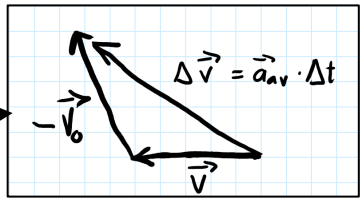
Part A: Multiple Choice

1) b
2) a
3) a
4) b
5) d
6) b
7) d
8) a
9) a
10) c
11) b
12) b
13) a
14) e
15) c
16) a

Part B: Problems

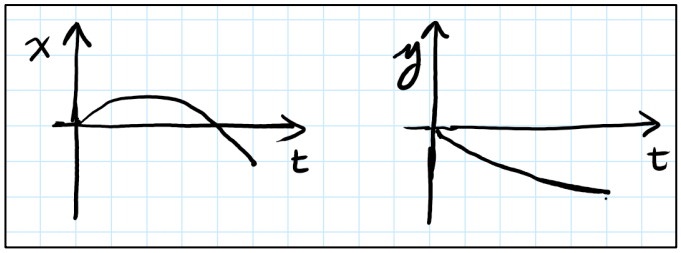
1a) $\vec{a} = 2.25\frac{m}{s^2}\ at\ 146°$

1b)



1c) Δx=-5.00m, Δy=-10.0m,

1d)



2) h = 20.3 m

3a) ω =31.4 rad/s
3b) α = -2.62 rad/s^2
3c) Δθ = 189 rads or 30.0 revs
3d) $\boldsymbol{a}_r$ = 197 m/s^2,towards the centre of the tub, a_t = 1.6m/s^2

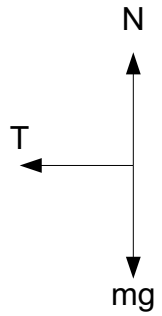
4) Draw the Free Body Diagram first

Horizontal: $\sum F_x = 0,\ T_2cos\theta_2 = T_1cos\theta_1$ (1), $\quad \therefore T_2 = T_1\frac{\cos\theta_1}{\cos\theta_2}$

Vertical: $\sum F_y = 0,\ [T_2sin\theta_2 + T_1sin\theta_1] = mg$ (2)

Sub T_2 into (2)

5a)



5b) l = R = 0.955 m
5c) T = 9.16 N

6a) a = 1.53 m/s^2
6b) P = 1267 W (*Note that the power calculated is negative, meaning that the tension does negative work on the counterweight. However, the question asked for magnitude*.)

7) x = 0.135 m

8a) v = 3.24 m/s at 312^o
8b) F_{max} = 292 N

9a) As the ball falls down the work done by gravity is positive and the kinetic energy increases, as $\Delta K = W_g$, (also the loss in potential energy is equal to the gain in kinetic energy).
9b) Momentum is conserved when the ball hits the cart, and the initial momentum of the ball is "shared" between the ball and the cart. The collision is not elastic, so kinetic energy is lost in the collision (mainly converted to heat).
9c) As the ball swings back up work done by gravity is negative, so the kinetic energy decreases by the same amount. (Also the loss in potential energy will be converted to potential energy). As the cart moves away after the collision it's kinetic energy will remain constant, unless there is a loss due to work done by friction.

10a) ω_f = 0.81 rad/s
10b) ΔK = -31 J