higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1200**(E)**(N17)T

NOVEMBER EXAMINATION

NON-NATIONAL CERTIFICATE

PLANT ENGINEERING: MINES AND WORKS

(8190306)

17 November 2014 (X-Paper)
09:00–12:00

This question paper consists of 9 pages.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
PLANT ENGINEERING: MINES AND WORKS
TIME: 3 HOURS
MARKS: 180

INSTRUCTIONS AND INFORMATION

1. No programmable calculators are to be used.
2. No cell phones are allowed in the examination room.
3. Draw a line after each question.
4. No pencil answers will be marked.
5. Candidates are not allowed to leave the examination room before one hours after commence of the examinations.
6. Candidates must be in the examination room 15 minute before the examination starts.
7. No text books are allowed on the desks.
8. Candidates without acceptance by the Commission of Examiners will be disqualified.
10. Write neatly and legibly.

SECTION A

QUESTION1

You are appointed as an engineer on a high production shaft that has two Koepe rock winders installed on surface and at the Sub shaft respectively. The winder installed on the sub shaft in a larger winders on surface thus the ropes differ in size. The sub shaft Koepe winder does not have tail sheaves installed but are free hanging although the surface Koepe winder has. After several tail rope failures on the Koepe winders your spare ropes will one be delivered in two months' time.

Rope data surface Koepe Winder operating between 1 000–2 000 m.

Head rope construction: UHP 15 strand 'Fishback' N/S

Tail rope construction: 17 strand N/S

Rope data on Subshaft Koepe winder operating between 500– 1 000 m.

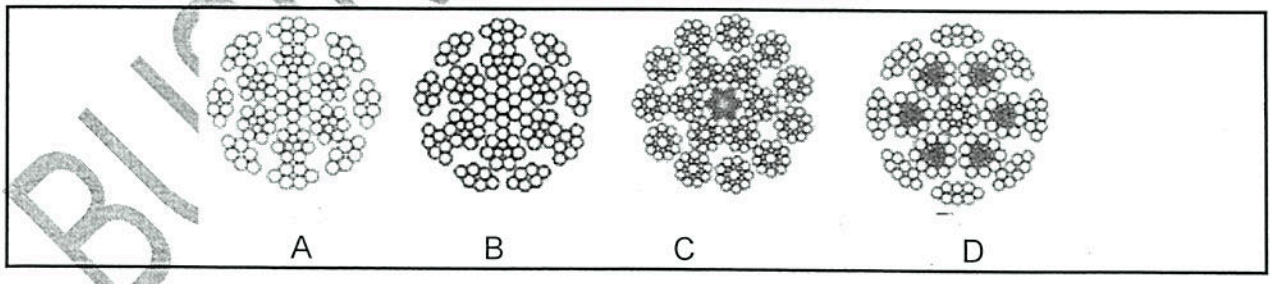
Head Rope construction: 18 strand N/S OL

Tail rope construction: 14 strand N/S

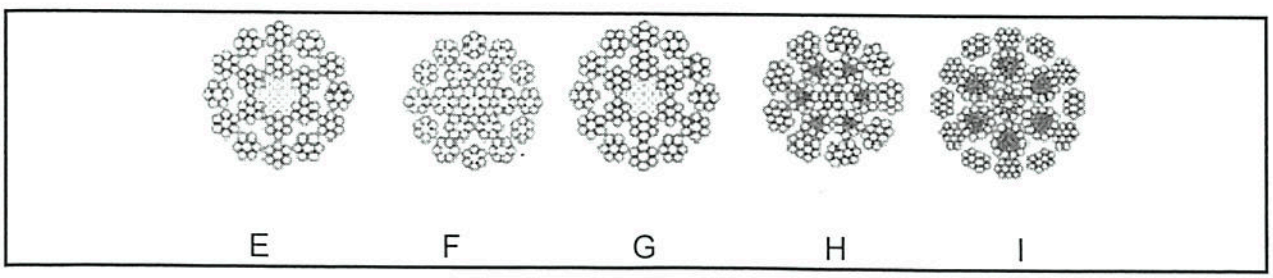
You have enquired at other mining group where similar winders are installed and there are ropes available to use if need be. The shaft where the ropes are is on care and maintenance and NO information or data books are available for the ropes. You need to send your maintenance personnel to investigate the sizing and correctness.

Information they came back with are as follows

Batch 1



Batch 2



Your selections should be confirmed with the actual construction detail.

1.1 Select from these samples the correct tail ropes for the subshaft Koepe?

1.2 Select the replacement head ropes for your sub shaft winder?

1.3 Which of these ropes can be used for the surface head ropes?

1.4 Which of these ropes can be used for the surface tail ropes?

1.5 What systems will you put in place to ensure that the tail ropes are always free hanging?

(5 × 4) **[20]**

QUESTION 2

2.1 You are an appointed engineer at a mine where an electrician got electrocuted whilst replacing insulators of a 6.6 kV overhead line that feeds the surface workshops. The electrician was standing on a steel ladder when the overhead line got struck by lightning, resulting in the fatal injury. The investigation into the matter revealed that the electrician failed to earth the overhead line to create an equipotential zone, before commencing with the repairs.

2.1.1 Draw a fully labelled sketch of the above scenario indicating how an equipotential zone can be created and explain briefly what equipotential zone is and why it is so important to have such a zone. (8)

2.1.2 Calculate the voltage and current that the electrician would have been subjected to if an equipotential zone was created.

The following resistance values are given:

Electricians' body resistance = 5 Ω
Earthing cables' resistance R1 = R2 = 0,0015 Ω
Earth wire's resistance to the earth rod = 0,0035 Ω
Earth resistance = 0,0035 (6)

2.1.3 What is the difference between control earth and working earth? (2)

2.2 With the use of a simple sketch, explain the significance of having a 'mush room switch' in the cable drum of a machine used in underground hazardous locations? (4)

[20]

QUESTION 3

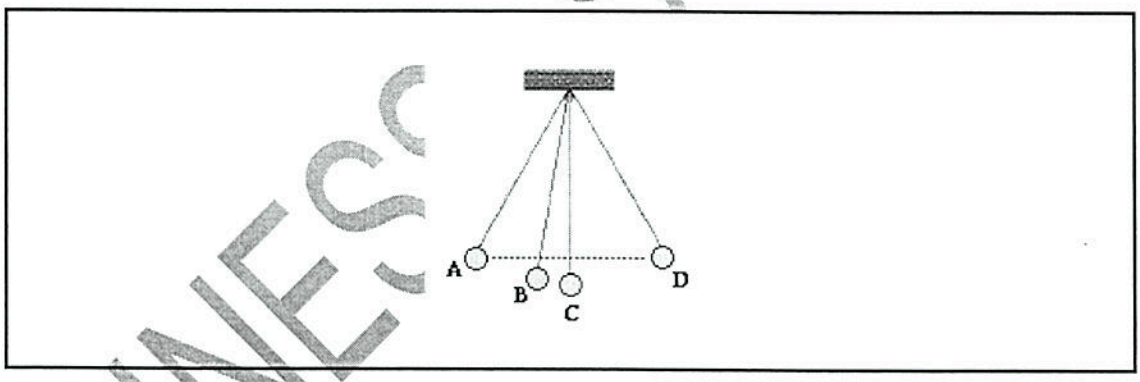
You are the Engineer appointed in an underground section where vertical spindle pumps are used to dewater the mine. You have had numerous injuries while installation of these pumps happen, while other operations even experienced fatal injuries. Most of your pumps are 1,4 m long, weighs 120 kg. Assume that the centre of gravity is 400 mm from the bottom of the pump. With your understanding of pendulums please answer the following questions that seek to address your high risk associated with pump installation.

3.1 If your eyebolt is 3 m above the sump of a vertical spindle pump, what will be the period of oscillation of the pump when it is mid-air and when it is about to be put in the sump.

State ALL other assumptions. (6)

3.2 Define risk and with this definition please explain at what position you have the highest risk (4)

3.3 If the pump swings as indicated in the sketch below:



Swings from position A to D where in this swing is the gravitational force the highest. (3)

3.4 Someone deduced that the weight of the pump is the cause of the accidents. Do you agree with this assessment? Explain your answer. (3)

3.5 Given that some design changes can be done to the pump, what would you recommend in order to reduce the probability of accidents? (2)

3.6 If the above is possible what would your recommendations be to reduce severity of these accidents? (2)

[20]

SECTION B

QUESTION 4

A conveyor belt runs at 1,5 m/s for 26 days per month, 20 hours per day, to convey 100 000 tons over a horizontal distance of 20m. The bulk density of the product conveyed is 1,6 t/m^3. The angle of wrap on the drive puller is 250o with a coefficient of friction of 0.35, and a coefficient of friction of the idlers of 0,04. The drive gearbox has an efficiency of 90%.

Determine the following:

4.1 The width of the conveyor belt (2)

4.2 The power of the driving motor required (6)

4.3 The mass of the counterweight required (2)

4.4 Name and discuss ten safety devices on a conveyor belt to establish a safe environment for where a midpoint change of direction, the discharge point and the loading point are not visible to each other. (10)
[20]

QUESTION 5

5.1 What are the effects of switching resistances connected across the contacts gaps of a 66 kV circuit breaker which operates frequently? (5)

5.2 An electric motor is used to drive a harmonic vibration screen. Due to extensive repairs, the mass of the screen was changed and thus the natural frequency changed. The shaft drive speed of the rotating mass has to be decreased from the current 970 r/min to 900 r/min. The vibrating shaft is directly connected to the motor. The power input to the 415 V, three phase, six-pole, 50 Hz induction motor is 50 kW when running at 970 r/min. The stator losses are 2 kW and the friction and windage losses are 1,5 kW.

Calculate the following:

5.2.1 The Rotor I^2R losses

5.2.2 The gross torque in Nm

5.2.3 The power output of the motor

5.2.4 The rotor resistance per phase if the rotor phase current is 110 A

5.2.5 The resistance to be added to each phase to achieve the reduced speed if the motor torque remains constant.

(15)
[20]

QUESTION 6

6.1 Sketch and describe a water treatment plan for water for domestic use. The water is pumped from a slow flowing river. The raw water has a high pH value and may contain disease bacteria. (5)

6.2 A pump is to raise 40 litres against a static head of 30 m and through a pipe, 400 m long. Determine the most economical pipe size to use (that which gives the least annual expense)

Power cost is R2,00 per kWh.

The pump operates 12 hours per day.

Interest on capital investment is 13% annually.

Annual depreciation is 2,5%.

The cost of pipe laid is R250 for 150 mm, R398 for 250 mm, R470 for 300 mm and R550 for 475 mm.

The pump and motor efficiencies are 70% and 85% respectively. (15)
[20]

QUESTION 7

7.1 Explain what is meant by the zoning of harardous location as contemplated in SABC 0108, revised in 2001. The classification of hazardous locations and the selection of apparatus for us in such locations. (6)

7.2 A fully equipped BASEEFA certified underground flameproof enclosure has been imported for use in a hazardous location in a fiery mine.

What is the procedure to be followed by engineering before such enclosure may be installed and operated in that? (4)

7.3 Two-way radios with the following specifications/particulars are to be used in a coal mine. Will they be safe for the applications?

Motivate your answer clearly by considering the information below.

SABS certification for propane gas:

Ignition temperature: 465 °C
Higher explosion limit: 9,5%
Lower explosion limit: 2,0%

Marking on nameplate of ratio:

Output power: 1 watt radiated power
Ex ib ITA T4
SABX M/V805 X

(10)
[20]

Question 8

8.1 During a trial on a three-phase electrode boiler the following information was obtained:

Boiler:	
Supply volts	500 V
Average current drawn	550 A
Power factor	0,9
Hot well temperature	86°
Pressure	600 kPa
Dryness fraction of steam	0,9

Double acting pump:	
Stroke	87,5 mm
Diameter of plunger	47,5 mm
Diameter of plunger rod	21,0 mm
Speed of motor	25 rev/sec
Gearbox reduction	24 : 1
Volumetric efficiency	82%
Overall drive efficiency	85%

If 25% of the boiler feed water is bypassed through the level control valve, determine the efficiency of the boiler. (15)

8.2 Explain why it is sometimes necessary to install a cooling tower in a steam plant which uses a surface condenser and state the function of the tower. (5)
[20]

QUESTION 9

9.1 You are the engineer on a mine and you have to select a suitable electrical cable for installation at the mine.

Explain according to SANs 1507-1 the meaning of the following colour stripe markings on an electrical cable:

9.1.1 Red stripe marking

9.1.2 Blue stripe marking

9.1.3 White stripe marking

(3 × 2) (6)

9.2 A problem arises which requires your expertise, certain electrical globes in the store fail to operate when used for maintenance purposes, the following appears on the globes

Explain what could be the reason for the malfunctioning. (6)

9.3 Two 2200/110 V transformers are operated in parallel to share a load of 125 kVA at 0,8 power factor lagging. The transformers are rated as follows:

A: 100 kVA; 0.9 % resistance and 10 % reactance

B: 50 kVA; 1 % resistance and 5 % reactance

Calculate the load carried by each transformer. (8)

[20]

TOTAL: 180