Notes for physics UAS final exam:

Study materials:

https://physics15.weebly.com/uploads/3/0/2/7/30272185/c5phys2023.docx

https://physics15.weebly.com/uploads/3/0/2/7/30272185/c6phys2023.docx

Instructions:

Write all your answers in this Word Document and email the Word Document with your answers to me.

Try to write only text. Try to avoid pictures, videos and other things, which make files big.

Write your name(s)

Write your student number(s)

s is your student number.

k = s mod 10000

T = s mod 100

m = s mod 35

a = s mod 25

L = s mod 10

m9 = s mod 9

e = s mod 8

m7 = s mod 7

m6 = s mod 6

m5 = s mod 5

m4 = s mod 4.

m3 = s mod 3

m2 = s mod 2

Questions:

1. Explain the standing wave.

Standing wave

en.wikipedia.org/wiki/Standing\_wave

https://youtube.com/watch?v=0Rfushlee0U

Characteristic equation: L = n(λ/2), n = 1,2,3,…

Waves in ocean can travel a great distance, just like sound waves, but some are confined to a specific region, like if you shake rope with one end fixed in space. Waves will travel down this rope and then back again, reflected at the boundary. Some waves are confined between two fixed boundaries, like string, where they experience reflection at both ends of the string, resulting in a multitude wave cycles, traveling in both directions. If this vibration is of particular frequency, it will produce an interference pattern, that is a stationary wave. These are called transverse standing waves. These kinds of waves can only have particular frequencies for strings of given length because they only have integer numbers of half-wavelengths, since the waves must return to zero amplitude at both boundaries. If the number of half-wavelengths was not an integer, the wave could not exist. This means that number of half-waves must be quantized, meaning, it can only exhibit certain discrete values, set of integers and not from continuous spectrum.

Standing waves contain nodes, where there is destructive interference and amplitude of zero, as well as antinodes, where amplitude is at maximum. The string will be stationary at the nodes and other sections, if vibrating rapidly enough, will appear to human eye to create loops and more nodes mean more energy.

Two-dimensional standing waves also exist. The nodes are lines and curves, in this case.

Standing waves are used in music.

Question:

Fill in the blanks:

Any standing wave must have an integer number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

In a standing wave, the places with zero amplitude are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

A standing wave with greater frequency corresponds with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy.

Question:

Solve the hydraulics problem.

You press the pedal with force of L Newtons. The area of the cross-section of the tube under the pedal is 1 squared millimetre. The area of the cross-section of the tube near the car wheals is 1 squared centimetre. Find the force on the car wheals.

Solution: Pressure is the same. The force is directly proportional to the area of the cross-section.

The force on the wheals will be 100 times bigger than the force on the pedal: 100L Newtons.

s = 22123456

L = s Mod 10

F = 100 \* L

MsgBox F

MsgBox "Force is measured in Newtons."

MsgBox "1 significant figure"

2. Find fluid resistance force.

$F=CρAv^{2}$ (resistance force (fluid mechanics))

Find fluid resistance force for C = $ρ $= A = v = s mod 25.

s = 22123456

a = s Mod 25

C = a

ro = a

area = a

v = a

resistanceForce = C \* ro \* area \* v \* v

MsgBox resistanceForce

MsgBox "Force is measured in Newtons."

MsgBox "1 or 2 significant figures"

Question:

How water level change if all floating icebergs melt?

0

3. Why do cats often stretch in hot places?

Question:

Calculate the heat engine efficiency.

Calculate heat engine efficiency for Q1 = 100J and Q2 = 50J.

Q1 = 100

Q2 = 50

efficiency = 1 - Q2 / Q1

MsgBox efficiency

MsgBox “Efficiency is dimensionless.”

MsgBox “1 significant figure”

4. Calculate the compound capacitance.

Capacitances addition

In parallel circuit: C = C1 + C2 + C3

In series circuit: $\frac{1}{C}=\frac{1}{C\_{1}}+\frac{1}{C\_{2}}+\frac{1}{C\_{3}}$

Calculate compound capacitance of C1 = 1 Farad, C2 = 2 Farad, C3 = 3 Farad.

C1=1

C2=2

C3=3

' For parallel circuit:

CP = C1 + C2 + C3

MsgBox CP

' For series circuit:

CS = C1 \* C2 \* C3 / (C1 \* C2 + C1 \* C3 + C2 \* C3)

MsgBox CS

MsgBox “Capacitance is measured in Farad.”

MsgBox “1 significant figure”

Question:

What is resistance of inductor to direct current?

0

5. Estimate the distances between the atoms.

Question:

Estimate the distances between the atoms of element number T in the periodic table of elements.

s = 22123456

T = s Mod 100

Avogadro\_number = 6 \* 10 ^ 23

'

' For Fluorine = F:

If T = 9 Then atomic\_weight = 0.018998: density = 1.696: GoTo 1

' For Magnesium = Mg:

If T = 12 Then atomic\_weight = 0.024: density = 1600: GoTo 1

' For Phosphorus = P:

If T = 15 Then atomic\_weight = 0.031: density = 1820: GoTo 1

' For Sulfur = S:

If T = 16 Then atomic\_weight = 0.032: density = 2000: GoTo 1

' For Chlorine = Cl:

If T = 17 Then atomic\_weight = 0.035: density = 3.2: GoTo 1

' For Argon = Ar:

If T = 18 Then atomic\_weight = 0.04: density = 1.8: GoTo 1

' For Patassium = K:

If T = 19 Then atomic\_weight = 0.039: density = 890: GoTo 1

' For Titenium = Ti:

If T = 22 Then atomic\_weight = 0.048: density = 4506: GoTo 1

' For Vanadium = V:

If T = 23 Then atomic\_weight = 0.050942: density = 6110: GoTo 1

' For Manganese = Mn:

If T = 25 Then atomic\_weight = 0.055: density = 7430: GoTo 1

' For Iron = Fe:

If T = 26 Then atomic\_weight = 0.056: density = 7874: GoTo 1

' For copper = Cu:

If T = 29 Then atomic\_weight = 0.064: density = 9000: GoTo 1

' For Bromine = Br:

If T = 35 Then atomic\_weight = 0.08: density = 3119: GoTo 1

'

MsgBox "You must find data for your T"

GoTo 2

'

1 distance\_between\_particles = (density \* Avogadro\_number / atomic\_weight) ^ (-1 / 3)

MsgBox distance\_between\_particles

2 your\_data = is\_missing

MsgBox “Distance is measured in metres”

MsgBox “1 significant figure”

Question:

Find energy and momentum of the photons.

Energy of photon

Energy: E = hf

h is constant

f is frequency

c = λf

Energy: E = hc/λ

c is speed of light

λ is wavelength

Momentum: p = h/λ

p is momentum

Question:

Find energy and momentum of photon of s Hz frequency.

s = 22123456

h = 6.62607004 \* 10 ^ (-34)

c = 2.99792458\* 10 ^ 8

frequency = s

E = h \* frequency

Lambda = c / frequency

Momentum = h / Lambda

MsgBox E

MsgBox "Energy is measured in Joules"

MsgBox Momentum

MsgBox "Momentum is measured in kilograms times meters per second"

MsgBox "7 or 8 significant figures"

Question:

Calculate the energy and momentum of a photon for Lambda = 0.05k nanometers.

s = 22123456

k = s Mod 10000

h = 6.62607004 \* 10 ^ (-34)

c = 2.99792458 \* 10 ^ 8

Lambda = 0.05 \* k \* 10 ^ (-9)

E = h \* c / Lambda

MsgBox E

MsgBox "Energy is measured in Joules"

Momentum = h / Lambda

MsgBox Momentum

MsgBox "Momentum is measured in kilograms times meters per second"

MsgBox "Maximum 4 significant figures"

6. Find the wavelengths of the matter.

Question:

Determine the wavelength of an electron that has been accelerated through the potential difference of T Volts.

s = 22123456

k = s Mod 10000

T = s Mod 100

h = 6.62607004 \* 10 ^ (-34)

ec = 1.60217662 \* 10 ^ (-19)

em = 9.10938356 \* 10 ^ (-31)

Voltage = T

velovity = Sqr(2 \* ec \* Voltage / em)

p = em \* velovity

Lambda = h / p

MsgBox Lambda

MsgBox “Wavelength is measured in meters.”

MsgBox “1 or 2 significant figures”

Question:

Calculate the wavelength of k grams desk moving T centimetres per second.

s = 22123456

k = s Mod 10000

T = s Mod 100

h = 6.62607004 \* 10 ^ (-34)

m = k \* 10 ^ (-3)

v = T \* 10 ^ (-2)

p = m \* v

Lambda = h / p

MsgBox Lambda

MsgBox “Wavelength is measured in meters.”

MsgBox “1 or 2 significant figures”

Question:

Find energy change of electron for hydrogen.

Find energy change of electron for hydrogen, n1 = T, n2 = s.

$$E= hf= 13.6Z^{2}\left(\frac{1}{n\_{2}^{2}}-\frac{1}{n\_{1}^{2}}\right)$$

s = 22123456

T = s Mod 100

n1 = T

n2 = s

Z = 1

E = 13.6 \* Z \* Z \* (1 / (n2 \* n2) - 1 / (n1 \* n1))

MsgBox E

MsgBox "Energy is measured in electron-volts."

MsgBox "1 significant figure"

7. Write ground state configuration for the atom.

1s1 for hydrogen

Question:

Find annihilation energy of the matter.

Find the annihilation energy of k grams of matter.

s = 22123456

k = s Mod 10000

T = s Mod 100

c = 2.99792458 \* 10 ^ 8

m = k \* 10 ^ (-3)

energy4annihilation = m \* c ^ 2

MsgBox energy4annihilation

MsgBox “Energy is measured in Joules”

MsgBox “Maximum 4 significant figures”

8. Give the structure of neutron and proton.

ddu = neutron (quarks, nuclear physics)

uud = proton (quarks, nuclear physics)

Question:

Explain the laws of the physics.

Explain main concepts, laws and theories of the physics.