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higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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NON-NATIONAL CERTIFICATE: ENGINEERING CERTIFICATE
OF COMPETENCY

PLANT ENGINEERING: MINES AND WORKS

(8190306)

11 November (X-Paper)
09:00 – 12:00

CLOSED-BOOK EXAMINATION

NO programmable calculators may be used.

This question paper consists of 6 pages.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NON-NATIONAL CERTIFICATE: ENGINEERING CERTIFICATE
OF COMPETENCY
PLANT ENGINEERING: MINES AND WORKS
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions in SECTION A. Answer any TWO questions in SECTION B.
 2. Read ALL the questions carefully.
 3. Number the answers correctly according to the numbering system used in this question paper.
 4. Rule off across the page on completion of each question.
 5. ALL calculations MUST be shown.
 6. Use only BLACK or BLUE ink.
 7. NO cellular phones are allowed in the examination room.
 8. Candidates arriving 30 minutes late will NOT be allowed to sit the examination. NO candidate must leave the EXAMINATION ROOM BEFORE ONE HOUR has elapsed from the commencement of the examination.
 9. Candidates who have NOT been accepted by the Commission of Examiners, will be disqualified.
 10. This is a CLOSED-BOOK EXAMINATION. Candidates may NOT use any notes, text books or reference works during this examination.
 11. Write neatly and legibly.
 12. NO programmable calculators may be used.
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SECTION A: (COMPULSORY)

Answer ALL the questions in this section.

QUESTION 1

- 1.1 A double cylindrical drum, geared, man winder with two DC motors operates two cages in a vertical shaft under the following conditions:

Length of suspended ropes	1 740 m
Total length of ropes	1 960 m
Mass per unit length of ropes	10,5 kg/m
Maximum permitted mass-load in cage	7 000 kg
Mass of cage and attachments	5 200 kg
Motor speed	6,25 rev/s
Maximum speed of winding	15,25 m/s
Diameter of each drum	4,25 m
Diameter of each sheave wheel	4,85 m
Moment of inertia of drums and gear wheel	258 000 kg.m ²
Moment of inertia of the two sheaves	16 300 kg.m ²
Moment of inertia of the two armatures and pinions	6 800 kg.m ²

The friction is 5% of the static weight resulting from the total travelling masses.

When a fully loaded cage is two-thirds of the way down the shaft, the winder trips out due to a power cut. Calculate the braking torque required to give a retardation of 2 m/s².

- 1.2 Sketch and describe the requirements of radius, profiles and tolerance of grooves of a winder sheave wheel? (3)
- 1.3 What are the recommended sheave groove measurements and recording intervals? (2)

(15)

(3)

(2)

[20]**QUESTION 2**

- 2.1 A 1 MVA Delta/star, 6 600/400 V transformer has an iron loss of 3,2 kW and copper loss of 3 kW at half-load. The transformer impedance is 4,75%.

Determine the following:

- 2.1.1 The full load efficiency at a lagging power of 0,8. (5)
- 2.1.2 The line voltage to be applied to the primary windings with the secondary short-circuited to produce full-load current in both the primary and secondary windings. (5)
- 2.1.3 The MVA fault value for a short circuit on the secondary terminals of the transformer, assuming infinite capacity in the primary windings. (5)

- 2.2.1 What are the factors which lead to the sludging of oil in a transformer? (2)
 - 2.2.2 What steps can be taken to eliminate or reduce the incidence of such sludging? (3)
- [20]

QUESTION 3

- 3.1 3.1.1 Make a sketch of the layout of an underground battery bay in a fiery mine and give the recommended charging cycles and air flow. (5)
 - 3.1.2 State the requirements for an underground battery bay in a fiery mine. (5)
 - 3.1.3 What is meant by 'tracking' in relation to a battery as used on an underground hauler? Is this dangerous and how can it be eliminated? (5)
 - 3.2 Name 10 safety devices required, with reference to underground railbound equipment. (5)
- [20]

TOTAL SECTION A: 60

SECTION B: ANSWER ANY TWO QUESTIONS

QUESTION 4

- 4.1 Briefly describe, with sketches, the construction and maintenance of a slime dam. Sketch a typical section and indicate outer wall, inner wall, run-off trench, free board, storm-water drainage and penstock. (10)
 - 4.2 An elevator brake consists of a 210 mm diameter drum, rotating at 500 r/min, with two centre-pivoted brake shoes acting on it. The shoes are pivoted by two brake shoe carriers which are hinged 152 mm vertically below the drum centre and 100 mm apart. The top ends of the brake shoe carriers are pulled together with a horizontal spring, 152 mm above the drum centre. The shoe pivots are 135 mm from the drum centre on a horizontal line through the drum centre. The angle of contact for each shoe is 120° and the co-efficient of friction between the shoes and drum is 0,3.

Determine the following:
 - 4.2.1 The spring force required to effect a braking torque of 240 Nm.
 - 4.2.2 The width of the shoes if the product of the normal force and slip velocity is 1,6 MNm/s per m² of the projected area. (10)
- [20]

QUESTION 5

5.1 A mining shuttle car uses solid state speed control on the DC traction motors. Answer the following questions regarding the control system and the DC machine:

5.1.1 Indicate with a diagram how the bridge power section is connected to the motor and also include the directional contacts to the motor. (5)

5.1.2 Name THREE electronic methods to control the semi-conductors in order to achieve supply voltage control to the DC motor. (5)

5.2 Identify the hazards associated with scraper winch operations and quantify the risks in terms of the probability and severity. Include the control measures and control shortcomings. (10)

[20]

QUESTION 6

6.1 You are required to double the payload of your service winder cage. State 10 items of the design that you will check to ensure that the winder will operate safely. State the requirements that must be met, before this winder can be put into operation. (10)

6.2 Explain the operation of:

6.2.1 All electrical safety devices

6.2.2 All mechanical safety devices

used on a conveyor in a fiery mine including the type of conveyor belting to be used. (5)

6.3 6.3.1 Explain the causes of conveyor belt slip. (3)

6.3.2 What can be done to reduce conveyor belt slip? (2)

[20]

QUESTION 7

7.1 A dump truck with a wheel base of 3 m travels at a speed of 36 km/h along a level road. The centre of gravity of the truck is situated 1,2 m behind the front axle and 0,6 m above the road level. The coefficient of friction between the wheels and the surface of the road is 0,6. Determine the minimum distance in which the dump truck can be stopped when:

7.1.1 The rear wheels only are braked

7.1.2 The front wheels only are braked and

7.1.3 All wheels are braked

7.2 A belt-driven fan delivers 570 m³/min of air through a 610 m long ventilation column at a water gauge of 100 mm when running at 750 r/min.

7.2.1 Calculate the speed of the fan in order to deliver 710 m³/min of air through a similar column 760 m long.

7.2.2 Calculate the power required to drive the fan under the conditions specified in 7.2.1 if the efficiency of the fan is 60%.

TOTAL SECTION B: 40
GRAND TOTAL: 100