The City College of New York / Grove School of Engineering
SCIENCE, TECHNOLOGY, ENGINEERING and MATHEMATICS (STEM)

PHYSICS Final Exam

Summer Semester: August 7, 2007

Name:_____

Show all details, neatly, to selection of each correct answer.

1. How many square kilometers are there in 10 acres? (1 acre = 43,560 ft^2 or $\frac{1}{640}$ mi^2)
   (a) $4.0469\ km^2$ (c) $4.0469\times10^{4}\ km^2$
   (b) $4.0469\times10^{-2}\ km^2$ (d) $4.3560\times10^{5}\ km^2$

2. In some countries the gasoline consumption of an automobile is expressed in liters consumed per 100 km of travel. If an automobile gets 27 miles/gallon, what is its fuel consumption in liters per 100 km? (1 gal = 3.7853 liters)
   (a) 0.8711 L/ 100 km (c) 0.0871 L / 100 km
   (b) 871.1394 L/km (d) 8.7114 L / 100 km

3. A ball bearing is dropped from rest at a point A. At the instant it passes a mark 10 m below A, another ball bearing is released from rest from a position 11 m below A. (i) At what time after its release will the second ball bearing be overtaken by the first? (ii) How far does the second bearing fall in that time?
   (a) (i) 0.0049 s, (ii) 14.0071 m (c) (i) 0.6969 s, (ii) 0.2380 m
   (b) (i) 0.0697 s, (ii) 0.0476 m (d) (i) 0.0697 s, (ii) 0.0238 m

4. A stone is dropped from rest into a well 50 m deep. If the speed of sound is 330 m/s, determine the time that has elapsed when the splash is heard after the stone is dropped.
   (a) 16,500 s (c) 6.60 s
   (b) 3.3459 s (d) 0.1515 s

5. The position of a particle that moves along the x axis is given by $x = 2 + 3t - 4t^2$ in SI units. What units are associated with the constant in each term?
   (a) 2 m, 3 m and 4 m (c) 2 m, 3 m/s and $4\ m/s^2$
   (b) 2 m/s, $3\ m/s^2$ and $4\ m/s^3$ (d) 2, 3 m/s and $4\ m/s^2$

6. For the particle in Question (5) above, derive the expression for the velocity v as a function of time t
   (a) $v = \frac{2}{t} + 3 - 4t$ m/s (c) $v = 3 - 4t$ m/s
   (b) $v = 3 - 8t$ m/s (d) $v = 2t + \frac{3}{2}t - t^3$ m/s

7. For the particle in Question (5) above, derive the expression for the acceleration a as a function of time t
   (a) $a = 3 - 8t\ m/s^2$ (c) $a = 3t - 4t^2\ m/s^2$
   (b) $a = -8t\ m/s^2$ (d) $a = -8\ m/s^2$

8. Find the time t and the position x when the particle of Question (5) above is at its maximum (positive) position
   (a) $t = 1.1754$ s and $x = 39.9999$ m (c) $t = 0.4254$ s and $x = 2.5523$ m
   (b) $t = 0.3750$ s and $x = 2.5625$ m (d) $t = 0.1250$ s and $x = 2.3125$ m

TURN OVER

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9. A mass m, moving with initial speed v_o, undergoes a head-on elastic collision with a mass M initially at rest $(M > m)$. The collision is one-dimensional, so that after the interaction both masses are moving along the original line of motion. Find the ratio of final kinetic energy to initial kinetic energy, K_f / K_i, for m.

(a) $\dfrac{(M-m)}{(M+m)}v_o$ (c) $\dfrac{Mm}{(M+m)}v_o$

(b) $\dfrac{(M-m)}{(M+m)}$ (d) $\dfrac{Mm}{(M+m)}$

10. (i) Find the momentum of a 1000-kg car traveling 12 m/s. (ii) If the car collides with a brick wall and comes to rest in 0.5 s, what average force did the wall exert on the car?

(a) (i) 1,200 kg · m/s, (ii) 2,400 N (c) (i) 12×10^4 kg · m/s, (ii) 24×10^4 N

(b) (i) 12,000 kg · m/s, (ii) 6,000 N (d) (i) 1.2×10^4 kg · m/s, (ii) 2.4×10^4 N

11. A 3-kg mass moving at 7.5 m/s has its direction reversed without any change in speed by a constant force acting for 0.05 s. Find the direction and magnitude of the force.

(a) 22.5 N, same direction (c) 900 N, opposite original direction

(b) 900 N, same direction (d) 22.5 N, opposite original direction

12. A varying force acting on a 4-kg object causes it to have a displacement given by $x = 2t - 3t^2 + t^3$ (where x is in meters and t is in seconds). The object starts from rest. Find the work that this force does on the object in the first 3 s of motion.

(a) 242 J (c) 72 J

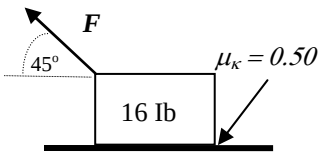
(b) 22 J (d) 4 J

13. Given the vectors $\overline{\mathbf{A}} = 3\overline{\mathbf{x}} + 4\overline{\mathbf{y}}$ and $\overline{\mathbf{B}} = 2\overline{\mathbf{x}} - 2\overline{\mathbf{y}}$. solve analytically to obtain the magnitude and direction of $\overline{\mathbf{C}} = \overline{\mathbf{B}} - 2\overline{\mathbf{A}}$

(a) $|\overline{\mathbf{C}}| = 14.0$ units at 98.13^o (c) $|\overline{\mathbf{C}}| = 10.7703$ units at 201.8^o

(b) $|\overline{\mathbf{C}}| = 10.7703$ units at 68.2^o (d) $|\overline{\mathbf{C}}| = 10.7703$ units at 248.2^o

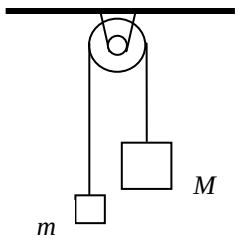
14. Find the force $\overline{\mathbf{F}}$ that will pull the box at constant speed along the floor. The coefficient of kinetic friction between the box and the floor is 0.50 as indicated.



(a) 7.5425 Ib (c) 8.0000 Ib

(b) 11.3137 Ib (d) 32.1740 Ib

15. Two unequal masses, $M > m$, are suspended vertically over a light pulley that has negligible friction. Find the tension T in the connecting cord.



(a) $\dfrac{2mMg}{M+m}$ (c) $\dfrac{2(m-M)g}{M+m}$

(b) $\dfrac{(M-m)g}{M+m}$ (d) $\dfrac{mMg}{M+m}$

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