PHYSICS

Exercises

1) x = v =t

2) h= $\frac{1}{2}gt^2$, v= $g \bullet t$

3) E= $h \cdot v$, $r = u \cdot v$

4) P = $p \cdot g \cdot h$

5) $\frac{F_1}{S_1} = \frac{F_2}{S_2}, \frac{m_1}{\sigma_1} = \frac{m_2}{\sigma_2}, \sigma = \sigma_{H_2 0} \cdot \frac{m}{m_{H_2O}}$

6) $p_1 + \frac{1}{2}pv_1^{\ 2} + pgh_1 = p_1 + \frac{1}{2}pv_2^{\ 2} + p \cdot gh_2$

7) F= $m \cdot a, v = a \cdot t, x = \frac{1}{2}at^2$

8) $w = m \cdot g, w = N, \mathrm{F}\tau\varepsilon\lambda = \Phi - \mathrm{T}, \mathrm{T} = \mathrm{N} \cdot \mathrm{N}$

9) $v = w \cdot r, w = 2\pi f, T = 4_f, a_2 = \frac{v^2}{r}$

10) $F = \frac{1}{4_\pi \varepsilon_o} \cdot \frac{9_1 \cdot 9_2}{r^2}, E = \frac{F}{9}, I = \frac{N}{R}, \mathrm{u} = \frac{w_e}{9_e}$

11) $R = p \cdot \frac{l}{s}, \mathrm{R} = \frac{u}{I}$

12) $R_{o\lambda} = R_1 + R_2 + ... + R_v$ (σε σειρά)

$\frac{1}{R_{o\lambda}} = \frac{1}{R_1} + \frac{1}{R_2} + ... + \frac{1}{R_v}$ (παράλληλα)

13) $d = \frac{m}{v}, d_1 = \frac{m_1}{m_{H_2O}} \cdot dH_2O$

14) $n = c \bullet v$ $c = \frac{n}{v}$ v-> Lt

15) $c = \lambda \cdot f, E = h \cdot f$

Quiz

1) Conductors allow the flow of electric current
2) Electrical resistivity of metals increases with temperature
3) Electrical resistivity of semiconductors decreases with increasing temperature
4) Centripetal acceleration $a_2 = w^2 \cdot r$
5) Density of ice < density of water
6) Surface tension decreases when temperature increases
7) iron -> ferromagnetic material
8) Wavelength of x-rays is smaller than wavelength of visible light
9) Visible light -> 380-740nm
10) Viscosity of fluid increases as temperature decreases
11) We measure blood pressure in torr.

12) Reflection angle A is smaller than B
13) Material 5000 → ferromagnetic
14) Material 3 → paramagnetic
15) Material 0,97 → diamagnetic
16) Ultrasound → >20KH_2
17) Circuit BC → + → -
18) r → coefficient of dynamic riscocity
19) Law of Dalton (total pressure) → p_1+p_2
20) If diameter of pipe + flow rate ↓
21) Object A 202 is equilibrium with B
Object C is equilibrium with A → C= 20^oC
22) If riscocity ↑ pressure↓
23) Element with electric conductor → copper
24) τύπος της βαρύτητας της Γης → $F = G.\frac{M}{R^2}$
25) Speed of fluid ↗ when pressure ↓
26) North magnetic pole of earth is at the South Pole and south magnetic pole of earth is at the North Pole

Mass and Weight : $F = G\frac{m_A m_B}{R^2}$ Cr = m.g

g= $9.81 m/s^2$

Aqueous solution: $C_1.V_1 = C_2.V_2$ only if $n_1=n_2$

Preparation

Pycnometer: $d = \frac{m}{v}$

$\frac{m_{H_2O}}{d_{H_2O}} . V= \frac{m_1}{d_1}$ $\frac{m_{H_2O}}{d_{H_2O}} = \frac{m_1}{d_1}$ → $d_1 = \frac{m_1.d_{H_2O}}{m_{H_2O}}$

Surface pressure by bubble

Stalagmometer: $\sigma = \frac{F}{2l}$ or $\sigma = \frac{dw}{ds} = \frac{dE}{ds}$. mg = 2nrσ ΔE = σ x ΔS

σ surface tension nrσ = radios of Stalagmometer tube

constant for every liquid = $\frac{m_1}{\sigma_1} = \frac{m_2}{\sigma_2}$ $\sigma = \sigma_{H_2O}.\frac{m}{m_{H_2O}}$

$\sigma = \sigma_{H_2O}.\frac{r}{r_{H_2O}}.\frac{n_{H_2O}}{n}$

Each liquid specific σ, which decreases with an increasing temperature.

Refractive index: n= $\frac{c}{v}$

Conductometry: I= $\frac{U}{R}$

Calorimetry: Q= m.L_m Q = mc (t_B- t_A) Q = C (t_B- t_A)

Q_1+ Q_2 = Q_3+Q_4

Thermistor: R = $Ra.e^{-B(\frac{1}{TA}-\frac{1}{T})}$ T.Kelvin e: Enter's number

R = A.$e^{\frac{B}{T}}$ Ra. resistance at the temp T_a

lu(R)= lu (A) + B. $\frac{1}{T}$

a= - $\frac{B}{T^2}$

Solving Problem

1) An object falls from a bridge. The maximum speed is 26ml.
What is the height? What is the time that fell?

2) Q_1 I_1= 100 Q_1 = 0,6 m^3/sec
Q_2 I_2= 200 Q_2= ?

3) A photon ultra violet has energy e= h.v, e= 40 J
What is the wavelength?
We know speed of light is C= uv, C= 20

4) Water: 20 drops ……….. mass m=20
Solution: 20 drops…… ,ass
If surface tension of H_2O =……… how much is for solution

5) h= $\frac{1}{2}gt^2$ a= $\frac{v}{t} \Rightarrow t = \frac{v}{g_2} = \frac{26}{9.81} = 2,65\sec$

h= $\frac{1}{2}$. 9.81.$(2.65)^2$

= $\frac{1}{2}$. 9.81. 7,022 → h = 34.44m

Pressure is the force per unit area applied in a direction perpendicular to the surface of an object

p= $\frac{F}{S}$ [$\frac{N}{m}$ = Pa]

hydrostatic pressure ph= $\frac{F(g)}{S} = \frac{m.g}{S} = \frac{V.p.g}{S}$

ph= $\frac{h.S.p.g}{S} = h.p.g$

Exercise: The areas of two pistons of a hydraulic press are S_1= 1200cm^2 and S_2= 8cm^2
Small piston exerts the force F_2= 500N
What force exerts the large piston?

$$\frac{F_1}{S_1}=\frac{F_2}{S_2}\Rightarrow F_1=\frac{F_2.S_1}{S_2}$$

$$\Rightarrow F_1=\frac{500x1200}{8}\Rightarrow F_1=75000N$$

Exercise: A submarine can withstand a pressure of 3 MPa. In what maximum depth can the submarine dive? p_{H_2O} = 1000

$$P= p.g.h \Rightarrow h=\frac{P}{pg}=\frac{3.10^6}{1000.9,81} = 305,8m$$

Exercise 1
We see that there is a storm not far away from us.
We hear the thunder 10 sec after we see the lighting.
In which distance the bolt strike?
The velocity of sound in air is v= 340 m/s
t= 10 sec x= v.t = 340.10 = 3400m
u=340m/s
x=?

Exercise 2
The stone falls from a height of 100m. With what velocity will the stone hit the earth?
h= 100m h = $\frac{1}{2}gt^2 \Rightarrow 100=\frac{1}{2}10t^2 \Rightarrow t^2=20 \Rightarrow t=\sqrt{20}=2\sqrt{5}$ sec
g= 10m/s^2
u=? u= g.t=10.2.$\sqrt{5}$ = 20$\sqrt{5}$ m/s

Exercise 3
After how many seconds will the light from the moon reach the earth? The moon is 383.000 km away from the earth and the velocity of light is 3x 10^8 m/s.

383.000km = 383.000x1000m= 383x10^6m
x= v.t $\Rightarrow t=\frac{x}{u}=\frac{383x10^6}{3x10^8}=127,66x10^{-2}\sec \Rightarrow t=1,87\sec$

Problems
Ss V κεραυνού = …. m/sec x= v.t
απόσταση= ?

2) ΥΠΟΒΡΥΧΙΟ
h_{max}= 14
density H_2O = …..
ποια η μέγιστη πίεση που μπορεί να ασκηθεί στο υποβρύχιο?
3) electric circuit

wavelength λ=…. $v= f.\lambda \rightarrow f = \frac{v}{\lambda}$

v ταχύτητα = …..

E= ? $E = h.f = f. \frac{v}{\lambda}$

4) πυκνόμετρο m= ….. d_{H_2O} = …

with water m_{H_2O} = …. d_{liquid} = ?

with liquid m_1 =….

$d= \frac{m}{v} \Rightarrow v = \frac{m}{d}$ $d_1 = \frac{m_1}{m_{H_2O}} . d_{H_2O}$

Questions
1) $a_c = w^2 \cdot r$ acceleration
2) Density of ice smaller than density of H_2O, d_{ice}=0,9167g/cm^2 d_{H2O}= 0,9998
3) Surface tension decreases when temperature increases
4) Iron = ferromagnetic material
5) Magnetic field
6) Movement of electrons in circuit / from the negative pole to positive
7) Wavelength of x-rays…. (smaller) than wavelength of visible light
8) 1st law of thermodynamics $\Delta U = Q - WX$
9) If temperature increases the electrical resistance of metal….? Increases too.

E = h.f Hypothesis
↓ h: 6, 626 x 10^{-34} Joule.sec

frequency of radiation

c= λ. f

$f= \frac{c}{\lambda}$

Visible light…. wavelength 380 – 740 nm. Speed of light = $3x10^8$ m/sec.
frequency 405-790 THz in vacuum

c= λ.f

velocity (m/sec) = wavelength x frequency $E= h.f = h. \frac{c}{\lambda}$

m1,cm, μm, nm (H_2)

The type of radiation based on wavelength of waves (in order of increasing wavelength)
1) gamma rays (short wavelength : $1x10^{-9}$ cm)
2) x-rays (0,03-30nm, too short to see)
3) ultraviolet (0,03 – 0,4nm)

4) visible light (0,4 – 0,7nm) detectable by eye)
5) infrared (0,7-14nm)
6) microwave (0,1-100cm)
7) radio waves (>100 cm up to several cms)

Exercise

A photon has energy…..
find the wavelength, speed of light = 3x10^8 m/sec

E= h. $\frac{c}{\lambda} \Rightarrow \lambda = \frac{h.c}{E}$

Measurement of air humidity: Φ= $\frac{mp}{V}$

Φ% = $\frac{\Phi}{\Phi_{max}} x100$

electrical resistance: $R_{eq} = R_1 + R_2 + R_3$ (in series) $I_1 = I_2 = I_3 = \ldots$

R = $\frac{U}{I}$ $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ (in parallel) $V_1 = V_2 = V_3 = \ldots$

riscocity of liquids F= n. S.$\frac{V}{y}$. dynamic viscocity [Pa.S]

↓ coefficient dynamic viscocity

v= $\frac{n}{p}$ kinetic viscocity (p= density of liquid) $[\frac{m^2}{S}]$

riscocimeter constant K = $\frac{n}{(p_s - p_1).t}$

p_s: density of sphere

p_1: density of liquid

Polarimetry $[a]_\lambda^t = \frac{a}{w.d.p}$ w= $\frac{100a}{[a]_\lambda^t d.p}$

$a_c = \bar{a} - a_o$

Quiz

1) Speed of light in water / in vacuum
speed of light in water is smaller than in vacuum
2) riscocity of fluid increases as temperature decreases
3) $P_{total} = P_1 + P_2$
4) μ= 0,097
ı) dicemagnetic ii) paramagnetic iii) ferromagnetic

5) When diameter of pipe reduced …. what happens to flow rate?
6) An object A with 20^o C is in equilibrium with body A. Object C is in equilibrium with body A. What's the temperature of object C? a) 0^o C, b) 20^oC, c) 273
7) Reflection angle and …… angle
a) larger, b) the same, c) depending
on the refraction index
8) The metals have conductor
bigger than semiconductors
almost the same
9) a) Gibbs free energy b) enthalpy, c) internal energy
spontaneous $\Delta G<0$

<u>Exercise 1</u>
An act on a car with force of 500N, duration 10 seconds.
If we ignore the friction, what will be the final velocity of the car and what distance will the car pass?
The weight of the car is 1 tone = 100Kg

F = m.a ↔ a= $\frac{F}{m} = \frac{500}{1000} = 0,5 m/s^2$

u= a.t= 0,5x10=5m/s

x= $\frac{1}{2}at^2 = \frac{1}{2}.0,5.\ 10^2 = \frac{0,5}{2}.100 = 25m$

<u>Exercise 2</u>
A bullet flew through a gun barrel after 0,02 sec with a velocity of 1000m/s. What force acted on the bullet?
Weight of the bullet is 15g.

t=0,02 sec

u=1000m/s

m=15gr=15.10^{-3}kg

u= a.t ↔a= $\frac{u}{t} = \frac{1000}{0,02}$ = 50.000m/s

F= m.a = $15x10^{-3} .50.10^3$=750N

<u>Exercise 3</u>
A box with weight of 60kg was pulled by a rope on a rough plane. The friction coefficient is 0,2 and the force tightening the rope is 150N. With what force did the box acted on the plane?
Calculate also the resultant force as well as the acceleration of the box.

W= m.g= 60.9,81=588,6N

W= N $F_{τελ}$=F-T

T= μ. N= 0,2x 588,6 = 117,72 N

F_{red} = F-T= 150- 117,72 = 32,28N

$F_{τελ}$ = m.a → a = $\frac{F_{τελ}}{m} = \frac{32,28}{60}$ = 0,538 m/s²

Exercise 4

A body glides on an inclined plane with an acceleration of 2 m/s^2. The inclination of the plane is 30%. Calculate the friction coefficient between the body and the plane.

$F_{τελ} = m.a$

$F_{τελ} = W_x - T \rightarrow W_x - T = m.a$

$a = 2m/s^2$

$φ = 30\%$

$μ = ?$

$W_x = W.sinφ = m.g.sinφ$

$T = m.N$

$N = -W_y$

$m.a = m.g.sinφ - m.N$

$\rightarrow m.a = m.g.sinφ - μ.m.g.cosφ$

$\rightarrow a = \frac{m(g.sinφ - μ.g.cosφ)}{m} \rightarrow a = g.sinφ - m.g.cosφ$

$\rightarrow μ.g.cosφ = g.\ sinφ - a \rightarrow μ = \frac{g.\sin φ - a}{g.\cos φ}$

$\sin 30 = \frac{1}{2}$

$\cos φ = \frac{\sqrt{3}}{2}$

$\rightarrow μ = \frac{9,81.\frac{1}{2} - 2}{9,81.\frac{\sqrt{3}}{2}} \rightarrow μ = \frac{4,905 - 2}{8,49} = \frac{2,905}{8,49} = 0,34$

Bernoulli's Principle

$p_1 + \frac{1}{2}p.V_1^2 + p.gh = p_2 + \frac{1}{2}p.\ V_2^2 + p.g.h_2$

As the velocity of a fluid increases the pressure exerted by that fluid decreases.

Exercise

Calculate the height of a liquid in a container.

The liquid flows from the bottom opening of container with a speed of 6,26m/s.

$p_1 = p_2 =$ ατμοσφαιρική πίεση

$p_1 + \frac{1}{2}p.\ V_1^2 + p.g.h_1 = p_2 + \frac{1}{2}\ p.\ V_2^2 + p.g.h_2$

$p_1 + p.g.h_1 = p_2 + \frac{1}{2}\ p.\ V_2^2$

$\rightarrow h_1 = \frac{\frac{p.V_2^2}{2}}{p.g} \rightarrow h_1 = \frac{p.V_2^2}{2p.g} \rightarrow h_1 = \frac{6,26^2}{2.9,81} = \frac{39,187}{19,62} \simeq 2m$

Exercise 5

What force will have a car with acceleration of $2m/s^2$, when the friction coefficient is 0,02? The weight of the car is 750kg.

$a = 2m/s^2$ $\quad$ $μ = 0,02$ $\quad$ $m = 750kg$ $\quad$ $F = ?$

$F_{τελ}$ = F-T
T = μ.N
N= W = m.g = 750.9,81 = 7357,5N
T= μ.N = 0,02 . 7357,5= 147,15N
$F_{τελ}$ = m.a ↔ F-T= m.a ↔ F- 147,15= 750.2 →F = 1500+147,15 → F= 1647,15N

Centripetal acceleration

$a_c = \frac{V^2}{r} = w^2.r[m.s^2]$

Exercise 1

Calculate the angular velocity, frequency and period of a rotating wheel of a bike, when the linear velocity of the bike is 20 km/h. The radius of the wheel is 350mm.
w=? f=? T=? V= 20 km/h r= 350mm

20km/h= $\frac{20.1000}{3600}$ = 5,5 m/s
r= 350mm= 0,35m

V= w.r $\Leftrightarrow w = \frac{V}{r} = \frac{5,5}{0,35}$ = 15,7rad

w= 2nf $\Leftrightarrow f = \frac{w}{2n} \Rightarrow f = \frac{15,7}{0,35} \Rightarrow f = 2,5Hz$

T = $\frac{1}{f} \Rightarrow T = \frac{1}{2,5} \Rightarrow T = 0,4\sec$

Electricity and magnetism

Coulomb's law F = $\frac{1}{4\pi\varepsilon_o}$ x $\left|\frac{q_1q_2}{r^2}\right|$ or $F = k_c\left|\frac{q_1q_2}{r^2}\right|$

ε_o : permittivity of vacuum
r: distance between the two charges

Electric field

$\vec{E} = \frac{\vec{F}}{q}$ E: intensity of the electric field

F: electric force
q: charge

Ohm's Law

I = $\frac{U}{R}$ I: current

U: potential
R: resistance

Exercise 1

The e^- in the hydrogen atom is 53 pm distant from the proton. Calculate the force acting on the e^-. What is the intensity of the electric field in the plane where the e^- is located? What is the potential of the electric field in the place where the electron is located with respect to infinity?

r=52pm= 53.10^{-12}m q_e= $-1,602.10^{-19}$C $\varepsilon_o = 8,854.10^{-12} C^2/N.m^2$

F=? E=? φ=?

$$F = \frac{1}{4\pi\varepsilon_o} \text{ x } \frac{q_1.q_2}{r^2}$$

$$F= \frac{1}{4.3,14.8,854.10^{-12}} . \frac{(-1,602x10^{-19})(1,602x10^{-19})}{(53x10^{-12})^2}$$

F= $-8,215.10^{-8}$N

$$E= \frac{F}{q} = \frac{-8,215.10^{-8}}{-1,602.10^{-19}} = 5,12.10^{-11} N/C$$

$$\varphi= \frac{W_e}{q_e} = \frac{q_p.q_e}{A\pi.\varepsilon_o.\text{r}} = \frac{1}{q_e}$$

Exercise 2

The specific electrical resistance of copper is p= $1,77x10^{-5}$Ω.m. Calculate the current flowing through the conductor with the cross –sectional area of $4mm^2$ and the length of 10m. The voltage at the ends of the conductor is 2V.

p= $1,77x10^{-5}$Ω.m

I=? $R= p. \frac{l}{s}$

s= $4mm^2$

l=10m $R= \frac{U}{I}$

U=2V

$$p. \frac{l}{s} = \frac{U}{I} \leftrightarrow I= \frac{U.s}{p.l} = \frac{2.4.10^{-6}}{1,77x10^{-5}x10} \Rightarrow I= 4,5.\ 10^{-2} = 0,045A$$

Conductors: materials that allow the flow of electric current
ex. metals, copper silver

In general electrical resistivity of metals increases with temperature.

Semiconductors: materials with electrical conductivity due to electron flow intermediate in magnitude between that of a conductor and in isolator.
ex. diamond, silicon

In general, electrical resistivity of semiconductors decreases with increasing temperature.
Isolators: materials that don’t respond to an electric field and completely resist the flow of electric charge.
Reflection: reflection angle is equal to the angle at which wave is incident on.

(SXEDIO)

Hydrostatic pressure

pressure= force (area p= $\frac{F}{A}[N/m^2]$

pressure = depth *weight density P=d.p

Calorie is amount of heat, which raises the temperature of 1 gram water by 1^o C.

Heat flow

W=C heat flow H= $\frac{k.t.A.\Delta T}{d}$ A: area t: time d: distance

ΔT: temp. difference k: thermal conductivity

Transfer of heat
radiation $P_{rad} = \sigma.\ \varepsilon.\ A.T^4$ σ = Stefan Boltzman constant
radiation rate ε = emisivity

Entropy: a measure of the amount of energy which is unavailable to work. a measure of the disorder of a system.

$\Delta S = \frac{Q}{T}[J/k]$ Q: energy transferred as heat to or from system

T: temperature of the system
Entropy is a state property

(SXEDIO)

Speed of light in vacuum is C = $2{,}9979 \times 10^8$ m/s

n= $\frac{c}{v}$ n: refractive index

$E_{photon} = h.v$ v=f

Viscocity: bigger the liquid’s viscosity is, more the flow speed of its liquid is reduced and/or more the movement of an object is slowed down in this liquid

Velocity of fluid increases as the pressure decreases.

Surface tension can be measured with stalagmometer.
The drop of a mass m gets released when its weight G=m.g is equal or greater than the surface force at the end of tube
m.g = 2nrσ   r= radius
σ= surface tension

$$\frac{m_1}{\sigma_1} = \frac{m_2}{\sigma_2}$$

σ= $\sigma_{\mathrm{H_2O}} \cdot \frac{m}{m_{H_2O}}$ m= μάζα σταγόνων

σ= $\sigma_{\mathrm{H_2O}} \times \frac{p}{p_{H_2O}} \times \frac{n_{H_2O}}{n}$ n= αριθμός σταγόνων νερού