higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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NOVEMBER 2012

NON-NATIONAL CERTIFCATE: ENGINEERING CERTIFICATE OF COMPETENCY

PLANT ENGINEERING: MINES AND WORKS

(8190306)

12 November (X-Paper)
09:00 – 12:00

CLOSED-BOOK EXAMINATION

Candidates are NOT allowed to use any notes, textbooks, references or cell phones during examination.

Programmable calculators may NOT be used.

This question paper consists of 7 pages and a formula sheet.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
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NON-NATIONAL CERTIFICATE: ENGINEERING CERTICATE OF COMPETENCY
PLANT ENGINEERING: MINES AND WORK
TIME: 3 HOURS
MARKS: 100

NOTE: If you answer more than the required number of questions, only the required number of questions will be marked. All work you do not want to be marked, must be clearly crossed out.

INSTRUCTIONS AND INFORMATION

1. SECTION A is compulsory.
2. Answer only TWO questions from SECTION B.
3. Read ALL the questions carefully.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Show ALL the calculations.
6. Answers written in pencil will NOT be marked.
7. Rule off across the page on completion of each question.
8. Examination results will be disqualified if the candidate had not been accepted by the Commission of Examiners PRIOR to the examination.
9. Candidates arriving 30 MINUTES late, will NOT be allowed to sit for the examination. NO candidate writing the examination may leave the examination room before ONE HOUR after commencement has lapsed.
10. Write neatly and legibly.

SECTION A: COMPULSORY

QUESTION 1

1.1 A double drum winder must hoists 67 500 tons of ore to the surface per month. The winder is in operation for 26 days per month and 20 hours per day.

1.1.1 Calculate the number of trips per hour if the following data apply:

Distance from collar to tip	15 m
Distance from collar to sheave	30 m
Distance from collar to loading station	1 585 m
Maximum winding speed	15 m/s
Uniform acceleration	0,84 m/s^2
Uniform retardation	0,83 m/s^2
Loading time	10 sec
Creep time	3 sec
Creep speed	1,5 m/s

1.1.2 Determine the mass of the skip if a skip factor of 0,63 is used. (15)

1.2 Determine the minimum sheave diameter required so that the following winding rope can be used on your winder. (D/d ratio)

The diameter of a winding rope is 33 mm. The winding speed is 2,5 m/s.

1.3 What types of winding ropes are normally used at a mine when the shaft is in the course of being sunk?

1.4 Calculate the minimum sheave diameter required for a winder used for shaft sinking purposes by using the table below.

1.5 The sheave diameter must not be smaller than calculated. Why is this important?

1.6 What will happen if the sheave diameter is smaller than calculated and the winding speed is increased?

Rope construction	**Minimum drum and sheave diameters (K)**
6 × 7 (6/1)	39 × rope diameter
Triangular strand ropes	42 × rope diameter
Non-spin winding ropes	42 × rope diameter
6 × 36 (14/7 + 7/7/1)/F	19 × rope diameter
6 × 25 (12/6F + 6/1)/F	23 × rope diameter
6 × 19 (9/9/1)/F	28 × rope diameter

(5)
[20]

QUESTION 2

2.1 Find the most economical cross sectional area per copper conductor of dry, impregnated paper insulated cable to transmit a three-phase balanced load which varies throughout the year as follows:

- 1 800 kVA for 1 500 hours
- 800 kVA for 1 600 hours
- No load for the remaining 5 660 hours

The following data is given:

Transmission voltage:	33 kV
Energy cost:	41,7 c/kWh
Conductor cost:	R142/kg
Conductor density:	8 860 kg/m^3
Conductor resistance:	0,177 Ω/km/cm^2
Annual interest and depreciation:	10%

Calculate the following:

2.1.1 Conductor diameter

2.1.2 Maximum current density

2.1.3 Load and form factors (15)

2.2 State the advantages and disadvantages of earthing the neutral of a power transformer when using:

- Solid earthing
- Earthing resistance (5)

[20]

QUESTION 3

3.1 In order to prevent the risk of injury to persons during coupling operations and derailments of rolling stock and re-railing, the code of practice ('COP') must address certain issues.

Name FIVE of these issues. (5)

3.2 Name FIVE aspects that must be addressed in the design and layout of a battery charging station, as set out in the code of practice ('COP') for underground railbound transport equipment. (5)

3.3 Name and discuss the requirement for 10 signalling/safety devices to be considered when drafting your COP for underground railbound transport equipment. (10)

[20]

TOTAL SECTION A: 60

SECTION B

Answer only TWO questions from this section.

QUESTION 4

4.1 Sketch and describe the function of a DSM cyclone, clearly stating how the mineral and waste is separated. What determines the size of the cyclone to be used and how is the quality of the final product manipulated? (15)

4.2 What medium is used to change the density of the pulp in a coal beneficiation plant? Why is this medium not suitable for use in a chrome beneficiation plant? (5)

[20]

QUESTION 5

5.1 Sketch and describe the function of flashback arrestors in flame-cutting equipment and state where it is installed. (5)

5.2 Name THREE types of external water treatment processes used for boiler feed water. (5)

5.3 As the engineer at a colliery you are requested by your manager to procure transport for underground use for each of the senior management members on your mine. You got hold of battery-operated vehicles with material canopies of which the only means of braking is a brake disc fitted to the prop shaft. These vehicles are similar to those used at golf courses.

Discuss how you will upgrade the vehicles to comply with the requirements of the Mine Health and Safety Act (MHSA). In what areas will it be permitted to be used and what controls will you implement to ensure the safe use of these vehicles? (10)

[20]

QUESTION 6

6.1 Describe what is meant by the term *stored energy* and how you will ensure the safety of persons before working on each of the following systems:

6.1.1 Belt conveyor installations (5)

6.1.2 Hydraulic cylinders of LHDs (3)

6.1.3 Electrical overhead power lines (2)

6.2 Briefly describe FOUR methods used for the non-destructive testing of metals. (10)

[20]

QUESTION 7

7.1 A large vertical shaft, 1 850 m in depth, is to be equipped with a compressed air column. To produce the required tonnage from the mine it is estimated that a peak number of 400 rock drills is needed. If each rock drill requires 3,8 m^3/min of free air and the pressure of the compressed air at the surface is 6,2 bar, determine the required diameter of the shaft column if the gauge pressure at the shaft bottom is not to be less than 6,2 bar.

The surface atmospheric pressure is 0,84 bar abs., the atmospheric pressure at the shaft bottom is 1,07 bar abs., and the mean atmospheric temperature is 20 °C. Assume all air passes to the shaft bottom. Gas constant = 287 J/kg K. (15)

7.2 As engineer you are responsible for maintaining a surface railway track in a safe condition. To do this, various important elements must be kept in mind.

Name at least EIGHT points that you regard as important. (5)
[20]

QUESTION 8

8.1 A pipeline with an internal diameter of 250 mm conveys water at a rate of 317 ℓ/s. There is a bend of 30° in the pipeline in the horizontal plane, where water pressure is 400 kPa.

What special provisions, if any, does this system call for and what will your recommendations be? (10)

8.2 Sketch and describe the function of the reducer in a pump column in each of the following:

8.2.1 Concentric reducer

8.2.2 Eccentric reducer. Also describe how the eccentric reducer is fitted in a horizontal column. (5)

8.3 Sketch and describe the following methods used to prime pumps:

8.3.1 Manual priming

8.3.2 Priming using a bypass line

8.3.3 Flooded suction pump (5)
[20]

QUESTION 9

9.1 Sketch and describe the operation of a Buchholz relay on a high-tension transformer. (10)

9.2 A motor vehicle with mass of 1 800 kg has to climb a gradient with a sine of 0,4. The drive is via the rear wheels. The wheelbase is 3 m and the centre of gravity of the vehicle is 1,2 m behind the front axle and 0,6 m above the ground.

If the vehicle ascends at a uniform speed, determine:

9.2.1 The minimum coefficient of friction between the tyres and the road

9.2.2 The power necessary if the constant speed is 16 km/h and the transmission efficiency is 60 per cent (10)
[20]

TOTAL SECTION B: 40
GRAND TOTAL: 100

PLANT ENGINEERING: MINES AND WORKS

FORMULA SHEET

$P = \sqrt{3}\ V\ I\ Cos\ \theta$

$Q = mC\Delta t$

$P = (T_1 - T_2)\ v$

$P = mgLSin\ \theta$

$P = \mu mgL$

$M = fz$

$hf = \dfrac{4fLv^2}{2gd}$

$h = \dfrac{k\ v^2}{2g}$

$pv = mRT$

$\dfrac{M}{I} = \dfrac{\sigma}{Y} + \dfrac{E}{R}$

$M = \dfrac{WL^2}{8}$

$M = \dfrac{WL}{4}$

$M = \sigma Z$

$Z = \dfrac{I}{Y}$

$I_{XX} = \dfrac{bd^3}{12}$

$T_1 / T_2 = e^{\mu\theta}$

$LMTD = \dfrac{\Delta T_1 - \Delta T_2}{Ln\ (\Delta T_1 / \Delta T_2)}$

$Q = U \times A \times LMTD$

$IP = PLACE$

$BP = 2\pi Tn$

$\Delta = 8FD^3n / Gd^4$

$\tau_{max} = kFD8 / \pi d^3$

$k = \dfrac{4(C-1)}{4(C-4)} + \dfrac{0{,}165}{C}$

$C = D / d$

$\Delta = 8FD^3n / Gd^4$