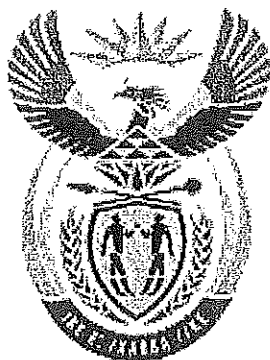


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higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T40(E)(J6)T
JUNE EXAMINATION

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

PLANT ENGINEERING: MINES AND WORKS

(8190306)

**6 June 2013 (X-Paper)
09:00–12:00**

CLOSED-BOOK EXAMINATION

Nonprogrammable calculators may be used.

This question paper consists of 8 pages and an answer sheet.

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

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 any TWO questions in SECTION B.
 3. Read ALL the questions carefully.
 4. Number the answers according to the numbering system used in this question paper.
 5. Rule off across the page on completion of EACH question.
 6. ALL calculations must be shown.
 7. Use only BLACK or BLUE ink.
 8. Questions are based on the requirements and practical application of the Mine Health and Safety Act, 1996 (Act 29 of 1996) and the regulations framed under Schedule 4. Answers must be confined to these requirements.
 9. Candidates arriving 30 minutes late will NOT be allowed to sit for the examination. NO candidates writing the examination may leave the examination room before ONE hour after commencement of the examination.
 10. This is a CLOSED-BOOK EXAMINATION. Candidates may NOT use any notes, text books or reference works during this examination.
 11. NO cellular phones are allowed in the examination room.
 12. Write neatly and legibly.
-

SECTION A: COMPULSORY**QUESTION 1**

- 1.1 As a shaft engineer you need to check several data sheets each morning, e.g. the driver's log sheet, the artisan's overtime, the hoisting report, the breakdown report, the tachograph from the winders, etc.
For several weeks now some complaints have been received from individuals that there is something wrong with the winder or with the winding engine driver on a certain shift. The winder in question is an 2300 HP Metvick AC Winder.

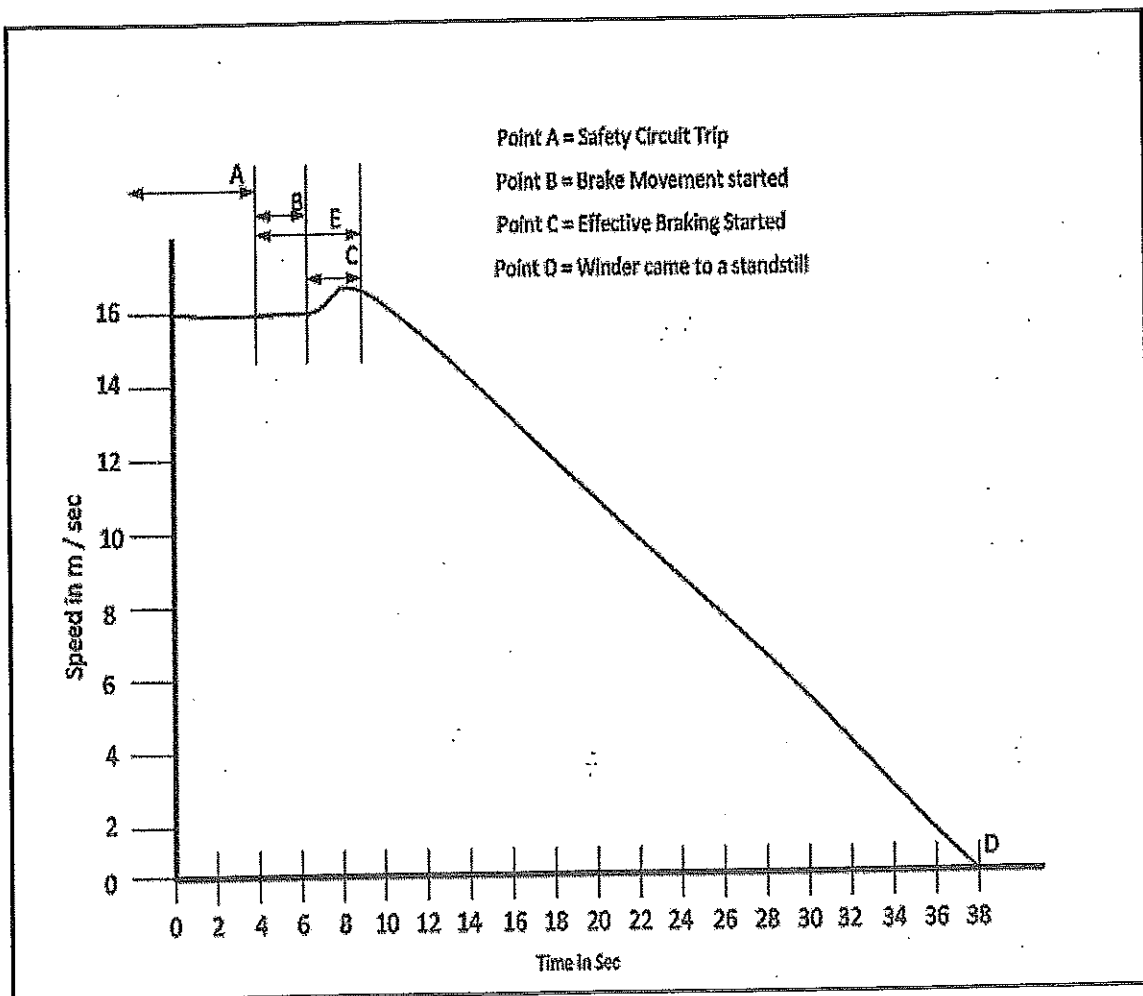
Attached is an ANSWER SHEET with a tachograph. You need to analyse the tachograph to ascertain what the problems are so the winder can be rectified.

Answer the following questions on the ANSWER SHEET by writing each question number where applicable. Insert the ANSWER SHEET in your ANSWER BOOK and hand it in together.

- | | | |
|--------|--|-----|
| 1.1.1 | Indicate on the sheet where the winder shifts from a bank to a level. | (1) |
| 1.1.2 | Indicate where slinging has taken place. | (1) |
| 1.1.3 | Indicate possible problems with the acceleration and deceleration of the winder. | (1) |
| 1.1.4 | Indicate that the responsible people have carried out their legals. | (1) |
| 1.1.5 | Indicate where the winder tripped and the driver resettled it to complete the cycle. | (1) |
| 1.1.6 | While analysing the data you identify sections where clutching has taken place. Indications are that the clutching speed exceeds the permissible speed. Indicate those sections. | (1) |
| 1.1.7 | The artisans rectified the clutching problem. Indicate where the clutching speed was corrected. | (1) |
| 1.1.8 | Indicate where the winding engine driver worked on open bells between stations. | (1) |
| 1.1.9 | Indicate where the winding engine driver possibly did not operate the winder correctly. | (1) |
| 1.1.10 | Are these problems in 1.1.3 in your opinion control problems or were they caused by the winding engine driver? Write your answer in the ANSWER BOOK. | (1) |

1.2 As a shaft engineer you need to do dynamic testing on the winders installed on your shaft. You have one man winder installed which is still equipped with a deadweight brake system. Below are the simplified dynamic test results for that winder:

- (a) Full speed is 16 m/s.
- (b) Brake gaps are 2 mm.
- (c) Drum diameter is 5 m.
- (d) There are 3 rope layers on the drum.
- (e) Diameter of triangular stranded rope is 52 mm.
- (f) Overrun distance from the bank to the spectacle plate is 25 m.
- (g) Length of rope on a turn in the middle layer rope is 15,8 m.



$$V^2 = u^2 + 2as$$

Determine the following:

- 1.2.1 By studying the dynamic trace, critical information can be collected and several decisions can be made from the interpretations. (5)
What are these interpretations? (5)
- 1.2.2 What is the maximum speed? (1)
- 1.2.3 Why does the winder speed up after the trip? (2)
- 1.2.4 What is the degree of protection for this winder? (2)
- [20]**

QUESTION 2

- 2.1 As the responsible engineer you are inspecting the 6,6 kV substation in your section. What protection will be provided on the following panels?
- 2.1.1 Incoming panel feeded from the main substation
- 2.1.2 300 Kw local transformer panel
- 2.1.3 Feeder panel to a next substation
- 2.1.4 A pump feeder to a 150 kw pump
- 2.1.5 A mini substation feeder panel
- (5 × 3) (15)
- 2.2 What is a neutral earthing compensator? (5)
Sketch it and indicate how it is connected to the reticulation system. **[20]**

QUESTION 3

You are the sectional engineer on a high production shaft. Suddenly you experience a total power failure. You were busy with shaft examination and have people stranded in each compartment 30 metres above the closest station.

- 3.1 List in order of priority the information you require prior to making decisions on your course of action. (3)
- 3.2 What steps must be taken prior to starting up the emergency generator? (3)
- 3.3 Which circuit breakers should be switched on first after connecting the emergency power supply to the 6,6 kV panel? (3)

- 3.4 What other emergency equipment must be started up and why? (3)
- 3.5 Explain the procedure for removing people from the conveyances. (4)
- 3.6 What instructions do you give your banksman? (3)
- 3.7 What instruction do you NOT give your winding engine driver? (1)
- [20]**

SECTION B

Answer any TWO questions in this section.

QUESTION 4

- 4.1 A two stage reciprocating compressor compresses 6,8 kg of air per second from a barometric pressure of 85 kPa (gauge pressure) to a delivery pressure of 700 kPa (gauge pressure). The temperature of the air at the inlet is 21 °C and that of the air leaving the high pressure cylinder is 125 °C.

The following readings have been obtained:

	V (l/min)	T _{in} (°C)	T _{out} (°C)
Jacket water, low pressure cylinder:	340	24	28.5
Jacket water, high pressure cylinder:	295	24.5	29.5
Cooling water to intercooler:	1220	23.8	32

Determine the isothermal efficiency of the compressor. (10)

- 4.2 Rock is to be transported by a conveyor belt to the top of five silos built in line. Describe a conveyor tipper system that can discharge this rock into any silo. Also state what safety devices should be installed for:

4.2.1 Circular silos and

4.2.2 Rectangular silos

(5 × 2) (10)
[20]

QUESTION 5

An important section of a plant is supplied with power from a 3 phase 150 kVA, 2,2 kV/380 V 50 Hz, star-delta transformer which suffered damage to its windings. The repair will take a few days. The only other transformer which is immediately available is a 3 phase 200 kVA, 3,3 kV/550V, 60 Hz star-delta unit. State whether this latter transformer can be used to supply the plant in the meantime, giving reasons for your answers.

[20]**QUESTION 6**

6.1 Explain the operation of the following types of scrubber box systems:

6.1.1 The water type scrubber

6.1.2 The dry type scrubber system

(3 × 2) (6)

6.2 What is the purpose of a scrubber box?

(3) (

6.3 Name SIX requirements for maintenance of a scrubber system?

(6)

6.4 A battery locomotive with a mass of 10 000 kg is required to haul a train of loaded cars with a total mass 60 000 kg up a gradient of 1 in 400 at an average speed of 2,7 m/s. The length of the haul is 2,5 km. The running resistance of the cars is 50 N per 1 000 kg and that of the locomotive 80 N per 1 000 kg.

Determine the capacity of the 96 V battery required for a shift of 8 hours.

(5)
[20]

QUESTION 7

7.1 What does the term *intrinsically safe* denote as applied to:

7.1.1 A circuit

7.1.2 Apparatus

(3)

7.2 To which types of electrical equipment can the safe-guard of intrinsically safe circuits and apparatus be applied and what are the advantages of the use thereof over the use of flame proof enclosures?

(5)

7.3 Under what conditions may extensions to intrinsically safe apparatus or circuits be made?

(2)

7.4 A pneumatic hammer rated at 500 kg has a piston of 310 mm diameter and stroke 560 mm. If the air pressure is 5,6 bar, find from first principals the kinetic energy of the hammer at full stroke.

(5)

7.5 Explain the following:

7.5.1 Potential energy

7.5.2 Stored energy

7.5.3 Kinetic energy on conveyor belts

(5)
[20]

QUESTION 8

8.1 Describe TWO different methods of mounting roller bearings on their shafts. (5)

8.2 Give reasons for your procedure and state how you would check the final accuracy. (5)

8.3 A mine is supplied with energy on a 2 part tariff of R25/kW for maximum demanded per annum and 0,4 cents/kWh.

It is decided to raise the power factor of a 500 kW motor from 0,81 to 0,9 by installing capacitors at R10/kVAr per annum.

Determine:

8.3.1 The annual savings resulting from the installation of the capacitors if the motor runs at full load for 96 hours per week

8.3.2 The most economical power factor

(5 × 2) (10)
[20]

QUESTION 9

9.1 Describe briefly one method you would use to lower and install a heavy XLPE electrical cable in a deep vertical equipped mine shaft. (10)

9.2 As an engineer you are required to draw up a procedure for working close to or under overhead power lines.

Name FIVE hazards and the associated risks you would address and what you would recommend to eliminate them.

(10)
[20]

TOTAL: 100