Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

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MECHANICAL TECHNOLOGY MEMORANDUM

MARKS: **200**

This memorandum consists of 12 pages.

QUESTION 1 is to be answered on this answer sheet.

VRAAG 1 moet op hierdie antwoordblad beantwoord word.

NAME/NAAM: _____

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

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

TOTAL	

Tear off this page and submit with answer book.

QUESTION 2 FORCES AND SYSTEMS AND CONTROL

(LEARNING OUTCOME 3: ASSESSMENT STANDARDS 6 AND 8)

2.1 2.1.1 Area = $\frac{\pi \times D^2}{4}$ √

$= \frac{\pi \times 0{,}024^2}{4}$ √

= 0,000452389 m^2 √

Stress = $\frac{force}{area}$

$= \frac{60 \times 10^3}{0{,}000452389}$ √

= 132629119,2 Pa

= 132,63 MPa √ (5)

2.1.2 Strain = $\frac{change\ in\ length}{original\ length}$ √

$= \frac{0{,}22}{212}$ √

= 0,001037735 √ (3)

2.1.3 Young modules = $\frac{stress}{strain}$ √

$= \frac{132{,}63 \times 10^6}{0{,}001037735}$ √

= 127,81 GPa √ (3)

2.2 Stress = $\frac{force}{area}$ √

Area = $\frac{380 \times 10^3}{420 \times 10^6}$ √

= 0,000904761 m^2 √

BUT:

Area = $\pi \times d \times t$ √

0,000904761 = $\pi \times d \times 0{,}014$

D = $\frac{0{,}000904761}{\pi \times 0{,}014}$ √

= 0,020571047 m

D = 20,57 mm √

Say diameter of hole is 21 mm (6)

2.3 Strain is directly proportional to the stress it causes, provided the limit of proportionality is not exceeded. √ √ (2)

2.4 Stress = $\frac{force}{area}$

force = stress x area √

= (300 x 10^3) x ($\frac{200}{1000}$ X $\frac{5}{1000}$) √

= 300N that is T_1 √

$\frac{T_1}{T_2} = \frac{2,5}{1}$ √

$T_2 = \frac{300}{2,5}$ √

T_2 = 120N √

T_e = 300 – 120 = 180 N √

Torque: T

T = T_e x radius

= 180 x ($\frac{1000}{2}$)√ = 180 x 0,5 m

= 90 N.m √

Power: P = $2 \times \pi \times \frac{N}{60} \times T$ **OR** P = $\pi \times \frac{N}{60} \times T_e \times D$

= $2 \times \pi \times \frac{200}{60} \times 90$ √ = $\pi \times \frac{200}{60} \times 180 \times 1$

= 1884,96 watt = 1884,96

= 1,88 kW √ = 1,88 kW (11)

2.5 2.5.1 Force on piston A: $\frac{F}{area\ A} = \frac{load}{area\ B}$

$\frac{F}{0,015} = \frac{800}{0,16}$ √

F = $\frac{800}{0,16} \times 0,015$ √

= 75 N √ (3)

2.5.2 $area_A \times stroke\ length = area_B \times stroke\ length$

0,015 x "X" = 0,16 x 10 √

"X" = $\frac{0,16 \times 10}{0,015}$ √

= 106,7 mm √ (3)

2.5.3 No effect because the pressure in the system is unchanged √

Piston A and B area did not change therefor no effect. √ (2)

2.6 2.6.1 $Mechanical\ advantage = \frac{load}{effort}$

$\therefore$ "F" $effort = \frac{1{,}57 \times 10^3}{4}$ √

= 392,5 N √ (2)

2.6.2 $Velocity\ ratio = \frac{2D}{d_2 - d_1}$

$= \frac{2 \times 210}{160 - 130}$ √

= 14 : 1 √ (2)

2.7 2.7.1 Consider a three start or even a four start screw thread √
A three start will move - 3 x 10 = 30 mm
A four start will move - 4 x 10 = 40 mm √
COMPARED TO
Two start will move - 2 x 10 = 20 mm (2)

2.7.2 Lead = pitch x number of starts
= 10 x 2
= 20 mm

EFFECTIVE DIA(D_E) = BD – (0,5 X PITCH)
= 55 – (0,5 x 10)
= 50 mm √

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

$= \frac{20}{\pi \times 50}$ √

Θ = 7,26° √ (3)

2.8 "P" power $= \frac{2 \times \pi \times N \times T}{60}$ **OR** T = μWnR

43,982 x 10^3 $= \frac{2 \times \pi \times 3000 \times T}{60}$ √ = 0,35 x 2,5 x10^3 x 2 x $\frac{0{,}16}{2}$

T = $\frac{43{,}982 \times 10^3 \times 60}{2 \times \pi \times 3000}$ √ = 140 N.m

= 139,999

Say= 140 N.m √ (3)
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QUESTION 3 TOOLS AND EQUIPMENT

(LEARNING OUTCOME 3: ASSESSMENT STANDARD 2)

3.1
1. Scale √
2. Indicator √
3. Upper platform √
4. Lower platform √
5. Compressing lever √ (5)

3.2 3.2.1 Determines the amount of CO being produced √ **OR** Analyse the exhaust gases (1)

3.2.2 To measure the pressure created in one cylinder √ (1)

3.2.3 To check whether the engine leaks gases from one cylinder during the compression stokes √ (1)

3.3
1. Shielding gas cylinder √
2. Wire-feed unit√
3. Continuous wire reel√
4. Welding gun √
5. Gas flow meter √
6. Power source **OR** AC transformer √ (6)

3.4
1. Check radiator for air bubbles - Air from cylinder is leaking into the water jackets√
2. Listen for air coming out of the carburettor/air cleaner - this indicates that inlet valve is leaking√
3. Air escaping through exhaust pipe - exhaust valve leaking√
4. Check for air escaping through the oil filler cap - worn or broken rings
5. Air escaping through adjacent cylinders - cracked or blown head gasket (Any 3) (3)

3.5
- Keep the meter dry √
- Keep it away from dust and dirt √
- Use and store it in normal temperature environments √
- Do not drop it
- Use only charged cells of correct size
- Remove cells when not in use (Any 3) (3)

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QUESTION 4 MATERIALS

(LEARNING OUTCOME 3: ASSESSMENT STANDARD 3)

4.1
1. Create a harder, tougher metal √
2. Producing a stronger metal √
3. Increase the resistance to corrosion and rust √
4. Changing the colour of the metal √
5. Increase electrical resistance √
6. Improve ductility and elasticity
7. Improving casting properties
8. Strengthening the metal against wear and tear
9. Lowering the cost of the metal
10. Lowering the melting point to below the mean of the metal components (Any 5) (5)

4.2 4.2.1 Copper + zinc √ √ (2)

4.2.2
- A hard alloy able to resist wear √
- Very good resistance to corrosion √
- Easily machined
- Lead acts as a lubricating agent (Any 2) (2)

4.3

	Properties	Uses	
4.3.1	Very light, ductile, malleable, soft, resist corrosion conduct electricity and non-magnetic√ (Any 1)	Transmission lines, electric cables, electric conductors, cooking utensils, gear crank cases, gear boxes, marine, aeroplane, motor vehicle, roofing, gutters, doors, etc. √ (Any 1)	(2)
4.3.2	• Work-hardens, ductility, malleability, electrical- and heat-conductivity, resist corrosion √ (Any 1)	• Electrical cables, switchboard parts, electrical bolts and nuts, water supply tubing and roofing √ (Any 1)	(2)
4.3.3	• Very soft, malleable, ductile and tough, bends and stretches easily √ (Any 1)	• Soft solder, bullets, lead cables, plumbing, sinkers etc. √ (Any 1)	(2)

4.4 Salt and oil √ √ (2)

4.5
- Water resistant √
- Oil resistant √
- Heat resistant √
- Corrosion resistant
- Needs no lubrication (Any 3) (3)

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QUESTION 5 SAFETY, TERMINOLOGY AND JOINING METHODS

(LEARNING OUTCOME 3: ASSESSMENT STANDARDS 1, 4 AND 5)

5.1
1. Never use damaged equipment √
2. No oil or grease close to oxygen equipment √
3. Never use oxygen to blow dirt or dust off clothing √
4. Never use matches or gas lighter to ignite the flame √
5. Sniff cylinders before assembling the regulators
6. Always make sure regulators have their adjusting screws released and purge them
7. Wear proper welding goggles, gloves and clothing
8. Make sure to have a fire extinguisher handy
9. Always use the proper regulator for the gas in the cylinder
10. Always use cylinders in the upright position
11. Always keep the acetylene cylinder valve wrench on the cylinder
12. Cylinder valve a maximum of one and a half turns open
13. Do not carry lighters or matches or other flammable objects in your pocket when welding
14. Take note of the area when welding
15. Be careful not to let welding hoses come in contact with the torch, flame or sparks from cutting (Any 3) (3)

5.2
1. Wear safety goggles √
2. Make sure that the test piece is properly mounted √
3. Do not exert too much stress in the beginning √
4. Only use apparatus if in good order
5. Make sure that machine stands firm
6. Make sure that all bolts and nuts on the apparatus are tight
7. Wear the correct personal protective safety wear
8. Before testing commences, make sure that the safety shield is in place
9. Work with care with the dial indicator, it can easily be damaged

(Any 3) (3)

5.3
1. Test only in well-ventilated area √
2. Make certain that the exhaust probe is fitted correctly to the exhaust pipe √
3. Do not run the engine for too long √
4. Make sure that the inlet hose is not stepped on or restricted √
5. Make sure that the hose connections are airtight
6. Check the valve on the condenser and be in the horizontal closed position
7. Check for leaks in the exhaust system, manifold or vacuum system
8. Clean the condenser and hose by blowing it with an air line
9. Drain the condenser after each test by means of the valve
10. Replace filter if it is light grey
11 Change fuel filter on condenser stand regularly
12. Make sure that the terminals are clean (Any 4) (4)

5.4
1. It keeps the work piece in position during machining √
2. It divides the circumference of the work piece in equal divisions √
3. It provides a turning action to work piece when doing helical milling √
4. It provides movement to the bed when milling a rack (Any 3) (3)

5.5 Angle 16°30' change (16 x 60') + 30' = 990'

Angle = $\frac{Angle}{540'}$

= $\frac{990'}{540'}$ √

= $1\frac{5}{6} \times \frac{4}{4}$ √

= one full turn of the index crank and 20 holes on the 24 hole circle √

OR

Angle = $\frac{16\frac{1}{2}}{9}$

= $\frac{33}{2} \times \frac{1}{9}$

= $1\frac{5}{6} \times \frac{4}{4}$

= one full turn of the index crank and 20 holes on the 24 hole circle (3)

5.6
- Rapid indexing √
- Differential indexing √
- Normal indexing/Simple indexing√
- Angular indexing (3)

5.7 5.7.1 Addendum = module √

= 2,0 mm √ (2)

5.7.2 Dedendum = 1,157 x m

= 1,157 x 2 √

= 2,314 mm √ (2)

5.7.3 Cutting depth = 2,157 x m

= 2,157 x 2 √

= 4,314 mm √

OR cutting depth = add + ded

= 2 + 2,314

= 4,314 mm (2)

5.7.4 Circle pitch = $\pi \times m$

= π × 2 √

= 6,28 mm √ (2)

5.7.5 Clearance = 0,157 x m

= 0,157 x 2√

= 0,314 mm √ (2)

5.7.6 PCD = $\frac{cp \times T}{\pi}$

= $\frac{6,28318 \times 40}{\pi}$ √

= 80 mm √

OR PCD = T x m

= 40 x 2

= 80 mm (2)

5.8
- Chance of teeth being sheared off is less √
- Less cost √
- Less power is required to drive the cutter √
- Can use high arbour speed
- Less vibration on the arbour (3)

5.9 r/min of cutter: N $N = \frac{V}{\pi \times D}$ √

$= \frac{28}{\pi \times \frac{65}{1000}}$ √

= 137,1181048 r/min √

Feed speed (*f*) = f_1 *x* T x N √

= 0,06 x 16 x 137,1181048 √

= 131,63 mm/min √ (6)

5.10 5.10.1

CAUSES	**CORRECTION**
Speed too fast √	Weld slowly √
Electrode too large √	Select correct electrode
Current too low	Set current up
	Leave enough space at bottom of the weld

(3)

5.10.2

CAUSES	**CORRECTION**
Speed too fast √	Weld slowly √
Current too low √	Select correct current
Faulty electrode	Change the electrode
Impaired base metal to a short arc	Check for impurities in metal Hold a longer arc

(3)

5.11
- Cut a nick on the length of the joint approximately 6,5 mm deep √
- Place the test piece on two steel supports √
- Use a sledge hammer to break the welded joint √
- Examine the broken surface of the weld for any possible defects √ (4)

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QUESTION 6 TURBINE AND MAINTENANCE

(LEARNING OUTCOME 3: ASSESSMENT STANDARD 7 AND 9)

6.1
1. Lubricating insufficient √
2. Operating temperature too excessive √
3. Oil/grease supply has foreign materials √
4. Incorrect lubricant √
5. Faulty design
6. Lubricant contaminated with water
7. Misalignment (Any 4) (4)

6.2 6.2.1
1. V-belts are used over short distances √
2. V-belts come in standard size for immediate replacement √
3. Silent in operation √
4. Requires very little maintenance
5. Is able to absorb shock loads
6. Operate at low bearing pressure
7. A number of v-belts can be used for heavy duty application
8. In a multi v-belt drive if one belt breaks the machine can still run on the remaining belts (Any 3) (3)

6.2.2
1. V-belt tension is too slack √
2. Oil on v-belt √
3. Grease on v-belt √
4. V-belt worn out/damaged sides (Any 3) (3)

6.3 6.3.1
1. Make sure engine is at working temperature √
2. Place container under sump. Remove oil filler cap. √
3. Unscrew sump plug and drain oil into container. √
4. Use a filter spanner and remove oil filter. √
5. Allow enough time for oil to drain. √
6. Apply sheen of oil to rubber seal of oil filter and mount with hand √
7. Screw sump plug fitted with new copper washer to sump. √
8. Refill engine with oil according to specifications and replace oil filler cap. √ (8)

6.3.2
(a) SAE "society of automotive engineers" √ (1)

(b) 20 A thinner oil for when the engine is still cold √ (1)

(c) W Indicates winter/colder conditions √ (1)

(d) `50 A thicker oil for when the engine is at optimal working temperature √ (1)

6.4
1. The work piece and cutting tool are kept cool √
2. The life of the cutting tool is prolonged √
3. A better finish is imparted to the surface √
4. Cuttings are washed away √
5. The machine is protected because the cutting process is eased √
6. The machine operator is protected from metal chips
7. Productivity is increased because of the cutting process is faster
8. The soluble oil prevents corrosion
9. It lubricates the machine (Any 5) (5)

6.5 6.5.1 Roots-blower √ (1)

6.5.2 Vane-blower √ (1)

6.5.3 Centrifugal-blower √ (1)

6.6
1. Inlet √
2. Outlet √
3. Rotor √
4. Casing √ (4)

6.7 Centrifugal-blower √ **OR** Figure 6.5.3 (1)

6.8

TURBO	**SUPERCHARGER**	
Driven by exhaust gases √	Mechanical driven √	(2)

6.9
1. Special shutdown procedure is required √
2. Special exhaust system needed√
3. Lag because of the exhaust gases to overcome the rotational inertia √ (3)

[40]

TOTAL: 200