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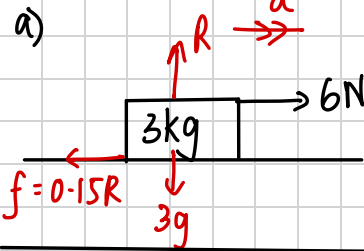
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Set A

BRONZE:



$$b) \uparrow = \downarrow R = 3g \quad \text{--- (1)}$$

$$R(\rightarrow): F = ma \Rightarrow 6 - 0.15R = 3a$$

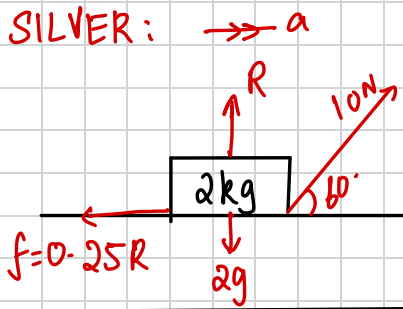
$$\Rightarrow 6 - 0.15(3g) = 3a \Rightarrow a = 0.53 \text{ m s}^{-2}$$

Given: $u = 0$ $s = s$ $t = 6$ $a = 0.53$

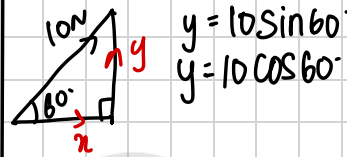
$$s = ut + \frac{1}{2}at^2 \Rightarrow s = \frac{1}{2}(0.53)(6)^2$$

$$s = 9.54 \text{ m}$$

SILVER:



Resolve 10N:



$$\uparrow = \downarrow: R + 10 \sin 60 = 20g \quad \text{--- (1)}$$

$$R(\rightarrow): F = ma$$

$$10 \cos 60 - 0.25R = 2a$$

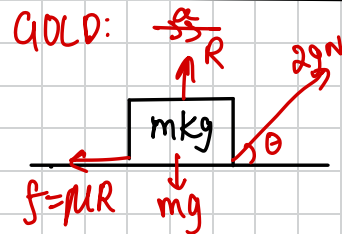
$$\Rightarrow 10 \cos 60 - 0.25(20g - 10 \sin 60) = 2a$$

$$\Rightarrow a = \frac{5 - 0.25(4 \cdot 9 - 5\sqrt{3})}{2} \Rightarrow a = \frac{2 + 2.5\sqrt{3}}{4} \text{ m s}^{-2}$$

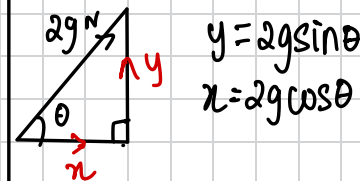
Given: $u = 0$ $t = 10$ $a = \frac{2 + 2.5\sqrt{3}}{4}$ $v = v$

$$v = u + at \Rightarrow v = \frac{2 + 2.5\sqrt{3}}{4}(10) = \frac{2 + 2.5\sqrt{3}}{4} \approx 11.3 \text{ m s}^{-1} \quad (3 \text{ sf})$$

GOLD:



Resolve 2gN:



$$\uparrow = \downarrow: R + 2g \sin \theta = mg$$

$$R = mg - 2g \sin \theta \quad \text{--- (1)}$$

$$R(\rightarrow): F = ma$$

$$2g \cos \theta - \mu R = ma$$

$$\Rightarrow 2g \cos \theta - \mu (mg - 2g \sin \theta) = ma$$

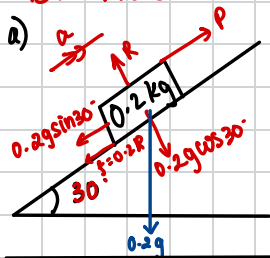
$$\Rightarrow 2g \cos \theta + 2g \sin \theta \mu - \mu mg = ma \Rightarrow a = g \left[\frac{2 \cos \theta + 2 \sin \theta \mu - \mu}{1} \right]$$

Given: $u = 0$ $v = v$ $t = t$ $a = a$

$$v = u + at \Rightarrow v = at \Rightarrow v = \left[\frac{2 \cos \theta + 2 \mu \sin \theta - \mu}{1} \right] gt$$

Set B

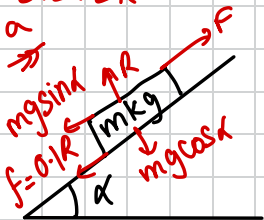
BRONZE:



b) $\uparrow = \downarrow: R = 0.2g \cos 30^\circ$
 $f = \mu R = 0.2(0.2g \cos 30^\circ)$
 $f = \frac{1}{5} \left(\frac{1}{5} g \frac{\sqrt{3}}{2} \right) = \frac{\sqrt{3}}{50} g$
 $f = \frac{49\sqrt{3}}{250} \text{ N}$

c) $a = 0.2$
 $R(\rightarrow): F = ma \Rightarrow P - 0.2g \sin 30^\circ - f = 0.2(0.2)$
 $P = \frac{1}{25} + \frac{49\sqrt{3}}{250} + \frac{49}{50}$
 $P = 1.359 \dots$
 $P = 1.36 \text{ N (3sf)}$

SILVER:



$\tan \alpha = \frac{3}{4}$

$\sin \alpha = \frac{3}{5}$

$\cos \alpha = \frac{4}{5}$

a) $\uparrow = \downarrow: R = mg \cos \alpha - \textcircled{1}$

$R(\rightarrow): f > mg \sin \alpha + \mu R$

$\Rightarrow f > mg \sin \alpha + 0.1 mg \cos \alpha$

$\Rightarrow f > mg (\sin \alpha + 0.1 \cos \alpha)$

$\Rightarrow f > mg \left[\frac{3}{5} + \frac{0.4}{5} \right] \Rightarrow f > \frac{17}{25} mg$

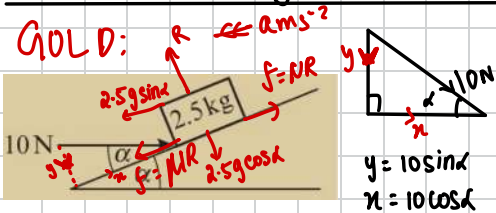
b) Given $F = 50$ $a = 1.1 \text{ ms}^{-2}$

$R(\rightarrow): F = ma \Rightarrow F - (mg \sin \alpha + 0.1R) = ma \Rightarrow 50 - \left(\frac{17}{25} mg \right) = m(1.1)$

$\Rightarrow 50 = 1.1m + \frac{17}{25} gm \Rightarrow m \left[1.1 + \frac{17g}{25} \right] = 50$

$\Rightarrow m = 6.44 \text{ kg (3sf)}$

GOLD:



$\uparrow = \downarrow: R = 10 \sin \alpha + 2.5g \cos \alpha \Rightarrow R = 2.5g \cos \alpha + 10 \sin \alpha - \textcircled{1}$

limiting equilibrium ($\uparrow = \downarrow; \rightarrow = \leftarrow$)

$\rightarrow = \leftarrow: 10 \cos \alpha = 2.5g \sin \alpha + 0.15R$ Scenario ①

$\Rightarrow 10 \cos \alpha = 2.5g \sin \alpha + 0.15(2.5g \cos \alpha + 10 \sin \alpha)$

$\Rightarrow 10 \cos \alpha = 2.5g \sin \alpha + 0.375g \cos \alpha + 1.5 \sin \alpha$ Scenario ②

$\Rightarrow 10 \cos \alpha - 0.375g \cos \alpha = 2.5g \sin \alpha + 1.5 \sin \alpha$

$\Rightarrow 6.325 \cos \alpha = 2.6 \sin \alpha$

$\Rightarrow \frac{6.325}{2.6} = \tan \alpha$

$\Rightarrow \alpha = 13.7^\circ \text{ (3sf)}$

ii) $10 \cos \alpha + 0.15(R) = 2.5g \sin \alpha$
 $10 \cos \alpha + 0.375g \cos \alpha = (2.5g - 1.5) \sin \alpha$

$\Rightarrow 13.675 \cos \alpha = 2.3 \sin \alpha$

$\Rightarrow \tan \alpha = \frac{13.675}{2.3}$

$\Rightarrow \alpha = 30.7^\circ \text{ (3sf)}$