Příklady se semestru-ZSL

ULTRAZUUK

$$\lambda = \frac{c}{p} \quad Z_{\underline{z}} =$$

$$=\frac{c}{p}$$
 $Z_{e}=\rho c$

$$C = \sqrt{|p_{K}|} | K = \frac{1}{E}$$

$$\frac{ULTRAZUUZ}{\lambda = \frac{C}{T}} \qquad \frac{Z_{z} = \rho c}{Z_{z}} \qquad \mathcal{R} = \frac{(2.-2c)^{2}}{(2.1+2c)^{2}} \qquad \mathcal{D}_{oppler} : \qquad f = \frac{c \pm r_{r}}{c \pm r_{s}} \cdot f \circ$$

$$c = \frac{1}{\sqrt{c_{s}}} \qquad | X = \frac{1}{c} \qquad | \frac{c \pm r_{s}}{r_{s}} \cdot f \circ |$$

1.1. ši teni signailu

$$R = \frac{1}{E}$$
 $c = \frac{1}{19k}$ -> $c = \frac{E}{19}$ -> $E = c^2p = 1540^2 \cdot 1000 = 2,37 GRa$

hypocitégité koeticient odram intensity mes: sommacem a viducliem, snimacim a gelen (voda). Popsvillete powe pour fel.

$$P = \frac{(2_1 - 2_2)^2}{(2_1 + 2_1)^2} \rightarrow P_{4-w} = \frac{(\frac{2_1}{2} - \frac{2_w}{2_w})^2}{(\frac{2_1}{2} + \frac{2_w}{2_w})^2} = \frac{(30_1 \cdot 8 \cdot 10^6 - 1_1 \cdot 5 \cdot 10^6)^2}{(30_1 \cdot 8 \cdot 10^6 + 1_1 \cdot 5 \cdot 10^6)^2} = \frac{0_1 \cdot 822}{(30_1 \cdot 8 \cdot 10^6 + 4_2 \cdot a)^2} = \frac{0_1 \cdot 999}{(30_1 \cdot 8 \cdot 10^6 + 4_2 \cdot a)^2} = \frac{0_1 \cdot 999}{(30_1 \cdot 8 \cdot 10^6 + 4_2 \cdot a)^2}$$

Gel pourirame, protore priched ma pale mensi odranivost

1.2.2. Militar Hen'n Ze = 800 k Payl; koot Zb = 6 H Rayl.

ther je podik odrazine evergie Ot na hranici kosti a mithe + kani

1.2.3. specifiche bondonest thani: 900 kg, rychlast UZ v m': 1540 5, kost 26=6,75 Alg they is harf event ordran mes thain a work?

$$\mathcal{P} = \frac{(2e - 2e)^2}{(2e + 2e)^2} = \frac{(1,386 - 6,75)^2}{(1,386 + 6,75)^2} = \frac{0,435}{(1,386 + 6,75)^2}$$

- 1.3.1. Netopýr dobaží dehlovat ozviny 1 ms od sebe. Jakou minima lu ' α xil veda leucot mus: objek z obleaže odehlovat. Corduct = 330 $\frac{m}{5}$ atrailur rozlišimi (podel taprsku) je $\lambda = \frac{c.t}{2} = \frac{330 \cdot 10^3}{2} = 0,165 \text{ m}$ lakval

 lakval

 lakou 'lur' rozlišemi' je u'mitur' frehren u a velikost a vzda 'leucsti od objekh
- 1.8.2. Delfin uvzerna, in joon 2 sicaloci od sebe, woland jsom od delatina NEda'lemi o 3,5 m. Poland ma' ulbrastak frukran ei 100 kHz, uliażte si tato schopmost mem' owesena jeho vluoron de'lhou. Jaluj mu'mimailui casovej twechil je delfin schopen runimas? $\lambda = \frac{c}{l}$; Croda = 1540 5 dedy podle toho sujmensi' rozpoznatelna' rzda'le nost) = 1540 = 15,4 mm 2 3,5m. Soliopniest nem' onesena & veno von de'lkon Vz. 3,5 meter tam a apartly troval we node t = 2.5 = 2.3,5 = 4,5 ms
- 1.4.1 Propozitejte mimima'hu' frehvenci, ktora' ma'm nmožmi rozliši 4

 co, 2 mm ~ lidoke' tlea'm: Do jale' klaubley je n'cimmy takou UZ jako souda?

 (nemiržne detekovzt roždil menši me); pro ef. klaubka plah' el= 500) 1.4. Rozlisèmi albrazunten

d = 500. x = 500.0,2 mm = 100mm = 10cm

1.5. Vnorhovar pulvence 1.5.1. Predpokla dejme blanden pranika do bidski he tela 20cm, rychlost 1540 mg fahon nejnyssi' možnou vzorkovaci' falevena: musime poušit pokud pro kardy snumek potitrajime 200 paprskie?

cesta ultrazvalu tum a 2 patky sabere t = 2.d 200 smim kie tedy rabere two = n.2.d

ra 1 s masmimame maximailué tros somme

Ab. Doppier

1.6.1. Dosma' frekvence: 3HHz pro mièrem remore. Vunne = $2\frac{em}{5}$, $c_{vs} = 15 to \frac{sm}{5}$. Rozsch ozwinových fine

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1.6.1. Dosma' frekvence: 3HHz pro mièrèm remore. 3HHz => 3Hz = 3HHz => 3HHz $f_{min} = \frac{c - N_b}{c + N_b} \cdot f_0$ $\Rightarrow f = f_0 \cdot \left(\frac{c + N_b}{c \cdot N_b} - \frac{c - N_b}{c \cdot N_b} \right) = \int_0^1 \frac{c^2 + 2c N_b + N_b^2 - c^2 + 2c N_b^2}{c^2 - N_b^2} = \frac{4c N_b}{c^2 - N_b^2} \cdot f_0$ Imax = c+n. fo) Sf = 4.1540.0,02 3.106 = 155,8Hz range: 311Hz ± 77,9Hz

HIKROSKOPIE

kouvenim' arakova' vzda'lenost d= 25 cm

$$z \sim t + s = \frac{y'}{y} = -\frac{\alpha'}{a}$$

20 bear oraci ree spojky.
$$\frac{1}{a} + \frac{1}{a'} = \frac{1}{f}$$

znitsení mi kroskopu
$$2 = \frac{\Delta}{lob} \cdot \frac{d}{loc} = \frac{teb}{lob} \cdot \frac{d}{loc}$$

Rayleigho limit revelisem d= 1.22. 2. NA

munuwicha apertura NA = n. sim 0

1.1. COCKY

spojmu čocka o olimistovou vedustenosti 10cm. Jake j avetsemi objektu o sujohon 6 cm, unistine lo do redallenost. 12 cm? f=0,1m, a=0,12m

$$\frac{1}{a} + \frac{1}{\alpha_{1}} = \frac{1}{f} - \frac{1}{a} - \frac{1}{a} = \frac{1}{a} - \frac{1}{a} - \frac{1}{a} - \frac{1}{a} = \frac{1}{a} - \frac{1}{a} = \frac{1}{a} - \frac{1}{a} -$$

1.2. Kikraskop I

ribroskop se dvou spojek. fob = 5mm s průmirem 1cm. della house 100 mm. folul = 25 mm. bypočítejk světsěmí halvæslek schema mi hroskopu.



1.3. Hikus kopII

ti kroskup se aritsením objektira 40 a aritsením akularu 10. de'lka tabusa = 12 cm. kypočítejte celhove avetsení a ahus kove vzdadbuosti cocik.

$$Z = \{ z_{ob} \cdot z_{ok} = 40.10 = 400 : z_{ob} = \frac{\Delta}{f_{ob}} \rightarrow f_{ob} = \frac{\Delta}{z_{ob}} : z_{ok} = \frac{d}{f_{ok}} \rightarrow f_{ok} = \frac{d}{z_{ok}}$$

$$WWF = \frac{o_1 42}{40} = \frac{3 \, mm}{40} : f_{ok} = \frac{d}{f_{ok}} = \frac{o_1 z_5}{10} = \frac{25 \, mm}{25 \, mm}$$

1.4. Rozlisení mikroskopu

Hikroshop & mumerichon aperhinon 0,4, a podoricemim 1=650 nm Julie je marima lui rostisemi pir tombo nastavem?

1.5. Rozlisèm' nikroskopu I

Olyikhr L 5 pobkulovým víhlem 0=30° r immeremím oleji (n=1,33) a normalum opretlemm (x=650 nm). Jalu' svetlo (x a barva) numornue pount, alydiam dotali skejne rodiseni pii pantiti reduclin (n=1)?

$$\frac{\lambda_1 = d_2}{\frac{\lambda_1}{2 \cdot n_1 \cdot sim\theta}} = \frac{\lambda_2}{\frac{\lambda_2}{2 \cdot n_2 \cdot sim\theta}} = \frac{\lambda_2}{\frac{\lambda_1}{2 \cdot n_2 \cdot sim\theta}} = \frac{\lambda_2}{\frac{\lambda_2}{2 \cdot n_2 \cdot s$$

Rentgen

Koeficient Williama: \u = \frac{\lambda 2}{\omega \gamma_2}

PoloHoustka: dr = e-ud

 $I_{2} = I_{0} e^{-\mu \lambda}$ $h = 4,135 \cdot 10^{15} e^{V \cdot H_{z}^{-1}} I_{2} = \left(\frac{1}{2}\right)^{\frac{1}{dy_{2}}} \cdot I_{0}$ $e = 3 \cdot 10^{8} m \cdot 5^{-1}$

1.1. Energie fotomu I

folou s l= 100 nm ma' energii 12 eV. Jakar je energie folona s l = 2 nm

$$E_1 = h \cdot \frac{e}{\lambda_1}$$
 $\downarrow = \rangle \underbrace{E_1 \cdot \lambda_1 = h \cdot e}_{\downarrow = h \cdot e}$ \vdots $E_2 \cdot \lambda_2 = h \cdot e$

$$E_1 \lambda_1 = E_2 \lambda_2 \rightarrow E_2 = E_1 \cdot \frac{\lambda_1}{\lambda_2} = 12 \cdot \frac{100}{2} = 600 \text{ eV}$$

1.7. Energie fotonu II

Dentgenka generaje sariem' a fotomi o himetichon energii 10 kel.

bypocitife vluovou de'llen RTG eavien' poked se na zariem' premin' poure 16 emqie

$$E = h \cdot \frac{c}{\lambda} \rightarrow \lambda = \frac{h \cdot e}{E_{R76}} = \frac{4,135 \cdot 10^{-15} \cdot 3 \cdot 10^{8}}{100} = 12,405 \cdot 10^{-9} m = 12,405 mm$$

1.3. Absorbce radiace

2TG ration's intensitor 10 cm2 prochated 10 cm that is polothoust kon 2 cm.

Jakar intersita vyjde ven? flustota thaint nHU? (uw= 6,22 cm²) lo je to za thain?

$$I_{10} = (\frac{1}{2})^5 \cdot I_0 = 0,812 \frac{\mu}{an^2}$$

$$I_{40} = (\frac{1}{2})^5 \cdot I_0 = 0.812 \frac{u}{cm^2}$$
 $u = \frac{\ln 2}{olv_1} \rightarrow I_{10} = I_0 \cdot e^{-\mu l} = 10 \cdot e^{-\frac{\ln 2}{2} \cdot 10} = 312 \frac{m^{1/2}}{cm^2}$

1.4. Absorbee radiace II

$$I_{AIB} = \left(\frac{4}{2}\right)^3 \cdot I_o$$

$$I_{AIB} = \left(\frac{1}{2}\right)^{3} \cdot I_{o} \qquad I_{AIB} = I_{o} \cdot e^{-\frac{L_{o}^{2}}{16} \cdot 30}$$

$$I_{2} = \left(\frac{1}{2}\right)^{\frac{7}{3}} \cdot I_{AIB} = \left(\frac{1}{2}\right)^{\frac{17}{3}} \cdot I_{o} \qquad I_{2} = I_{AIB} \cdot e^{-\frac{L_{o}^{2}}{3} \cdot 8} = I_{o} \cdot e^{-\frac{17}{8}L_{o}^{2}}$$

1 No B dy2 = 3 em 16cm

NA = 6,023.1023 mol 1 $N = n \cdot N_A$

Pospedova konstanta pro polocas rozpadu: 1 = lu2 |

$$A = \lambda \cdot N$$

1.1. Radioaktivita

hund most radioalet ruile i rotopu sa 3 roky, kdy i se o holik se pruzi na rule smini

$$\bigcirc$$
 $\left(\frac{1}{4}\right)^3 = \frac{1}{64}$

$$\frac{N}{N_0} = e^{-\lambda \cdot t} = e^{-\lambda \cdot t}$$

$$e^{-\frac{\ln k}{t_k} \cdot t} = \frac{k \cdot 4}{t_k \cdot 4}$$

②
$$\frac{N}{N_0} = e^{-\lambda \cdot t} = e^{-\frac{\ln k}{t_K} \cdot t} = e^{-\frac{\ln k}{t_K} \cdot t} = e^{-\frac{\ln k}{t_K} \cdot 3} = \frac{1}{64}$$

1.2. Radioaktivui rozpad

Poča tetmi nychlost surpadu (ale hinita) 1 g inotopu 226 Pa je 1Ci = 3,7.10 Bq July je poločas rozpadu? rolarun' huotnost je 226.10-3 kg.

$$A = \lambda \cdot N = \frac{\ln 2}{T_{1/2}} \cdot \frac{m}{H} \cdot N_A \rightarrow T_{1/2} = \frac{\ln 2 \cdot m \cdot N_A}{A \cdot M} \cdot \begin{pmatrix} \min h & \text{cluy roley} \\ 60 \cdot 60 \cdot 24 \cdot 365 \end{pmatrix}$$

$$T_{1/2} = \frac{L.2.10^{3}.6.023.10^{23}}{3.7.10^{10}.226.10^{23}} \cdot () = 1583, 15 lef$$

1.3. Radio far maka I

brouele 18 F ma' ~ 10:40 ale hinite 30 MBq. Do parcienta je spraven ~ 11:30.

Kolik alehinitz Affe bylo parcientovi aplikova no? Taz = 109,8 min $\Delta t = 50 \text{ min}$ $A_{\pm} = A_0 \cdot e^{-\lambda t} = A_0 \cdot e^{-\frac{\ln 2}{T_h} \cdot t} = 30.10^6 \cdot e^{-\frac{\ln 2}{109.8} \cdot 50} = 21.9 \text{ M/sg}$

1.4. Radiofarma Ka II

Oboghle' Madio farmalum s Ty, aktivity 130 min a The climinace 2 tila 35 min 30 minut prèd injeka je nyrobeno 4.10 mol propravka.

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Jaka je alahmita pri injeka ? Jaka je alahmita po 15 minutove akcinici ?

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$$A_{i} = A_{o} \cdot e^{-\frac{L_{i}^{2}}{T_{i2}} + i} \qquad \text{Manifolding}$$

$$A_{o} = \lambda_{A} \cdot n_{o} \cdot N_{A} = \frac{L_{i}^{2}}{T_{i_{A}A}} \cdot n_{o} \cdot N_{A}$$

$$A_{o} = A_{i} \cdot e^{-(\lambda_{A} + \lambda_{E}) \cdot t_{a}}$$

$$A_{i} = \frac{\ln 2}{T_{N_{i},A}} \cdot h_{0} \cdot N_{A} \cdot e^{-\frac{\ln 2}{T_{N_{i},A}}} \cdot t_{i}$$

$$A_{i} = \frac{\ln 2}{130 \cdot 60} \cdot 4 \cdot 10^{-12} \cdot 6_{1}023 \cdot 10^{23} \cdot e^{-\frac{\ln 2}{130}} \cdot 30^{0} = 182_{1}44 \cdot H_{8q}$$

$$A_{\alpha} = A_{i} \cdot e^{-\left(\frac{\ln 2}{130} + \frac{\ln 2}{25}\right) \cdot 15} = 125_{1}14 \cdot H_{8q}$$

1.5. PET

PET S dehl boroog'm proteucem o priimiru 1 m Aroung' 200 dehle korg otym' relikook. Foltaj nadioal tivitz. pri smi ve strich proteuce o alibriti $f:=10^6$ 8q. (athir anan menainji vorehny detektory).

Julia je pravdipodobnost oleklece uda look hou hra tru' olraji ci' olekle tori ?

Julia je oloba a poždimi men nozpadem a olekleci

Julia je oti ka mana olek mita r case T=10 mum, potud ma'

nadioal ti vrii latta polotus nozpadu olek mtz $f_{i,i} = 10$ min a climinu $f_{i,j} = 10$;

Nadioal ti vrii latta polotus nozpadu olek mtz $f_{i,j} = 10$ min ?

Juliy je porit deklorumých uda losh' od poča tku olo T=10 min ?

Ny počítej te celkový počít uda losh' od poča tku olo T=10 min ?

Pravdopodo bnost: $P=\frac{1}{100}=\frac{1}{100}$ Doba spožděm': $t=\frac{s}{r}=\frac{0.5}{c}=\frac{0.5}{3.10}=\frac{1}{6}$. $10^{-8}=\frac{1.6}{1.6}$

Doba spožolimi: $t = \frac{s}{r} = \frac{6.5 \cdot d}{c} = \frac{6.5}{3 \cdot 10^{5}} = \frac{1}{6} \cdot 10^{-8} = \frac{1.6 \text{ ns}}{10^{6}}$ Al hini ha r = 10: $A_{10} = A_{0} \cdot e^{-(\lambda_{A} + \lambda_{E}) \cdot t} = 10^{6} \cdot e^{-(\frac{L_{12}}{10} + \frac{L_{12}}{10}) \cdot 10} = \frac{250 \text{ kBq}}{10^{6}}$

Pocit udaílostí: $N_0 = \frac{A_0}{\lambda_A}$; $N_{A0} = \frac{A_0}{A_{A0}}$; polonima byla a kla vylautena (!asi protorie Tr_A à Tr_E sè 1:1 ???)

castic

 $N_{\text{dekka'}} = \frac{N_{\text{o}} - \frac{A_{10}}{A_{\text{o}}} \cdot N_{\text{o}}}{2} = \frac{1 - \frac{A_{10}}{A_{\text{o}}}}{2} \cdot N_{\text{o}} = \frac{1 - \frac{G_{1} \cdot S \cdot 10^{6}}{10^{6}}}{2} \cdot N_{\text{o}} = \frac{3}{8} \cdot N_{\text{o}}$ $N_{\text{o}} = \frac{1 - \frac{A_{10}}{A_{\text{o}}} \cdot N_{\text{o}}}{2} \cdot N_{\text{o}} = \frac{3}{8} \cdot N_{\text{o}}$

 $N_{\text{detek}} = \frac{3}{8} \cdot \frac{A_0 \cdot T_{\text{Ni},A}}{l_{\text{ni}} 2} = \frac{3}{8} \cdot \frac{10^6 \cdot 10.60}{l_{\text{ni}} 2} = \frac{324, 6 \cdot 10^6}{l_{\text{ni}} 2}$

Ndeteku' = Ndeteku' = 3,246.106 dekku' ma detektor