Welcome to the exam for PHY117 Physics for life science

- Deposit all prohibited items (including bags, jackets, etc.) at the back or at the sides of the lecture hall.
- Make sure that your mobile phone is switched off or muted.
- Place your Legi (or other ID with picture) on your desk.
- Only open the envelope when you are asked to do so !

The following are allowed at your seat:

- A white envelope.
- The provided TI30 calculator
- Writing utensils
- Protractor (Geodreieck), ruler
- Drinks (in bottle), snacks
- Light jackets, handkerchiefs

The following are forbidden at your seat:

- Any means of communication, like e.g. mobile phones
- Any wristwatch (analogue, smart, etc.)
- Any kind of personal calculator, laptop, or other electronic device
- Any additional formula sheets or written notes.

Thermodynamics

Ideal gases

Energy in 3D	$K = \frac{\#d.o.f.}{2} N k_B T$
Equation of state	$pV = nRT = Nk_BT$
Work	$W = \int_{V_1}^{V_2} p\,dV$
Heat capacity (constant p)	$C_p = C_v + nR$
Ratio of constants	$\gamma = \frac{C_p}{C_v}$
Adiabatic expansion	$Q = 0$ and $pV^\gamma =$ constant and $TV^{\gamma-1} =$ constant
Work in adiabatic expansion	$W = \frac{1}{\gamma - 1}(p_1 V_1 - p_2 V_2)$

Real gases

Equation of state	$(p + \frac{an^2}{V^2})(V - bn) = nRT$

K	kinetic energy	N	number of particle	a	attractive force
V	volume	n	particle per mol	b	correction to volume
Q	heat	k_B	Boltzmann constant	C_v	heat capacity (constant V)
p	pressure	R	gas constant		

Heat

Temp. change at constant volume	$Q = \Delta U = mc\Delta T$
Phase change	$Q = mL_f$ and $Q = mL_v$
Heat flow	$I = \frac{\Delta Q}{\Delta T} = \kappa A \frac{\Delta T}{\Delta x}$
Thermal resistance	$R = \frac{\Delta x}{\kappa A}$ and $\Delta T = IR$
Heat resistance in series	$R_{eq} = R_1 + R_2 + \ldots$
Heat	
Ther	
Heat	
Equi	

Heat

Temp. change at constant volume $Q = \Delta U = m$

Phase change $Q = mL_f$ an

Heat flow $I = \frac{\Delta Q}{\Delta T} = \kappa$

Thermal resistance $R = \frac{\Delta x}{\ldots}$ and

Δt

Heat

First

Heat

Carn

Carn

Perf

Heat pump efficiency

Q_C	heat cold reservoir	T_C	temp. cold reservoir	U	internal energy
Q_H	heat hot reservoir	T_H	temp. hot reservoir	κ	thermal conductivity

Electromagnetism

Electrostatics

Coulomb force	$F_E =$
E-field of a point charge:	$\vec{E} = k$
Gauss' Law	$\oint_S \vec{E} \cdot$
Electrical Potential difference	ΔV_{AB}
Potential energy & electric potential	$\Delta U =$
E-field in dielectric	$E = E$
Dipole	$\vec{p} = q$

Capacitance

Capacitance:	$C =$
Energy in capacitor	$U = \frac{1}{2}$
Capacitors in series	$\frac{1}{C_{eq}} =$
Capacitors in parallel	$C_{eq} =$
Plate capacitor	$C = \kappa$
E-field in parallel capacitor	$E = \frac{V}{d}$

Electrodynamics

Ohm's law:	$V = I$
Current	$I = \frac{\Delta}{\Delta}$
Series circuits	$R_{tot} =$
Parallel circuits	$I_{tot} =$
Electric power:	$P = I$
	$R = \rho$
	$\rho = \rho_2$
	$v_d =$
	$\vec{F} = q$
	$\vec{F} = I$
	$B(r) =$
	$B =$
	$\Phi_m =$
	$\oint_C \vec{B} \cdot$
	$\vec{\mu} = IA$
Magnetic moment in B-field	$U = -$
Faraday's law	$\mathcal{E} = \oint_C$