A LL Computational Work

- Define the following terms.
  - Mass
  - Centripetal force
  - Beta (β) particle
  - Faraday's Law

(b) In the last twelve years, roughly four trillion (million-million) dollars have been added to the United States' national debt. (15 points)

(a) Express that in scientific notation.

(b) Each dollar bill is 15 cm long. If these four trillion dollars were laid end to end, how many centimeters long would it be? How many meters? Express your answers in scientific notation. (10 points)

(i) Choose which statements are True or False:

The Field Theory is:

(a) Not as valid a scientific theory as action-at-a-distance because it is more complicated.
(b) Is a valid scientific theory because it is falsifiable.
(c) A valid scientific theory because it has been proven.
(d) Equally as valid as action-at-a-distance because they both explain how forces arise.
(e) Not a valid scientific theory because it is just an abstract idea that does not really explain or predict any more than action-at-a-distance.
(4) Each of the above graphs describe the motion of some object along a straight line.
(a) Give the letters of graphs representing non-zero constant acceleration motion.
(b) Give the letters of graphs representing non-zero constant velocity motion.

(5) Choose which statements are True or False

a) When an object is thrown straight up into the air, its acceleration is zero at its highest point.
b) If an object accelerates, its direction must change.
c) Newton's 3rd law explains why objects accelerate
d) If the position of an object changes, its velocity must change too.
e) If an object accelerates, its speed must change.

(6) For each quantity listed below state whether it is a scalar or vector:

(a) Momentum
(b) Miles/Hour
(c) Kinetic Energy
(d) Angular momentum
(e) Period of a pendulum
(7) A compact car and a school bus both go through the same turn at the same speed.

Fill in the blanks with one of (less than, equal to, greater than):

(a) The acceleration of the car is _________ the acceleration of the bus.
(b) The force on the car is _________ the force on the bus.
(c) The force on the car by the road is _________ the force on the road by the car.

(8) What are (is) the dominant fundamental force(s) at work:
   i) when there is friction
   ii) between two protons in the nucleus
   iii) which is (are) responsible for the hardness of steel.

(9) (a) Show, using law(s) we have studied, that all objects fall with the same acceleration.
   (b) We cannot "weigh" the earth. Therefore find an expression that would allow you to calculate the mass of the earth in terms of other measurable or known quantities. Define clearly the symbols you use.

(10) Choose which statements are True or False.
   (a) In order to have an electric field, there must be at least two charges present.
   (b) Light is produced when charged particles accelerate.
   (c) A single charged particle could create both an electric and magnetic field under the right circumstances.
   (d) The electric force on a charge particle is produced by the action of an electric field acting on that particle.
   (e) The source of the magnetic field is positive or negative charges that must be in motion.
   (f) The source of the electric field is positive or negative charges whether in motion or at rest.

(11) Astronomers assume that the spectrum of light emitted by atoms is the same on distant stars as on earth.
   (a) Does this employ the idea of a symmetry?
   (b) If so, name two symmetries that apply. If not, explain why not.
12) A piece of wood is at rest. A piece of putty with initial speed of \(20\ \text{m/sec}\) hits the wood and sticks to it. The mass of the wood is 0.9 kg and the mass of the putty is 0.1 kg. Ignore friction.

a) What is the final speed of the wood-putty combination?

b) What is the total initial Kinetic Energy?

c) What is the total final Kinetic Energy?

d) Is energy conserved? Explain!
1) $4 \times 10^{12}$
(b) $L = (4 \times 10^{12}) \times 15 = 60 \times 10^{12} = 6 \times 10^{13}$ cm = $6 \times 10^{11}$ meters

3) (a) F
(b) T
(c) F
(d) F
(e) F

4) (a) C, D, E, G
(b) A, F, I

5) (a) F
(b) F
(c) F
(d) F
(e) F

6) (a) equal
(b) less than
(c) equal

7) $E = m c^2$

8) i) Strong Nuclear

9) $Q = F/m$, $F = G M E / R_e^2$  $\Rightarrow \alpha = \frac{G M E / R_e^2}{m} = \frac{G M E}{R_e^2}$
(b) $G M_e / R_e^2 = \eta$  $\Rightarrow M_e = \frac{\eta R_e^2}{G}$, if we know $\eta$, we can calculate $M_e$

10) (a) F
(b) T
(c) T
(d) T
(e) T
(f) T

11) (a) Yes
(b) Space & Time Translation Symmetry

12) $V = 2 \text{ m/s}$

(a) $E_k = 20 \text{ Joules}$

(b) $E_f = 2 \text{ Joules}$

(c) K.E. is not conserved but total energy is