-2}A^o$)

16. Un electron are viteza de 300 m/s masurata cu o precizie de 0,01% cu ce precizie maxima putem determina pozitia acestui electron. Dar in cazul unui glonte cu masa de 50g. Discutati caracterul de particula si unda in cele doua cazuri.

17. O celula fotoelectrica cu catod din potasiu este iluminata cu urmatoarele radiatii si se obtin urmatoarele tensiuni de franare. Completati tabelul, reprezentati grafic $E_c=f(\nu)$ si deduceti din grafic lucrul de extractie, frecventa prag si constanta lui Planck.

culoare	λ	U_f	ν	$\varepsilon=h\nu$	$\varepsilon=h\nu$	E_c
	(nm)	(V)	(Hz)	(J)	(eV)	(eV)
violet	436	0,5				
ultraviolet I	365	1,1				
ultraviolet II	254	2,6				

1. Calculate the wavelength of light, in nm, illuminating a barium surface if the threshold frequency of barium is 6.07×10^{14} Hz and the kinetic energy of the electron emitted is 1.31×10^{-18} J. Ans. 116 nm
2. If barium has a threshold frequency of 6.07×10^{14} Hz, calculate the kinetic energy of the electron emitted when barium is illuminated with a wavelength of 385 nm.
Ans. 1.14×10^{-19}.
3. Calculate the threshold wavelength, in nm, of a metal if that metal emits an electron with a kinetic energy of 6.32×10^{-19} J when illuminated with light that has a frequency of 1.97×10^{15} Hz. Ans. 295 nm
4. Calculate the frequency of light illuminating a copper surface if the threshold frequency of copper is 1.08×10^{15} Hz and the velocity of the electron emitted is 1.11×10^{6} m/s.
Ans. 1.92×10^{15} Hz.
5. An instrument is sensitive to light packets that carry at least 1.03×10^{-16} J of energy. How many photons of light of frequency of 3.02×10^{13} Hz can the instrument detect?
Ans. 5160 photons.
6. A laser emits a pulse of light containing 2.46×10^{-16} J of energy at a frequency of 3.25×10^{14} Hz. How many photons are present in the pulse?
7. Calculate the threshold wavelength, in nm, of a metal if that metal emits an electron with a kinetic energy of 2.09×10^{-19} J when illuminated with light that has a frequency of 1.40×10^{15} Hz. Ans. 278 nm
8. If potassium has a photoelectric threshold frequency of 5.37×10^{14} s^{-1}, calculate the velocity of the electron emitted when potassium is illuminated with light with a wavelength of 3.29×10^{-5} cm. Ans. 7.39×10^{5} m/s.
9. Calculate the threshold wavelength, in nm, of a metal if that metal emits an electron with a velocity of 1.66×10^{6} m/s when illuminated with light that has a wavelength of 101 nm. Ans. 279 nm
10. Calculate the frequency of light illuminating a sodium surface if the threshold frequency of sodium is 5.51×10^{14} Hz and the velocity of the electron emitted is 1.06×10^{6} m/s.
Ans. 1.32×10^{15} s^{-1}.
11. Calculate the energy, in kJ/mol, of a mole of photons in the blue visible region of the electromagnetic spectrum that has a frequency of 7.30×10^{14} s^{-1}. Ans. 292 kJ/mol.
12. Calculate the threshold frequency of a metal if that metal emits an electron with a kinetic energy of 1.04×10^{-18}J when illuminated with light that has a wavelength of 142 nm.
Ans. 5.51×10^{14} Hz.

13. Calculate the energy, in kJ/mole of a mole of photons in the infrared region of the electromagnetic spectrum that has a wavelength of 79.4 ⌠m. Ans. 1.51 kJ/mol.
14. An instrument is sensitive to light packets that carry at least 6.61×10^{-17} J of energy. How many photons of light of wavelength of 7.88×10^{-6} m can the instrument detect?
Ans. 2620 photons.
15. A photon in the microwave region of the electromagnetic spectrum has an energy of 1.28×10^{-22} J, calculate the wavelength in mm, of the photon. Ans. 1.55 mm
16. If aluminum has a photoelectric threshold wavelength of 295 nm, calculate the kinetic energy of the electron emitted when aluminum is illuminated with light with a wavelength of 241 nm. Ans. 1.49×10^{-19}J.

Quantum physics is a branch of science that deals with discrete, indivisible units of energy called quanta as described by the Quantum Theory. There are five main ideas represented in Quantum Theory:

1. Energy is not continuous, but comes in small but discrete units. [1]

2. The elementary particles behave both like particles *and* like waves. [2]
3. The movement of these particles is inherently random. [3]
4. It is *physically impossible* to know both the position and the momentum of a particle at the same time. The more precisely one is known, the less precise the measurement of the other is.[4]
5. The atomic world is *nothing* like the world we live in. [5]