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.

a) Calcule la energía y la longitud de onda de un fotón cuya frecuencia es: $\nu = 2 \times 10^{15}$ **Hz. Exprese la longitud de onda en micrómetros y la energía en electronvoltios.**

b) Se usa un haz de esos fotones para extraer electrones de un metal que tiene una función de trabajo $W_0 = 1{,}70$ **eV. Calcule la energía cinetica máxima de los electrones arrancados por efecto fotoeléctrico. Exprese el resultado en eV. En caso de que no se puedan arrancar electrones con dicha luz explique por qué pasa esto.**

Datos: Constante de Planck: $h = 6{,}63 \times 10^{-34}$ **J.s, velocidad de la luz,** $c = 3 \times 10^8$ **m/s.** 1 **eV=** $1{,}6 \times 10^{-19}$ **J.**

PROBLEMA 2.

Un sistema de cargas está formado por cuatro cargas en los cuatro vértices de un cuadrado. El vértice 1 **se encuentra en el punto** $(2, 0)$ **y sobre el está una carga** $q_1 = 2\ \mu$**C. El vértice** 2 **está en el punto** $(0, -2)$ **y sobre él hay una carga** $q_2 = 2\ \mu$**C. El vértice** 3 **está en el punto** $(-2, 0)$ **y sobre él hay una carga** $q_3 = 2\ \mu$**C. El vértice** 4 **se encuentra en el punto** $(0, 2)$ **y sobre él está una carga** q_4**. Calcule:**

a) El valor de q_4 **para que el potencial en el centro del cuadrado sea cero.**

b) Supongamos que en este apartado $q_4 = 2\mu$**C. Calcule el trabajo que cuesta traer una carga** $Q = 1$ **C desde el infinito al centro del cuadrado.**

Dato: Constante $K_e = 9 \times 10^9$ **Nm^2/C^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.

The mass of Jupiter is 100 times the mass of the Earth and its radious is 5 times the Earth Radious. The acceleration of the gravity on Earth's surface is $g_T = 9{,}8$ m/s^2 and $G = 6,67 \times 10^{-11}$ N m^2/kg^2.

1.- Calculate the relation g_J/g_T between the gravity acceleration on the Jupiter's surface and Earth's surface.

a) $g_J/g_T = 1$.

b) $g_J/g_T = 2$.

c) $g_J/g_T = 4$.

2.- Calculate the distance h over the Earth's surface for which the gravity acceleration would be equal to the gravity acceleration on the Earth's surface (In this question R_T is the terrestrial radious).

a) $h = R_T$.

b) $h = 2R_T$.

c) The value of h does not exist since over the terrestrial surface the gravity cannot have the value that it has on Jupiter's surface.

3.- We know that a girl weigths 98 N on the Earth surface. Calculate the girl's mass on Jupiter's surface

a) $m = 10$ **kg.**

b) $m = 20$ **kg.**

c) $m = 1$ **kg.**

4.- Which of the following expressions allows to correctly calculate the total energy E_T of a spaceship of mass m that orbits around Jupiter with a constant speed v and at a distance R from the center of the planet in a circular orbit. M is the mass of Jupiter.

a) $E_T = -\frac{GMm}{R^2} + \frac{1}{2}mv^2$.

b) $E_T = -\frac{GMm}{R} + \frac{1}{2}mv^2$.

c) $E_T = \frac{GMm}{R} + \frac{1}{2}mv^2$.

The equation of a wave in the international system of units is: $y(x,t) = 4\sin\left[2\pi\left(4x - 8t\right)\right]$**.**

5.- The phase velocity of the wave is:

a) $v_f = 1\pi$ **m/s.**

b) $v_f = 1$ **m/s.**

c) $v_f = 2$ **m/s.**

6.- The phase-shift between two points of the wave separated from each other by $\frac{1}{8}$ **m is:**

a) $2/\pi$ **rad.**

b) $1/\pi$ **rad.**

c) π **rad.**

7.- Complete with the right sentence. If we double the wavelenght of $y(x,t)$**,**

a) its phase velocity and its frecuency also double.

b) its phse shift doubles and its frecuency does not change.

c) Neither the phase velocity nor the frecuency change.

8.- At $t = 0$ **the wave amplitude is zero if,**

a) $x = n/8$ **with** $n = 0, 1, 2, ...$

b) $x = n/5$ **with** $n = 0, 1, 2, ...$

c) $x = n/6$ **with** $n = 0, 1, 2, ...$

9.- An electron accelerates in a sincrotron ring up to a speed $v = 0{,}9c$**, with** c **being the speed of light. When the electron is moving at that speed its relativistic mass is,**

a) Greater than its rest mass m_0**.**

b) Lesser than its rest mass m_0**.**

c) Equal to its rest mass m_0**.**

10. Which must be the electron seped for its mass to be 10 times its rest mass? c **is the speed of light.**

a) $v = c\sqrt{\frac{1}{100}}$**.**

b) $v = c\sqrt{\frac{99}{100}}$**.**

c) $v = c$**.**

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) Calculate the energy and the wavelength of a photon with the frecuency $\nu = 2 \times 10^{15}$ Hz. Give the wavelength in micrometers and the energy in electronvolts.

b) A beam of those photons is used to extract electrons from a metal with a work function $W_0 = 1{,}70$ eV. Calculate the maximum kinetic energy of the electrons extracted form the metal due to photoelectric effect. Give the result in eV. In case that using this light it is not possible to extract electrons from the metal explain why.

Help: Planck's constant: $h = 6{,}63 \times 10^{-34}$ J.s, speed of light, $c = 3 \times 10^8$ m/s. 1 eV$= 1{,}6 \times 10^{-19}$ J.

PROBLEM 2.

A system of charges is formed by four charges that are at the four cornes of a square. Corner 1 is at the point $(2, 0)$ and on it there is a charge $q_1 = 2\ \mu$C. Corner 2 is at the point $(0, -2)$ and on it there is a charge $q_2 = 2\ \mu$C. Corner 3 is at the point $(-2, 0)$ and on it there is a charge $q_3 = 2\ \mu$C. Corner 4 is at the point $(0, 2)$ and on it there is a charge q_4. Calculate:

a) The value of q_4 that makes the electric potential to be zero at the center of the square.

b) Let us assume for this parte of the problem that $q_4 = 2\mu$C. Caclulate the work needed to bring a charge $Q = 1$ C from infinity to the center of the square.

Data: Constant $K_e = 9 \times 10^9$ Nm^2/C^2.