1. WHAT IS THE FIELD EFFICIENCY OF A TWO-WHEEL TRACTOR WITH ROTOTILLER AS IMPLEMENT GIVEN THE FOLLOWING TESTS RESULTS DATA:

TEST AREA = 25x20m

ROTOTILLER WIDTH OF CUT = 700mm

TOTAL TIME OF TESTING = 30min.

NO. OF TURNS FROM HEADLAND TO HEADLAND (ONE LOOP) = 60 rounds

SPEED = 40m/min

GIVEN:

Area = $25 \times 20\,m = 500\,m^2$

Width = $700\,mm \times \frac{1\,m}{1000\,mm} = 0.7\,m$

Speed = 40m/min

SOLUTION:

Theoritical Time $= \frac{A}{W \times S}$

$= \frac{500\,m^2}{(0.7\,m)(40\,m/min)}$

T.T = 17.86 min

Field Eff = $\frac{TFC}{AFC} \times 100$

$= \frac{17.86\,min}{30\,min} \times 100$

$\boxed{\text{Field Eff} = 59.53\%}$

2. ACCORDING TO THE WIND ATLAS, AN AGRICULTURAL AREA DETERMINES A 9m/s WIND SPEED. DETERMINE THE THEORITICAL POWER AND MAXIMUM POSSIBLE POWER THAT CAN BE PRODUCED BY THE WIND TURBINE W/ 6 BLADES THAT ARE EACH 2.5m LONG. ASSUME THE WIND TURBINE IS AT SEA LEVEL?

GIVEN:

$V_W = 9\,m/s$

$r = 2.5\,m$

SOLUTION:

$P_t = ?$

$P_{max} = ?$

$P_t = \frac{1}{2} \rho A V^2$

$= \frac{1}{2} \left(1.225 \frac{kg}{m^3}\right)\left(\pi (2.5\,m)^2\right)(9\,m/s)^3$

$P_t = 8767.25\,W \times \frac{1\,kW}{1000\,W}$

$\boxed{P_t = 8.77\,kW}$

$P_{max} = P_t \times C_p$

$= 8.77\,kW \times \frac{16}{27}$

$\boxed{P_{max} = 5.197 \approx 5.20\,kW}$

3. THE AMIHAN 63V32, A 1.25MW WIND TURBINE, HAS THREE BLADES AND ROTOR DIAMETER OF 120m WHICH ROTATES AT 12rpm UNDER 18 m/s WIND SPEED. WHAT IS THE TIP SPEED RATIO FOR THIS TURBINE? HOW DOES THIS COMPARE TO THE 'OPTIMAL' TIP SPEED RATIO OF THE TURBINE.

GIVEN:

RATED POWER = 1.25MW
\# of BLADES = 3
VELOCITY = 18 m/s
DIAMETER = 120m
ROT. SPEED = 12rpm

SOLUTION:

- TSR = ?
- TSR of OPTIMAL TSR

$$\ell = \frac{\text{BLADE TIP RATIO}}{\text{WIND VELOCITY}}$$

$$BTR - \omega r = 2\pi f \times r$$

$$= 2\pi \left(12rpm \times \frac{1hz}{60rpm} \right) \times \frac{120}{2}$$

$$BTR = 75.398 m/s$$

$$\boxed{\ell = \frac{75.398 m/s}{18 \ m/s} = 4.19}$$

$$\text{OPTIMAL TSR} = \frac{4\pi}{\text{no. of blades}} = \frac{4\pi}{3}$$

$$\boxed{OP.TSR = 4.19}$$

4. AT A HEIGHT OF 6m, WATER FALLS AT A RATE OF 110L/s. DETERMINE THE THEORITICAL POWER THAT CAN BE PRODUCED

GIVEN:

H = 6m
Q = 110lps

SOLUTION:

$$P_t = \frac{QH}{102}$$

$$= \frac{(110lps)(6m)}{102}$$

$$\boxed{P_t = 6.47 KW}$$

5. A STREAM HAD THE FOLLOWING DATA: AVERAGE WIDTH OF 10ft; AVERAGE DEPTH = 1.5ft, VELOCITY = 12ft/min, HEAD = 4.5ft WHAT IS THE THEORITICAL POWER AVAILABLE FROM THE STREAM?

GIVEN:

AREA = 10ft × 1.5ft = $15ft^2$

VELOCITY = 12ft/min

HEAD = 4.5ft

SOLUTION:

$Q = VA$

$P_t = \rho Q H$

$Q = (12 ft/min)(15 ft^2)$

$Q = 180\ ft^3/min$

$P_t = \rho Q H$

$= (62.4\ lb/ft^3)(180\ ft^3/min)(4.5ft)\left(\frac{1min}{60s}\right)\left(\frac{1hp}{550\ lb \cdot ft/s}\right)$

$\boxed{P_t = 1.53\ hp}$

6. DETERMINE THE TIME (hours) TO PLOW A HECTARE FIELD USING 16cm ANIMAL-DRAWN PLOW WITH AN AVERAGE DEPTH OF CUT OF 10cm TRAVELING AT A SPEED OF 3.0kph AND EFFICIENCY OF 30%. WHAT IS THE TOTAL DISTANCE (km) TRAVELED BY THE FARMERS UPON COMPLETION OF THE PLOWING OPERATION. IF THE DRAFT REQUIRED TO PULL THE PLOW IS 40kg. DETERMINE THE COMBINED POWER OUTPUT OF THE MAN AND ANIMAL IN KILOWATT.

GIVEN:

W = 16cm = 0.16m

D = 10cm = 0.10m

S = 3.0kph

Eff = 90% = 0.90

Draft = 40kg

SOLUTION

$C = \frac{SWEff}{10}$

$= \frac{(3.0kph)(0.16m)(0.90)}{10}$

$C = 0.0432\ ha/hr$

$Time = \frac{1}{C}$

$= \frac{1}{0.0432}$

$T_c = 23.15\ hr/ha$

$A = \frac{WD}{10} \rightarrow 1ha = \frac{0.16D}{10}$

$D = 62.5\ km$

If Draft is missing

$A = \frac{WDEff}{10}$

$1ha = \frac{(0.16)D(0.90)}{10}$

$D = 69.44$

Power $\Rightarrow hp = \frac{DS}{274} = \frac{(40kg)(3.0)}{274}$

$hp = 0.4379\ hp \times \frac{0.746\ kW}{1hp} \rightarrow \boxed{hp = 0.3267\ kW}$

7. HOW LONG WILL IT TAKE (in hours) TO PLOW A 4ha FIELD USING A 200mm ANIMAL-DRAWN PLOW WITH AN AVERAGE DEPTH OF CUT OF 120mm, TRAVELING AT A SPEED OF 1.86 mph AND A FIELD EFFICIENCY OF 75%?

GIVEN:

A = 4ha

W = 200 mm = 0.2m

D = 120mm = 1.2m

Eff = 75% = 0.75

S = 1.86 mph

SOLUTION:

$$T_c = \frac{SW\,Eff}{10}$$

$$= \frac{\left(1.86\,mph \times \frac{1.61\,km}{1m}\right)(0.2)(0.75)}{10}$$

$$T_c = 0.0449\ ha/hr$$

$$T_c = \frac{A}{T} \rightarrow T = \frac{A}{T_c} = \frac{4ha}{0.0449\,ha/hr}$$

$$\boxed{T = 89.09\,hr}$$

8. AN ENGINE HAVING A COMPRESSION RATIO OF 8:1, STROKE OF 7.14cm AND A BORE DIAMETER OF 3cm WAS USED AS PRIME MOVER FOR FIELD OPERATION. WHAT SHOULD BE THE CLEARANCE VOLUME TO ACHIEVE THIS RATIO?

GIVEN:

$CR = 8:1 = \frac{8}{1}$

L = 7.14cm

D = 3cm

SOLUTION:

$$CR = \frac{TV}{CV}$$

$$\frac{8}{1} = \frac{TV}{CV} \rightarrow 8CV = TV$$

$$PD = \frac{\pi D^2 L}{4}$$

$$= \frac{\pi (3cm)^2 (7.14cm)}{4}$$

$$PD = 50.47cc$$

$$TV = PD + CV$$

$$8CV = 50.47cc + CV$$

$$8CV - CV = 50.47$$

$$\frac{7CV}{7} = \frac{50.47cc}{7}$$

$$\boxed{CV = 7.209 \approx 7.21cc}$$

9. AN 4x8cm, 7hp, 4-STROKE SINGLE CYLINDER COMPRESSION IGNITION ENGINE IS OPERATING AT 1400rpm. IF THE CLEARANCE VOLUME IS 20cc, DETERMINE THE FOLLOWING:

a) PISTON DISPLACEMENT
b) COMPRESSION RATIO
c) TORQUE
d) AVERAGE PISTON SPEED

GIVEN:

D = 4cm
L = 8cm
N = 1400rpm
CV = 20cc

SOLUTION

a.) $PD = \frac{\pi D^2 L}{4}$

$= \frac{\pi (4cm)^2 (8cm)}{4}$

$\boxed{PD = 100.53cc}$

$TV = PD + CV$

$TV = (100.53 + 20)cc$

$TV = 120.53cc$

b.) $\frac{TV}{CV} = CR = \frac{120.53cc}{20cc}$

$\boxed{CR = 6.03 \approx \frac{6}{1}}$

c.) $P = 2\pi TN$

$\frac{746W}{1hp} \times 7hp = 2\pi T (1400rpm) \times \frac{1min}{60sec}$

$\boxed{T = 36.1 \ N \cdot m}$

d.) $Sp = 2LN$

$= 2(8cm)(1400rpm)$

$\boxed{Sp = 22{,}400}$

10. IF IT IS THE DESIRED TO REDUCE THE FORWARD SPEED OF THE TWO-WHEEL TRACTOR TO 3Kph, WHAT SHOULD BE THE DIAMETER OF D2 IF D1 & N1 REMAIN THE SAME?

1st REDUCTION	2nd REDUCTION	3rd REDUCTION	TRACTION WHEELS
N1 = 1200 RPM	N3 = 477.45RPM	N5 = 127.32rpm	N7 = 31.83rpm
N2 = 477.45RPM	N4 = 127.32RPM	N6 = 31.83 rpm	D7 = 50cm
D1 = 10cm	T3 = 20 TEETH	T5 = 25 TEETH	SPEED = 3Kph
D2 = 25.13cm	T4 = 75 TEETH	T6 = 100 TEETH	

SOLUTION

$V_w = \pi D7 N7$

$3kph = \pi (50cm) N7 / 1000 \times 60$

$\boxed{N7 = 31.83 \ RPM}$

$N7 = N6$

$N5T5 = N6T6$

$N5 = \frac{N6T6}{T5} = \frac{(31.83RPM)(100t)}{25t}$

$\boxed{N5 = 127.32rpm}$

$N5 = N4$

$N4T4 = N3T3$

$N3 = \frac{N4T4}{T3} = \frac{(127.32rpm)(75t)}{20t}$

$\boxed{N3 = 477.45 \ rpm}$

$N3 = N2$

$N_1 D_1 = N_2 D_2$

$D_2 = \frac{N_1 D_1}{N_2} = \frac{(1200rpm)(10cm)}{477.45rpm}$

$\boxed{D_2 = 25.13cm}$

11. DETERMINE THE FORWARD SPEED V_W OF THE TWO-WHEEL TRACTOR (kph) IF THE SPECIFICATIONS OF THE TRANSMISSION DEVICES ARE AS GIVEN BELOW

1st REDUCTION	2nd REDUCTION	3rd REDUCTION	TRACTION WHEELS
N_1 = 3000 RPM	N_3 = 1000rpm	N_5 = 250rpm	N_7 = 75rpm
N_2 = 1000rpm	N_4 = 250rpm	N_6 = 75 rpm	D_7 = 50 cm
D_1 = 10cm	T_3 = 25t	T_5 = 33t	Speed = 7.07kph
D_2 = 30cm	T_4 = 100t	T_6 = 110t	

SOLUTION:

$N_1D_1 = N_2D_2$

$N_2 = \frac{N_1D_1}{D_2} = \frac{(3000\,RPM)(10cm)}{30cm}$

$\boxed{N_3 = N_2 = 1000\,RPM}$

$N_3T_3 = N_4T_4$

$T_3 = \frac{N_4T_4}{N_3} = \frac{(250RPM)(100t)}{1000RPM}$

$\boxed{T_3 = 25t}$

$N_4 = N_5$

$N_5T_5 = N_6T_6$

$T_6 = \frac{N_5T_5}{N_6} = \frac{(250RPM)(33t)}{75RPM}$

$\boxed{T_6 = 110t}$

$V_W = \pi D_7 N_7$

$V_W = \pi\left(50cm \times \frac{1m}{100cm}\right)\left(75RPM \times \frac{1\,km}{1000m} \times \frac{60sec}{1min}\right)$

$\boxed{V_W = 7.07kph}$

12. DETERMINE THE HECTARE PLOWED PER HOUR WHEN A TRACTOR IS OPERATING AT 6.4kph AND IS PULLING FOUR 36cm MOLDBOARD BOTTOMS AT A DEPTH OF 20cm. HOW MANY HECTARES CAN BE PLOWED IN 10 HOURS IF FIELD EFFICIENCY IS 78%? IF THE SOIL IS CLAY LOAM, WHAT IS THE DRAFT REQUIRED WORKING THE SOIL? DRAFT Hp REQUIREMENT? TRACTOR Hp REQUIREMENT?

GIVEN:

$S = 6.4kph$

$W = 4 \times 36cm \approx 0.36m$

$D = 20\,cm \approx 0.20m$

$Eff. = 78\% = 0.78$

$t = 10hrs$

SOLUTION:

$C = \frac{SWEff}{10}$

$= \frac{(6.4kph)(4 \times 0.36m)(0.78)}{10}$

$C = 0.72\ ha/hr$

$C_{10} = 0.72\ ha/hr \times 10hrs$

$= 7.2hr$

$DS = SD \times W \times d$

$= (0.49\ kg/cm^2)(4 \times (36cm)(20cm)$

$DS = 1411.2\ kg$

$Da = Ds \times 1.42$

$= 1411 \times 1.42$

$Da = 2003.62kg$

$Hp_{draft} = \frac{Da \times S}{274} = \frac{(2003.6kg)(6.4kph)}{274}$

$\boxed{Hp_{draft} = 46.80hp}$

$Hp_{tractor} = \frac{Hp_{draft}}{0.8} = \frac{46.80hp}{0.8}$

$\boxed{Hp_{tractor} = 58.5hp}$

13. A FOUR-WHEEL TRACTOR W/ 3x36cm MOLDBOARD PLOW IS TO OPERATE ON SILTY LOAM SOIL AT A DEPTH OF 25cm. THE MAXIMUM DRAFTS OF THE TRACTORS AT DIFFERENT WORKING SPEEDS ARE GIVEN BELOW. DETERMINE THE TRACTOR HORSEPOWER

GIVEN

$W = 3 \times 36cm$

$D = 25cm$

SOLUTION

a) $D = SD \times W \times d$

$= (0.42\ kg/cm^2)(3 \times 36cm)(25cm)$

$D = 1134\ kg$

b) @ 1,300kg max draft → 7.0kph

@ 7.0kph → 147% increase

$Da = 1134 \times 147\%$

$= 1666.98kg > 1300\ kg\ max$

@ 2,200kg max draft → 5.5kph

@ 5.5kph → 134% increase

$Da = 1134 \times 134\%$

$\boxed{Da = 1519.56\ kg < 2,200\ kg\ max}$

$hp = \frac{Da \times S}{274} = \frac{1519.56kg \times 5.5kph}{274}$

$\boxed{hp_{draft} = 30.50hp}$

$hp_{Tractor} = \frac{hp\ draft}{0.8} = \frac{30.50hp}{0.8}$

$\boxed{hp_{tractor} = 38.13hp}$

14. THE FERTILITY OF A FIELD IS SUCH THAT MAXIMUM CORN YIELDS ARE OBTAINED WITH A POPULATION OF 54,000 PLANTS PER HECTARE. THE ROWS ARE 0.75m APART AND AN AVERAGE EMERGENCE OF 85% IS EXPECTED. HOW MANY SEEDS PER HILL SHOULD BE PLANTED IF THE HILLS ARE 0.5m APART?

GIVEN:

$PP = 54000\ plants/ha$

$S_{row} = 0.75m$

$A.Emergence = 85\% = 0.85$

$S_{hill} = 0.5m$

SOLUTION:

$\frac{Area}{hill} = RS \times HS$

$= (0.75m)(0.5m)$

$= 0.375m^2/hill$

$N_H = \frac{PP}{A} = \frac{10,000\ m^2/ha}{0.375m^2/hill}$

$N_H = 26,667\ hill/ha$

$Ns = \frac{PP}{AE} = \frac{54,000 plants/ha}{0.85}$

$Ns = 63,529.14\ seeds/ha$

$Ns/_H = \frac{63,529}{26,667} = 2.38$

$\boxed{\text{TOTAL NUM. OF SEEDS = 2 to 3 seeds}}$

15. USING THE SPECIFICATIONS OF THE TRANSMISSION SYSTEM OF THE METERING DEVICE OF THE TWO-ROW CORN PLANTER, DETERMINE THE HILL SPACINGS. IF THE ROW SPACING IS 0.75m AVERAGE SPEEDS PER HILL IS TWO AND EMERGENCE IS 90 PERCENT, WHAT ARE THE EXPECTED PLANT POPULATIONS PER HECTARE?

GIVEN:

$S_{Row} = 0.75m$
seeds/hill = 2
Emergence = 90%
# of rows = 2
# of cells of speed plate (SP) = 20
Ground wheel (GW) diameter = 0.60m

NO. OF TEETH	SPEED RATIO (GW/SP)
T=6	6/1
T=8	5/1
T=10	4/1
T=12	3/1

FIND

a.) HILL SPACING
b.) EXPECTED PLANT POPULATIONS

SOLUTION

Circumference of GW $= \pi D$
$= \pi(0.60m)$
$= 1.8849m$

HILL SPACING & EXPECTED PLANT POPULATION

T_1 : $HS1 = \frac{C \times SR}{SP} = \frac{1.8849m \times 6}{20}$

$\boxed{HS1 = 0.565}$

$A1 = \frac{Area}{hill} = RS \times HS$
$= 0.75 \times 0.565$
$A1 = 0.424\ m^3/hill$

$EPP1 = \frac{10{,}000m^2/ha \times seeds/hill \times Emergence}{Area/hill}$

$= \frac{10{,}000m^2/ha \times 2 \times 0.90}{0.42\ m^3/hill}$

$\boxed{EPP1 = 42{,}557\ \text{plants/ha}}$

T_2 : $HS2 = \frac{C \times SR}{SP} = \frac{1.88 \times 5}{20}$

$\boxed{HS2 = 0.47}$

$A2 = \frac{Area}{hill} = RS \times HS$
$= 0.75 \times 0.47$
$A2 = 0.3525\ m^3/hill$

$EPP2 = \frac{10{,}000m^2/ha \times 2 \times 0.90}{0.35}$

$\boxed{EPP2 = 51{,}429\ \text{plants/ha}}$

T_3 : $HS3 = \frac{C \times SR}{SP} = \frac{1.8849m \times 4}{20}$

$\boxed{HS3 = 0.37698}$

$A3 = \frac{Area}{hill} = RS \times HS$
$= 0.75 \times 0.37698$
$A3 = 0.29$

$EPP3 = \frac{10{,}000m^2/ha \times seeds/hill \times Eme}{Area/hill}$

$= \frac{10{,}000m^2/ha \times 2 \times 0.90}{0.29}$

$\boxed{EPP3 = 62{,}069\ \text{plant/ha}}$

T_4 : $HS4 = \frac{C \times SR}{SP} = \frac{1.8849m \times 3}{20}$

$\boxed{HS4 = 0.28}$

$A4 = \frac{Area}{hill} = RS \times HS$
$= 0.75 \times 0.28$
$A4 = 0.21m^3/hill$

$EPP4 = \frac{10{,}000m^2/ha \times 2 \times 0.90}{0.21}$

$\boxed{EPP4 = 85{,}714\ \text{plants/ha}}$

16. USING THE RESULTS OF THE CALIBRATION TEST OF 9x7 GRAIN DRILL, DETERMINE THE SEEDING RATE ADJUSTMENT TO USE IF IT IS DESIRED TO PLANT AT THE RATE OF 100KG PER HECTARE.

GIVEN

GROUNDWHEEL (GW) DIAMETER = 1.22m

WIDTH = 9 rows × 7in/row

NO. OF GW REV = 10

ADJUSTMENT	DISCHARGE/10 rev of GW (gm)
close	0
1/4	140
1/2	460
3/4	740
Full	1100

FIND

a) CALIBRATION CURVE

b) ADJUSTMENT at 100kg/ha

SOLUTION

$$\text{Width} = 9\text{rows} \times \frac{7\text{in}}{\text{row}} \times \frac{0.0254\text{m}}{1\text{in}}$$

$$= 1.6002\text{ m}$$

Distance → $s = \pi DN$

$$S_{10} = \pi(1.22\text{m})(10\text{rpm})$$

$$S_{10} = 38.327\text{m}$$

Area → $A = W \times S_{10}$

$$= 1.6002 \times 38.327\text{m}$$

$$A = 61.33\text{ m}^2$$

DISCHARGE FORMULA

@ 1/4

$$X_{1/4} = \frac{140\text{gm}}{1000} \times \frac{10000\text{m}^2/\text{ha}}{61.33\text{m}^2}$$

$$\boxed{X_{1/4} = 22.827 \approx 23\text{kg/ha}}$$

@ 1/2

$$X_{1/2} = \frac{460}{1000}\text{kg} \times \frac{10{,}000\text{m}^2/\text{ha}}{61.33\text{m}^2}$$

$$\boxed{X_{1/2} = 75.00 \approx 75\text{kg/ha}}$$

@ 3/4

$$X_{3/4} = \frac{740}{1000}\text{kg} \times \frac{10{,}000\text{m}^2/\text{ha}}{61.33\text{ m}^2}$$

$$\boxed{X_{3/4} = 120.65 \approx 121\text{ kg/ha}}$$

@ Full

$$X_f = \frac{1100}{1000}\text{kg} \times \frac{10{,}000\text{m}^2/\text{ha}}{61.33\text{m}^2}$$

$$\boxed{X_f = 179.357 \approx 179\text{ kg/ha}}$$

17. YOU ARE DESIGNING A SOLAR POWER SYSTEM FOR A SMALL CABIN THAT NEEDS TO GENERATE 3kwh OF ENERGY DAILY. HOW MANY 250W SOLAR PANELS (SOLAR EFF = 80%) WILL YOU NEED IF YOUR LOCATION RECIEVES AN AVERAGE OF 5hrs/day?

GIVEN

$E_{req.} = 3\text{Kw/day} = 3000\text{W}$

$N_{panel} = 250\text{W}$

$PSH = 5\text{hrs/day}$

$Eff = 80\% = 0.80$

SOLUTION

$I = P\varnothing T$, let x be the no. of panels

$$\frac{3000\text{W}}{\text{day}} = (x \cdot 250\text{W})(5\text{hrs/day})(0.80)$$

$$\boxed{x = 3\text{ panels}}$$

18. A THREE-BLADED WIND TURBINE WIND A ROTOR DIAMETER OF 10m IS LOCATED IN AN AREA WHERE THE AVERAGE WIND SPEED 8m/s. CALCULATE THE POWER EXTRACTED BY THE TURBINE AND ELECTRIC POWER THAT CAN BE GENERATED ASSUMING THE WIND TURBINE IS AT SEA LEVEL. Cp = 0.38 AND COMBINED CONVERSION EFFICIENCIES OF 42%

GIVEN

NO. OF BLADES = 3

ROTOR DIA. = 10m

$V = 8 m/s$

$C_p = 0.38$

$\eta = 42\% = 0.42$

SOLUTION

$A = \pi r^2$

$= \pi (5m)^2$

$A = 78.54 m^2$

$P_t = \frac{1}{2} \rho A V^3 \times C_p$

$= \frac{1}{2} (1.225 \frac{kg}{m^3})(78.54 m^2)(8 m/s)^3 \times 0.38$

$\boxed{P_t = 9359.45 W}$

$P_e = \eta_e \eta_m \eta_t$

$= (0.42)(9359.45)$

$\boxed{P_e = 3930.97 W}$

19. CALCULATE THE MAXIMUM LOCKED-ROTOR CURRENT (STARTING CURRENT) FOR A 4.5hp, 220Vdt, SINGLE-PHASE MOTOR, WITH H MOTOR CODE:

GIVEN

$P = 4.5 hp$

$V = 220V$

single phase

H motor code = 7.09 kVA/hp

SOLUTION

$I_{max} = \frac{P}{V}$

$= \frac{\left(7.09 kVA/hp \times \frac{1000 VA}{1 kVA}\right)(4.5 hp)}{220 V}$

$\boxed{I_{max} = 145.02 A}$

20. CALCULATE THE POWER USED BY THE ELECTRIC MOTOR to ROTATE A 10KG AT 60RPM USING A 5-INCH LEVER ARM.

GIVEN

$m = 10 kg$

$N = 60 rpm$

$L = 5 in \times \frac{0.0254 m}{1 in} = 0.127 m$

SOLUTION

$F = mg$

$= (10 kg)(9.81 m/s^2)$

$F = 98 N$

$T = FL$

$= (98.1 N)(0.127 m)$

$T = 12.46 N \cdot m$

$P = \frac{2\pi TN}{60}$

$= \frac{2\pi (12.46 N \cdot m)(60 rpm)}{60}$

$\boxed{P = 78.29 W}$