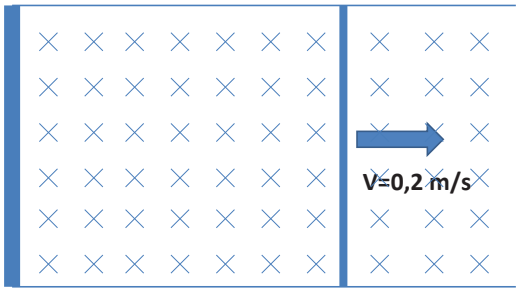
PROBLEMAS:

El valor de esta parte es de hasta 5,0 puntos. La respuesta a los problemas debe ser razonada. En la solución de cada uno de los problemas deben incluirse todos los pasos necesarios para llegar al resultado y aquellos comentarios que se estime que son convenientes para un correcto seguimiento de las resoluciones. Las respuestas a los problemas debe hacerse en el papel que para ello se le proporcione. El valor de cada uno de los problemas es de 2,5 puntos. Cada uno de los apartados dentro de cada problema tiene el mismo valor.

PROBLEMA 1.

Una varilla conductora se desliza sin rozamiento y con una velocidad de 0,2 m/s sobre unos raíles conductores separados 2 cm tal y como se muestra en la figura. El sistema está dentro de un campo magnético que es perpendicular al plano en el que se encuentran las varillas y está dirigido como se muestra en la figura. Sabemos que para $t = 0$ la superficie encerrada en el circuito vale 2 m^2. Sabemos además que el campo magnético B es una función del tiempo con la forma $B(t) = 6\,\mathrm{sen}(5t)$ T. Calcule:



a) El flujo magnético como función del tiempo que hay en el circuito formado por los raíles más la varilla.

b) Deduzca la función que describe la fuerza electromotriz inducida como función del tiempo. Indique su valor en $t = 0$ s

PROBLEMA 2.

Un planeta esférico de densidad uniforme y de radio $R = 6,0 \times 10^5$ km tiene una aceleración sobre su superficie $g = 125$ $\mathrm{m/s}^2$.

a) Determine la densidad del planeta.

b) Indique cuál es el radio del movimiento de un satélite que orbita circularmente alrededor del planeta sabiendo que su periodo es de 12 horas.

Dato: $G = 6,67 \times 10^{-11}$ $\mathrm{Nm}^2/\mathrm{kg}^2$.

TRADUCCIÓN DEL EXAMEN AL INGLÉS.

USE OF NO PROGRAMMABLE CALCULATOR IS ALLOWED IN BOTH THE TEST AND THE PROBLEMS.

TEST

The maximum grade in this part is 5.0 points. The right answer to each question is graded with 0.5 points. Each wrong answer to a question has a penalty of 0.125 points. If you do not give the answer to a question there is no penalty on the grade.

The test will be graded using the computerised answer sheet. You DO NOT have to hand over to the examinators any other information concerning the solution to the questions of the test but that computerised answer sheet with the marked answers.

An $L = 34$ cm long pipe filled with air has open its two ends. The seped of the sound inside the pipe is $v = 340$ m/s.

1.- The lowest frecuency for which a standing wave is formed in the pipe is:

a) 125 Hz.

b) 250 Hz.

c) 500 Hz

2.- The standing wave has:

a) Only one node at the center of the pipe:

b) Two nodes, placed in both ends of the pipe.

c) Does not have any node.

3.- If now one of the ends of the pipe is opened and the other is closed; the lowest frecuency for which a standing wave is formed in the pipe is:

a) 125 Hz.

b) 250 Hz.

c) 500 Hz

$^{210}_{82}$Pb emits two beta particles and it is transfomed into Polonium. After that the Polonium emits one alpha particle and gets transformed back into Pb. The nuclear decay period for the $^{210}_{82}$Pb is $T_{1/2} = 22,3$ years.

4.- The result of the two beta decays can be expressed by means of the formula:

a) $^{210}_{82}\mathrm{Pb} \rightarrow {}^{210}_{80}\mathrm{Po} + 2\ {}^{0}_{-1}e^{-} + 2\ {}^{0}_{0}\nu_e$

b) $^{210}_{82}\mathrm{Pb} \rightarrow {}^{210}_{80}\mathrm{Po} + 4\ {}^{0}_{-1}e^{-} + 2\ {}^{0}_{0}\nu_e$

c) $^{210}_{82}\mathrm{Pb} \rightarrow {}^{210}_{84}\mathrm{Po} + 2\ {}^{0}_{-1}e^{-} + 2\ {}^{0}_{0}\bar{\nu}_e$

5.- The desintegration constant λ for the $^{210}_{82}$Pb nuclei is:

a) $0,0311$ **years.**

b) $0,0311$ **years^{-1}.**

c) $0,0211$ **years^{-1}.**

6.- The equation describing the α decay is:

a) $^{210}_{84}\mathrm{Po} \rightarrow {}^{204}_{82}\mathrm{Pb} + {}^{6}_{3}\mathrm{Li}$.

b) $^{210}_{84}\mathrm{Po} \rightarrow {}^{206}_{82}\mathrm{Pb} + {}^{4}_{2}\mathrm{He}$.

c) $^{210}_{84}\mathrm{Po} \rightarrow {}^{206}_{82}\mathrm{Pb} + {}^{2}_{4}\mathrm{He}$.

Two point charges $q = 2$nC are on the two vertices of an equilateral triangle with a 2 cm side that lie on the OX axis. The third vertex is on the positive part of the OY axis and it is free of charges. ***Help:*** $K = 9 \times 10^9$ $N.m^2/C^2$.

7.- The electrostatic potential on the triangle vertex that is free of charge is:

a) 900 V.

b) 1800 V.

c) 0 V.

8.- The electric field on the free vertex is:

a) E $= 9 \times 10^4$ **j N/C.**

b) E $= 4,5\sqrt{3} \times 10^4$ **j N/C.**

c) E $= 2,25\sqrt{3} \times 10^4$ **j N/C.**

9.- Calculate the work that is necessary to carry a charge $Q = 0{,}01$ C from the point $(0, 0)$ to the vertex having no charge.

a) -18 J.

b) 0 J.

c) 18 J.

10.- The electric field on the point $(0, 0)$ is

a) E$= 1,8\sqrt{3} \times 10^5$**i N/C.**

b) E$= 1,8 \times 10^5$**i N/C.**

c) E$= 0$ **N/C.**

PROBLEMS:

This part has a value of up to 5.0 points. The answer to the problems must be reasoned. In the solution of each one of the problems you must include all the necessary steps to reach the results and all the comments you deem as appropiate to provide a rightly follow the solutions. The answers to the problems must be done in the paper you will get from the examinators. Each problem will be graded up to 2.5 points. Each part of each problem has the same value.

PROBLEM 1.

A conducting rod slides without friction and with a constant speed of 0,2 m/s on two conducting rails that are separated by a distance of 2 cm as shown in the figure. All the system is inside a magnetic field perpendicular to the plane containing the rails and the conducting rod. The magnetic field has the sense shown in the figure. For $t = 0$ the circuit forms a square that has a surface of two square meters. The magnetic field modulus changes with time according to the function $B(t) = 6\,\mathrm{sen}(5t)$ T.

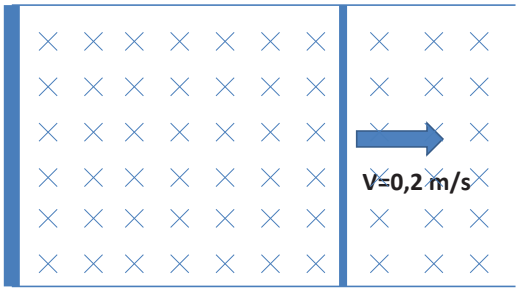


Figure for problem 1.

a) The time dependent function for the magnetic flux that crosses the circuit formed by the rod and the two rails.

b) The electromagnetic force induced in the circuit due to the time change of the flux. Calculate the value of $\varepsilon(t)$ in $t = 0$ s

PROBLEM 2.

On the surface of a spherical planet with an uniform density and a radius $R = 6,0 \times 10^5$ km the acceleration of gravity is $g = 125$ m/s^2.

a) Calculate the density of the planet.

b) A satellite describes a circular orbit around the planet with a period $T = 12$ h; calculate the distance between the satellite and the center of the planet.

Help: $G = 6,67 \times 10^{-11}$ Nm^2/kg^2.