DEPARTMENT OF MINERALS AND ENERGY

MINE MANAGERS EXAMINATION

**METALLIFEROUS AND COAL MINING
MECHANICAL AND ELECTRICAL
ENGINEERING**

DATE: 15 MAY 2008   TOTAL MARKS: 100
                                         TO PASS: 50%

TIME ALLOWED: 3 HOURS
                (12:30-15:30)

NOTE:

1.   All calculations must be shown.

- All answers and sketches must be presented in a neat and decipherable manner.

- Papers will not be marked if undecipherable.

- Restrict the use of highlighters.

- Do not use a red pen.

- Read the directions on the front page of your answer book carefully.

- The use of computers, laptops and palmtops is prohibited.

QUESTION 1

A single drum incline shaft winder has the following properties:

- Electric motor   525V, 3 phase,50Hz, 4 pole
- Motor efficiency   80%
- Power factor   0,75
- Drum diameter   800mm
- Gearbox ratio   50:1
- Gearbox efficiency   90%
- Acceleration force   125% of full-load force
- Rope diameter   25mm
- Number of layers on drum   3
- Rail friction losses   25N
- Incline shaft slope   25°
- Incline shaft vertical height   120m.

Calculate the following:

1.1   The maximum rope speed when an empty conveyance is pulled up the incline.

(5)

1.2   The time required to pull the conveyance up the incline from bottom to top.

(5)

1.3   The maximum load mass in the car whilst being pulled up the incline that will result in a load of 40A on the electric motor, considering that the conveyance has a mass of 1 000kg   10)

[20]

QUESTION 2

With the use of sketches, explain how an epicyclic gear train on a scraper winch may be used as a clutch and as a reduction gearbox.

[20]

QUESTION 3

Draw a circuit diagramme of the switch and its internal wiring for a 950 volt 3 phase supply to a 150kW explosion-protected face machine via a trailing cable connected to a 5 pin plug and socket. Name the major components of the circuit.

[20]

QUESTION 4

An underground ventilation district has five Load-Haul-Dumpers operating simultaneously on a permanent basis.

The district is served by a vee-belt driven fan with the following characteristics:
- Electric motor   525V, 3-phase slip-ring
- Power factor   0,8
- Motor efficiency   80%
- Vee-belt losses   20%
- Fan efficiency   75%

It has been established that the ventilation requirement is $20m^3$/s per LHD. Air pressure drop over the district is determined to be 1,5kPa.

4.1   Calculate the electric motor power required to operate the fan to adequately ventilate the district.   (6)

4.2   Calculate the current drawn by the electric motor.   (4)

4.3   What is the purpose of the slip-rings on the electric motor and how is it used?   (2)

4.4   Explain the causes of the air pressure drop.   (3)

4.5   Name two types of main fans in use in mines.   (2)

4.6   List three safety devices required to be utilised on a main ventilation fan.   (3)

[20]

QUESTION 5

A plunger pump is used to pump sludge from shaft bottom in a vertical shaft.

Given:

No. Of plungers	3		Plunger stroke	220mm
Plunger diameter	120mm		Sludge relative density	$1,2t/m^3$
Pump speed	30rpm		Pump slip	10%
Solids relative density	$2,9t/m^3$		Shaft depth	1200m
Friction head	9% of static head		Electric motor	3-phase 380V
Shifts worked	3x8Hrs/day		Overall efficiency	75%

Calculate:

5.1   The mass of sludge pumped per day.   (3)

5.2   The mass of solids pumped per day.   (4)

5.3   The electric motor power required to drive the pump.   (4)

5.4   The pressure exerted on the non-return valve at shaft bottom

         when the column is full of sludge.   (4)

5.5   List at least three disadvantages of pumping sludge by the above means and

         list at least two alternatives.   (5)

                                                                                                                   [20]

                                                                              TOTAL MARKS: [100]