# Page 332 Ex 13D

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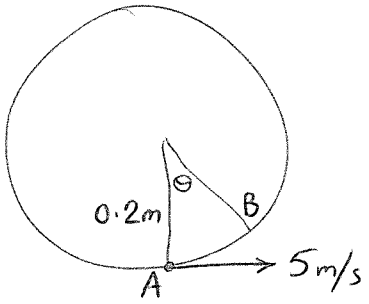


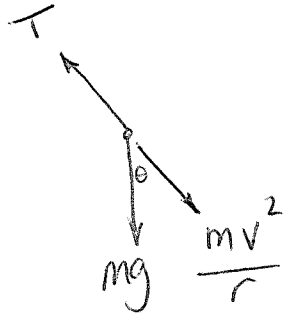


**at A**

KE + PE

$= \frac{1}{2}mv^2 + mgh$

$= \left(\frac{1}{2} \times 2 \times 5^2\right) + (0)$

$= 25\text{ J}$

**At B**

$T = \frac{mv^2}{r} + mg\cos\theta$

$= \frac{2 \times 4.88^2}{0.2} \times 2 \times 9.8 \times \cos 45$

$= 252\text{ J}$

**At B**

KE + PE

$= \frac{1}{2}mv^2 + mgr(1-\cos\theta)$

$= \frac{1}{2} \times 2v^2 + 2 \times 9.8 \times 0.2(1-\cos 45)$

$= v^2 + 1.15$

So

$25 = v^2 + 1.15$

$v = 4.88\text{ m/s}$

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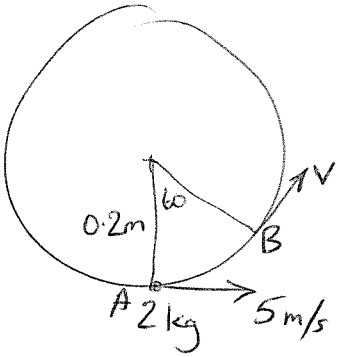



at A

KE + PE

$\frac{1}{2}mu^2 + mgh$

$= \left(\frac{1}{2} \times 2 \times 5^2\right) + (0)$

$= \underline{\underline{25\,J}}$

At B

KE + PE

$= \frac{1}{2}mv^2 + mgr(1-\cos\theta)$

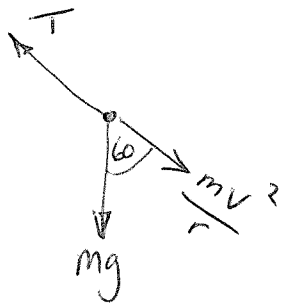
$= \frac{1}{2} \times 2 \times v^2 + 2 \times 9.8 \times 0.2(1-\cos 60)$

$= v^2 + 1.96$

$v^2 + 1.96 = 25$

$v^2 = 23.04$

$\underline{\underline{v = 4.8\ m/s}}$




$T = \frac{mv^2}{r} + mg\cos 60$

$= \frac{2 \times 23.04}{0.2} + 2 \times 9.8 \times \frac{1}{2}$

$= \underline{\underline{240.2\,N}}$

# Ex13D

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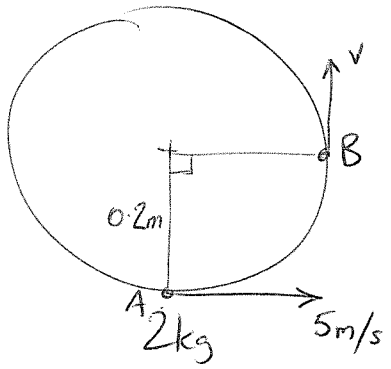



**At A**

KE + PE

$= \frac{1}{2}mu^2 + mgh$

$= \frac{1}{2} \times 2 \times 5^2$

$= \underline{25\text{ J}}$

**At B**

KE + PE

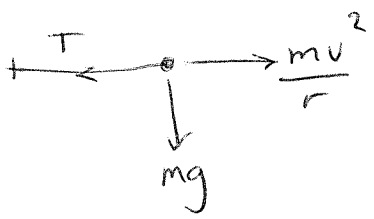
$= \frac{1}{2}mv^2 + mgr(1-\cos\theta)$

$= \frac{1}{2} \times 2 \times v^2 + 2 \times 9.8 \times 0.2(1-\cos 90)$

$= \underline{v^2 + 3.92}$

$25 = v^2 + 3.92$

$\underline{\underline{v = 4.6\text{ m/s}}}$

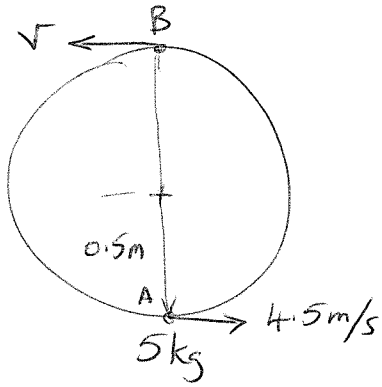



$T = \frac{mv^2}{r}$

$= \frac{2 \times (4.6)^2}{0.2}$

$= \underline{\underline{210.8\text{ N}}}$

(10)




at A

$KE + PE$

$= \frac{1}{2}mv^2 + mgh$

$= \left(\frac{1}{2} \times 5 \times 4.5^2\right) + (0)$

$= 50\frac{5}{8}$ J

At B

$KE + PE$

$= \frac{1}{2}mv^2 + mg(2r)$

$= \frac{1}{2} \times 5 \times v^2 + 5 \times 9.8 \times 1$

$= 2.5v^2 + 49$

$$50\frac{5}{8} = 2.5v^2 + 49$$

$$v = 0.81 \text{ m/s}$$

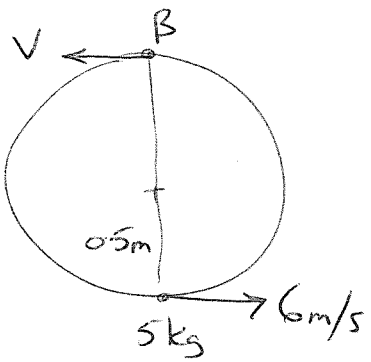

$$T = \frac{mv^2}{r} - mg$$

$$= \frac{5 \times 0.81^2}{0.5} - 5 \times 9.8$$

$$= -42.5 \text{ N}$$

ie 42.5 in compression (thrust)

11




**At A**

KE + PE

$= \frac{1}{2}mu^2 + mgh$

$= \left(\frac{1}{2} \times 5 \times 6^2\right) + (0)$

$= \underline{\underline{90\ J}}$

**At B**

KE + PE

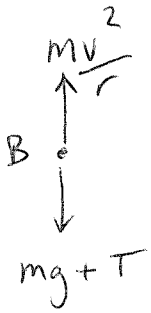
$= \frac{1}{2}mv^2 + mg(2r)$

$= \frac{1}{2} \times 5 \times v^2 + 5 \times 9.8 \times 1$

$= 2.5v^2 + 49$

$$2.5v^2 + 49 = 90$$

$$\underline{\underline{v = 4.05\ m/s}}$$

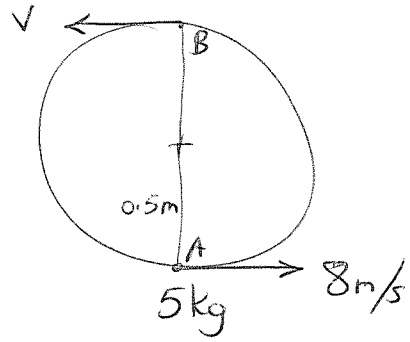



$$mg + T = \frac{mv^2}{r}$$

$$5 \times 9.8 + T = \frac{5 \times (4.05)^2}{0.5}$$

$$\underline{\underline{T = 115\ N}}\ \text{(tension)}$$

(12)




**At A**

KE + PE

$= \frac{1}{2}mv^2 + mgh$

$= \frac{1}{2} \times 5 \times 8^2 + 0$

$= 160$ J

**At B**

KE + PE

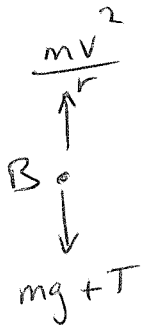
$= \frac{1}{2}mv^2 + mg(2r)$

$= \frac{1}{2} \times 5 \times v^2 + 5 \times 9.8 \times 1$

$= 2.5v^2 + 49$

$2.5v^2 + 49 = 160$

$v = 6.66$ m/s




$mg + T = \frac{mv^2}{r}$

$T = \frac{5 \times 6.66^2}{0.5} - 5 \times 9.8$

$= 395$ N tension

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# Ex 13 D

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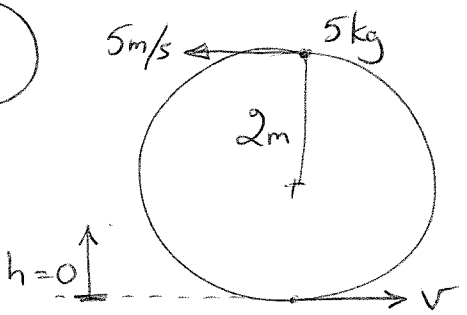



(a)

At ~~Bott~~ Top

KE + PE

$= \frac{1}{2}mu^2 + mgh$

$= \left(\frac{1}{2} \times 5 \times 5^2\right) + (5 \times 9.8 \times 4)$

$= 62.5 + 196$

$= 258.5$

At ~~Top~~ Bottom

KE + PE

$= \frac{1}{2}mv^2 + mgh$

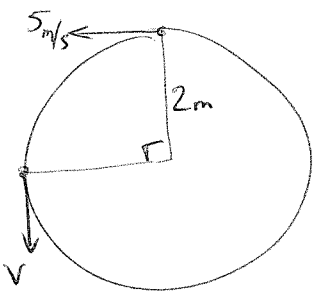
$= \frac{1}{2} \times 5 \times v^2 + 0$

$= 2.5v^2$

$2.5v^2 = 258.5$

$v = 10.2 \text{ m/s}$

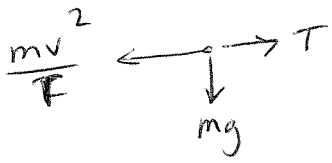
(b)




$258.5 = \frac{1}{2}mv^2 + mgr$

$258.5 = \frac{1}{2} \times 5v^2 + 5 \times 9.8 \times 2$

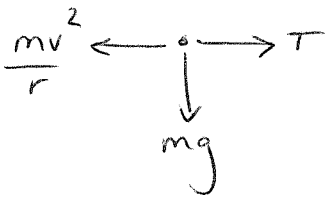
$v = 5\sqrt{3} = 8.66 \text{ m/s}$




$T = \frac{mv^2}{r} = \frac{5 \times 8.66^2}{2}$

$= \cancel{187.5\text{N}}\ 160.5\text{N}$

13 (c)



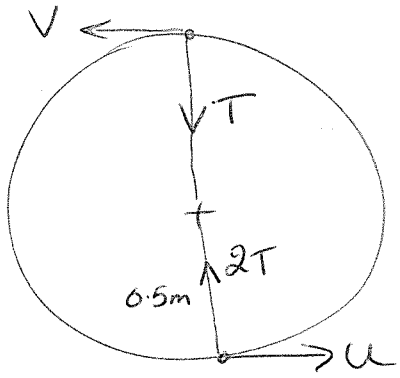

tangential acceleration (ie downwards)

$= g$

$= 9.8 \ m/s^2$

# Ex 13 D

14




$$KE + PE = KE + PE$$

$$\frac{1}{2}mu^2 + 0 = \frac{1}{2}mv^2 + mg$$

$\boxed{\times \frac{2}{m}}$

$$u^2 = v^2 + 2g$$

---

**At Bottom**

$2T$ ↑

$mg + \frac{mu^2}{r}$

**At Top**

$\frac{mv^2}{r}$ ↑

$T + mg$

$$2T = mg + \frac{mu^2}{r}$$

$$T = \frac{mv^2}{r} - mg$$

$\times 2$

$$2T = \frac{2mv^2}{r} - 2mg$$

---

~~equating~~

$$\cancel{\frac{2mv^2}{r} - 2mg = mg + \frac{mu^2}{r}}$$

See next page!

(14) continued

$$\frac{2mv^2}{r} - 2mg = mg + \frac{mu^2}{r}$$

$$\frac{2mv^2}{r} - \frac{mu^2}{r} = 3mg$$

$\times \frac{r}{m}$

$$2v^2 - u^2 = 3gr$$

(earlier we derived $u^2 = v^2 + 2g$)

$$2v^2 - (v^2 + 2g) = 3gr$$

$$v^2 - 2g = 3gr$$

$$v^2 = 3gr + 2g \qquad \left(r = \tfrac{1}{2}\right)$$

$$v^2 = \frac{3g}{2} + 2g$$

$$= \frac{3g}{2} + \frac{4g}{2}$$

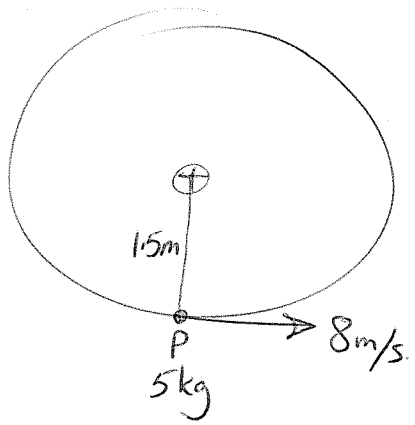
$$v^2 = \frac{7g}{2}$$

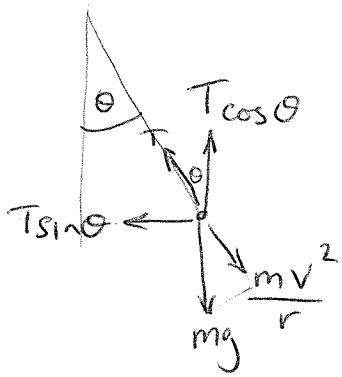
$$u^2 = v^2 + 2g$$

$$u^2 = \frac{7g}{2} + 2g = \frac{11g}{2}$$

# Page 332 Ex 13D

(16)




$$KE + PE = KE + PE$$

$$\frac{1}{2}mu^2 + 0 = \frac{1}{2}mv^2 + mgr(1-\cos\theta)$$

$$u^2 = v^2 + 2gr(1-\cos\theta)$$

$$v^2 = u^2 - 2gr(1-\cos\theta)$$

$$T = \frac{mv^2}{r} + mg\cos\theta = 0$$ when tension is zero.

$$\frac{m\left(u^2 - 2gr(1-\cos\theta)\right)}{r} + mg\cos\theta = 0$$

$$u^2 - 2gr(1-\cos\theta) + gr\cos\theta = 0$$

$$u^2 - 2gr + 2gr\cos\theta + rg\cos\theta = 0$$

$$\cos\theta(2gr + gr) = 2gr - u^2$$

(16) continued

$$\cos\theta = \frac{2gr - u^2}{3gr}$$

$$= \frac{(2\times 9.8\times 1.5) - 8^2}{3\times 9.8\times 1.5}$$

$$= -0.785$$

$$\theta = 180 - 38.3^\circ$$

$$= \underline{\underline{141.7^\circ}}$$

$$v^2 = u^2 - 2gr(1-\cos\theta)$$

$$= 8^2 - 2\times 9.8\times 1.5(1+0.785)$$

$$= 11.5$$

$$\underline{\underline{v = 3.4\ m/s}}$$

# Ex13D

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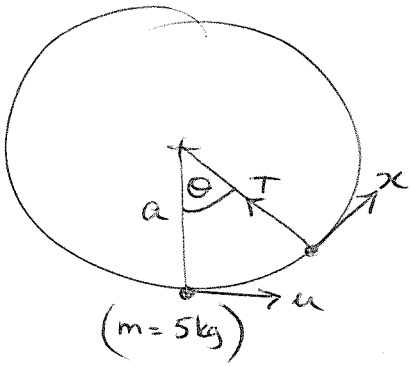


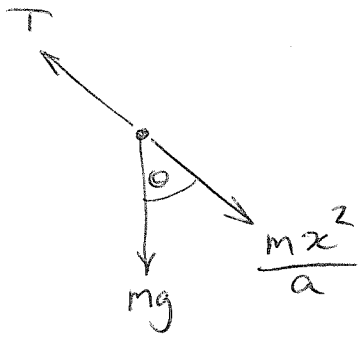


$$KE + PE = KE + PE$$

$$\frac{1}{2}mu^2 + 0 = \frac{1}{2}mx^2 + mga(1-\cos\theta)$$

$$u^2 = x^2 + 2ga(1-\cos\theta)$$

$$x^2 = u^2 - 2ga + 2ga\cos\theta$$

$$T = \frac{mx^2}{a} + mg\cos\theta$$

$$= \frac{m}{a}(u^2 - 2ga + 2ga\cos\theta) + mg\cos\theta$$

$$= \frac{5u^2}{a} - 10g + 10g\cos\theta + 5g\cos\theta$$

$$T = 15g\cos\theta + \frac{5u^2}{a} - 10g$$