

**Placement test A**  
**Physics**  
(100 minutes)

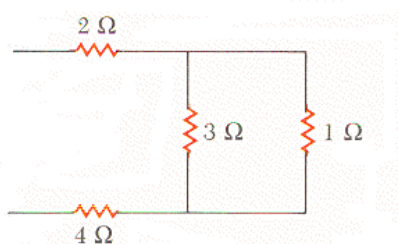
Name:  
Group:  
Date:

Problems:  
Questions:  
Total:

**Problems**

Numerically correct **results** with the good **units** are accepted only. Show your work on an extra sheet! Write clearly and **box in the results!**

1. An object moves according to the equation  $\vec{r}(t) = (2 + 3t)\vec{i} + (3 + 2t - 5t^2)\vec{j}$  m. Determine
  - a. the displacement vector between  $t = 2$ s and  $t = 3$ s
  - b. the average velocity between  $t = 2$ s and  $t = 3$ s
  - c. the instantaneous velocity at  $t = 2$ s
  - d. the average acceleration between  $t = 2$ s and  $t = 3$ s.
  
2. A firefighter, 50 m away from a burning building directs a stream of water from a firehose at an angle of  $30^\circ$  above the horizontal.
  - a. If the initial speed of the stream is 40 m/s, at what height does the water strike the building?
  - b. Find the vertical component of the velocity of the stream at the building.
  
3. A 0.5 kg block slides down a plane having an inclination of  $15^\circ$ . The coefficient of kinetic friction is  $\mu = 0.1$ . If the block starts from rest at the top and the length of the incline is 2m, find
  - a. the normal force acting on the block
  - b. the force of kinetic friction
  - c. the acceleration of the block
  - d. its speed when it reaches the bottom of the incline.
  
4. A battery having an open-circuit voltage of 12 V and an internal resistance of  $0.4 \Omega$  is connected to the circuit, shown in the figure. Find
  - a. the current through the battery,
  - b. the terminal voltage, and
  - c. the power developed in the  $2 \Omega$  resistor.



5. Two moles of an ideal monoatomic gas at an initial temperature of 273 K and initial pressure of  $2 \times 10^5$  Pa undergoes an isothermal expansion until its pressure decreases to  $10^5$  Pa. Then the gas expands in an isobaric process until its volume is doubled. The molar heat capacity of the gas at constant pressure is  $C_p = 29.09$  J/mol K,  $R = 8.31$  J/K mol. Find
  - a. the initial volume
  - b. the final temperature
  - c. the work done by the gas during the second process
  - d. the amount of heat added to the gas

**Fill in the appropriate words, numbers, expressions into the sentences below to make their statements true**

1. If the position-time function of a moving particle is  $x(t)=-3-4t+2t^2$ , the initial velocity of the body is ..... m/s.
2. If the position-time function of a moving particle is  $x(t)=-3-4t+2t^2$ , the velocity of the body is .....
3. If the position-time function of a moving particle is  $x(t)=-3-4t+2t^2$ , the acceleration of the particle is .....m/s<sup>2</sup>.
4. The direction of the velocity vector is .....
5. In uniform circular motion the acceleration vector is .....
6. The tangential acceleration of a particle is due to the change .....
7. The centripetal acceleration cannot change the ..... of the particle.
8. When we approach a negative electric charge, the electric potential .....
9. Parallel electric currents ..... each other.
10. When light goes from an optically ..... medium to an optically ..... medium, the rays are bent towards normal.