Physics DP Entrance Test

1. A mug of water floats in a pot of water. Will water in a mug boil if the pot is put on fire? Explain your answer fully.

2. The stone lies at the bottom of the vessel, completely immersed in water. Will the stone pressure on the bottom change (and if it does, how) if table salt is added to the water? Explain your answer fully.

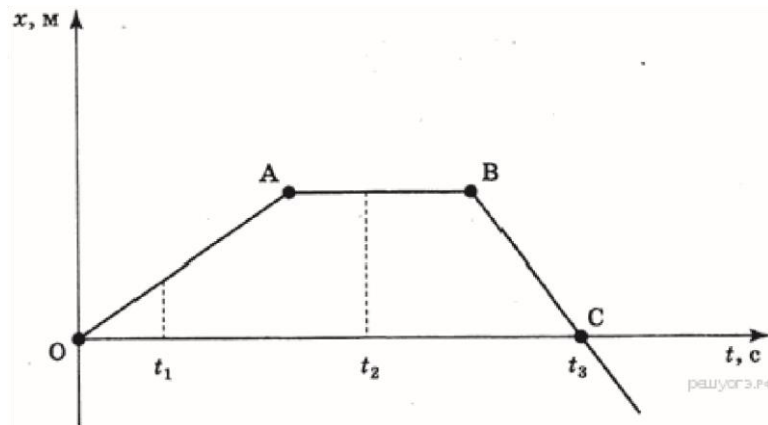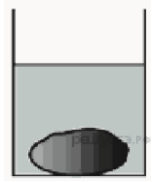**3.** The Figure 2 shows a graph of the coordinate versus time for a body moving along the Ox axis.

Figure 2

Use the graph to choose **two** correct statements from the list:

1) The **BC** section corresponds to uniformly accelerated movement.
2) At time instance t_3, the velocity of the object is zero.
3) In the time interval from t_1 **to** t_2, the object changed the direction of motion to the opposite.
4) At time instance t_2, the velocity of the object is zero.
5) The distance corresponding to the **OA** section is equal to the distance corresponding to the **BC** section.

4. The student conducted an experiment to study the spring constant by stretching various wires.

   a) What could be independent, dependent and controlled variables in this experiment?
   b) Formulate research question
   c) Formulate a hypothesis

5. Read the text and fill in the gaps the words (phrases) from the list below.

Reactive is a movement that occurs under the action of _____ (A) acting on a moving body from the side of the jet of matter ejected from the engine. It is possible to explain the principle of reactive motion using the example of rocket propulsion. Suppose that in an engine mounted on a rocket, fuel is combusted and combustion products (hot gases) are ejected from the engine nozzle under high pressure. For each portion of the gases ejected from the nozzle, a certain force acts on the engine side, which sets this portion of gases in motion. In accordance with _____ (B) Newton's law, the force exerted by the gases emitted from the engine is the same in magnitude and opposite in direction. This force is called reactive. Under its action, the rocket acquires acceleration and accelerates in the direction _____ (C) to the emission of gases. When a rocket moves in a jet, its mass is continuously reduced due to the combustion of fuel and the expulsion of combustion products. For this reason,

the acceleration module of the rocket all the time _____ (D), and the speed of the rocket non-linearly depends on the mass of the burned fuel. For the first time, the task of finding the modulus of the final velocity v of a rocket, the mass of which changed from m0 to m, was solved by the Russian scientist, pioneer of space exploration K.E. Tsiolkovsky.

List of words and phrases:

1) reaction force
2) gravity
3) first
4) second
5) the third
6) the opposite direction
7) coinciding with the direction
8) changes
9) remains constant

Write down the selected numbers in the table under the corresponding letters. The numbers may be repeated.

A	B	C	D

For tasks 6 and 7, you need to write down a complete solution, including given, formulas, the use of which is necessary and sufficient to solve the problem, as well as mathematical transformations and calculations leading to a numerical answer.

6. A mass-spring system oscillates. The graph shows how the potential energy of the spring changes with displacement.
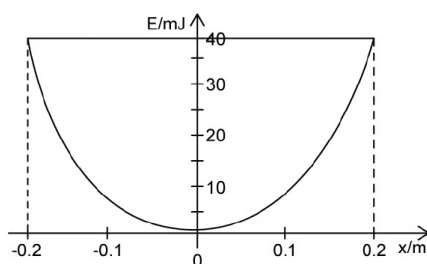
a. For the mass-spring system, determine:
  (i) The maximum potential energy
  (ii) The total energy
b. Using the graph in part (a), determine:
  i) The amplitude x of the oscillation
  ii) The potential energy in the spring when the displacement $x = 0.1$ m
c. The block used in the same mass-spring system has a mass m of 25 g. The maximum kinetic energy o the block is 40 mJ. Calculate the maximum velocity of the oscillating block

7. A stainless-steel ball fell from a height of h = 26 m onto a lead plate of mass m_2 = 1 kg and stopped. In this case, the plate was heated by 3.2°C. What is the mass of the ball, if 80% of mechanical energy went on heating the plate? (specific heat capacity of lead 130 J/kg.K, specific heat capacity of stainless steel 468 J/kg.K)