NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING AND BUILT ENVIRONMENT

DEPARTMENT OF CIVIL, MINING AND PROCESS ENGINEERING

QUALIFICATION: BACHELOR OF MINING ENGINEERING	
QUALIFICATION CODE: 08BMIN	**LEVEL: 7**
COURSE CODE: MHD721S	**COURSE NAME: MATERIALS HANDLING 324**
SESSION: NOVEMBER 2022	**PAPER: THEORY**
DURATION: 3 HOURS	**MARKS: 100**

FIRST OPPORTUNITY QUESTION PAPER	
EXAMINER(S)	**Mr H.K Hengari**
MODERATOR:	**Mr L. Madziwa**

INSTRUCTIONS
1. Answer all questions. 2. Read all the questions carefully before answering. 3. Marks for each question are indicated at the end of each question. 4. Please ensure that your writing is legible, neat and presentable.

PERMISSIBLE MATERIALS

1. Examination paper.
2. Calculator and appropriate stationery

THIS QUESTION PAPER CONSISTS OF 8 PAGES (Including this front page)

Question 1 [15 marks]

Acquiring equipment for a specific mining operation is one of the major concerns of mine planning. Equipment can be bought, rented, or leased.

a) State five (4) advantages of buying machinery over the other methods of procurement. (4 marks)
b) Consider a dozer with an ownership cost of N$ 238.20 per hour. Cost is based on assumption that the machine will work 2400 hours each year of its service life. Checking with a local rental company, the mine receives rental quotes of N$ 40 000 per month (168 hrs), N$15 600 per week (40 hrs), and N$ 5000 per day (9 hrs). What are the breakeven working hours for all four options? (16 marks)

Question 2 [20 marks]

A 15.8 m^3 shovel is used to load poorly blasted rock (1.65 t/m^3, bucket fill =0.85). Consider loading a CAT 777D truck, with a heaped volume of 60.1 m^3 and a maximum payload of 90.4 tonnes. The shovel bucket swing cycle time is 49 seconds. Dump time is 1.2 minutes. The haul distance is 7.7 km from the face to the dumping point. The ramp is 1.3 km, with a gradient of 10%. The rolling resistance of the haul road will be maintained at 5%. Both machines operate on a 50 min/hr efficiency.

a) How many buckets are needed to fill the truck? Perform a gravimetric check on the number of buckets you select (3 marks)
b) Estimate the cycle time of the truck and the balanced number of trucks (10 marks)
c) What is the overall mine production in tonnes per hour? (3 marks)
d) Discuss two (2) modifications will you make to the truck-shovel operation to increase production, without changing the size of the units. (4 marks)

Question 3 [20 marks]

Given the following data work out the design parameters of a friction sheave hoist:

Two balanced skips, tower mounted hoist.
Production rate = 500 tonnes/hr
Shaft depth = 600m
Headframe height = 30m
Hoist rope 4 flattened stranded
Skip weight = 13 tonnes
live load =13 tonnes
Hoist speed = 4 m/s
Load time = dump time = 6 sec
Acceleration = retardation = 1.29 m/s^2

Calculate the following:

a) Minimum rope diameter to be used in this operation (5 marks)
b) Rope slippage, if the friction ratio should be below 1.6. (5 marks)
c) Sheave diameter and tread pressure (5 marks)
d) Horsepower to accelerate the suspended load (5 marks)

Question 4 [20 marks]

A 1200 mm wide conveyor belt is to be designed for coal (SG =0.96) haulage up a 600 m-long 5° slope. The peak capacity is estimated to be 1,000 tph, and the belt speed will be set at 3 m/s. The belt drive will have a counterweight, lagged pulley, and a 240° arc of contact. Due to high production rates, consider heavy-duty operations.

a) Estimate the required tensions on both sides of the belt. (10 marks)
b) If the maximum allowable sag of the belt is 0.02 m, will 1.5 m and 3 m spacing for the carrying and return idlers be sufficient to support or will additional tensioning be required (6 marks)
c) Calculate the Allowable tension of the belt to suit this operation (2 marks)
d) If motor drive efficiency is assumed to be 90%, determine the power required. (2 marks)

Question 5 [20 marks]

In an underground mine, water must be pumped from the working. There are 650 m between the water source to the shaft. From there, there is a vertical height of 590 m. The mixture of water and solids has a density of 1.36 t/m^3.

a) How many pumps are needed to pump this water if the maximum power rating of the pump available is 50 kW? The pumping rate is assumed to be 0.05 m^3/s. The piping to be used has a diameter of 139 mm and a friction factor of 0. 0084. All the coupling and fittings in the system have K_L = 6.5. The efficiency of the pump is 80% and the motor that drives it at 84%. (10 marks)
b) What improvements can you suggest for this design? (5 marks)
c) What are the benefits of pit dewatering in mining operations? (5 marks)

Formula Sheet

$T_e = T_1 - T_2$	$m_G = \frac{Q}{3.6v}$	$EAC = \frac{Pi}{\left(1 - \frac{1}{(1+i)^n}\right)}$
$p = \frac{T_1 + T_2}{NDd}$	$SF = \frac{25000}{4000 + H}$	$T_e = T_2 K$
$HP1 = \frac{TSL \times V^2}{77gt_a}$	$Tension = \frac{T_{max}}{B}$	$d = \sqrt{\frac{L}{N\left(\frac{K_1}{SF} - K_2 H\right)}}$
$P = \frac{\rho g H Q}{\eta}$	$P = \frac{S}{(1+i)^n}$	$P_A = \frac{T_e V}{\eta}$
$h_L = \frac{flv^2}{2gd} + K_L \frac{v^2}{2g}$	$TSL = W_e + W_o + 2W_S + 2W_R$	$T_{c\,min} = \frac{l_c^2 (m_b + m_G) g}{8S}$
$BP = \frac{TC}{LT}$	$T_{r\,min} = \frac{l_r^2 (m_b) g}{8S}$	$Truck\ Load \times \#\ of\ Trucks \times \frac{60}{TC} \times jF \times \rho$

$$T_e = afLg\{m_{idlers} + (2m_b + m_G)\cos\delta\} + R_s + m_G gL\sin\delta$$

Belt Width (mm)	Belt Width (in)	Operating Conditions		
		Light Duty kg/m (lb/ft)	Medium Duty kg/m (lb/ft)	Heavy Duty kg/m (lb/ft)
500	20	4.1 (2.75)	6.2 (4.16)	10.3 (6.92)
600	24	5.0 (3.36)	7.4 (4.97)	12.3 (8.26)
750	30	6.2 (4.16)	9.3 (6.25)	15.5 (10.41)
900	36	7.4 (4.97)	11.1 (7.46)	18.5 (12.43)
1050	42	8.6 (5.78)	13.0 (8.73)	21.6 (14.51)
1200	48	9.8 (6.58)	14.8 (9.94)	24.7 (16.60)
1350	54	11.0 (7.39)	16.7 (11.22)	27.8 (18.68)
1500	60	12.3 (8.26)	18.6 (12.50)	30.9 (20.76)
1650	66	13.5 (9.07)	20.5 (13.77)	33.9 (22.78)
1800	72	14.7 (9,88)	22.3 (14.98)	37.0 (24.86)

Belt Width (mm)	Belt Width (in)	Mass of Moving Parts (kg/m) (lb/ft)			
		Light Duty 4" Idlers **Light Belt**	Medium Duty 5" Idlers **Moderate Belt**	Heavy Duty 6" Idlers **Heavy Belt**	Extra Heavy Duty 6" Idlers **Steel Cord Belt**
450	18	23 (15.4)	25 (16.8)	33 (22.2)	
600	20	29 (19.5)	36 (24.2)	45 (30.2)	49 (33.0)
750	24	37 (25.0)	46 (31.0)	57 (38.3)	63 (42.3)
900	30	45 (30.0)	55 (37.0)	70 (47.0)	79 (53.0)
1050	36	52 (35.0)	64 (43.0)	82 (55.0)	94 (63.2)
1200	42	63 (42.3)	71 (47.7)	95 (63.8)	110 (74.0)
1350	48	70 (47.0)	82 (55.0)	107 (72.0)	127 (85.3)
1500	54		91 (61.2)	121 (81.3)	143 (96.0)
1650	60		100 (67.2)	132 (88.7)	160 (107.5)
1800	66			144 (96.7)	178 (119.6)
2100	72			168 (112.8)	205 (137.7)
2200	84			177 (119.0)	219 (147.2)

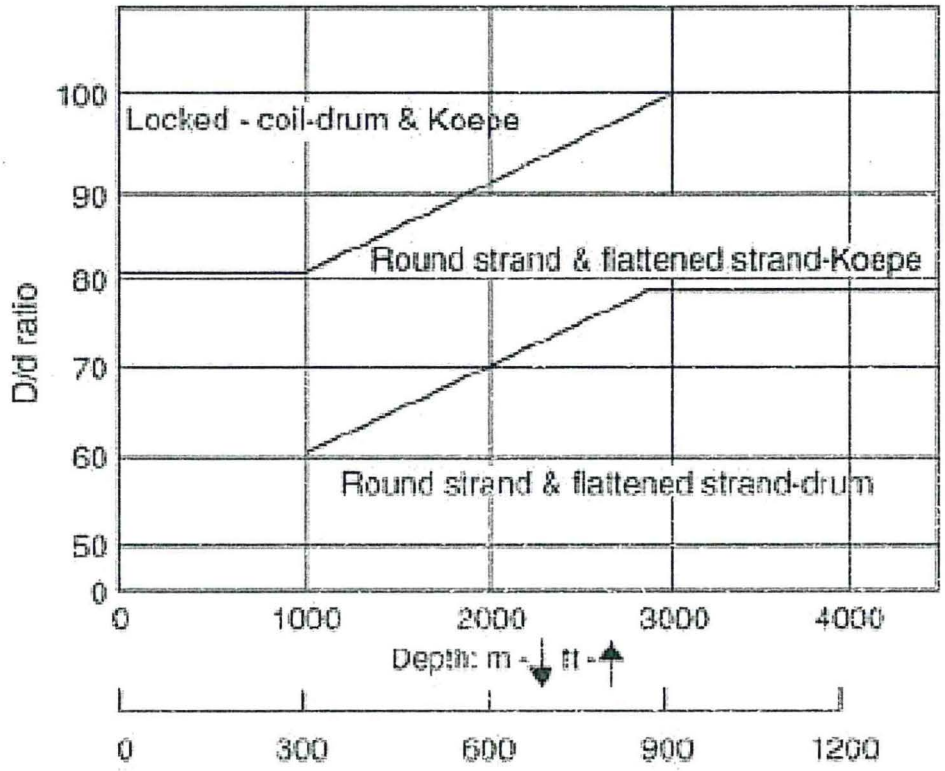
TABLE 1

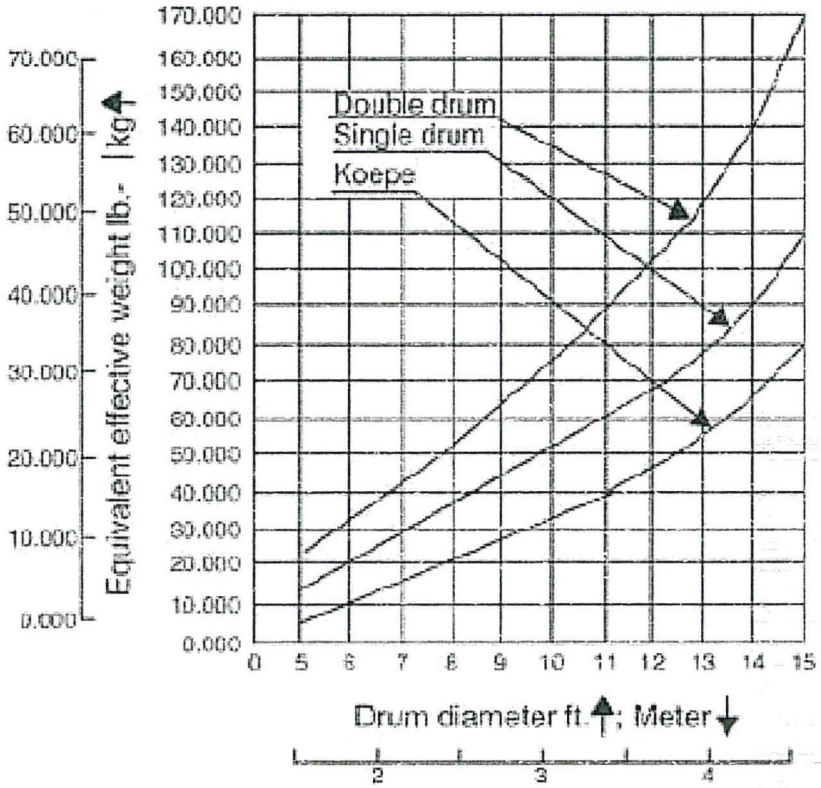
STANDARD DRIVE FACTOR "K" VALUES

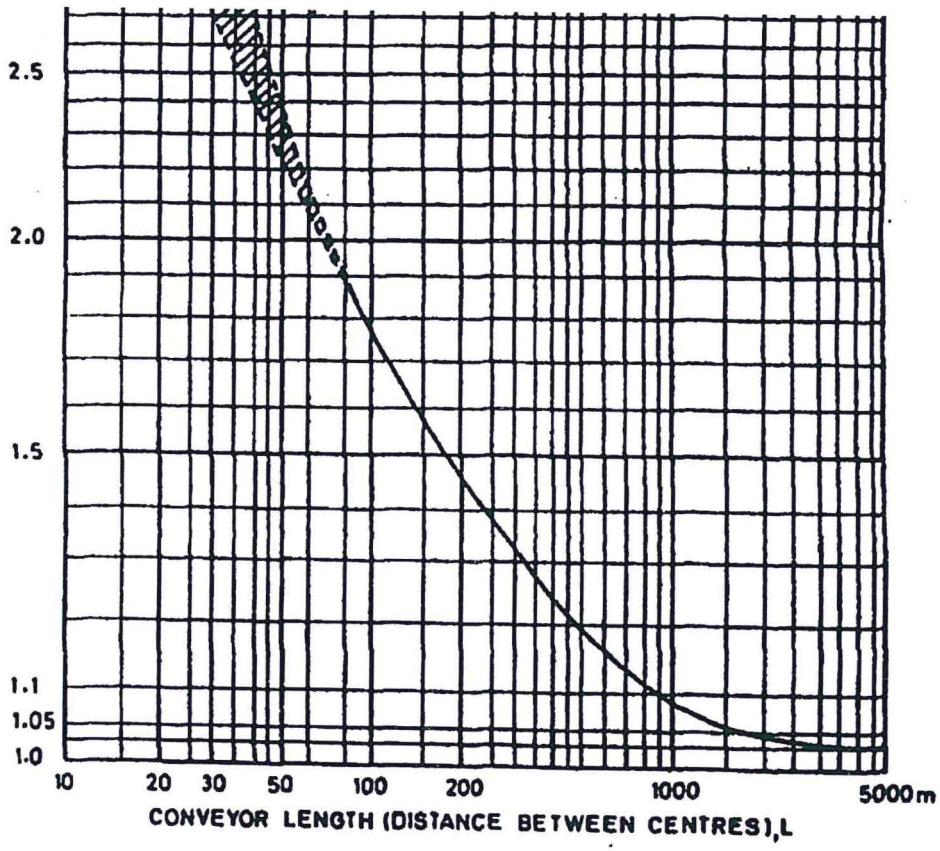
ARC OF CONTACT (Degrees)	COUNTERWEIGHT TAKE-UP		SCREW TAKE-UP	
	Bare pulley $\mu = 0.30$	Lagged pulley $\mu = 0.35$	Bare pulley For 20% higher T_1	Lagged pulley For 20% higher T_1
Single pulley				
*180	0.64	0.50	0.97	0.90
*210	0.50	0.38	0.80	0.66
*220	0.46	0.35	0.76	0.63
*230	0.43	0.32	0.72	0.59
*240	0.40	0.30	0.68	0.56
270	0.32	0.24	0.58	0.49
Tandem Pulley				
360	0.18	0.13	0.42	0.36
390	0.15	0.11	0.39	0.33
*420	0.13	0.09	0.36	0.31
*440	0.11	0.07	0.34	0.30
*450	0.11	0.07	0.33	0.29
*460	0.09	0.06	0.32	0.29
480	0.09	0.06	0.31	0.27

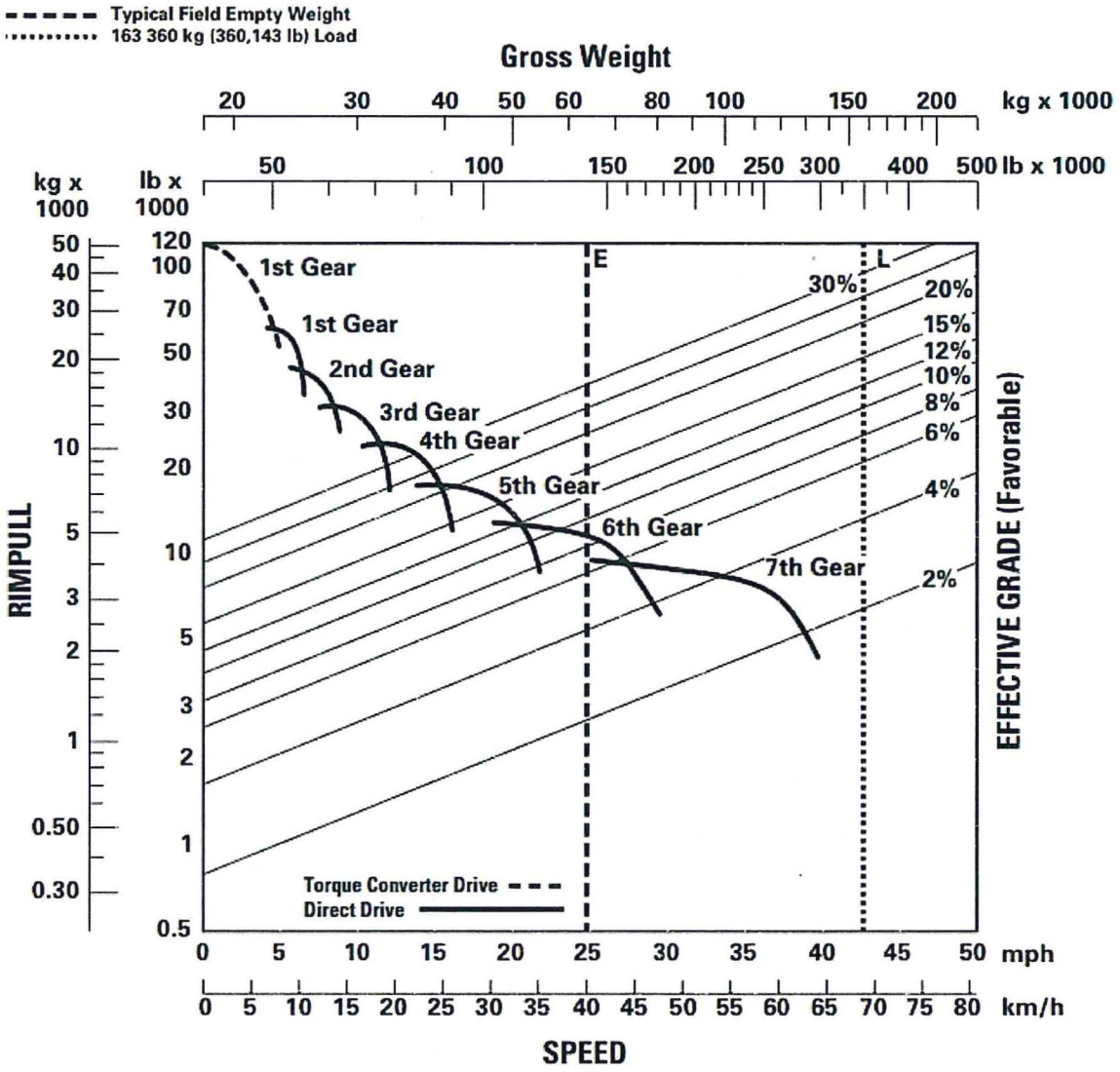
*** Arc of contact commonly met in actual practice**

Rope design	Rope Weight (kg/m)	Rope Strength (kN)
Round Strand	$0.0036d^2$	$0.59d^2$
Flat rope	$0.0041d^2$	$0.63d^2$
Locked coiled	$0.0056d^2$	$0.85d^2$


Locked - coil-drum & Koepe
Round strand & flattened strand-Koepe
Round strand & flattened strand-drum
D/d ratio
100
90
80
70
60
50
0
0
1000
2000
3000
4000
Depth: m ↓ ft ↑
0
300
600
900
1200


Double drum
Single drum
Koepe
Equivalent effective weight lb. | kg
70.000
60.000
50.000
40.000
30.000
20.000
10.000
0.000
170.000
160.000
150.000
140.000
130.000
120.000
110.000
100.000
90.000
80.000
70.000
60.000
50.000
40.000
30.000
20.000
10.000
0.000
0 5 6 7 8 9 10 11 12 13 14 15
Drum diameter ft. ↑; Meter ↓
2
3
4


2.5
2.0
1.5
1.1
1.05
1.0
10
20
30
50
100
200
1000
5000m
CONVEYOR LENGTH (DISTANCE BETWEEN CENTRES), L


Typical Field Empty Weight
163 360 kg (360,143 lb) Load
Gross Weight
20 30 40 50 60 80 100 150 200 kg x 1000
50 100 150 200 250 300 400 500 lb x 1000
kg x 1000
lb x 1000
RIMPULL
50 40 30 20 10 5 3 2 1 0.50 0.30
120 100 70 50 30 20 10 5 3 2 1 0.5
1st Gear
1st Gear
2nd Gear
3rd Gear
4th Gear
5th Gear
6th Gear
7th Gear
E
L
30%
20%
15%
12%
10%
8%
6%
4%
2%
EFFECTIVE GRADE (Favorable)
Torque Converter Drive
Direct Drive
0 5 10 15 20 25 30 35 40 45 50 mph
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 km/h
SPEED