

PART I (42 points) Answer all MC question below 6 best will count for the 42 % of your mark.

1. For large mass number, stable nuclei have the ratio of neutrons to protons that is
 - a. equal to 1
 - b. greater than 1
 - c. less than 1
 - d. unrelated to the stability of nuclei
 - e. almost 2 to 1

2. The isotope, tritium, has a half-life of 12.3 years. Assume we have 10 kg of the substance. How much tritium will be left after 20 years?
 - a. 0.20 kg
 - b. 1.8 kg
 - c. 0.18 kg
 - d. 3.2 kg
 - e. none of the above

3. A photon whose wavelength is $= 3.0 \times 10^{-11}$ m is scattered backwards in Compton scattering. What is the wavelength of the scattered wave?
 - a. 3.5×10^{-11} m
 - b. 4.5×10^{-11} m
 - c. 5.5×10^{-11} m
 - d. 7.5×10^{-11} m
 - e. none of the above

4. A neutron has a mass of 1.67×10^{-27} kg. Its de Broglie wavelength is 1.8×10^{-10} m. What is its kinetic energy (in eV)?
 - a. 4
 - b. 0.4
 - c. 0.042
 - d. 0.026
 - e. none of the above

5. A stopping potential of 4.0 V is needed for radiation whose wavelength is 200 nm. What is the work function (in eV) of the material?
 - a. 2.2
 - b. 3.0
 - c. 5.0
 - d. 6.0
 - e. none of the above

6. A body oscillates with simple harmonic motion along the x-axis. Its displacement varies with time according to the equation $x = 5.0 \sin(\pi t)$. The acceleration (in m/s^2) of the body at $t = 0.5$ s is approximately
 - a. -49
 - b. 0
 - c. 49
 - d. 15
 - e. none of the above

7. A uniform rod (length $L = 1.0$ m, mass = 2.0 kg) is suspended from a pivot a distance $d = 0.10$ m above its center of mass. The angular frequency in rad/s for small oscillations is approximately
 - a) 1.3
 - b) 2.2
 - c) 3.2
 - d) 4.1
 - e) none of the above

PART II (10%) there could be more than one word that need to entered into the space provided.

1 List the symbols of all the quarks: _____.

2 List the symbols of all the leptons: _____.

3 Each baryon is meson is made of _____ .

4 Quarks interact with each other via EM interaction by exchanging of _____ .

5 Particles that interact via weak interactions, do so by exchanging of _____.

6 According to Noether Theorem the conservation of linear momentum is direct consequence of the _____

7 The _____ are spin integer particles which do not obey _____ .

8 Hubble discovered _____ of the Universe by observing the _____ of the spectra of distant galaxies.

9 The small fluctuation of the temperature of the Relic Radiation is a strong confirmation of the _____ in the early Universe.

10 In the stable stage of its evolution, (when it is a main sequence star) , the star of the mass similar to the mass has stable size due to the equilibrium between force of _____ and the force of _____.

PART III

Solve 3 out of the following 4 problems (each problem is worth 16 points

On the front pge of the exaministion booklet clearly state which problems you want to be marked.

1 The half life of ^{131}I is 8.04 days
(a) calculate the decay constant for this nuclide
(b) Find the number of ^{131}I nuclei necessary to produce a sample with an activity of 5.40mCi.
(c) a sample of ^{131}I with this initial activity decays for 30.2d
What is the activity at the end of that period?

2 A hydrogen atom is in its third excited state ($n=3$).
a) Using $r_n = \frac{n^2 \hbar^2}{m k_e e^2}$ find the radius for the electron's orbit
b) Find the momentum of the electron in this state
c) Find de Broglie wavelength of the electron in this orbit
d) Obtain the expression for the radius from first principles

3 Electrons are ejected from the metallic surface with speeds of up to $4.60 \times 10^5 \text{m/s}$ when light of wavelength 625nm is used.
a) Find the work function of the surface
b) Find the cutoff frequency for this surface?

4 A pendulum of length L and point mass M has a spring of force constant k connected to it at a distance h below its point of suspension . Find the frequency of vibration of the system for small values of the amplitude (small θ). Assume the vertical suspension of length L is rigid, but ignore its mass.

