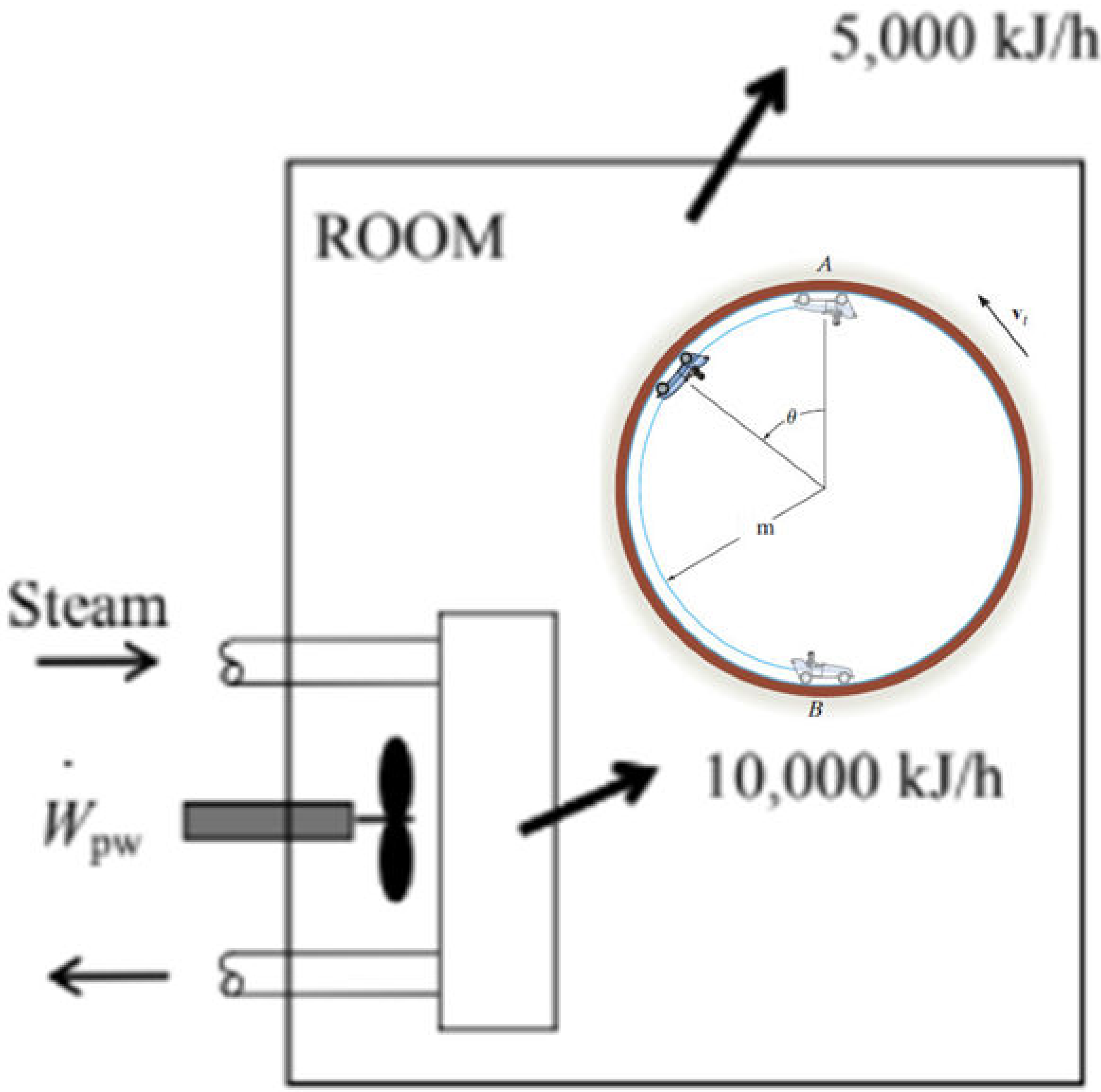

The "flying car" is a ride at a model amusement park, in a room which consists of a car having wheels that roll along a track mounted inside a rotating drum. By design the car cannot fall off of the track. However, motion of the car is developed by applying the car's break, thereby gripping the car to the track and allwoing it to move with a constant speed of the track. Vt= 3m/s. If the rider applies the brake when going from B to A and then releases it at the top of the drum, A, so that the car coasts freeley down along the track to B (theta= pi rad), determine the speed of the car at B and the height of the car at B. Neglect friction during the motion from A to B. The rider and car have a total mass of 2.3kg and the center of mass of the car and rider moves along a circular path having a raduis of 1.2m. The car and rider can be represented by a block that is 15cm high and 20cm long at the beginning of the day when the temperature is 10ºC. The room is a 4mx5mx7m room. The the heater is switched in and the radiator of the steam-heating system heats the room at a rate of 10000kJ/h and a 100W fan is used to distribute the warm air in the room. The rate of heat loss form the room is estimated to be about

5000kJ/h. If the initial temperature of the room is 10ºC, and the heater is left on for 831s, what is the height of the block (car) after 831s? Assume constant specific heats at room temperature.

**Kies op as positief $\uparrow +$

```
format long;
```

Die massa m is:

```
m= 2.3; %kg
```

V_t is:

```
Vt= 3 %m/s
```

```
Vt =
     3
```

α is die Termiese Uitsettings Koëffisient:

```
alpha = 11*10^(-6);
```

E is die Materiaal Styfheid of Young's Modulus of Modulus van Elastisiteit:

```
E= 22.1*10^9;
```

ρ is die Digtheid:

```
rho=2380;    %kh/m^3 Digtheid
```

a = gravitasie versnelling

```
g= 9.81;    % Gravitasieversnelling
```

r is die radius van die baan:

```
r= 1.2; %m
```

By punt B is $\theta =$

```
theta= pi %rad
```

```
theta =
   3.141592653589793
```

h is die oorspronklike hoogte van die kar:

```
h=0.015;       % Hoogte
```

x is die lengte van die kar:

```
x= 0.02; % m
```

$m = \rho V$

$V = \dfrac{m}{\rho}$

$\mathrm{xyL} = \dfrac{m}{\rho}$

$y = \dfrac{m}{\rho \mathrm{Lx}}$

y is die breedte van die kar:

```
y= m/(rho*h*x) % m
```

```
y =
   3.221288515406163
```

A is die Area:

```
A=x*y       % Area m
```

```
A =
   0.064425770308123
```

TOEGEPAS:

Die reguit lun verplasing s is:

```
deltaS = r*2
```

```
deltaS =
   2.400000000000000
```

Die tangente versnelling by punt B:

$V_B{}^2 \ = \ V_t^{\ 2} + 2g\Delta s$

$V_B = \sqrt{V_t^2 + 2g\Delta s}$

```
VB= sqrt(Vt^2+ 2*g*deltaS) %m/s
```

```
VB =
   7.489192212782364
```

Die 'centrepetal' versnelling is:

$a_n = \dfrac{V_B{}^2}{r}$

```
an=VB^2/r
```

```
an =
  46.740000000000009
```

Die krag F_B as gevolg van die beweging is:

```
FB= m*an
```

```
FB =
     1.075020000000000e+02
```

Enter your equation.

TERMODINAMIKA:

```
T1= 10; % deg C
T1K= 10+273.15 %K
```

```
T1K =
     2.831500000000000e+02
```

Die Volume van die kamer is:

```
Vkamer= 4*5*7
```

```
Vkamer =
   140
```

Die Atmosferiese Druk is:

```
Patm= 101.325; %kPa
P1= Patm;
```

R_{air} is:

```
Rair=0.2870; %kPam^3/kgK
```

tyd is:

```
time= 831; %s
```

Drywing gebruik deur die waaier is:

```
Dfan= 100*10^-3; % kW
```

c_v at 200K (room temperature) on Table A-2 is:

```
cv= 0.718; %kJ/kg.K
```

Radiator heat transfer rate is:

```
radiatorhtr= 10000/3600; % kJ/s
```

Rate of heat lost form the room is:

```
roomhloss= 5000/3600; % kJ/s
```

So Calculate T2:

$E_{\text{in}} - E_{\text{out}} = \Delta E_{\text{system}}$

$Q_{\text{in}} + W_{\text{in}} - Q_{\text{out}} = \Delta U \approx mc_v(T_2 - T_1)$ (assume KE=PE=0)

$(\mathrm{Q}_{\text{in}} + \dot{W}_{\text{in}} - \mathrm{Q}_{\text{out}})\Delta t = \Delta U \approx mc_v(T_2 - T_1)$

$(\mathrm{Q}_{\text{in}} + \dot{W}_{\text{in}} - \mathrm{Q}_{\text{out}})\Delta t = mc_v(T_2 - T_1)$

$$(\mathrm{Q}_{\text{in}} + \dot{W}_{\text{in}} - \mathrm{Q}_{\text{out}})\frac{\Delta t}{mc_v} = (T_2 - T_1)$$

$$(\mathrm{Q}_{\text{in}} + \dot{W}_{\text{in}} - \mathrm{Q}_{\text{out}})\frac{\Delta t}{mc_v} + T_1 = T_2$$

$T_2 = T_1 + (\mathrm{Q}_{\text{in}} + \dot{W}_{\text{in}} - \mathrm{Q}_{\text{out}})\dfrac{\Delta t}{mc_v}$ and $m_{\text{air}} = \dfrac{P_1\text{Volume}}{RT_1}$

```
mair= (P1*Vkamer)/(Rair*T1K)
```

```
mair =
     1.745605836775302e+02
```

```
T2= T1+(radiatorhtr+Dfan-roomhloss)*(time/(mair*cv)) % deg C
```

```
T2 =
  19.871716692084291
```

```
deltaT= T2-T1
```

```
deltaT =
   9.871716692084291
```

STERKTELEER:

Formule vir Hoogte Verandering: $\Delta L = -\int_o^{0.015}\frac{W(x)}{\mathrm{AE}} - \frac{\mathrm{PL}}{\mathrm{AE}} + \alpha\Delta_{\mathrm{T}}L$

$-\frac{\mathrm{PL}}{\mathrm{AE}}$ is die $\Delta L_{\text{Puntlas}}$ as gevolg van die puntlas 15kN

$\alpha\Delta_{\mathrm{T}}L$ is die ΔL_{Temp} as gevolg van die Temperatuur verandering

$-\int_o^{0.015}\frac{W(x)}{\mathrm{AE}}\mathrm{dx}$ is die $\Delta L_{\text{eiegewig}}$ as gevolg van die balk se eiegewig

Die krag van die beweging op die kar is $F_B = P_{\text{Puntlas}}$

```
Ppuntlas = FB
```

```
Ppuntlas =
     1.075020000000000e+02
```

$-\frac{\mathrm{PL}}{\mathrm{AE}}$ is die $\Delta L_{\text{Puntlas}}$ as gevolg van die puntlas is:

```
deltaLPuntlas = (Ppuntlas*h)/(A*E) %N
```

```
deltaLPuntlas =
```

```
    1.132546153846154e-09
```

$\alpha\Delta_{\mathrm{T}}L$ is die ΔL_{Temp} as gevolg van die Temperatuur verandering

```
deltaLTemp = alpha*deltaT*h %m
```

```
deltaLTemp =
    1.628833254193908e-06
```

$-\int_{o}^{0.015}\frac{W(x)}{\mathrm{AE}}\mathrm{dx}$ is die $\Delta L_{\mathrm{eiegewig}}$ as gevolg van die balk se eiegewig:

In Toegepaste Wiskunde is gewig (of eiegewig):

$F_{\mathrm{eiegewig}} = \mathrm{mg} \qquad \mathrm{g} = 9.81\ \frac{m}{s^2} \qquad \mathrm{m} = \rho\mathrm{V}$

So $\quad F_{\mathrm{eiegewig}} = \rho\mathrm{Vg} \quad$ in Toegepaste Wiskunde is V= Xdeursnit x Ydeursnit x Lengte of V= Area x Lengte. Met daardie berekening word dit aangeneem dat die krag wat uitgewerk word geneem word aan die onderste punt van die objek (in hierdie geval balk). **Dit is nogsteeds die geval met hierdie balk, maar die balk se Lengte gaan verander soos wat die Temperatuur verarander en soos wat die Puntlas daarop inwerk so daarom gebruik ons eerder 'n integraal om die L voor te stel of uit te werk - alhoewel on steeds van 0m op die grandvlak to 8m bo die grondvalk in die integraal gaan in sit (Onthou Kies op as positief $\uparrow +$ in al my bewerkinge).

So

$F_{\mathrm{eiegewig}} = \ \mathrm{mg}$

$F_{\mathrm{eiegewig}} = \ \mathrm{mg}$

$F_{\mathrm{eiegewig}} = \rho\mathrm{Vg}$

$F_{\mathrm{eiegewig}} = \rho\mathrm{gAL}$

$P_{\mathrm{eiegewig}} = \rho\mathrm{gAL}$
$P_{\mathrm{interne\ aksiaal\ krag\ by\ }z}(z) = \rho\mathrm{gAz}$
$W(z) = \rho\mathrm{gAz}$

In Sterkteleer is $W(s) = \rho\mathrm{gAs}$ waar s die verplasing in die ortogonale rigting van die snit is. In hierdie geval is die vergelyking dus $W(z) = \rho\mathrm{gAz} = P(z)$ die interne aksiaalkrag by z. As jy die totale interne aksiaalkrag wil uitwerk oor die hele balk dan moet jy $W(z) = \rho\mathrm{gAz} = P(z)$ integreer oor die volle Lengte, L, van die balk.

So

$F_{\mathrm{eiegewig}} \ = \int_{o}^{L} W(z)\,\mathrm{dx} = \rho\mathrm{gA}\int_{o}^{L} z\,\mathrm{dz} = \rho\mathrm{gA}\int_{o}^{0.015} z\,\mathrm{dz}$

So volgens Toegepaste Wiskunde Berekeninge is die Feiegewig:

```
Feiegewig = rho*g*A*h %N
```

```
Feiegewig =
  22.563000000000002
```

En dus is die Normaalkrag op die kar:

```
Normaalkrag= (Ppuntlas + Feiegewig)*10^3 % kN Wat die regte antwoord is volgens Toeg Hibbeler 1
```

```
Normaalkrag =
      130065
```

En volgens Sterkteleer Berekinge is die Feiegewig:

So $W(z) =$

```
syms z;
Wz= rho*g*A*z;
```

en vir interessantheid $W(0.015) =$

```
W15= rho*g*A*0.015 %N
```

```
W15 =
  22.563000000000002
```

en so = $\int_o^L W(z)\,\mathrm{dx} = \rho \mathrm{gA} \int_o^L z\,\mathrm{dz} = \rho \mathrm{gA} \int_o^{0.015} z\,\mathrm{dz} = P_{\mathrm{eiegewig}}$

```
Feiegewig= Wz;
Peiegewig= Feiegewig;
```

So $-\int_o^{1.5} \frac{W(x)}{\mathrm{AE}}\mathrm{dx}$ is die $\Delta L_{\mathrm{eiegewig}}$ as gevolg van die balk se eiegewig

```
deltaLeiegewig = int((Peiegewig)/(A*E), 0, h);
vpa(deltaLeiegewig)
```

ans = $0.00000000011885192307692305607347338739999$

So die Finale Antwoord is:

Formule: $\Delta L = -\int_o^{0.015} \frac{W(x)}{\mathrm{AE}} - \frac{\mathrm{PL}}{\mathrm{AE}} + \alpha \Delta_{\mathrm{T}} L$

$\Delta L = -\Delta L_{\mathrm{eiegewig}} - \Delta L_{\mathrm{Puntlas}} + \Delta L_{\mathrm{Temp}}$

```
deltaL= -deltaLeiegewig - deltaLPuntlas + deltaLTemp;
vpa(deltaL)
```

ans = $0.0000016275818561169848997104716985 32$

So die nuwe Lengte (hoogte) van die kar is:

```
Lfinal = h+deltaL;
```

```
vpa(Lfinal) %In m
```

ans = 0.015001627581856116984899710471699

***EK WIL NOU GRAAG HIERDIE PLOT OP 'N WISKUNDIGE 3D MANIER... EK WIL BYVOORBEELD 'N VERANDERING MAAK AAN DIE GROTE VAN DIE PUNTLAS EN DAN VISUEEL KAN SIEN DAT DIE BALK NOU KORTER OF LANGER IS...

```
%Z= [linspace(0,L);
%    linspace(0,L)];
%x= linspace(0, x);
%y= linspace(0, y);
%[X,Y]= meshgrid(x,y);
%surf(X,Y,z)
```