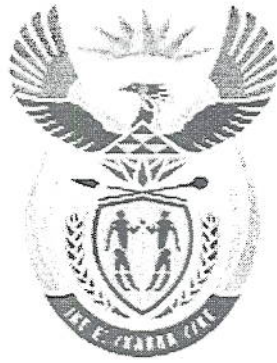


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# higher education & training

Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

**T40(E)(J6)T  
JUNE 2012**

**NON-NATIONAL CERTIFICATE:  
ENGINEERING CERTIFICATE OF COMPETENCY**

**PLANT ENGINEERING: MINES AND WORKS**

**(8190306)**

**6 June (X-Paper)  
09:00 – 12:00**

**REQUIREMENTS: Graph papier.**

**CLOSED-BOOK EXAMINATION**

**NO programmable calculators may be used.**

**This question paper consists of 7 pages, a formula sheet and a 2 page-answer sheet.**

## SECTION A: COMPULSORY

### QUESTION 1

- 1.1 You are the engineer at a mine and are required to complete the section on capacity and static factor on the MD1 form.

The details are as follows:

Double drum winder servicing a vertical shaft:

Weight of rope	5,502 kg per metre
Distance from sheave to lowest winding point	526 meters
Breaking force of one rope	977,25 kN
Breaking force of second rope	983,3 kN
Mass of conveyance	6 500 kg
Number of persons allowed to travel in the cage	52

Complete the attached ANSWER SHEET and place it in the ANSWER BOOK. (10)

- 1.2 You are the engineer on a vertical shaft and the shaft is plagued by power outages. You have been requested to develop a procedure that will enable the release of the winder brakes to get the passengers to the nearest level safely.

List the critical safety issues that you will consider while developing this procedure. (5)

- 1.3 Explain how one would seat the newly replaced brake linings on a calliper brake of a double drum winder. (5)

[20]

### QUESTION 2

- 2.1 Give THREE properties desirable in material used for an earthing electrode. (3)
- 2.2 What form of electrode would you install in deep sandy soil? Give reasons. (2)
- 2.3 What form of earth electrode would you install in soil with underlying rock at 2 m? Give reasons. (2)
- 2.4 How would you test the resistance with respect to each of such electrodes? (4)
- 2.5 Describe the storage requirements for electrical power cables stored on drums on surface indoors and underground. (5)

- 2.6 There has been an increase in underground fires at the mine at which you are the responsible engineer. These fires have been caused by electrical cables and joints.

What interventions would you implement to reduce the number of these incidents?

(4)  
[20]

### QUESTION 3

- 3.1 Explain the meaning and purpose of the following terms as applied to an underground railway track:

- |       |                         |     |
|-------|-------------------------|-----|
| 3.1.1 | Super-elevation         | (2) |
| 3.1.2 | Vertical curve          | (2) |
| 3.1.3 | Gauge                   | (1) |
| 3.1.4 | Cross slacks (twist)    | (1) |
| 3.1.5 | Horizontal misalignment | (2) |
| 3.1.6 | Vertical misalignment   | (2) |

- 3.2 As an engineer you are requested to check the boxfronts. Develop a check list for evaluating these boxfronts in your section listing safety critical areas. (10)  
[20]

**TOTAL SECTION A: 60**

## SECTION B

### QUESTION 4

A coal mine shuttle car uses solid state speed control on the DC traction motors. Answer the following questions regarding the control system of the DC machine:

- 4.1 Indicate, with a diagram, how the power bridge section is connected to a motor include the directional change contacts to the motor. (3)
- 4.2 Name THREE electronic methods to control the solid state devices to achieve supply voltage control on the DC motor. (3)
- 4.3 Explain the kick inductive method to adjust the brushes to the neutral position so that sparking can be eliminated. (3)
- 4.4 Name any other method to set the neutral position for the brushes. (1)
- 4.5 A series motor from a shuttle car runs at 900 rpm with a solid state voltage speed control system. Under this 900 rpm the motor armature is 260 amperes mps and the supply voltage is 180 volts. The motor armature and field resistance is 0,8 ohm. Calculate the supply voltage needed from the bridge power section to reduce the speed to 500 rpm if the gross torque is:
  - 4.5.1 Constant (5)
  - 4.5.2 Proportional to the speed (5)

[20]

### QUESTION 5

- 5.1 For the lubrication of ball and roller type bearings, when would you use:
  - 5.1.1 Oil (3)
  - 5.1.2 A sodium based grease (3)
  - 5.1.3 A lime or lithium based grease (2)

- 5.2 A centrifugal pump, having a characteristic curve given by the following figures, delivers water to a reservoir against a static head of 16 m:

Head (m)	20,0	20,4	20,8	21,0	20,6	19,8	18,4	16,2	13,0
Delivery (ℓ/s)	0	20	40	60	80	100	120	140	160

The normal delivery of 80 ℓ/s is inadequate, and it is desired to connect a second identical pump to obtain the maximum flow. How should the pump be connected and what is the possible maximum flow?



Use the graph paper supplied and scale 10 mm = 10 ℓ/s and 10 mm = 2 m.

If the cost of energy for pumping using one pump is 90 cents/MI delivered, calculate what the new cost will be assuming that the overall efficiency remains unchanged.

(12)  
[20]

### QUESTION 6

- 6.1 In order to prevent injuries you as engineer must insist that critical items be maintained, inspected and re-inspected and repaired when required on a conveyor belt installation under your control.

Name FIVE critical areas of the conveyor belt that you would insist be maintained, inspected and re-inspected to ensure that there is no danger.

(10)

- 6.2 What steps must be taken when any defects are found that cannot be repaired immediately and that may cause danger to persons?

(5)

- 6.3 Explain the term *stored energy* with relation to conveyor belt installations.

(5)  
[20]

### QUESTION 7

- 7.1 Part of your responsibilities is a large electrically driven reciprocating air compressor. What would you instruct the compressor driver to do:

7.1.1 before starting the compressor

(2)

7.1.2 when starting

(2)

7.1.3 after starting

(2)

7.1.4 when stopping

(2)

- 7.2 What safety measures would you insist on during the excavation of a foundation pit 10 m long by 10 m deep? The soil is reasonably firm.

(4)

- 7.3 The following observations were taken at an underground refrigeration plant:

Chilled water: inlet temperature	24 °C
Outlet temperature	8 °C
Rate of circulation	32 ℓ/s

Condenser water: inlet temperature	42 °C
Outlet temperature	53 °C

Compressor motor: voltage	6 600 V
Current	50 A
Power factor	0,85
Efficiency	92

Calculate the following:

- 7.3.1 Heat exchanged from chilled water
  - 7.3.2 Power consumed by compressor motor
  - 7.3.3 Coefficient of performance
  - 7.3.4 Quantity of water required to dissipate heat
- (8)  
[20]

**TOTAL SECTION B: 40**  
**GRAND TOTAL: 100**

ER SHEET

EXAMINATION NUMBER:

WINDING ROPE FACTORS - SEE REGULATIONS 16.30 TO 16.40

HYSTOUFAKTORE - KYK REGULASIES 16.30 TOT 16.40

A. CAPACITY FACTORS (Breaking force of rope ÷ Effective combined weight)\*

VAUGHANFAKTORE (Breekkrag van tou ÷ Effektiewegesamentlike)\*

Distance from sheave to lowest winding point.....m

Afstand van katrolwiel tot laagstehypspunt

Corresponding mass load of rope.....kg

Ooreenkomstigemassavrag van tou

Breaking force of ropes (a)..... (b).....

Breekkrag van toue

(c)..... (d).....

Capacity factors below based on rope breaking load of.....

Vaughanfaktorehieronder is bereken op toubreekbelasting van

Angle to horizontal if inclined shaft.....Sine of angle.....

Hoekonderhorizontale as hellendeskagSinus van hoek

Type of conveyance Soortvoertuig	Mass of Conveyance Massa van voertuig kg	Mass of persons Massa van persone kg	Mass of material Massa van materiaal kg	Mass of mineral Massa van Mineraal kg	Effective combined weight Effektiewege- samentlikegewig kN*	Capacity factor Vaughanfaktore	Ratio Verhouding Reg. 16.31

Note - The weight in newtons is found by multiplying the mass in kilograms by 9,81

Let wel - Die gewig in newtons word berekend deur die massa in kilograms met 9,81 vermenigvuldig.

## SWER SHEET

EXAMINATION NUMBER:

## B. STATIC FACTORS / STATIESE FAKTORE

Description of attached load Beskrywing van aangehegtevrag	Effective combined weight Effektiewe gesamentlikegewig kN*	Effective weight of rope Effektiewe gewig van tou kN*	Total Effective combined weight Totaaleffektiewe gesamentlikegewig kN*	Static factor Statiesefaktor

See definition of " Effective combined weight" in regulation 16.30.1

Kykvirdefinisie van " Effektiewegesamentlikegewig" in regulasie 16.30.1

Use one line for each type of loading

Gebruik een lyn vir elke tipe van belading