Province of the
**EASTERN CAPE**
EDUCATION

# NATIONAL SENIOR CERTIFICATE

## GRADE 12

## SEPTEMBER 2011

# MECHANICAL TECHNOLOGY MEMORANDUM

**MARKS: 200**

This memorandum consists of 11 pages.

**SECTION A:**

**QUESTION 1 MULTIPLE-CHOICE QUESTIONS**

**NAME/NAAM: Memorandum**

| ANSWER SHEET/ANTWOORDBLAD | | |
|---|---|---|
| **QUESTION/VRAAG** | **1** | **(MULTIPLE CHOICE QUESTIONS) /(MEERVOUDIGEKEUSE-VRAE)** |

| | | | | |
|---|---|---|---|---|
| 1.1 | ~~A~~ | B | C | D |
| 1.2 | A | B | C | ~~D~~ |
| 1.3 | ~~A~~ | B | C | D |
| 1.4 | A | B | ~~C~~ | D |
| 1.5 | A | B | C | ~~D~~ |
| 1.6 | A | B | ~~C~~ | D |
| 1.7 | A | B | ~~C~~ | D |
| 1.8 | A | B | ~~C~~ | D |
| 1.9 | A | ~~B~~ | C | D |
| 1.10 | ~~A~~ | B | C | D |
| 1.11 | A | B | C | ~~D~~ |
| 1.12 | ~~A~~ | B | C | D |
| 1.13 | A | B | C | ~~D~~ |
| 1.14 | A | B | C | ~~D~~ |
| 1.15 | A | B | C | ~~D~~ |
| 1.16 | A | B | C | ~~D~~ |
| 1.17 | A | B | C | ~~D~~ |
| 1.18 | ~~A~~ | B | C | D |
| 1.19 | A | ~~B~~ | C | D |
| 1.20 | A | B | ~~C~~ | D |

| | |
|---|---|
| **TOTAL** | **[20]** |

## QUESTION 2 FORCES AND SYSTEMS AND CONTROL

2.1 2.1.1 AREA = $\frac{\pi D^2}{4}$

= $\frac{\pi \times 0{,}024^2}{4}$ √

= 0,000452389 $m^2$ √ (2)

2.1.2 STRESS = $\frac{65 \times 10^3}{0{,}000452389}$ √

= 143681545,8 Pa√

= 143,68 MPa √ (3)

2.1.3 STRAIN = $\frac{Change\ in\ length}{original\ length}$

= $\frac{0{,}5}{1200}$ √

= 0,000416666 √ (2)

2.1.4 Young's modules = $\frac{stress}{strain}$

= $\frac{143{,}68 \times 10^6}{0{,}000416666}$ √√

= 344,83 GPa √ (3)

2.2 Safety factor = $\frac{break\ stress}{work\ stress}$

= $\frac{100}{25}$ √√

= 4 √ (3)

2.3 Power =(350)x$\pi$ x(0,34)x $\frac{2000}{60}$ √ √

= 12,46 kW √ (3)

2.4 2.4.1 Lead = $\frac{\pi x 120}{\tan 37°}$ √

= 500,28 mm

= 500 mm √ (2)

2.4.2 Number of teeth = $\frac{120}{3}$ √

= 40 teeth √ (2)

2.4.3 Lead of machine = 40x 6

= 240 mm √

$\frac{DR}{DN} = \frac{240}{500} = \frac{(12)(4)}{(25)(4)}$ √

DR = 48 teeth and √

DN = 100 teeth √ (4)

2.5 2.5.1 $\frac{F_1}{1,8}=\frac{100}{0,2}$ √

$\therefore F_1 = \frac{100X1,8}{0,2}$ √

= 900 N √ (3)

2.5.2 Area x distance = Area x distance

1,8 x distance = 0,2 x 0,09 √

$\therefore$ distance = $\frac{0,2x0,09}{1,8}$ √ √

= 0,01 m

= 10 mm √ (4)

2.6 PITCH = $\frac{12}{3}$

= 4 mm √

EFFECTIVE DIA($D_E$) = BD – (0,5 x PITCH)

= 50 – (0,5 x 4)

= 48 mm √

Helix angle Tan θ = $\frac{lead}{\pi \times D_e}$

= $\frac{12}{\pi x48}$ √

θ = 4,55° √

LEADING ANGLE = 90° - (helix angle + clearance angle)

= 90° - (4,55° + 3°) √

= 82,45° √

TRAILING ANGLE = 90° + (helix angle – clearance angle)

= 90° + (4,55° - 3°) √

= 91,55° √ (8)

2.7 2.7.1 Effort applied = $\frac{1300}{4}$ √

= 325 N √ (2)

2.7.2 V.R. = $\frac{2x210}{160-130}$ √

= $\frac{14}{1}$

= 14:1 √ (2)

2.7.3 Mechanical efficiency = $\frac{4}{14}$x100% √

= 28,57% √ (2)

2.8 2.8.1 Torque = 0,36x(3,25x$10^3$)x2x $\frac{0,16}{2}$ √

= 187,2 N.m √ (2)

2.8.2 Power = $\frac{2x\pi x2700x187,2}{60}$ √

= 52,93 kW √ (2)

2.8.3 Use an extra clutch plate. √ (1)

**[50]**

## QUESTION 3 TOOLS AND EQUIPMENT

| | | | | |
|---|---|---|---|---|
| 3.1 | 3.1.1 | 82 Brinell hardness √ | | (1) |
| | 3.1.2 | 10 mm diameter steel ball √ | | (1) |
| | 3.1.3 | 1 500 kg load √ | | (1) |
| | 3.1.4 | 30 seconds √ | | (1) |
| 3.2 | Vickers-hardness test √<br>Rockwell-hardness test √ | | | (2) |
| 3.3 | Independent√ four jaw chuck √ (one mark for four jaw chuck) | | | (2) |
| 3.4 | 3.4.1 | A blown head gasket between adjacent cylinders √ √ | | (2) |
| | 3.4.2 | Excessive bore wear √<br>Excessive ring wear √<br>Dirty rings<br>Motor with high mileage<br>Bent valves | (Any 2) | (2) |
| 3.5 | Vernier tooth calliper √ | | | (1) |
| 3.6 | 3.6.1 | Inlet valve leaking √ | | (1) |
| | 3.6.2 | Outlet valve leaking √ | | (1) |
| | 3.6.3 | Worn piston rings √ | | (1) |
| | 3.6.4 | Worn piston rings √ | | (1) |
| 3.7 | 1. To give the yield stress √<br>2. To give the ultimate tensile stress √<br>3. To give the percentage elongation √ of a piece of material | | | (3) |
| | | | | **[20]** |

## QUESTION 4 MATERIALS

4.1 Low carbon steel – (0,15% to 0,3%) √ √
Medium carbon steel – (0,3% to 0,75%) √ √
High carbon steel – (0,75% to 1,7%) √ √ (6)

4.2 Light weight √
Ductile √
Malleable √
Soft
Resistance to corrosion
Non-magnetic
Bluish-white – silvery-white colour (Any 3) (3x1) (3)

4.3

| ADVANTAGES | DISADVANTAGES |
|---|---|
| Rapid moulding and extrusion √ | Lack of durability √ |
| No wastage √ | Creep √ |
| Scrap and rejects can be used again.√ | Degradation√ |
| | Loss of shape |
| | Brittleness |

(Any 3) (3x2) (6)

4.4 4.4.1 PET √ (1)

4.4.2 HDPE √ (or PE – HD) (1)

4.4.3 PP √ (1)

4.5 Tennis racquets √
Badminton racquets √
Squash racquets
Racing-bicycle frames
Ski's
Surfboards
Boat masts (Any 2) (2)

**[20]**

## QUESTION 5 SAFETY, TERMINOLOGY AND JOINING METHODS

5.1 Straight (parallel) shank – 0,5 to 13 mm diameter √ √
Taper shank – 13,5 to 50 mm diameter √ √. (2x2) (4)

5.2
- Make sure that all guards are in place.
- Do not use a michine or come close to its moving parts while wearing loose cloting.
- Keep any cleaning material such as waste and rags away from rotating parts.
- Check that there is no oil or grease on the floor around the machine.
- Do not leave spanners or key on rotary parts.
- Always disconnect, remove or stand clear from hand wheels, levers or chuck keys before setting your machine or feeds in motion.
- Never apply a spanner to revolving work.
- Always clamp work pieces and holding devices safely and firmly. A loose fit, especially of spanners and keys, may cause slipping and result in injury.
- Do not use your hands to remove the cuttings while a machine is in motion, use a wire hook or brush to the clean cuttings away once the machine has stopped.
- Never adjust the cutting tool while a machine is running.
- Resist the habit of leaning on machinery.
- Do not attempt to stop a machine by placing your hand on the chuck while the machine is slowing down.
- Give attention to cutting-fluid before switching on a michine.

(Any 4) (4)

5.3 5.3.1 Ind $= \frac{40}{N}$

$= \frac{40}{23}$ √

$= 1\frac{17x(2)}{23x(2)}$ √

= 1 full turn and 34 holes on the 46 hole circle √ (3)

5.3.2 Angle ind $= \frac{N}{540}$

$= \frac{(61x60)+20}{540}$ √

$= \frac{3680}{540}$ √

$= 6\frac{44}{54}$ √

= 6 full turns and 44 holes on the 54 hole circle √ (4)

5.4 5.4.1 Ind $= \frac{40}{N}$

$= \frac{40}{110}$ √

$= \frac{4x(6)}{11x(6)}$ √

= no turn but 24 holes on the 66 hole circle √ (3)

5.4.2 Change gears needed:

$\frac{DR}{DN} = \frac{A-N}{A} \times \frac{40}{1}$

$= \frac{(110-113)}{110} \times \frac{40}{1}$ √ √

$= \frac{-12x(4)}{11x(4)}$ √ √

= simple drive

DR = 48T and the DR = 44T √ √ (6)

5.4.3 Direction of rotation is to the left (negative) (anti-clockwise) √ (1)

5.5 5.5.1 Upcut method or Upcut milling √ (1)

5.5.2 Straddle milling √ (1)

5.6 Rack and pinion √ (1)

5.7
- Store full cylinders separately from empty ones. √
- Keep cylinders in cool place away from direct sunlight and other heat sources. √
- Always store cylinders in upright position. √
- Store oxygen and acetylene apart.
- Never stack cylinders.
- Do not bang or work on cylinders.
- Do not let cylinders fall.
- No oil or grease to come into contact with fittings.
- Keep caps on cylinders.
- The screw thread for oxygen is r/h.
- The screw thread for acetylene is l/h. (Any 3) (3)

5.8

| defect | causes | prevent |
|---|---|---|
| Porosity √ | Atmospheric contamination √<br>Surface contamination<br>Dirty or wet electrodes<br>Rusted MIG-wire | Check for leakage on gas supply √<br>Clean surface<br>Change electrode<br>Change MIG-wire |
| Slag inclusion √ | Flux is trapped within the solidified metal √<br>Welding temperature is too low | Chip slag thoroughly from previous weld √<br>Brushing weld bead with wire brush<br>Set current correct |
| Weld craters/ faulty restart | Welding is resumed at the bottom of weld instead of at the top of previous weld | Start at the top of previous weld |
| Incomplete penetration | The weld bead does not penetrate the entire thickness of base plate<br>Two opposing weld beads do not inter-penetrate<br>The weld bead does not penetrate the toe of a fillet weld | Set welding current higher<br>Alter torch angle<br>Too slow travel speed<br>Make root gap wider<br>Keep arc on leading edge of molten pool |
| Lack of fusion | Poor welding technique to a wide weld joint<br>Excessive iron oxide | Increase the travel speed<br>Make the weld joint narrower<br>Increase the welding voltage |
| Undercutting | Wrong travel speed<br>Wrong arc voltage | Decrease travel speed<br>Increase the arc voltage<br>Change the leading torch angle closer to 90°<br>Keep the arc length short |

**ANY TWO DEFECTS WITH CAUSES AND PREVENTIONS** (6)

5.9 * Clean the surface to be tested √
* Spray the liquid dye penetrant onto surface √
* Allow dye to dry √
* Use cloth and cleaning detergent to remove excess dye √
* Spray developer on weld and allow to dry √
* Defects will start to show. (ultraviolet light is sometimes used) √ (6)

5.10 Cutter r/min = N

$N = \frac{30}{\pi \times 0{,}075}$ √ √

= 127,32 r/min √

Feed (f) = $f_1$ x T x N

f = 0,04 x 18 x 127,32 √ √

= 91,67 mm/min √ (6)

5.11 To divide the circumference of a round work piece into equal divisions √ (1)

**[50]**

## QUESTION 6 TURBINE AND MAINTENANCE

6.1 6.1.1 Make sure engine is at working temperature √
Place container under sump. Remove oil filler cap. √
Unscrew sump plug and drain oil into container. √
Use a filter spanner and remove filter. √
Allow enough time for oil to drain. √
Apply sheen of oil to rubber seal of oil filter and mount with hand. √
Screw sump plug fitted with new copper washer to sump. √
Refill engine with oil according to specifications and replace oil filler cap. √ (8)

6.1.2 Oil loses its characteristics or viscosity due to heat √
Due to friction small metal chafings can block filter or oil channels √
Formation of gum, acids and lacquer due to combustion of fuel (2)

6.2 Viscosity index √
Load-carrying √
F2G test √
Pour point √
Corrosion and rust resistance
Water separation (demulsibility)
Foam resistant
Oxidation resistant (Any 4) (4)

6.3 Refers to the resistance of oil to flow. √ √ (2)

6.4 Water soluble oil √
Water √ (2)

6.5 Manual transmission √
Automatic transmission √ (2)

6.6 6.6.1 Centrifugal charger √ (1)

6.6.2 More power is obtained compared to a similar vehicle without turbocharger √
More economical per given kilowatt output to similar engine size √
Less fuel is used compared to engine mass
power loss at altitude is eliminated
Supercharger do not suffer lag.
Superchargers do not need special exhaust systems.
Supercharger does not need special shutdown procedure.
(Any 2) (2)

6.6.3 1. inlet √
2. outlet √
3. rotor √
4. vane √ (4)

6.7 Small amount of power loss because it uses engine power √
Higher fuel consumption if power generated not fully used √
Owing to compression of air if there is an increase of working temperature √
The lifespan of the engin is decreased √ (4)

6.8 Insufficient belt tention (to slack) √
Excessive loading √
Oil on belt √
Grease on belt √
Dirt on belt (Any 4) (4)

6.9 Remove all balance pieces √
Remove mud and dirt from rim √
Remove small stones and mud from wheel surface √
Inspect the wheel surface for wear √
Check the side walls
Inspect the rims
Check if the wheel size are the same
Check the working of the shock absorbers (Any 5) (5)
**[40]**

**TOTAL: 200**