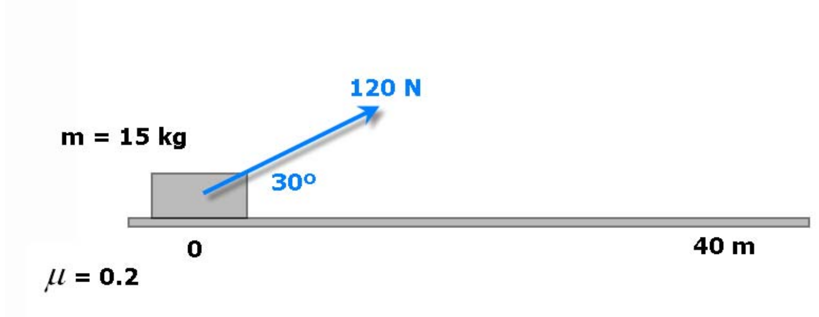
DYNAMICS: MOCK EXAM	
Name:	**Group:**

1	**An external force of 120 N is exerted on the body, as indicated in the picture, along the first 40 m. Initially, the body is at rest.** **Determine:** • **the value of the normal force** (0.50 POINTS) • **the acceleration of the body** (1.50 POINTS) • **the velocity at the point x = 40 m** (0.50 POINTS) Estimated time: 15 min



① * The value of the normal force

$$N + F_y - W = 0 \Rightarrow N + 60\,N - 150\,N = 0 \Rightarrow \boxed{N = 90\,N}$$

$$W = 15\,Kg \times 10\,m/s^2 = 150\,N$$

$$F_y = 120\,N \times \sin 30^\circ = 60\,N$$

* The acceleration of the body

$$F_{net} = m \times a \rightarrow 85.9\,N = 15\,kg \times a \rightarrow a = \frac{85.9\,N}{15\,Kg} = \boxed{5.73\,\frac{m}{s^2}}$$

$$F_{net} = F_x - F_f = 85.9\,N$$

$$F_x = 120\,N \times \cos 30^\circ = 103.9\,N$$

$$F_f = 0.2 \times 90\,N = 18\,N$$

* The velocity at the point x = 40 m

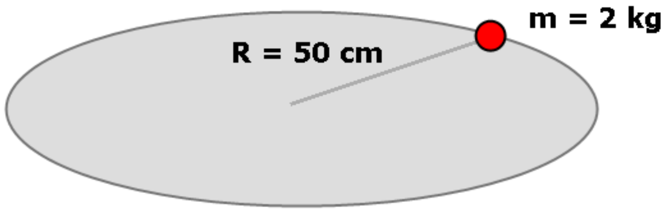
$$x = \frac{1}{2} a t^2 \rightarrow x = 2.87\,t^2\ (m) \rightarrow v = 5.73\,t\ (m/s)$$

When $x = 40$:

$$40 = 2.87\,t^2 \rightarrow t = \sqrt{\frac{40}{2.87}} = 3.73\,s$$

$$v = 5.73 \times 3.73 = \boxed{21.4\,m/s}$$

2	**A tension force is responsible for keeping a body moving along a circular path, as shown in the picture. The value of the tension is 40 N. Determine:** • **the acceleration** (0.50 POINTS) • **both velocities: linear and angular (in rad/s and rpm)** (1 POINT) • **the period** (0.25 POINTS) • **the frequency** (0.25 POINTS) • **the distance travelled by the body in 15 s** (0.50 POINTS) Estimated time: 10 min



(2) * The centripetal acceleration is:

$$F = m \times a_c \rightarrow a_c = \frac{40\ N}{2\ kg} = \boxed{20\ \frac{m}{s^2}}$$

* Linear and angular velocities:

$$a_c = \frac{v^2}{R} \rightarrow v = \sqrt{a_c \times R} = \sqrt{20\ \frac{m}{s^2} \times 0.5\ m} = \boxed{3.16\ m/s}$$

$$v = \omega \times R \rightarrow \omega = \frac{v}{R} = \frac{3.16\ m/s}{0.5\ m} = \boxed{6.32\ rad/s}$$

$$\omega = 6.32\ \frac{rad}{s}\ \frac{60\ s}{1\ min}\ \frac{1\ rev}{2\pi\ rad} = \boxed{60.4\ rpm}$$

* The period

$$\omega = \frac{2\pi}{T} \rightarrow T = \frac{2\pi}{\omega} = \frac{2\pi\ rad}{6.32\ rad/s} = \boxed{0.99\ s}$$

* The frequency is:

$$f = \frac{1}{T} = \boxed{1.01\ Hz}$$

* The distance travelled by the body in 15 s:

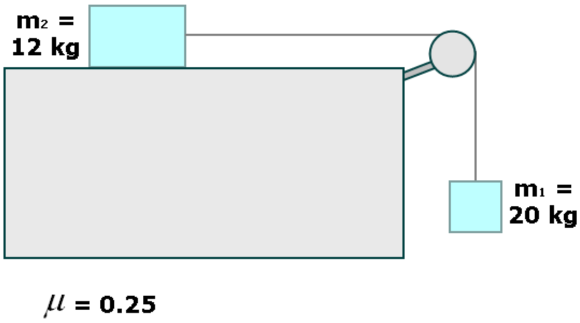
$$d = v \times t = 3.16\ \frac{m}{s} \times 15\ s = \boxed{47.4\ m}$$

3

In the system below, determine:

- **the value of the friction force** (0.5 POINTS)
- **the acceleration of the system** (1 POINT)
- **the value of the tension** (1 POINT)

Estimated time: 10 min



③ * The value of the friction force

$$F_f = \mu \times N = 0.25 \times 120\,N = \boxed{30\,N}$$

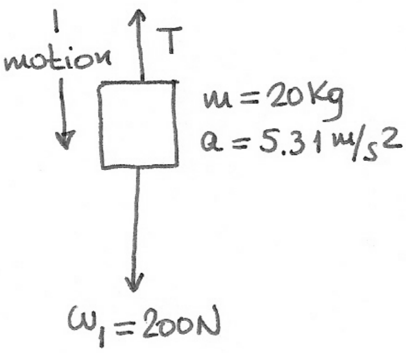
* The acceleration of the system

$$F_{net} = m_T \times a \rightarrow a = \frac{170\,N}{32\,kg} \rightarrow \boxed{a = 5.31\,\frac{m}{s^2}}$$

$$m_T = 12\,kg + 20\,kg = 32\,kg$$

$$F_{net} = W_1 - T + T - F_f = 200\,N - 30\,N = 170\,N$$

* The value of the tension



$$F_{net} = m \times a$$

$$F_{net} = 200\,N - T$$

$$200\,N - T = 20\,kg \times 5.31\,m/s^2$$

$$200\,N - T = 106.2\,N$$

$$T = 200\,N - 106.2\,N$$

$$\boxed{T = 93.8\,N}$$

4	**An AB system is moving to the right at a speed of 5 m/s. In order to move quicker a force** $\vec{F} = 20\,\vec{i}$ (N) **is applied during 6 seconds. Suddenly, as a result of an explosion, the system is split in two parts and the "B" part of the system starts moving to the right at a velocity of 20 m/s. Determine:** • **the impulse on that system due to the force applied** (0.5 POINTS) • **the final linear momentum of the system before the explosion** (1 POINT) • **the velocity of "A" after the explosion** (1 POINT)

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* The value of the impulse

$\vec{J} = \vec{F} \times t \rightarrow \vec{J} = 20\,\vec{i}\ \text{N} \times 6\,\text{s} \Rightarrow \boxed{\vec{J} = 120\,\vec{i}\ (\text{N.s})}$

* The final linear momentum (before the explosion)

$\vec{J} = \Delta\vec{p} = \vec{p}_{final} - \vec{p}_{initial}$

$\vec{p}_{initial} = 16\,\text{Kg} \times 5\,\vec{i}\,(\text{m/s}) =$
$= 80\,\vec{i}\ (\text{Kg}\cdot\text{m/s})$

$120\,\vec{i}\ (\text{N.s}) = \vec{p}_{final} - 80\,\vec{i}\ (\text{Kg.m/s})$

$\boxed{\vec{p}_{final} = 200\,\vec{i}\ \frac{\text{Kg.m}}{\text{s}}}$

* v_A after the explosion

$\vec{p}_{initial} = \vec{p}_{final}$

$200\,\vec{i}\ \frac{\text{Kgm}}{\text{s}} = 10\,\text{Kg} \times \vec{v}_A + 6\,\text{Kg} \times 20\,\vec{i}\,(\text{m/s})$

$200\,\vec{i}\ \frac{\text{Kgm}}{\text{s}} = 10\,\text{Kg} \times \vec{v}_A + 120\,\vec{i}\ \frac{\text{Kgm}}{\text{s}}$

$80\,\vec{i}\ \frac{\text{Kgm}}{\text{s}} = 10\,\text{Kg} \times \vec{v}_A$

$\vec{v}_A = \frac{80\,\vec{i}\ \text{Kg.m/s}}{10\,\text{Kg}} \rightarrow \boxed{\vec{v}_A = 8\,\vec{i}\ (\text{m/s})}$