UNIVERSITY OF JOHANNESBURG

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| **PROGRAMS** | : BEng. Tech<br>MINING ENGINEERING |
| **SUBJECT** | : **MINE EQUIPMENT 2B** |
| **CODE** | : **MEQMNB2** |
| **ASSESSMENT** | : **EXAM** |
| **DATE** | : 20 November 2019 |
| **DURATION** | : (SESSION 1) 08:30 - 11:30 |
| **WEIGHT** | : 60% |
| **TOTAL MARKS** | : 87 |

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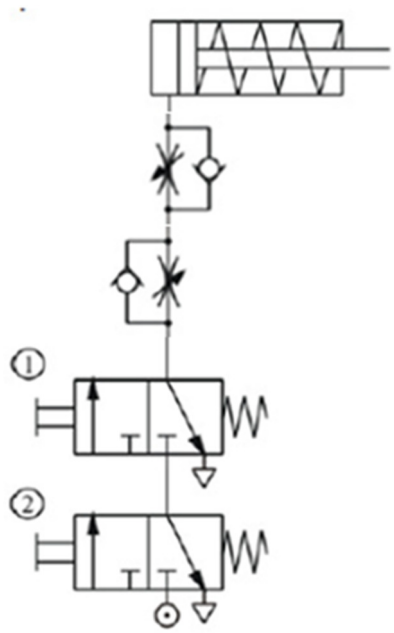
| **ASSESSOR :** | Mr. AMULI BUKANGA |
| **MODERATOR:** | Dr. SHANIEL DAVRAJH |
| **NUMBER OF PAGES:** | **05** |

**INSTRUCTIONS**

1. ANSWER ALL QUESTIONS.
2. CELLPHONES MUST BE SWITCHED OFF.
3. CALCULATORS ARE ALLOWED

**Question 1**

1.1. Give the advantages of pneumatic systems (8)
1.2. Explain briefly the working principle of the pneumatic system below (8)




**Question 2**

With the aid of a neat sketch explain briefly the principle of auto-transformer starting method for 3-phase induction motors (8)

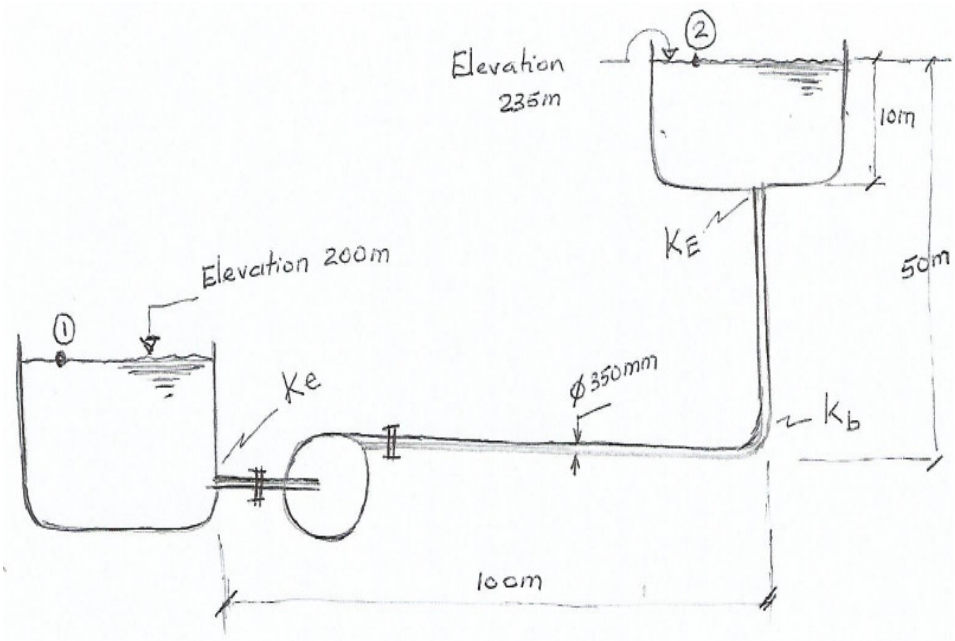
**Question 3**

With the aid of a neat sketch label clearly the components of a refrigeration system (8)

**Question 4**

Calculate the power for a pump pumping water through a steel pipe from one tank to another (see below figure). The pipe diameter is D = 350mm, water flow rate Q = 0.314 $m^3/s$ and the coefficient K for different fittings and other physical factors are:

- Pipe entrance $K_e = 0.03$
- Pipe expansion (exit) $K_E = 0.85$
- Pipe bend $K_b = 0.28$
- Kinematic viscosity of water = $10^{-6} m^2/s$
- Pipe roughness ε = 0.046 mm




(26)

**Question 5**

A 300 kVA transformer has a primary winding resistance of 0.4 Ω and a secondary winding resistance of 0.0015Ω. The iron loss is 2kW and the primary and secondary voltages are 4kV and 200V respectively.
If the power factor of the load is 0.78, calculate the efficiency of the transformer on full load

(13)

**Question 6**

1950 tons of crushed limestone have been transported using a conveyor belt that runs non-stop for 6 hours. Other operating data from the equipment are given in the following table:

| | |
|---|---|
| Belt speed | 1.5m/s |
| Friction coefficient (belt vs pulley) | 0.28 |
| Wrap angle | 225º |
| Incline angle | 17º |
| Friction driving force | 6.5kN |
| Inclined distance between loading and discharge points | 150m |
| Efficiency motor of drive & pulley | 85% |

Calculate the following:

6.1. Power required to elevate the load (4)
6.2. Power required to overcome the friction in the system (4)
6.3. Power required from the motor (4)
6.4. Effective tension in the conveyor belt (4)

## Formula sheet

### 1. Pumping system

Major losses in a pipe

$$H_f = f \frac{L}{D} \frac{V^2}{2g}$$

Where f = friction factor, L length (m), Q (flow rate), D= pipe diameter (m)

### 2. Conveyor belt

Power to overcome Friction

$P_f = F_\mu \times v$

$F_\mu$ = developed frictional force from the pulley to drive the belt (N)

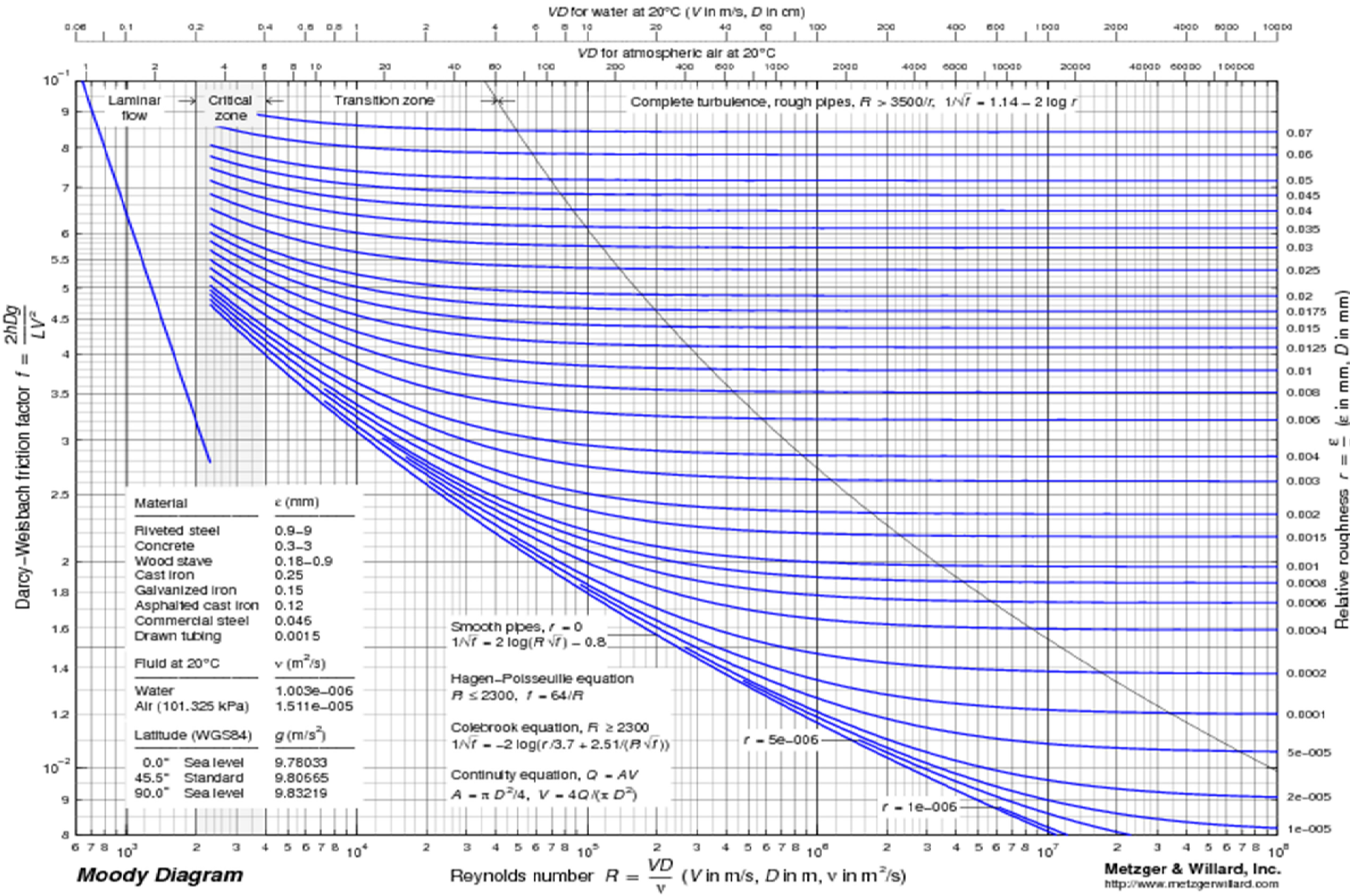
$v$ = belt linear speed (m/s)

Belt tension ratio

$T2 / T1 = e^{\mu\theta}$

μ = friction coefficient between belt and pulley

ɵ = wrap angle


VD for water at 20°C (V in m/s, D in cm)
VD for atmospheric air at 20°C
Laminar flow
Critical zone
Transition zone
Complete turbulence, rough pipes, R > 3500/r, 1/√f = 1.14 – 2 log r
Darcy–Weisbach friction factor f = 2hDg/LV²
Relative roughness r = ε/D (ε in mm, D in mm)
Material | ε (mm)
Riveted steel 0.9–9
Concrete 0.3–3
Wood stave 0.18–0.9
Cast iron 0.25
Galvanized iron 0.15
Asphalted cast iron 0.12
Commercial steel 0.046
Drawn tubing 0.0015
Fluid at 20°C | ν (m²/s)
Water 1.003e–006
Air (101.325 kPa) 1.511e–005
Latitude (WGS84) | g (m/s²)
0.0° Sea level 9.78033
45.5° Standard 9.80665
90.0° Sea level 9.83219
Smooth pipes, r = 0
1/√f = 2 log(R √f) – 0.8
Hagen–Poisseuille equation
R ≤ 2300, f = 64/R
Colebrook equation, R ≥ 2300
1/√f = –2 log(r/3.7 + 2.51/(R √f))
Continuity equation, Q = AV
A = π D²/4, V = 4Q/(π D²)
r = 5e–006
r = 1e–006
Moody Diagram
Reynolds number R = VD/ν (V in m/s, D in m, ν in m²/s)
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