1. Are the following statements true (T) or false (F)? Every correct answer gives you +1 p and every wrong one –1 p. An empty answer is worth 0 p.

    a) The number of transistors in leading-edge integrated circuits has tripled roughly every 18 months (Moore's law) _____
    b) Embedded systems are usually reactive _____
    c) Real-time systems are always also embedded systems _____
    d) A microprocessor can be implemented by a programmable logic device _____
    e) A custom VLSI implementation of an embedded system can lead to a lower power consumption than an implementation by a general-purpose microprocessor _____
    f) In the recent years, the productivity of integrated circuit designers has grown faster than the complexity of leading-edge circuits _____

2. A watchdog timer uses a 32-bit up-counter. The input of this up-counter is connected to an 11.981-MHz clock oscillator and the overflow output to the system's RESET line. The watchdog should activate the RESET line if 5 minutes has elapsed since the application program called the function watchdog_reset. What initial value should be loaded into the up-counter each time when the particular function is called (a decimal number is an adequate answer)?

3. Draw the timing diagram for an I/O-bus protocol that is handshaked, non-addressed, and transfers 24 bits of data over an 8-bit data bus. Data transfer takes place between a "master" and a "servant".

4. The following table shows a comparison of the characteristics of different types of memory. Fill in the missing data (grey boxes) to make the table complete.

Type	Volatile	Writeable	Erase size	Max erase cycles	Cost per byte	Speed
DRAM	a)	Yes	Byte	Unlimited	Moderate	k)
EEPROM	No	Yes	Byte	g)	Expensive	Fast to read, slow to erase/write
EPROM	No	Yes, with a device programmer	e)	Limited (consult datasheet)	Moderate	Fast
Flash	No	Yes	Sector	Limited (consult datasheet)	Moderate	l)
Mask ROM	No	c)	-	-	i)	Fast
NVRAM	b)	Yes	Byte	h)	Expensive (SRAM + battery)	Fast
OTP ROM	No	d)	-	-	Moderate	Fast
SRAM	Yes	Yes	f)	Unlimited	j)	Fast

5. Your embedded system has an 8-bit microcontroller, which has a 16-bit address bus. In addition, you have an 8-Kbyte ROM chip and a 16-Kbyte RAM chip. You want to locate the ROM chip to addresses 0000–1FFF (hexadecimal numbers) and the RAM chip to addresses 2000–5FFF. Both memory chips have a single CS selection line, which is controlled by an 8 x 2 OTP-ROM chip. What are you going to program into the contents of the OTP-ROM, and how are you going to connect it to the microcontroller and the memory chips?