Midterm Examination
Physics 204/4
February 14, 2014

Time Allowed: 1 1/4 hr. **Maximum marks: 30**

---

1. A car makes a trip of 240 km to east at an average speed of 30 km/hr and then goes 360 km north in 15 hours to reach its destination. (a) What is the average speed for the whole trip? (b) What is the displacement of the destination point from the starting point? (c) What is the average velocity for the whole trip? (1,1,2)

2. A jet plane lands with a velocity of 100m/s and can accelerate at a maximum rate of -5.0 m/s^2 as it comes to rest. (a) From the instant it touches the runway, what is the minimum time needed before it stops? (b) Can the plane land at the airport where the runway is 1.2 km long? (1,2)

3. A boat crosses a wide river with a speed of 12 km/hr relative to water. The river has a uniform speed of 6 km/hr due east relative to earth. (a) Determine the speed of the boat relative to the stationary ground observer. (b) In what direction should the boat be heading to reach an opposite point directly across the river? (1, 2))

4. A safe weighing 3000 N is to be lowered at constant speed down skids 5 m long, from a truck 2 m high. (a) If the coefficient of sliding friction between safe and skids is 0..2, (a) will the safe need to be pulled down or held back? (b) How great a force parallel to the skids is needed? (1, 2)

5. A ball is thrown vertically upward from the ground with a velocity of 30 m/s. (a) How long will it take to rise to the highest point? (b) How high does the ball rise? (c) How long after projection will the ball have a velocity 10 m/s downward? (1,1,1)

6. A man weighs 980 N on the earth ($g = 9.8\ m/s^2$). (a) What would be his weight on Jupiter, where the free fall acceleration is 25.9 m/s^2? (b) How much would be his mass on Jupiter? (c) What is his mass on the earth? (2, 1, 1)

7. A 350N force applied up the plane pushes a 30-kg-box up a rough sloping plane, inclined at an angle of 30°to the horizontal, having a coefficient of kinetic friction of 0.3. (a) What is the frictional force? (b) What is the acceleration of the box? (2,1)

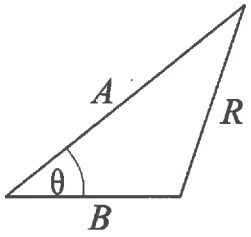
8. An elevator weighing 30,000 N comes down with acceleration of 5 m/s^2. (a) What is the tension in the supporting cable? (b) What would be the tension if the elevator were going up with a uniform velocity of 8 m/s? (2, 2)

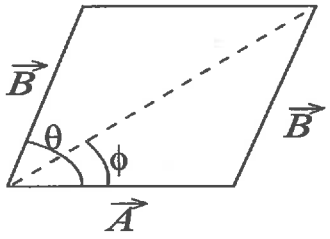
9. An astronaut weighing 980 N lands on the Moon. (a) What is the mass of the astronaut on the Moon, (b) What is his weight on the Moon. (Given: Mass of the Moon = 7.36×10^{22} kg , Mean Radius of the Moon = 1.74×10^{6} m) (1,2)

10. A fullback weighing 980N is running with a speed of 9 m/s due south.. Calculate his momentum. (2)

(Please turn over for formulae)

Some useful formulae





Cosine law: $R^2 = A^2 + B^2 - 2AB\cos\theta$

$\tan\varphi = \dfrac{B\sin\theta}{A + B\cos\theta}$

Scalar Product: $\vec{A}.\vec{B} \equiv AB\cos\angle(\vec{A},\vec{B})$ $\qquad \vec{A}.\vec{B} = A_xB_x + A_yB_y + A_zB_z$

Vector Product: $\vec{A}\times\vec{B} \equiv AB\sin\angle(\vec{A},\vec{B})$

$$\vec{A}\times\vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

π rad $= 180^\circ$, $\qquad$ Density: $\rho = \dfrac{M}{V}$

static $\rightarrow f_{max} = \mu_s R_n$, $\qquad$ kinetic $\rightarrow$ $f_{max} = \mu_k R_n$, $\qquad$ $\mu_s = \tan\varphi$ ($\phi \rightarrow$ angle of friction),

$v = v_0 + a\,t$, $\qquad s = v_0\,t + \tfrac{1}{2}\,a\,t^2$, $\qquad v^2 - v_0^2 = 2\,a\,x$,

$v_x = v_{0x} + a\,t$, $\qquad v_y = v_{0y} - gt$, $\qquad \vec{p} = m\,\vec{v}$

(Gravitation) $\vec{F} = -\dfrac{Gm_1m_2}{r^2}\hat{r}$ $\qquad$ ($G = 6.67\text{x}10^{-11}\ \dfrac{Nm^2}{Kg^2}$), $\qquad$ $g_s = \dfrac{GM_E}{R_E^2}$,

(Grav. Pot) $U_g = -G\dfrac{m\,M_E}{R_E}$

$S = \frac{d}{t}$

$30 = \frac{240}{x}$

$30x = 240$

$x = \frac{240}{30}$