Computational Engineering Mechanics 2

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Project

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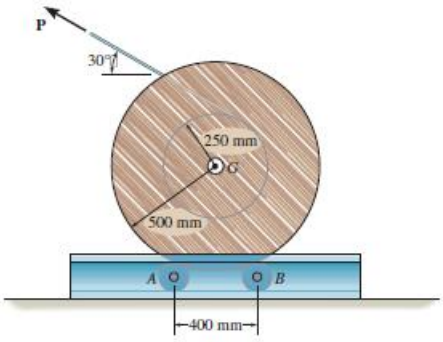
Problem 1: Description

A force of P = 20 N is applied to the cable, which causes the 175-kg reel to turn since it is resting on the two rollers A and B of the dispenser. Determine the angular velocity of the reel after it has made two revolutions starting from rest. Neglect the mass of the rollers and the mass of the cable. The radius of gyration of the reel about its center axis is k_G = 0.42 m.



Solution:

Sol'n) $T_1 + \Sigma U_{1-2} = T_2$

$0 + 20(2)(2\pi)(0.250) = \frac{1}{2}[175(0.42)^2]\omega^2$

$\omega = 2.02 \text{ rad/s}$

MATLAB CODE:

```
syms p
syms m
syms r
syms k
syms w
syms T1
syms T2
T1=0
syms M
syms N
syms n
M=p*r
o=2*2*3.14
p=20
r=0.250
M=p*r
U=M*o
m=175
k=0.42^2
I=m*k
syms T1
syms T2
T1=0
w=sqrt(125.6/I)
```

Output (Screen Shot of MATLAB)

```
T1 = 0


M = p r
o = 12.5600
p = 20
r = 0.2500
M = 5
U = 62.8000
m = 175
k = 0.1764
I = 30.8700


T1 = 0
w = 2.0171
```

Problem 2: Description

If a horizontal force of P = 100 N is applied to the 300-kg
reel of cable, determine its initial angular acceleration.
The reel rests on rollers at A and B and has a radius of
gyration of kO = 0.6 m.

Solution:

Sol 2.) Equations of Motions

mass moment of inertia of the wheel about o is

$$I_0 = MK_0^2 = 300(0.6)^2$$
$$= 108 kg\,m^2$$

$$\Sigma M_0 = I_0 \alpha \qquad -100(0.75) = 108(-\alpha)$$

$$\alpha = 0.6944\ rad/s^2$$
$$= 0.694\ rad/s^2 \text{ //}$$

MATLAB CODE:

```
syms p
syms ko
syms m
m=300
k=0.6^2
I=m*k
syms alpha
p=100
r1=0.75
MO=p*r1
MO=I*alpha
MO=75
alpha=75/108
```

Output (Screen Shot of MATLAB)

```
m = 300
k = 0.3600
I = 108
p = 100
r1 = 0.7500
MO = 75
```

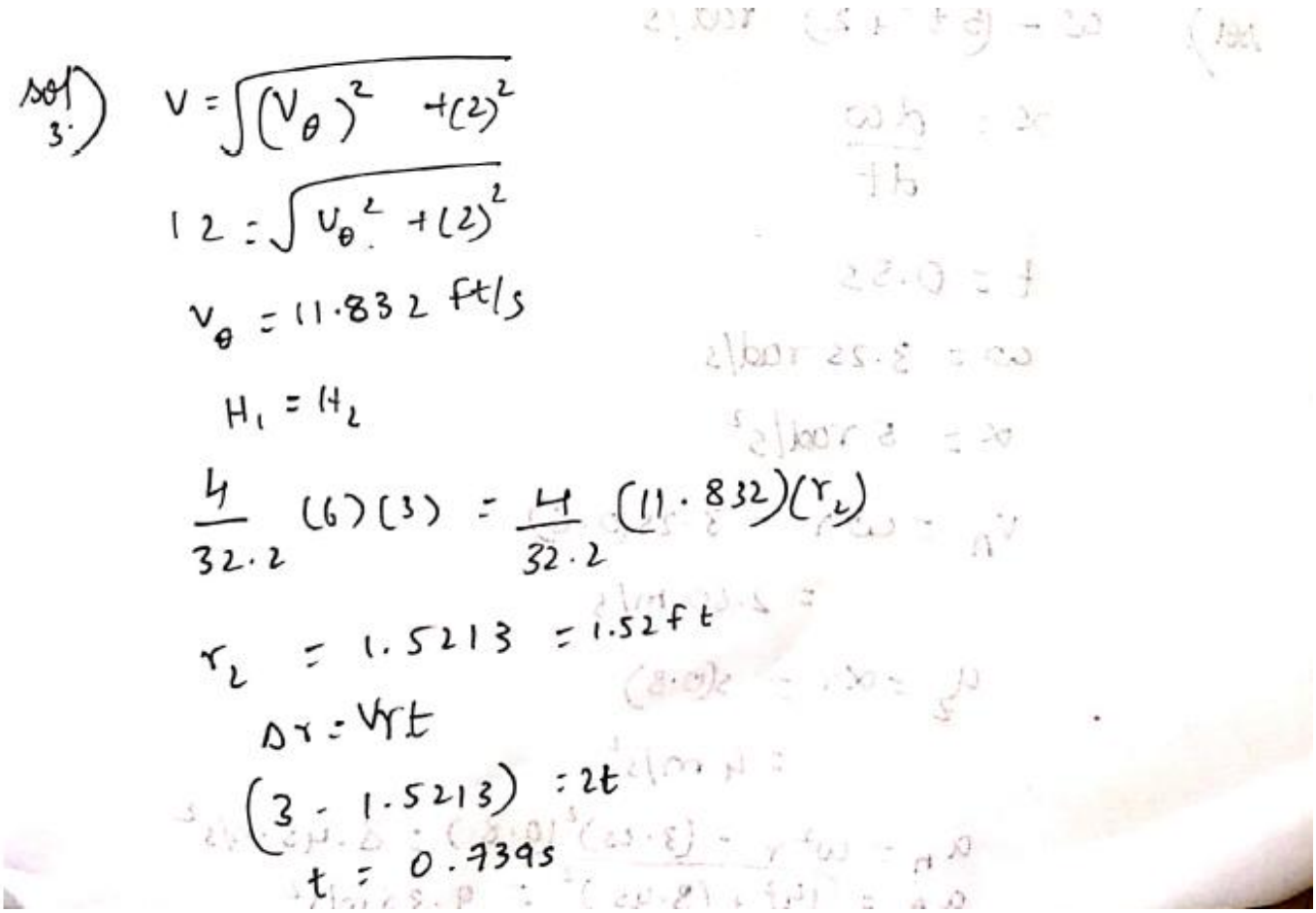
$$MO = 108\,\alpha$$

```
MO = 75
alpha = 0.6944
```

Problem 3: Description

A 4-lb ball B is traveling around in a circle of radius $r_1 = 3$ ft with a speed $(v_B)_1 = 6$ ft/s. If the attached cord is pulled down through the hole with a constant speed $v_r = 2$ ft/s, determine how much time is required for the ball to reach a speed of 12 ft/s. How far r_2 is the ball from the hole when this occurs? Neglect friction and the size of the ball.

Solution:



MATLAB CODE:

```
syms t v v_theta r2;
r1=3;
v_r=2;
v_theta=solve(subs(v==sqrt((v_theta)^2+2^2),v,12),v_theta);
v_theta=max(v_theta);
H_1=4/32.2*6*3;
H_2=4/32.2*11.832*r2
r2=solve(H_1==H_2,r2)
delt_r=r1-r2;
t=solve(delt_r==v_r*t,t)
```

Output (Screen Shot of MATLAB)

```
H_2 =
```

$$\frac{5916\, r_2}{4025}$$

```
r2 =
```

$$\frac{750}{493}$$

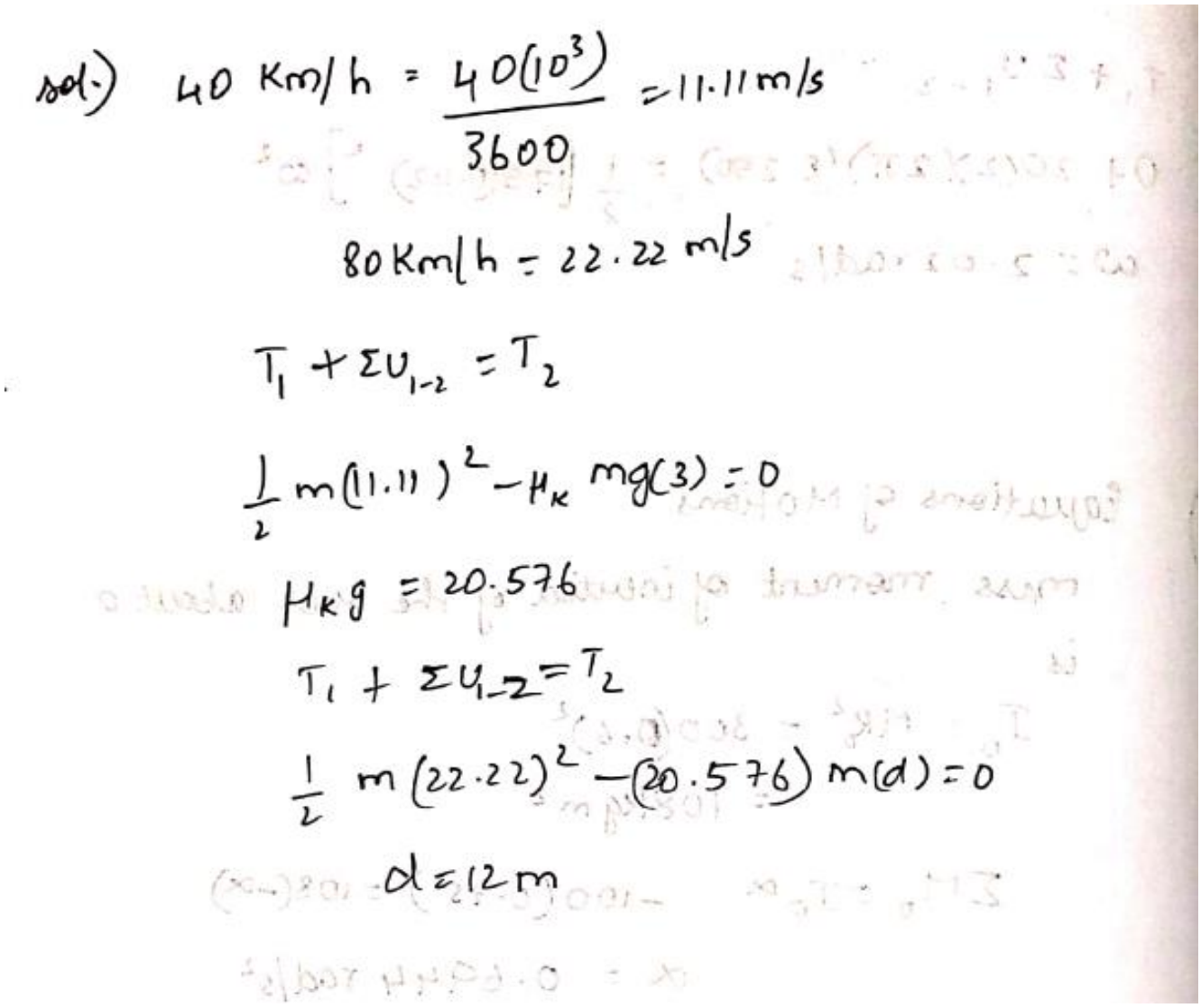
```
t =
```

$$\frac{729}{986}$$

Problem 4: Description

When the driver applies the brakes of a light truck traveling
40 km/h, it skids 3 m before stopping. How far will the truck
skid if it is traveling 80 km/h when the brakes are applied?

Solution:



sol.) $40\ \text{Km/h} = \frac{40(10^3)}{3600} = 11.11\ \text{m/s}$

$80\ \text{Km/h} = 22.22\ \text{m/s}$

$T_1 + \Sigma U_{1-2} = T_2$

$\frac{1}{2} m(11.11)^2 - \mu_k mg(3) = 0$

$\mu_k g = 20.576$

$T_1 + \Sigma U_{1-2} = T_2$

$\frac{1}{2} m(22.22)^2 - (20.576)\, m(d) = 0$

$d = 12\ \text{m}$

MATLAB CODE:

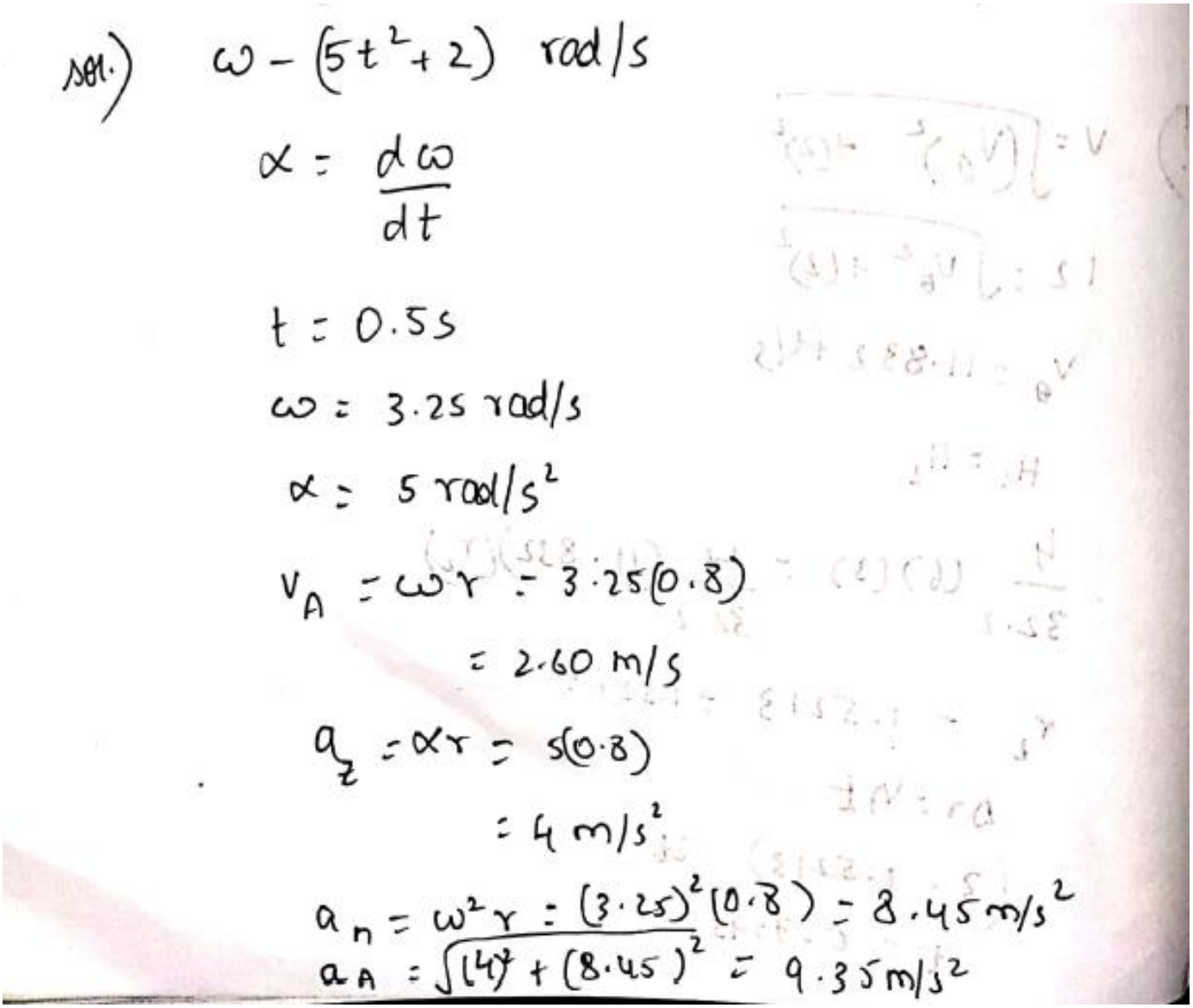
```
Speed1InMeterPerSecond=40*1000/3600;
syms u m g ;
Work_by_friction = u*m*g*3;
T_1= (1/2)*m*(Speed1InMeterPerSecond)^2;
U_1to2= -u*m*g*3;
T_2=0;
eqn= T_1+U_1to2==T_2;
u=solve(eqn,u);
Speed2InMeterPerSecond=80*1000/3600;
syms d;
T_1=(1/2)*m*(Speed2InMeterPerSecond)^2;
U_1to2=-u*m*g*d;
T_2=0;
eqn=T_1+U_1to2==T_2;
d=solve(eqn,d)
```

Output (Screen Shot of MATLAB)

Problem 5: Description

The angular velocity of the disk is defined by $\omega = (5t^2 + 2)$ rad/s,
where t is in seconds. Determine the magnitudes of the velocity and acceleration of point A on
the disk when t = 0.5 s.

Solution:



Sol.) $\omega = (5t^2 + 2)$ rad/s

$\alpha = \frac{d\omega}{dt}$

$t = 0.5$ s

$\omega = 3.25$ rad/s

$\alpha = 5$ rad/s^2

$v_A = \omega r = 3.25(0.8)$

$= 2.60$ m/s

$a_t = \alpha r = 5(0.8)$

$= 4$ m/s^2

$a_n = \omega^2 r = (3.25)^2(0.8) = 8.45$ m/s^2

$a_A = \sqrt{(4)^2 + (8.45)^2} = 9.35$ m/s^2

MATLAB CODE:

```
t=0.5;
r=0.8;
w=(5*t*t+2);
a=10*t;
va=w*r;
az=a*r;
an=w*w*r;
aa=sqrt(az*az+an*an);
disp(aa);
```

Output (Screen Shot of MATLAB)

```
t=0.5;
r=0.8;
w=(5*t*t+2);
a=10*t;
va=w*r;
az=a*r;
an=w*w*r;
aa=sqrt(az*az+an*an);
disp(aa);
```

```
9.3489
```

References:

Russel C.Hibbler-Engineering Mechanics _Statics & Dynamics (textbook)

https://matlab.mathworks.com/

www.wikipedia.com

www.google.com

thank you