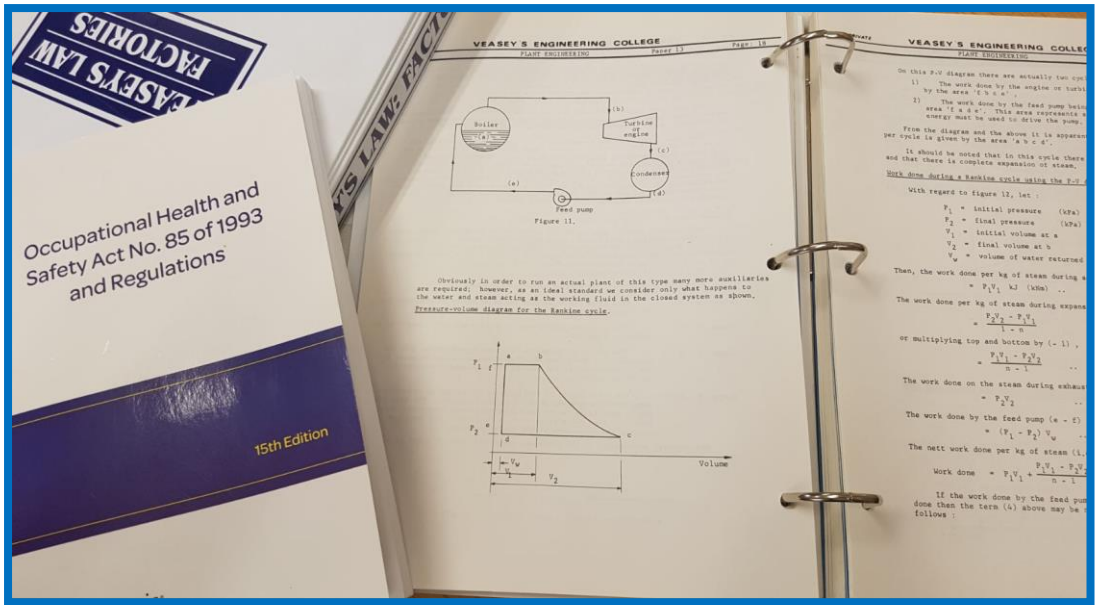
VEASEY'S
ENGINEERING COLLEGE

This is a sample of our study material with which we hope will attract you into purchasing the full package to assist you in your study journey to the examinations for the Engineer's Certificate of Competency – the GCC.

The following is included in this pack:

- An extract from Plant Engineering: MINES and FACTORIES course notes
- A Plant Engineering: MINES mechanical question and proposed solution
- A Plant Engineering: MINES electrical question and proposed solution
- A Plant Engineering: FACTORIES electrical question and proposed solution
- A Plant Engineering: FACTORIES mechanical question and proposed solution
- A Legal Knowledge: MINES question and proposed answer*
- A Legal Knowledge: FACTORIES question and proposed answer*
- An extract from "TAKE YOUR MARKS…..on writing the GCC examinations"

* The questions are on the left and the suggested answers on the right.



If you think Veasey's Engineering College can assist you in attaining this qualification visit our site at www.veaseys.co.za or contact Caitlyn Jones on 076 921 7110 or info@veaseys.co.za.

We also have a social presence on:

Good luck with your GCC studies and please consider Veasey's Engineering College as your study partner!

Plant Engineering: MINES and FACTORIES course notes

Internal gear pumps:

FIGURE 13

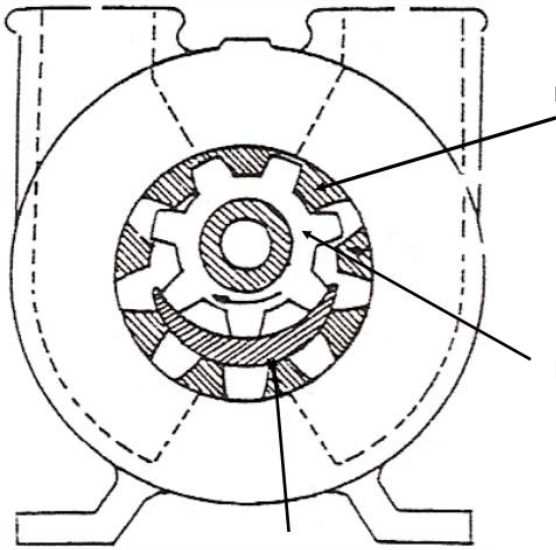
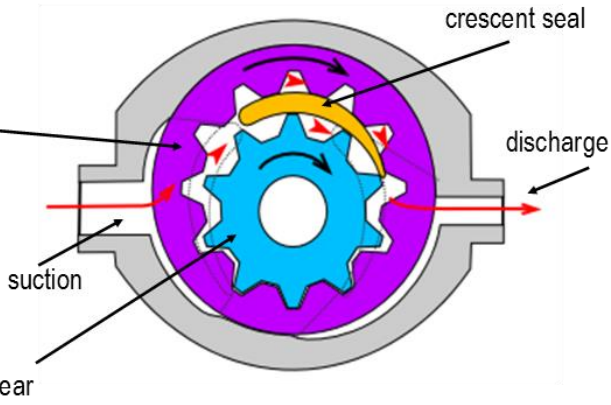


FIGURE 13a



This type of pump is shown in Figure 13 & 13a. The internal gear or rotor is driven from the pump shaft and the idler or external gear is free to rotate on a separate shaft mounted off centre.

The space between the internal diameter of the rotor and the external diameter of the idler is sealed by a crescent shaped seal. Oil is carried by both gears, past the crescent seal to the delivery side where it is sealed from the suction side by the meshing of the gears.

Size for size this pump has a somewhat higher capacity than the external gear pump. It is more silent in operation, but is not suitable for pressures in excess of 3,5 MPa.

Plant Engineering: MINES mechanical question

Sketch the layout for a long conveyor belt which has a tandem drive and a counterweight operating in vertical guides for maintaining tension in the slack side of the belt. Such a belt raises 360 tonnes per hour through a vertical distance of 36 m at a belt speed of 75 m/sec. The ratio of tensions in the tight and slack sides is 8:1 and a total of 11 kW is absorbed in friction. The belt has a mass of 18 kg/m.

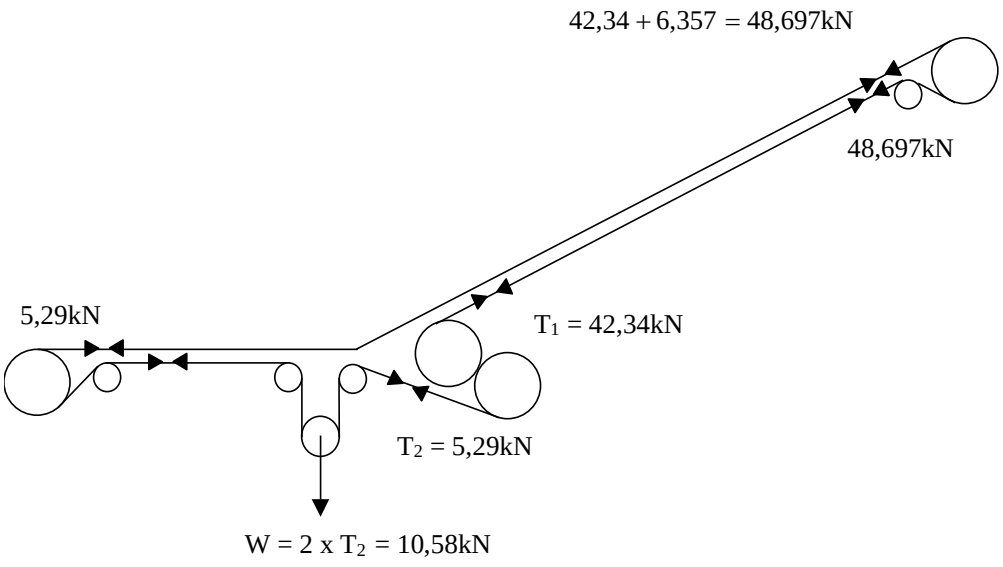
Determine the weight of the counterweight and mark on your sketch the tensions in the belt before and after each pulley. For this purpose you may assume that the whole of the friction losses occur in the troughing idlers.

Proposed Solution

w = 2 × T_2 = 10,58 kN

Effective pull due to payload = $\frac{\text{weight in N per min.} \times \text{elevation in m}}{\text{belt m / min.}}$

= $\frac{360 \times 10^3 \times 9{,}81 \times 36}{60 \times 75}$ = 28,25 kN



Effective pull due to friction load = $\frac{\text{power in kW}}{\text{speed in m / sec.}}$ = $\frac{11 \times 60}{75}$ kN = 8,8 kN

Total effective pull = 28,25 + 8,8 kN or $T_1 - T_2$ = 37,05 kN or $T_1 (1 - \frac{1}{8})$ = 37,05 kN

$\frac{7}{8} T_1$ = 37,05 kN ∴ $T_1 = \frac{8}{7} \times$ 37,05 kN = 42.34 kN

∴ $T_2 = \frac{42{,}34}{8}$ and counterweight = 2 × T_2 = 10,58 kN = 5,29 kN

Additional tension at head pulley due to belt weight = elevation in m × wt. per metre of belt -
= 36 × 18 × 9,81 = 6 357 N or 6,357 kN

Plant Engineering: MINES electrical question

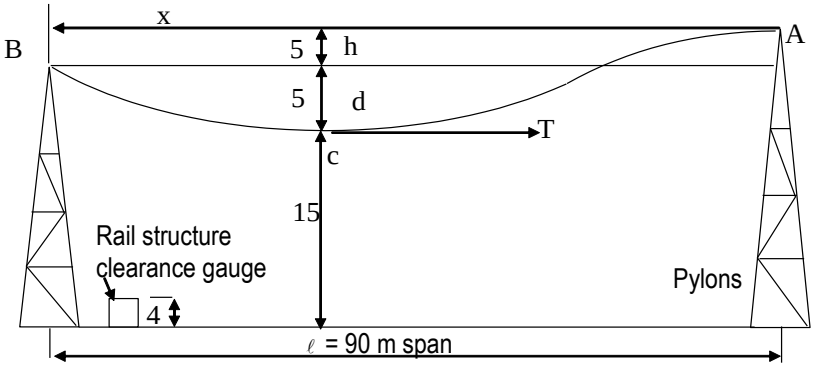
A 33 kV overhead transmission line with steel core aluminium conductors spans a non-electrified railway line and a main road owned by the mine 80 m wide. One end is 5 m above the other end and 16 m above the lowest point. The mass of the line is 5 kN/m over the whole span.

Calculate the maximum tension in a conductor.

Proposed Solution

T is the horizontal tension at C For the section BC $T = \frac{m x^2}{2 d}$ ..... ①

For the section AC $T = \frac{m (\ell - x)^2}{2 (d + h)}$ ..... ②



① = ②

$\frac{m x^2}{2 d} = \frac{m (\ell - x)^2}{2 (d + h)}$ $\frac{x^2}{d} = \frac{(\ell - x)^2}{(d + h)}$ $\frac{x^2}{5} = \frac{(90 - x)^2}{(5 + 5)}$

$2 x^2 = 8100 - 180 x + x^2$

$x^2 = 180x - 1800 = 0$ by formula, x 37,28 m

Substitute for x in ① $T = \frac{m x^2}{2 d} = \frac{5 \times 90 \times 37.28^2}{2 \times 5}$ = 62 541 kN = **62,541 MN**.

Plant Engineering: FACTORIES mechanical question

In a test on a water-tube steam generator the following average readings were obtained:

Coal fired, inclusive of 4% surface moisture		3 500 kg/h
Mass of dry, saturated steam raised		22 150 kg/h
Pressure of steam at steam-generator stop valve		3 000 kPa
Feedwater temperature		50 °C
Temperature of flue gasses at base of stack		150 °C
Steam-generator house temperature		15 °C
Calorific value of coal		26 MJ/kg
Analysis of coal	Carbon	68 %
	Hydrogen	12 %
	Oxygen	3,5 %
	Ash	16,5 %
Atmospheric pressure		85 kPa
Excess air used		55 %
Specific heat at constant pressure for dry air		1,005 kJ/kg.K
Oxygen by mass contained in air		23 %

Assume that ALL the carbon is burnt to form carbon dioxide.

Calculate the following:

a) The mass of the flue gas per kg of dry coal burned
b) The heat to the flue gases per hour
c) The steam generator efficiency (12)

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a) The question states that all carbon, C is burnt to form Carbon Dioxide, CO_2

$$C + O_2 \xrightarrow{\text{yields}} CO_2$$

Atomic mass →

$$12 + (2 \times 16) \xrightarrow{\text{yields}} 12 + (2 \times 16)$$

$$12 + 32 \xrightarrow{\text{yields}} 44$$

$$\frac{12}{12} + \frac{32}{12} \xrightarrow{\text{yields}} \frac{44}{12}$$

$$1\text{kg Carbon} + 2.67\text{kg Oxygen} \xrightarrow{\text{yields}} 3.667\text{ kg Carbon dioxide}$$

Now using the analysis of the coal, calculate how much oxygen is used to burn 0.68kg of carbon,

$$2.67 \times 0.68 = 1.81kg\ O_2$$

Hydrogen, H_2 to Water, H_2O

$$2H_2 + O_2 \xrightarrow{\text{yields}} 2H_2O$$

Atomic mass →

$$2 \times (2 \times 1) + (2 \times 16) \xrightarrow{\text{yields}} 2 \times (2 \times 1) + 16$$

$$4 + 32 \xrightarrow{\text{yields}} 36$$

$$\frac{4}{4} + \frac{32}{4} \xrightarrow{\text{yields}} \frac{36}{14}$$

$$1kg\ hdrogen + 8kg\ Oxygen \xrightarrow{\text{yields}} 9kg\ Water$$

Now using the analysis of the coal, calculate how much oxygen is used to burn 0.12kg of hydrogen,

$$8 \times 0.12 = 0.96\ kg\ O_2$$

Calculate how much oxygen is required to burn 1 kg of coal

$$1.81 + 0.96 - 0.035 = 2.735\ kg\ O_2$$

$$Theoretical\ air\ required = \frac{100}{23} \times 2.735 = 11.89\ kg$$

$$Excess\ aire\ supplied = 11.89 \times 0.55 = 6.54\ kg$$

$$Actual\ air\ supplier = 11.89 + 6.54 = 18.43\ kg$$

Products of combustion: these will include the water from the combustion of hydrogen but not the 4% surface moisture because the products of dry coal are required.

$$H_2O = 9 \times\ H_2 = 9 \times 0.12 = 1.08\ kg$$

$$CO_2 = 2.67 \times C = 2.67 \times 0.68 = 2.49\ kg$$

$$O_2 = 0.23\ \times excess\ air = 0.23\ \times 6.54 = 1.504\ kg$$

$$N_2 = 0.77\ x\ actual\ air = \ 0.77\ \times 18.43 = 14.19\ kg$$

$$Total\ mass\ of\ flue\ gas\ (wet) = 19.264\ kg$$

$$Total\ mass\ of\ flue\ gas\ (dry) = \mathbf{18.184\ kg}$$

b) It will be assumed that the flue gas is dry for this part of the question, as only the specific heat, C_p, for dry flue gas is given.

$$Heat\ lost\ per\ kg\ of\ coal = mass \times C_p \times (t_2 - t_1) = 18.184 \times 1.005 \times (150 - 15)$$
$$= 2467\ kJ$$

Now the total heat lost will be based on the dry mass of the coal fired

$$Mass\ of\ dry\ coal = wet\ mass - mass\ of\ moisture = 3500 - (3500 \times 0.04)$$
$$= 3360kg$$

$$Total\ heat\ lost = 2.467 \times 3360 = \mathbf{8\ 289\ MJ/h}$$

c) Heat added in the boiler to generate dry saturated steam at 3000 kPa

$$heat\ added = hg - h_{feed\ water} = 2803 - (418 \times 50) = 2594\ kJ/kg$$

$$Mass\ of\ stam\ raised\ per\ kg\ coal = \frac{22150}{3500} = 6.33\ kg$$

$$heat\ supplied\ in\ coal = 26\ MJ/kg\ \ (given)$$

$$\eta_{boiler} = \frac{6.33 \times 2594}{26 \times 10^3} = \mathbf{0.6315\ or\ 65.15\ \%}$$

Plant Engineering: FACTORIES electrical question

The primary and secondary windings of a 500 kVA transformer have resistances of 0,42 Ω and 0,0011 Ω respectively. The primary and secondary voltages are 6 600 V and 400 V respectively, and the iron loss is 2,9 kW.

1. Calculate the efficiency on the following assuming the power factor of the load to be 0,8.

a) Full load (7)

b) Half load (3)

2. Find the output at which the efficiency of the above mentioned transformer is a maximum and calculate its value, assuming the power factor to be 0,8 (5)

Proposed Solution:

It should be noted that this problem should be treated as a single phase calculation as the question does not state that it is a three phase transformer, nor how the primary and secondary windings are connected (i.e. star, delta), and does not state the resistance per phase. The candidate should not make unnecessary assumptions.

1(a) Calculate primary current, I_p

$$I_p = \frac{Transformer\ rating}{V_p} = \frac{500 \times 10^3}{6600} = 75.758\ A$$

Calculate primary current, I_s

$$I_s = \frac{Transformer\ rating}{V_s} = \frac{500 \times 10^3}{400} = 1250\ A$$

Now calculate the copper loss both in the primary and the secondary windings, P_{copper}

$$P_{copper} = \left[\left(I_p^2 \times R_p\right) + \left(I_s^2 \times R_s\right)\right] = \left[(75.758^2 \times 0.42) + (1250^2 \times 0.0011)\right] = 4.129kW$$

And the iron loss is constant with loading, P_{iron} = 2.9 *kW*

Now calculate efficiency at full load where *k=1*, $\eta_{full\ load}$

$$\eta_{full\ load} = \frac{k \times E \times I \times \cos \emptyset}{k \times EI\ cos\ \emptyset + P_{iron} + k^2 P_{copper}} = \frac{1 \times 500 \times 10^3 \times 0.8}{1 \times 500 \times 10^3 \times 0.8 + 2900 + (1)^2 4129} = \mathbf{98.27\%}$$

1(b) Now calculate efficiency at full load where k=½, $\eta_{half\ load}$

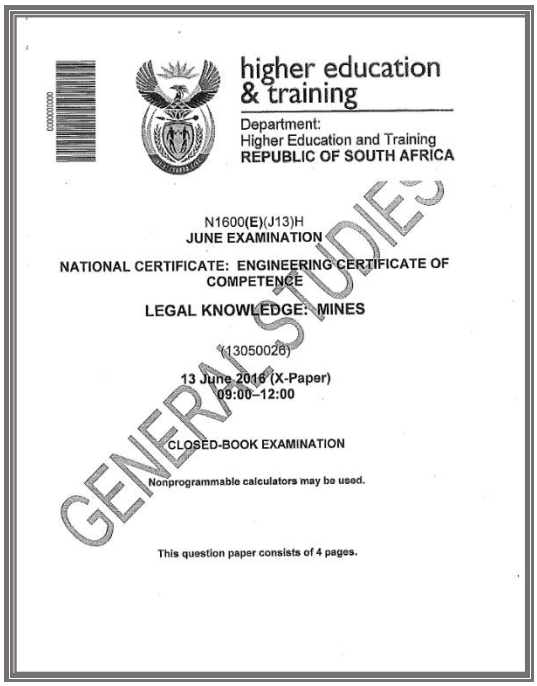
$$\eta_{half\ load} = \frac{(0.5)E \times I \times \cos \emptyset}{(0.5)EI\ cos\ \emptyset + P_{iron} + (0.5)^2 P_{copper}} = \frac{250 \times 10^3 \times 0.8}{250 \times 10^3 \times 0.8 + 2900 + (0.25)4129}$$
$$= \mathbf{98.07\%}$$

2. For maximum efficiency, η_{max}, copper loss = iron loss, where k is the fraction of load where this occurs

$$\eta_{max}\ when\ k^2 P_{copper\ full\ load} = P_{iron} \therefore k = \sqrt{\frac{P_{iron}}{P_{copper}}} = \sqrt{\frac{2900}{4129}} = \mathbf{0.8381\ of\ full\ load}$$

$$\eta_{max} = \frac{kE \times I \times \cos \emptyset}{kEI\ cos\ \emptyset + P_{iron} + k^2 P_{copper}} = \frac{(0.8381) \times 500 \times 10^3 \times 0.8}{(0.8381) \times 500 \times 10^3 \times 0.8 + 2900 + (0.8381)^2 \times 4129}$$
$$= \mathbf{98.3\%}$$

A Legal Knowledge: MINES question and proposed answer



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

N1600(E)(J13)H
JUNE EXAMINATION

NATIONAL CERTIFICATE: ENGINEERING CERTIFICATE OF COMPETENCE

LEGAL KNOWLEDGE: MINES

(13050026)

13 June 2016 (X-Paper)
09:00–12:00

CLOSED-BOOK EXAMINATION

Nonprogrammable calculators may be used.

This question paper consists of 4 pages.

Question

State 10 requirements pertaining to conveyor belt installations as expounded in Regulation 8.9(1). [10]

Proposed answer

8.9 Conveyor belt – (1) In compliance with regulation 8.8(1) the employer must ensure that –

(a) A conveyor belt installation is **not cleaned when any of its parts are in motion**;

(b) The power supply of a stationary conveyor belt installation is **locked-out** during repairs, maintenance, routine cleaning and cleaning of spillage;

(c) The **driving machinery of the conveyor belt installation can be stopped by any person from any point, along its length where access to the belt is possible**;

(d) The **driving machinery of the conveyor belt installation is stopped should the belt break, jam or slip excessively**;

(e) **Persons are prevented from entering any side of a conveyor belt installation** where there is no walkway, unless means has been provided to do so safely;

(f) One or more devices are fitted and used to give all persons at any point where access to the conveyor belt installation is possible **sufficient prior warning for a period to be determined by the mine's risk**

assessment with a minimum period of 10 seconds that any part of such a conveyor belt installation is about to be put into motion;

(g) The **take-up or belt tensioning device will not move during repairs, routine cleaning, cleaning of spillage, maintenance or belt splicing**;

(h) Where two or more conveyor belt installations are used in series, **sequence interlocking** is provided which automatically will –

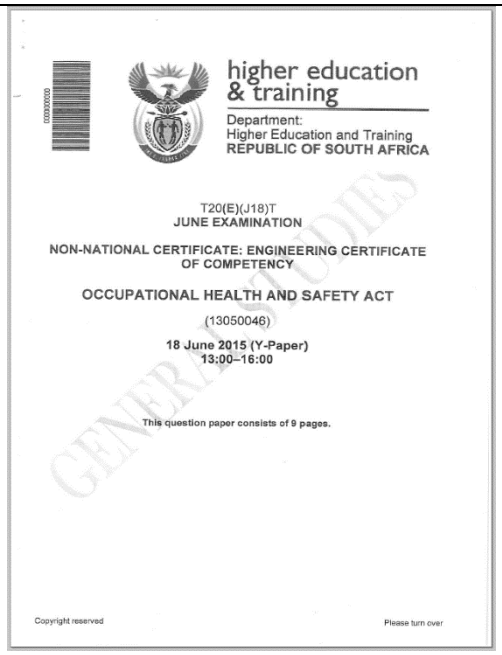
(i) **Stop all conveyor belt installations** feeding a belt conveyor that has stopped; and

(ii) **Prevent a conveyor belt from starting until the conveyor belt onto which it feeds is moving**;

(i) **Only persons authorised to do so by the employer operate, maintain, clean and repair a conveyor belt installation**;

(j) The **belt of any conveyor belt installation cannot run away**; and

(k) The **overall structural design of every conveyor belt installation is approved by a competent person**.



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T20(E)(J18)T
JUNE EXAMINATION

NON-NATIONAL CERTIFICATE: ENGINEERING CERTIFICATE OF COMPETENCY

OCCUPATIONAL HEALTH AND SAFETY ACT

(13050046)

18 June 2015 (Y-Paper)
13:00–16:00

This question paper consists of 9 pages.

GENERAL STUDIES

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Please turn over

A Legal Knowledge: FACTORIES question and proposed answer

Question		**Proposed answer**
Q151-5.1.1 Pressure equipment	(2)	**"pressure equipment"** means a steam generator, pressure vessel, piping, pressure accessory and safety accessory, transportable gas container, and fire extinguisher and includes, but is not limited to, an accumulator, a hot-water geyser, and hyperbaric chambers.
Q151-5.1.2 Steam generator	(2)	**"steam generator"** means any apparatus to convert water continuously into steam at a pressure higher than that due to the atmosphere and where the heat is derived from a source other than steam, and includes any super heater or economiser which is an integral part of a steam generator or is separately fired there from, fired steam and hot-water boilers, waste-heat boilers, waste-incineration boilers, and electrode or immersion-type electrically heated boilers.
Q151-5.2 Before certain pressure equipment, such as pressure cylinders, may be placed in the market, it requires a permit issued by an organisation approved by the chief inspector.		
Q151-5.2.1 Who must obtain such certificate?	(1)	5(3) Any pressure equipment that requires a permit to be issued by an organisation approved by the chief inspector **shall ensure that such approval is obtained by the importer or manufacturer** before the pressure equipment is placed in the market: Provided that such equipment shall comply with the relevant health and safety standard incorporated into these Regulations under section 44 of the Act.
Q151-5.2.2 When must such a certificate be obtained?	(3)	Any pressure equipment that requires a permit to be

(1)	issued by an organisation approved by the chief inspector shall ensure that such approval is obtained by the importer or **manufacturer before the pressure equipment is placed in the market:** Provided that such equipment shall comply with the relevant health and safety standard incorporated into these Regulations under section 44 of the Act.
Q151-5.3 Who must ensure that new pressure equipment put on the market complies with the pressure equipment regulations? (1)	5(1) **Importers and suppliers** shall ensure that pressure equipment sold complies with the requirements of these Regulations.
Q151-5.4 Irrespective of compliance to the various standards incorporated into the regulations for pressure equipment, what must all pressure equipment be subjected to? (1)	3(3) All pressure equipment for use in the Republic **shall be categorized and submitted to the applicable conformance assessments of SANS 347** in addition to the requirements of the relevant health and safety standard incorporated into these Regulations under section 44 of the Act.
Q151-5.5 You may not use a steam generator unless you have a certificate of registration issued by the provincial director of the Department of Labour. After registration and when in use, name TWO cases you have to immediately notify the provincial director in writing. (2) **[10]**	8(7) A user of a steam generator shall immediately notify the provincial director in writing when - (a) such steam generator **is no longer in use**; (b) the right of control over the use of the steam generator is **transferred by the user to any other user**; or (c) the user **moves the steam generator to premises other than the premises reflected on its certificate of registration**.

TAKE YOUR MARKS

..... ON WRITING GCC EXAMS

ABSTRACT

Explore some common sense exam writing points which could make the difference between passing and failing your Engineer's Certificate of Competence examinations.

Veasey's Engineering College

Note: this is only an extract as the full document is 8 pages

TAKE YOUR MARKS… ON WRITING GCC EXAMS

The GCC is about being a good Engineer and not about a whole lot of silly schoolchild principles and techniques, right? That's true, but it's sad that sometimes good Engineers who know their work fail GCC because they can't show the examiner what they are really worth. In this paper I will discuss some common sense exam writing points which could make the difference between failing and passing. It might be that some of these ideas don't work for you or don't seem worth worrying about; that's fine. Decide on your own approach and move on……..

NAME OF THE GAME What to expect and how to study

I've heard a few complaints that the examiners are stupid, they think if you can learn like a parrot you're a good Engineer, etc., etc. We all know that these statements are not true. And even if they are, we still have to pass the exam. It is more helpful to try to see the exams through the examiners' eyes. What qualities are they looking for in a candidate? What difficulties do they have to deal with?

Let's get one thing clear. The pass rate is usually low, especially for Plant Engineering, and everybody would prefer it to be higher……

…… LEGAL KNOWLEDGE

- The Commission of Examiners has been clear: Candidates must know the Act and be able to apply it in practice. The first two questions are likely to be directly from the Act, not regulations.
- We have also been told that the Examiner uses a matrix of Regulations: Don't expect the more specialized ones to never come up.
- You are expected to be specific and detailed. For example, "as per the definition" is a bad answer: you must state the definition. "Adhere to Construction regulation 14(1)" is not good enough. You will have to state what the regulation specifies…….
- ……PLANT ENGINEERING
- Many candidates complain that they didn't have enough time for this exam. When you're reasonably well prepared for the exam we propose you deal with this potential problem as follows:
    - Answer old exam papers of different types, and time yourself on each question. Don't cheat; write it all down like the real thing……

- ……..For calculations, it is more important than you think to show how you get to your answer. With safety factors, reading off tables, different methods etc. it is not impossible for clearly different answers to both be worth full marks, if the marker can understand where they come from. Some principles:
    - Show the formulae you use.
    - Try to write down each step of the calculation so if you happen to get the answer incorrect, the examiner can still go back to see where you went wrong and allocate marks accordingly.
    - Use, and state, the correct units: kVA, kWh, m^4, MPa, rad/s^2, $kg.m^2$, kg.K, etc.