



TECHNISCHE  
UNIVERSITÄT  
DRESDEN



biotec  
nanobiophysics  
Master of Science

**DON'T BETRAY  
YOURSELF!**

**PLEASE TRY TO FIND  
YOUR OWN SOLUTION  
BEFORE READING THE  
KEY!**

## KEY TO SELF-ASSESSMENT TEST

### Question 1

**Answer** yes

### Question 2

**Answer** polymer: synonym = macromolecule; A molecule of high relative molecular mass, the structure of which essentially comprises the multiple repetition of units derived, actually or conceptually, from molecules of low relative molecular mass.

### Question 3

**Answer**  $\frac{\pi}{2}$

**Comment** Basic integration techniques must be known.

### Question 4

**Answer**  $\begin{pmatrix} 2x \\ -2y \\ 0 \end{pmatrix}$

**Comment** The student has to know calculus (normal and partial derivatives) and vector calculus (gradient).

### Question 5

**Answer** <http://en.wikipedia.org/wiki/Cytoskeleton>

### Question 6

**Answer**  $x_1 = \pm \sqrt{\frac{1}{2}} \begin{pmatrix} 1 \\ 1 \end{pmatrix}$  and  $x_2 = \pm \sqrt{\frac{1}{2}} \begin{pmatrix} 1 \\ -1 \end{pmatrix}$

**Comment** to solve this problem the student has to know vector analysis (vectors, scalar products) and linear algebra (matrices, determinants, linear equations, eigenvalue problems)

### Question 7

**Answer** carbon is element number 6 in the periodic table of elements with it electronic

ground state:  $1s^2 2s^2 2p^2$ ; this means it has 4 valence electrons ( $[\text{He}]2s^2 2p^2$ ), so it forms 4 bonds in virtually all its compounds e.g. 4 single bonds, then molecule orbital is  $sp^3$  hybridized.

### Question 8

**Answer**  $\ddot{x} + \omega^2 x = 0$

**Comment** Lagrange formalism and Euler-Lagrange equations must be known.

### Question 9

**Answer** This is the momentum operator.

**Comment** basic knowledge of quantum mechanics

### Question 10

**Answer** One can classify 3 major types of forces:

- Coulomb forces (electrostatics of charges and dipoles)
- polarisation forces (induced dipoles; also known as van der Waals forces or London dispersion)
- hydrogen bonds (sometimes referred to as almost chemical bond)

**Comment** Basics on intermolecular interactions are essential to understand assembly and function of complex biological nanoscale and microscale objects.

### Question 11

**Answer** Yes.

**Comment** Prepares the student that he has to work with the computer and do programming.

### Question 12

**Answer**  $\kappa = -1/V \partial V / \partial p = 1/p$  (with ideal gas equation  $pV = NkT$ )

**Comment** Basic thermodynamic knowledge.

### Question 13

**Answer** <http://en.wikipedia.org/wiki/Endocytosis>

**Question 14**

**Answer**  $1 - 1/16 = 15/16$  (simplest solution via complementary event – no disease in four successive cases).

**Comment** Basic knowledge of combinatorics and probability calculations.

**Question 15**

**Answer** The change of entropy between two thermodynamic equilibrium states  $a$  and  $b$  is

given by  $S = \int_a^b \frac{dQ}{T}$  where the integral is taken over a reversible process from  $a$  to  $b$ .

**Comment** Basic thermodynamic knowledge.