

**Physics 180 Term Test #1**  
**October 19, 2006**

*Aids permitted: Writing/drawing aids and non-programmable calculators.*

Do all 3 questions. Provide appropriate reasoning for your answers.

PUT YOUR NAME, TUTORIAL SECTION AND STUDENT NUMBER ON ALL BOOKS

*S.I. (m-k-s) units are used throughout with  $g = 9.8 \text{ m/s}^2$ .*

1) a) In 3 sentences or less, discuss each of the following (WITHOUT symbols, equations or graphs).

- i) What is the difference between a field and contact force?
- ii) What is the difference between linear and angular velocity?
- iii) What is meant by an inertial frame of reference?
- iv) What is meant by a Galilean transformation?
- v) What is meant by the resonance frequency of a simple harmonic oscillator?

*(5 marks for each part)*

b) A ball of mass  $m$  falls under gravity in a fluid and experiences a drag force that varies with speed,  $v$ , as  $F = -bv$ , where  $b$  is a constant. If the ball starts from rest, derive an expression for: i) the time dependence of the speed and; ii) its terminal velocity in terms of  $b$ ,  $g$  and  $m$ . iii) If the ball is initially moving downward with speed  $v_0$ , how does your answer to part i) change?  
*(15 marks)*

2) A wheel 2.0 m in diameter lies in a vertical plane and rotates with a constant angular acceleration of  $4.0 \text{ radians/s}^2$ . The wheel starts at rest at  $t = 0$ , and the radius vector of a certain point P on the rim makes an angle of 1 radian with the horizontal at this time. When  $t = 2.0 \text{ s}$  find:

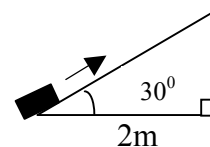
- i) The angular speed of the wheel;
- ii) The tangential speed and the total (linear) acceleration of point P;
- iii) The angular position of point P.

*(10 marks for each part)*

3) A 1 kg sled is launched at a speed of 10 m/s along a fixed incline that makes an angle of  $30^\circ$  relative to the horizontal. The coefficient of friction between the sled and the incline is 0.5, and the base of the triangular shaped incline is 2 m long.

- 1) What is the acceleration of the sled while on the incline?
- 2) What is the speed of the sled when it leaves the top of the incline?
- 3) What time after launch does the sled reach its maximum vertical height?
- 4) How far is the sled from the top of the incline when it reaches its maximum height?
- 5) What is the speed of the sled when it reaches the same elevation (height) as it began?

*(6 marks for each part)*



**Total marks: 100**

**Hints:** For motion on a circle  $\vec{r} = R\hat{r}$ ,  $\frac{d\hat{r}}{dt} = \frac{d\theta}{dt}\hat{\theta}$ ,  $\frac{d\hat{\theta}}{dt} = -\frac{d\theta}{dt}\hat{r}$ .

For motion in 1-D with constant acceleration,  $x = x_i + v_i t + \frac{1}{2} a_0 t^2$ .