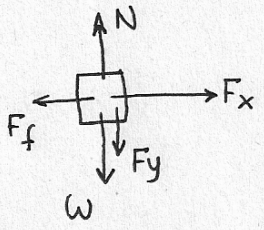
EXAM : DYNAMICS

① ⓐ



Vertical forces:

$N = W + Fy$

$Fy = 1200N \times \sin 30^\circ = 600N$

$W = 50Kg \times 10\,m/s^2 = 500N$

$N = 500N + 600N \rightarrow \boxed{N = 1100\,N}$

$F_f = \mu \times N = 0.25 \times 1100\,N \rightarrow \boxed{F_f = 275N}$

ⓑ $F_{net} = m \times a$

$F_{net} = F_x - F_f$

$F_x = 1200N \times \cos 30^\circ = 1039N$

$F_{net} = 1039N - 275N = 764N$

$a = \frac{F_{net}}{m} = \frac{764N}{50Kg} \rightarrow \boxed{a = 15.3\,\frac{m}{s^2}}$

ⓒ

$x = v_0 t + \frac{1}{2} a t^2 \rightarrow x = 4t + 9.65t^2$

Condition: $x = 25m$

$25 = 4t + 9.65t^2 \rightarrow 9.65t^2 + 4t - 25 = 0$

$t = \frac{-4 \pm \sqrt{16 + 965}}{19.3} = \frac{-4 \pm 31.3}{19.3} \rightarrow t = 1.4\,s$

$v = v_0 + at \rightarrow v = 4\,\frac{m}{s} + 15.3\,\frac{m}{s^2} \times 1.4s \rightarrow \boxed{v = 25.4\,\frac{m}{s}}$

② ⓐ $a_c = \frac{F_c}{m} \rightarrow a_c = \frac{120\,N}{5\,kg} \rightarrow \boxed{a_c = 24\ \frac{m}{s^2}}$

ⓑ $a_c = \frac{v^2}{R} \rightarrow v = \sqrt{a_c \times R} \rightarrow v = \sqrt{24\ \frac{m}{s^2} \times 0.8\,m} \rightarrow \boxed{v = 4.4\ \frac{m}{s}}$

$v = \omega \times R \rightarrow \omega = \frac{v}{R} = \frac{4.4\ m/s}{0.8\,m} \rightarrow \boxed{\omega = 5.5\ rad/s}$

$\omega = 5.5\ \frac{rad}{s} \times \frac{60\,s}{1\,min} \times \frac{1\,rev}{2\pi\ rad} \rightarrow \boxed{\omega = 52.5\ rpm}$

ⓒ $\omega = \frac{2\pi}{T} \rightarrow T = \frac{2\pi}{\omega} = \frac{2\pi}{5.5\ rad/s} \rightarrow \boxed{T = 1.14\ s}$

$f = \frac{1}{T} \rightarrow \boxed{f = 0.88\ Hz}$

ⓓ $x = 52.5\ \frac{rev}{min} \times 10\,min = \boxed{525\ rev}$

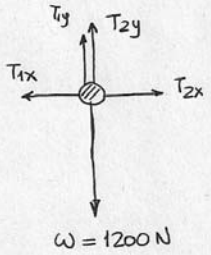
③ ⓐ $P_{initial} = 0.125\,kg \times (-20\ m/s) = -2.5\ \frac{kg\,m}{s}$

$P_{final} = 0.125\,kg \times 30\ m/s = 3.75\ \frac{kg\,m}{s}$

$\Delta p = 3.75\ \frac{kg\,m}{s} - (-2.5\ \frac{kg\,m}{s}) \rightarrow \boxed{\Delta p = 6.25\ \frac{kg\,m}{s}}$

ⓑ $\Delta p = F \times t \rightarrow t = \frac{\Delta p}{F} = \frac{6.25\ kgm/s}{300\,N} \rightarrow \boxed{t = 0.02\ s}$

④



Expressions:

$T_{1x} = T_{2x}$

$T_{1y} + T_{2y} = 1200\,N$

$T_{1x} = T_1 \times \sin 30^\circ = 0.5\ T_1$

$T_{1y} = T_1 \times \cos 30^\circ = 0.87\ T_1$

$T_{2x} = T_2 \times \sin 45^\circ = 0.7\ T_2$

$T_{2y} = T_2 \times \cos 45^\circ = 0.7\ T_2$

System of two equations

$0.5\ T_1 = 0.7\ T_2$

$0.87\ T_1 + 0.7\ T_2 = 1200\,N \rightarrow 0.87\ T_1 + 0.5\ T_1 = 1200\,N \rightarrow$

$\rightarrow 1.37\ T_1 = 1200\,N$

$\boxed{T_1 = 876\,N}$

$T_2 = \dfrac{0.5\ T_1}{0.7} \rightarrow \boxed{T_2 = 626\,N}$