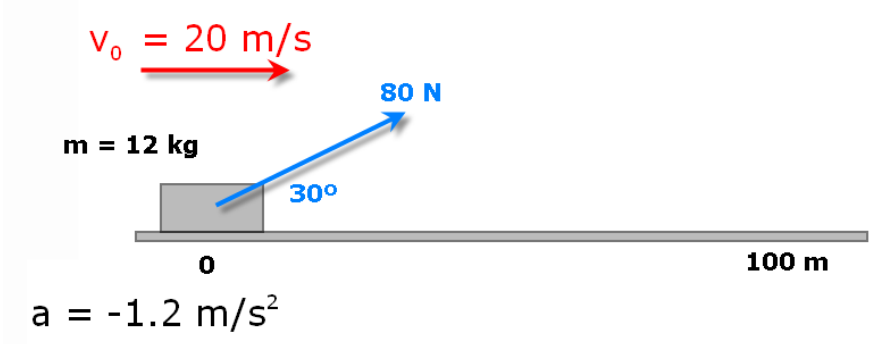
EXAM: DYNAMICS	
Name:	**Group:**

1	**A body is moving according to the picture below. Initially, this body is moving at a speed of 20 m/s. Determine:** **a) The value of the normal force** **b) The values of the friction force and friction coefficient** **c) The velocity of the body when its position is x = 100 m (the first time it reaches the position)**



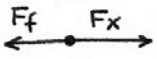
① a) The value of the normal force is

$N + Fy = W \rightarrow N = 120N - 40N \rightarrow \boxed{N = 80N}$

$Fy = 80N \times \sin 30^\circ = 40\,N$

$W = 12Kg \times 10 m/s^2 = 120N$

b) The values of friction force and the coefficient are:



$F_{net} = m \times a \rightarrow F_{net} = 12\,Kg \times (-1.2 m/s^2) = -14.4\,N$

$F_x = 80N \times \cos 30^\circ = 69.3N$

$F_{net} = F_x - F_f \rightarrow -14.4N = 69.3N - F_f$

$\boxed{F_f = 83.7\,N}$

$F_f = \mu . N \rightarrow F_f = 83.7N = \mu \times 80N \rightarrow \mu = \frac{83.7\,N}{80\,N} \rightarrow \boxed{\mu = 1.05}$

① c) The velocity at $x = 100\ m$

$x = 20t - 0.6t^2 \xrightarrow{\text{diff.}} v = 20 - 1.2t$

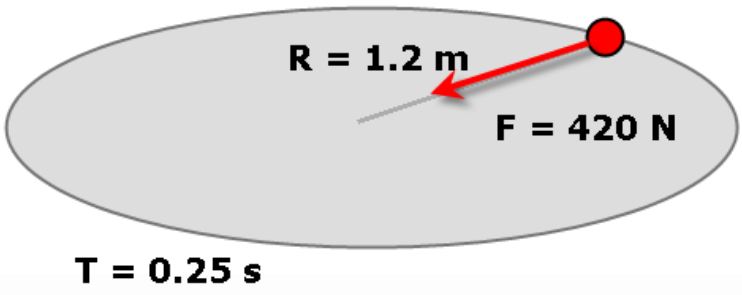
Condition: $x = 100\ m$

$100 = 20t - 0.6t^2 \rightarrow 0.6t^2 - 20t + 100 = 0$

$t = \frac{20 \pm \sqrt{400 - 240}}{1.2} = \frac{20 \pm 12.7}{1.2}$ → $t_1 = 27.25\ s$, $t_2 = 6.08\ s$

$v = 20 - 1.2 \times 6.08 \rightarrow \boxed{v = 12.7\ \frac{m}{s}}$

2	**A body is rotating due to a centripetal force of 420 N. The radius of the circle is R=1.2 m and the period of the motion is T=0.25 s. Determine:** • **The angular (in rad/r and rpm) and linear velocities** • **The centripetal acceleration** • **The mass of the body** • **The frequency of motion**



② a) The velocities

$$\omega = \frac{2\pi}{T} \rightarrow \omega = \frac{2\pi}{0.25\,s} \rightarrow \boxed{\omega = 25.1\ rad/s}$$

$$\omega = 25.1\ \frac{rad}{s} \times \frac{60\,s}{1\,min} \times \frac{1\ rev}{2\pi\ rad} \rightarrow \boxed{\omega = 239.7\ rpm}$$

$$v = \omega \times R \rightarrow v = 25.1\ \frac{rad}{s} \times 1.2\,m \Rightarrow \boxed{v = 30.12\ m/s}$$

b) The centripetal acceleration

$$a_c = \frac{v^2}{R} \rightarrow a_c = \frac{(30.12\ m/s)^2}{1.2\,m} \rightarrow \boxed{a_c = 756\ m/s^2}$$

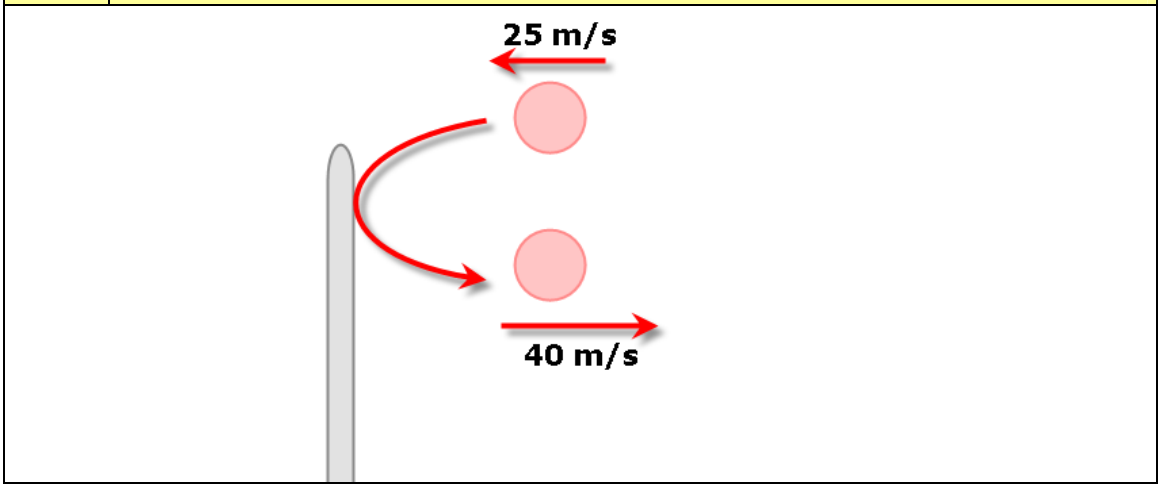
c) The mass of the body

$$F_c = m \times a_c \leftrightarrow a_c = \frac{F_c}{m} \leftrightarrow m = \frac{F_c}{a_c} \rightarrow m = \frac{420\,N}{756\ m/s^2} \rightarrow \boxed{m = 0.56\,Kg}$$

d) The frequency of the motion

$$f = \frac{1}{T} \rightarrow f = \frac{1}{0.25\,s} \rightarrow \boxed{f = 4\ Hz}$$

3	**A ball is hit and its direction changes, as indicated in the picture. The mass of the ball is 200 g and the time interval in which the ball and the bat are in contact is 0.025 seconds. Determine:** • **The change in the linear momentum of the ball** • **The average force exerted on the ball by the bat**



③ a) The change in momentum is:

$$P_{initial} = 0.2\,Kg \times (-25\,m/s) = -5\,Kg.m/s$$

$$P_{final} = 0.2\,Kg \times 40\,m/s = 8\,Kg.m/s$$

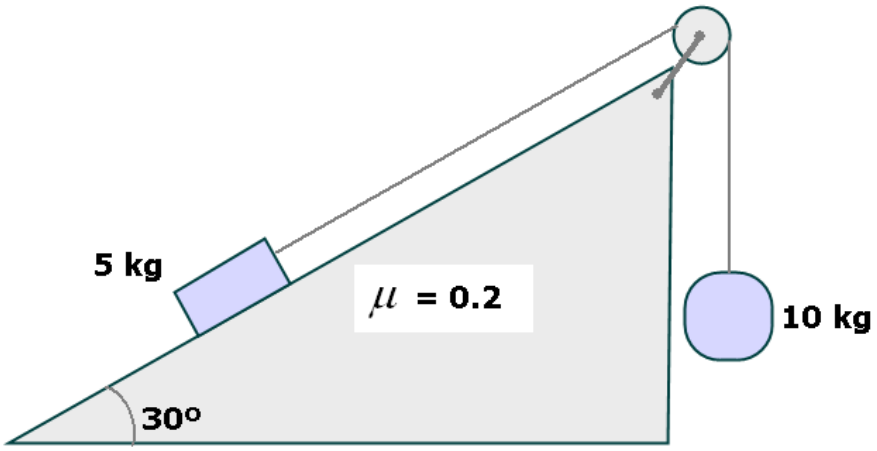
$$\Delta p = P_{final} - P_{initial} \rightarrow \Delta p = 8\,\frac{Kgm}{s} - \left(-5\,\frac{Kgm}{s}\right) \rightarrow \boxed{\Delta p = 13\,\frac{Kgm}{s}}$$

b) The value of the force is

$$J = \Delta p \rightarrow F \times 0.025\,s = 13\,\frac{Kg\,m}{s} \rightarrow F = \frac{13\,\frac{Kgm}{s}}{0.025\,s} \rightarrow$$

$$\rightarrow \boxed{F = 520\,N}$$

4	**Two bodies are tied and moving as shown in the picture. Determine:** • **The normal and friction forces** • **The acceleration** • **The tension force**



④ a) Determination of normal and friction forces

$N = W_y = 5\,kg \times 10\frac{m}{s^2} \times \cos 30^\circ \rightarrow \boxed{N = 43.3\,N}$

$F_f = \mu \times N = 0.2 \times 43.3N \rightarrow \boxed{F_f = 8.7\,N}$

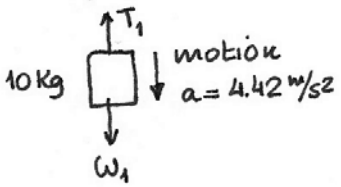
b) The acceleration

$F_{net} = m \times a \rightarrow a = \frac{F_{net}}{m} = \frac{66.3\,N}{15\,kg} \rightarrow \boxed{a = 4.42\,m/s^2}$

$F_{net} = W_1 - W_{2x} - F_f = 100N - 25N - 8.7N = 66.3\,N$

$W_{2x} = 50\,N \times \sin 30^\circ = 25N$

c) The tension force



$F_{net} = m \times a \rightarrow 100N - T_1 = 10kg \times 4.42\frac{m}{s^2}$

$F_{net} = W_1 - T = 100N - T_1$

$\boxed{T_1 = T_2 = 55.8\,N}$