AP CollegeBoard

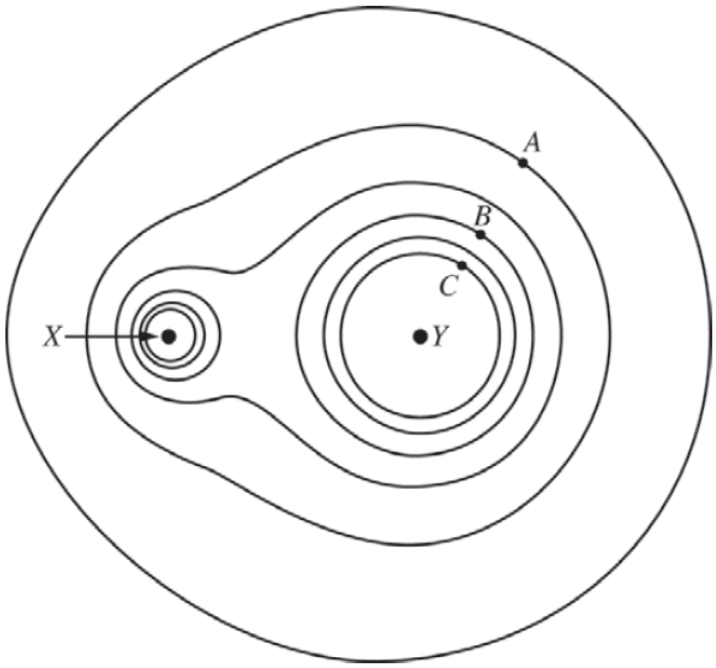
2020 Exam Sample Questions

AP® PHYSICS 2

2020 Exam Sample Question 1

(Adapted from: AP® Physics 2, 2016 Exam, FRQ 3)

Allotted time: 25 minutes (+ 5 minutes to submit)



The dots in the figure above represent two identical spheres, X and Y, that are fixed in place with their centers in the plane of the page. Both spheres are charged, and the charge on sphere Y is positive. The lines are isolines of electric potential, also in the plane of the page, with a potential difference of $50\ \text{V}$ between each set of adjacent lines. The absolute value of the electric potential of the outermost line is $50\ \text{V}$

(a) Indicate the values of the potentials V_A, V_B, and V_C, including the signs, at the labeled points A, B, and C. Explain your reasoning.

(b) Compare the magnitude and signs of the charges of sphere X and sphere Y. Justify your answer.

(c) The spheres at points *X* and *Y* have masses in the same ratio as the magnitudes of their charges. The isolines of gravitational potential for the spheres have shapes similar to those of the isolines shown. Explain why the two sets of isolines have similar shapes.

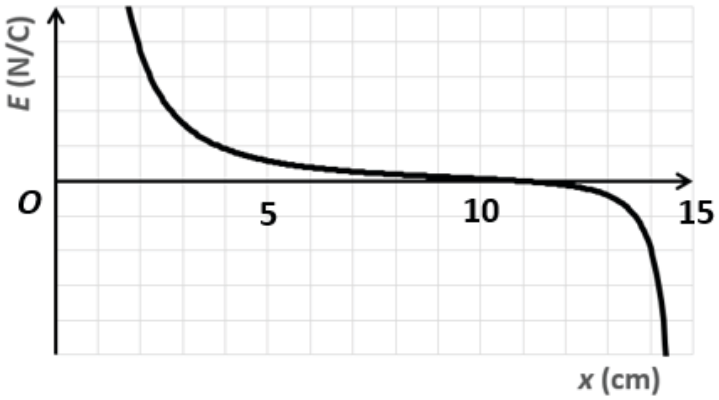
A proton with charge plus $+q$ and mass m is released from rest at point B.

(d) Describe how the magnitude of the acceleration of the proton changes after being released. Explain your reasoning with reference to electric potential.

At some time after being released from rest at point B, the proton has moved through a potential difference of magnitude 20 V. Two students are discussing how and why the kinetic energy of the proton would change after it is released.

- Student 1 says that if the system is defined as the proton and the spheres, the increase in the proton's kinetic energy is due to a change in the system's potential energy as the proton moves through the 20 V potential difference.
- Student 2 says that if the system is defined as only the proton, the kinetic energy of the proton increases because positive work is done on the proton by the electric field as the proton moves through the 20 V potential difference.

(e) Discuss each student's claims, explaining why each is correct or incorrect.



The spheres are separated by $15\ \text{cm}$. Let $x = 0$ be the location of sphere X and $x = 15\ \text{cm}$ be the location of sphere Y. A student sketches the graph above of the electric field as a function of x along the line that joins the two spheres. For this graph, positive values of E represent electric field directed to the right.

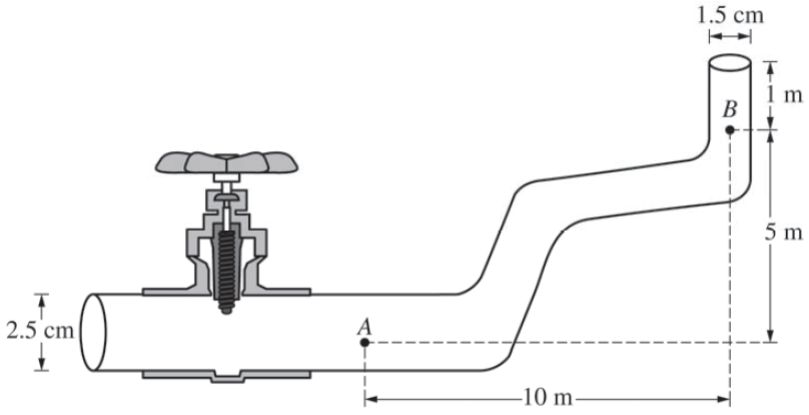
(f) State one aspect of the graph that correctly represents the electric field and explain your reasoning.

(g) State one aspect of the graph that incorrectly represents the electric field and explain your reasoning.

2020 Exam Sample Question 2

(Adapted from: AP Physics 2, 2017 Exam, FRQ 1)

Allotted time: 15 minutes (+ 5 minutes to submit)



Note: Figure not drawn to scale.

Two students observe water flowing from left to right through the section of pipe shown above, which decreases in diameter and increases in elevation. The pipe ends on the right, where the water exits vertically into the bottom of a large, deep pool.

(a) A bubble of air passes point A and later point B without changing temperature. In a clear, coherent, paragraph-length response that may reference equations, state whether the volume of the bubble at point B is greater than, less than, or equal to the volume of the bubble at point A.

(b) Suppose the pipe remained a constant diameter, but the elevation of the pipe changed the same amount as in part (a). Would the difference in pressure between points A and B be greater than, less than, or equal to the difference in pressure between points A and B when the pipe narrowed as in part (a)? Justify your answer.

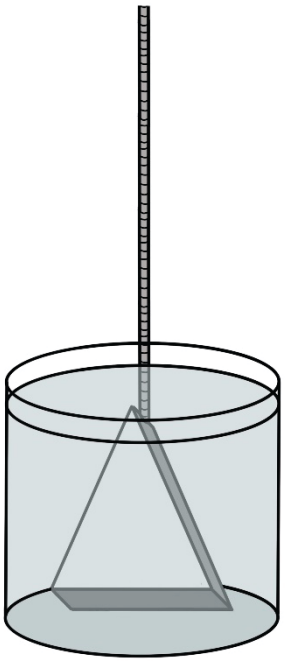


Figure 1

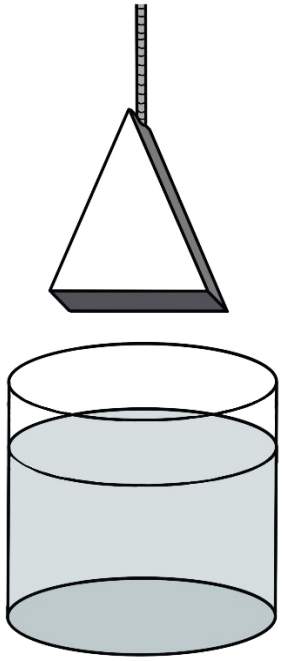
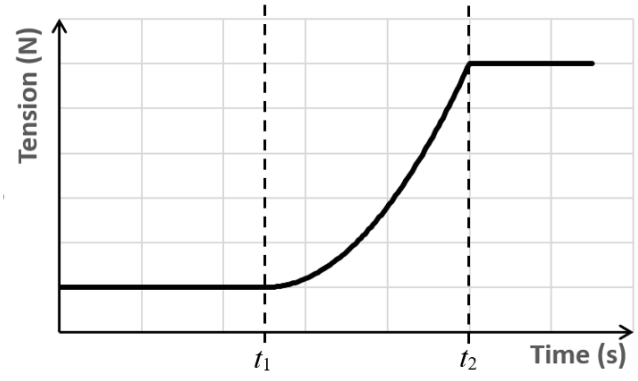


Figure 2

A triangular prism is fully submerged in a tank of water while suspended from a rope without touching the bottom of the tank as shown in Figure 1. At time $t = 0$ the rope pulls the prism upwards at a constant speed. At time t_1 the top of the prism reaches the surface of the water, and at time t_2 the prism has been completely removed from the water, shown in Figure 2. The prism always moves with constant speed. The graph below shows the tension in the rope as a function of time.



(c) In terms of relevant physics principles, explain the behavior of the tension vs. time graph from $t = 0$ until a time after t_2.