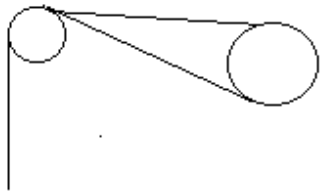
Examination June 2008

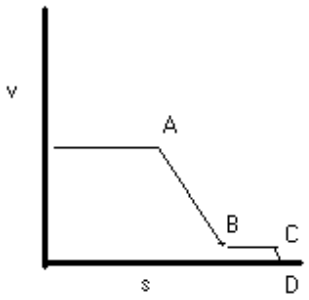
Section 1: Compulsory (answer all three questions)

Question 1

The two sheave wheels in a men-material sub-vertical shaft, equipped with an AC double drum winder, have to be replaced. The appointed engineer specified that the new rim design be heavier to extend the life of the sheave wheels. During an inspection 6 months later, he noticed severe wear on the crown of the rope wires on the sheave wheels whilst the winder is decelerating.

(i) Determine the cause of the excessive wear from your calculations
(ii) Present a practical solution to the problem





Winding parameters	
Full speed	10 m/s
Winding distance	400 m
Mass of empty cage	5 t
Pay load	3,5 t
Rope mass	5,823 kg/m
Rope diameter	37 mm
Average deceleration	1,5 m/s^2
Creep speed	0,5 m/s
Distance BC	1,2 m
Diameter of new sheave wheel	2.4 m
Inertia of new sheave wheel	25000 kg m^2
Friction factor between rope and sheave wheel	0,25 contact angle 100 ^{0}
Distance between highest stopping point and the sheave wheel	7 m

[20]

Question 1 – Winders

The majority of candidates were on the right track, but could not see that the deceleration was the actual problem due to the increased mass of the sheaves. Many candidates were of the opinion that increasing the angle of wrap could solve the problem without realising the practicality of the answer.

Question 2

2.1 You are the Reg. 2.13.3.1. appointed engineer on a high production shaft. During the morning, while you are still on surface, you experience a total Eskom power failure in the district. Initial, unconfirmed, reports say that the outage could last as long as three days. Nobody in the vicinity has power to assist with ring feeds and there is no emergency generator available.
Your engineering staff was busy with shaft examination at the time of the black-out and you have people stranded thirty meters above the closest station.
A full morning shift is also underground.

(i) Describe, in chronological order, the steps you will take to ensure the safety of your staff, getting the underground shift to surface, while maintaining the critical equipment and services in the shaft
(ii) You do receive limited power during the early evening. How will this affect your activities?
(iii) How do you manage hoisting operations during the evacuation period?

(16)

2.2 What are the effects of, and dangers that you would experience in a typical domestic reticulation system if the neutral wire on the load side of the reticulation falls away? The neutral wire is not earthed solidly on the load side.

(4)
[20]

Question 2 –Power outage and electrical

Reading and answering this was a major problem. The majoroty of candidates would start the emergency generator and release the brakes of the winder to lower the people to the next level loosing sight of the fact that there is no generator. Some candidates thought of obtaining a generator from a neighbouring mine. Good idea but a time consuming exercise, partial power could have been available before the borrowed generator would be on line and it is very seldom that such capacity generator is available. The majority of candidates did not make use of the second outlet as an escape route, It would appear that some candidates watch to much TV, especially McGyver.

The majority of candidates did not understand the function of a neutral wire in a three phase system, especially under fault conditions.

Question 3

You are the Reg. 2.13.3.1. appointed engineer on a shaft and are requested by the manager to draw up a shaft examination procedure. This procedure should detail the type of inspection required, the method used to determine the condition of the components in the shaft, the frequency and criteria against which the persons conducting the examination should evaluate the shaft.

[20]

Question 3- Shaft Examination

In answering this question the candidates were testing winder ropes, attachments ect. in lieu of doing shaft examination. The question clearly states that the method of doing the tests should be described and was not done. The candidates seem not to be familiar with legal requirements pertaining to shaft examinations e.g. winding engine driver's logbook is not signed at beginning or end of the inspection neither is the conveyance being run through the shaft ect. Very disappointing answers received.

Section 2: answer two out of the 6 questions

Question 4

4.1. A 500 V shunt motor – connected to a 500 V DC supply - was replaced with a similar motor but was found to run hotter and slower for the same duty. The new motor runs at 1000 r/min and draws 2.67 A under light conditions and runs at 935 r/min and draws 40.67 A under the required duty. The shunt winding resistance is 750 Ω and the armature resistance is 0.6 Ω

(i) Neglecting armature reaction, determine the correct speed for the required duty

(ii) . Discuss briefly the reasons for this condition

(15)

4.2 Name the advantages of used oil analysis for lubrication oil

(5)

[20]

Question 4- Electrical Motor and used oil

Very few candidates attempted this question and there were hardly any correct answers.

Question 5

5.1 The aluminium top of a high pressure hydraulic pump is held down with eight 6 mm x 30 mm, high tensile SI bolts (Young's modulus is $210x10^9$). The thickness of the aluminium top and packing is 13 mm. A pretension of 500 kPa is induced in the bolts with a torque wrench, set very low to reduce the effect of friction in the threads and collar. Neglect the reduction in diameter due to the thread.
Thread angle to the perpendicular is 30^0 and pitch is 1 mm.
How many turns must the bolt head be turned from the pretension position to raise the tension in a bolt to 350 MPa?

(8)

5.2. (i) As the appointed engineer you received the results of the 6 monthly rope tests. Sketch the resultant graph and indicate the important points on the graph and explain the importance of these points.
(ii) Which characteristic from these results forecasts that a rope is approaching the end of its life.

(12)
[20]

Question 5- Hydraulic pump and rope examination

Hardly any candidate attemted this question and the majority were guessing work

Question 6

6.1 The traversing speed of an electrically driven crab of an overhead crane is 0,375 m/s. The maximum lifting capacity is 5000 kg. and the mass of crab is 2500 kg. The traversing drive has no mechanical brake and depends solely on electrical braking assisted by the resistance of the wheels on the track, which can be taken as 1350 N when the crab is fully loaded.
Moment of inertia of traversing motor armature is 0,04 kg m^2 and the speed of the motor is 950 r/min.
The diameter of the wheels are 125 mm and the wheels are driven by double reduction gears with ratios of 18 to 110 and 15 to 82. and the efficiency of the gearing is 90%.

Calculate the maximum distance the crab will travel after a power failure whilst the crab travels fully loaded and the electrical brake fails as well.

(12)

6.2 (i) Mention, and briefly describe, the losses you anticipate to find in a large transformer.
(ii) Describe briefly the protection devices on a large transformer

(8)
[20]

Question 6- Winch crab on overhead crane and transformer
A few brave attempts with very little success on the first question
The few that attempted this question scored well on the transformer question

Question 7

A slimes pump has an efficiency of 48% and must pump slime to a slimes dam against a static head of 25 m. The density of the dry solids is 2,4 t/m^3 and the solid to water ratio is 1,1/1 by mass. The pump column is 750 m long and has a diameter of 150 mm. Make practical assumptions because the quantity pumped could not be measured due to the nature of slime.

(i) Calculate the dry mass of the solids that can be pumped per day if the motor is drawing 55 A from a 550 V 3 ph supply.

(15)

(ii) Identify potential problems and develop procedures to start the pump after an unplanned power failure of 6 hrs.

(5)

[20]

Question 7- Slimes pump

The majority of candidates attempted this question and once again they did not comply with the requirements of the question.

Question 8

8.1 A 600 mm wide, 6-ply troughed-belt conveyor running at 2,0 m/s is required to deliver crushed stone at 230 t/hr over a horizontal distance of 150 m with a lift of 25 m. The belt is driven by the head pulley, 0,6 m diameter, and the tension is maintained with a gravity take-up after the head pulley. The angle of lap is 210^{0} and friction between the belt and pulley is 0,23. The tension for this belt is not to exceed 8 kN/meter width/ply and 11% of the shaft power is absorbed by friction.

(i) Calculate the power required and the gearbox ratio to drive the belt if a 4 pole motor is used.
(ii) Determine the mass of the gravity take-up.
(iii) Comment on devices preventing run-back

(12)

8.2 In the Code of Practice on 'The safe use, operation and inspection of man-riding belt conveyors,' SABS 0266: 1995, recall and enumerate the requirements with regard to:

(i) Safety devices
(ii) Responsibilities

(8)
[20]

<u>Question 8 Conveyors</u>

It would appear that the lack of basic, as well as legal knowledge in answering these questions was their downfall especially the lack of knowledge from SABS standards.

Question 9

9.1 An underground rescue chamber which is equivalent to an area of radius 5 m, is to be illuminated by a single lamp vertically above. The minimum illuminance is 6 lx and the maximum illuminance 20 lx.
Assume the luminous intensity to be uniform in all directions and that the utilisation factor is 0,6.

(i) Find the mounting height in metres
(ii) Find the mean spherical luminous intensity of the lamp

(10)

9.2 (i) Enumerate and describe the purpose of every piece of equipment required for a rescue chamber.
(ii) What is the designed area for a person in the rescue chamber?

(10)
[20]

Question 9-Rescue Chambers

Less than 10 candidates attempted this questiom with no correct answer, limited knowledge of rescue bay requirements.

INFORMATION PAGE **INLIGTINGSBLADSY**

Cable Information for 4 core PVC cables.

Voltage rating	**1000 V**								
					3.3 to 11 kV				
Conductor size	**mm²**	**4**	**6**	**10**	**16**	**95**	**120**	**150**	**185**
Current rating at 70⁰ C	**A**	**48**	**59**	**79**	**100**	**235**	**280**	**310**	**350**
Impedance at 70⁰ C	**Ω/km**	**10.5**	**9.76**	**8.93**	**8.32**	**4.33**	**3.78**	**3.33**	**2.87**
Conductor DC resistance.	**Ω/km**	**4.48**	**2.99**	**1.79**	**1.12**	**0.19**	**0.15**	**0.12**	**0.10**
Reactance at 70⁰ C	**Ω/km**	**9.50**	**9.29**	**8.75**	**8.24**	**4.33**	**3.78**	**3.33**	**2.87**
Short circuit rating	**kA/1 s**	**0.6**	**1.1**	**1.8**	**2.2**	**13.3**	**16.8**	**20.7**	**25.9**

De-rating factors
In ground 1000 V 0.95
In air 0.98

In water 1.00

$$Illuminance = \frac{luminous\ intensity}{h^2} \qquad Verligting = \frac{ligverspreiding}{h^2}$$

$T_1 = T_2 e^{\mu\theta} \quad v^2 = u^2 + 2as$	$M = F x r$	$V = I x R$	$F = \sigma x A$	$\sigma = E x \varepsilon$	$x = \varepsilon x l$

$T = I x \alpha$	$T = F x r$	$F = m x a$

$P = \sqrt{3} x V I \cos\theta$	$h_{friction} = 0,002 l v^2 \rho / d$	$Power = \frac{hQ\rho g}{\eta}$	$Power = \frac{mgh}{\eta}$	$Power = (T_1 - T_2)v$