

XF.13

PHYS-107(13) (Kaldon-20939)

WMU - Spring 2002

Final Exam - 200,000 points

107

Name _____

CHECK-OUT: T1 T2 Q21 Q23 _____

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State Any Assumptions You Need To Make – Show All Work – Circle Any Final Answers
Use Your Time Wisely – Work on What You Can – Be Sure to Write Down Equations
Short Answers Should Be Short! – Feel Free to Ask Any Questions

“The End” (50,000 points) Multiple-Guess-Pick-The-Best-Answer-Fill-In-The-Bubbles1.) In parts (a)-(d), select which Newton’s Law or Conservation Law best applies.

(a) Just because we have a force present, doesn’t mean we have an acceleration.

A = Newton’s 1st B = Newton’s 2nd C = Newton’s 3rd
 D = Momentum E = Energy F = None of these

 A B C D E F

(b) A cowboy in the Old West spits a wad of tobacco at a spittoon and knocks it over, shows conservation of...

A = Newton’s 1st B = Newton’s 2nd C = Newton’s 3rd
 D = Momentum E = Energy F = None of these

 A B C D E F(c) Object 1 has a net charge Q . Object 2 has no net charge. The motion between 1 and 2 is governed by...

A = Newton’s 1st B = Newton’s 2nd C = Newton’s 3rd
 D = Momentum E = Energy F = None of these

 A B C D E F(d) $Q_H = Q_c + W$ illustrates the principle of conservation of...

A = Newton’s 1st B = Newton’s 2nd C = Newton’s 3rd
 D = Momentum E = Energy F = None of these

 A B C D E FIn parts (e)-(h), select which speed best represents the situation described.

(e) “And Robby Benson’s NASCAR racing car rounds Turn 3 here on the short track...”

A = 0.70 m/s B = 7.0 m/s C = 70. m/s D = 700 m/s E = 7000 m/s
 F = 70,000 m/s

 A B C D E F

(f) “Boy, that guy must be late for his connecting flight.”

A = 0.70 m/s B = 7.0 m/s C = 70. m/s D = 700 m/s E = 7000 m/s
 F = 70,000 m/s

 A B C D E F

(g) “That baby just crawled across its crib.”

A = 0.70 m/s B = 7.0 m/s C = 70. m/s D = 700 m/s E = 7000 m/s
 F = 70,000 m/s

 A B C D E F

(h) “Look! It’s Halley’s Comet – zooming right around the Sun.”

A = 0.70 m/s B = 7.0 m/s C = 70. m/s D = 700 m/s E = 7000 m/s
 F = 70,000 m/s

 A B C D E FIn parts (i)-(j), select the answer that best fills in the blank.

(i) Any two resistors in parallel have an equivalent resistance that is _____ the resistance of either of them.

A = more than B = less than C = the same as
 D = None of these

 A B C D(j) Parallel light rays from the sun shine into a magnifying glass made from a single positive bi-convex thin lens and converge at a point whose distance from the center of the lens is _____ the focal length f .

A = more than B = less than C = the same as
 D = None of these

 A B C D**“Pheelings, Physics Students Phace Nothing More Than Pheelings...” (50,000 points)**

2.) A car of mass 3310 kg is traveling in the +x direction at a constant speed of 70 mph (31.3 m/s). (a) How far does this car travel in one minute (60.0 sec)?

(b) The engine of the car has to produce 50.0 h.p. of useful power just to maintain this speed against air resistance and friction. Find the useful work in Joules during this time. *1 h.p. = 746 W*(c) Using the definition of Work, find the magnitude of the force F_f that the car exerts to do this useful work. *If you did not get an answer to (b), use $W = 55,500 J$.*(d) The yellow turn signal light glows with a wavelength $\lambda = 555 \text{ nm} = 5.55 \times 10^{-7} \text{ m}$. Find the frequency of this color of visible light. *The speed of light is $c = 2.998 \times 10^8 \text{ m/s}$.*(e) To start the car, the 12.0 volt battery had to deliver a current of 555 Amps to the starter motor. Find the power dissipated by the starter motor in Watts and then in horsepower (h.p.). *1 h.p. = 746 W*

“Dr. Welby... Paging Dr. Welby... Please Report to Emergency, Stat.” (50,000 points)

3.) Joey ($m = 65.0$ kg) pushes on Terry (75.0 kg) with a force of 255 N. (a) Find the minimum coefficient of static friction if Joey does not slip or slide on the floor.

(b) Terry is sliding at a constant speed of 0.500 m/s. Find Terry's coefficient of kinetic friction with the floor.

Car A (1810 kg) is moving at 19.1 m/s and Car B (1910 kg) is moving at 18.1 m/s. Find the total vector momentum, \vec{p} , if Car A is going in the $+x$ direction and:

(c) ... Car B is going in the $-x$ direction.

(d) ... Car B is going in the $+y$ direction.

(e) Dr. Phil saw an odd thing the other day on his commute at 65 mph (29.1 m/s). Something white and furry was sitting on the back shelf of a car, behind the rear seat. Maybe it was a real sleeping dog, maybe it was a child's plush toy. Whatever it was, it wasn't wearing a seat belt. If this car were in an accident and suddenly stopped, would the white furry toy hit the front windshield or the back window, and at what speed? *Assume no friction.*

Odds & Ends – Mostly Odd, From the Ends of the Earth (50,000 points)

4.) The Earth orbits around the Sun at a radius of $93,000,000$ miles ($149,700,000$ km) in a period of one year.

(a) Find the average speed of the Earth in this circular orbit.

(b) A twenty foot tall model rocket on display at the Grand Rapids IMAX Theatre goes from rest to $+600.$ m/s in 20.0 seconds. Assuming constant acceleration, what distance did the rocket travel in that time?

(c) Assuming the gas doesn't get absorbed by the liquid, bubbles should get bigger as they rise. The pressure of an air bubble two and a half miles down at the *Titanic* wreck site in the North Atlantic is $470.$ atmospheres, while the air pressure at the surface is 1.00 atmospheres ($101,300$ Pa). Temperature down there is 1.11°C (34°F), up on the surface is 20°C (68°F). Find the ratio of the volumes (V_2 / V_1) of the bubble between *down there* and *up here*.

(d) Finally we end with a terrifying tale that had a happy ending. Last week it was discovered that an asteroid passed by the Earth in between the Earth and the Moon – i.e., it was *close*. Given the current mania connected with World Cup 2002, the press were describing this asteroid as “the size of a soccer field”. Assuming that the asteroid was a solid ball $120.$ meters in diameter and the rock had a mass-to-volume ratio of $\rho = 4300$ kg/m³, what was the mass of the asteroid? *If you don't remember how to find the volume of sphere, you can make it a cube with sides $L = 120.$ meters for the price of 2000 points.*

(e) If the asteroid was moving at $55,000$ mph ($24,600$ m/s), find the kinetic energy of the asteroid. *If you didn't get an answer to (d), use $m = 1,250,000,000$ kg. As a point of comparison, the first Atomic Bomb released an energy of 5.85×10^{13} J, so it was good that this thing missed us. (Actually, these things happen all the time, the press gets excited, but I wouldn't lose any sleep over it. Space is REALLY big and it's hard to hit a target as small as a planet with an asteroid.)*