Province of the
EASTERN CAPE
EDUCATION

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REPUBLIC OF SOUTH AFRICA

CHIEF DIRECTORATE – CURRICULUM MANAGEMENT

GRADE 12 LEARNER SUPPORT PROGRAMME

REVISION AND REMEDIAL TEACHING INSTRUMENT: ANSWERS

SUBJECT: MECHANICAL TECHNOLOGY

June 2009

This document consists of 14 pages.

Strictly not for test/examination purposes

QUESTION 1 MULTPLE-CHOICE QUESTIONS

(Learning Outcome 3: Assessment Standards 1 – 6)

1.1 D (1)

1.2 A (1)

1.3 B (1)

1.4 A (1)

1.5 A (1)

1.6 D (1)

1.7 B (1)

1.8 C (1)

1.9 D (1)

1.10 A (1)

1.11 D (1)

1.12 D (1)

1.13 A (1)

1.14 D (1)

1.15 A (1)

1.16 A (1)

1.17 A (1)

1.18 A (1)

1.19 A (1)

1.20 C (1)

TOTAL: [20]

QUESTION 2 APPLIED MECHANICS (FORCES)

(Learning Outcome 3: Assessment Standards 6 and 8)

2.1 2.1.1 Solution for reaction forces:

Clockwise moments = Anti-clockwise moments

Taking moments about Q

$P \times 5 = (5 \times 1) \div (6 \times 2,5) \div (10 \times 3,5)$ kN √

$P \times 5 = 5 + 15 + 35$ kN √

$P = \frac{55}{5}$ √

P= 11 kN √ (4)

2.1.2 Taking moments about (P):

$Q \times 5 = (10 \times 1,5) \div (6 \times 2,5) \div (5 \times 5)$ kN √

$Q \times 5 = 15 + 15 + 20$ √

$Q = \frac{50}{5}$ √

Q = 10 kN √ (4)

2.1.3 Calculate the shear forces:

SF(a) = P
= 11 kN √

SF(b) = P − B
= 11 − 10
= 1 kN √

SF (c) = P – (B + C)
= 11 – (10 + 6)
= –5 kN √

SF (d) = P – (B + C+ D)
= 11 – (10 + 6 + 5)
= 10 kN √

SF (e) = Q kN
= 10 kN √ (5)

2.1.4 Calculate bending moments:

BM (A) = P × Distance
= 11 × 0
= 0 kN.m √

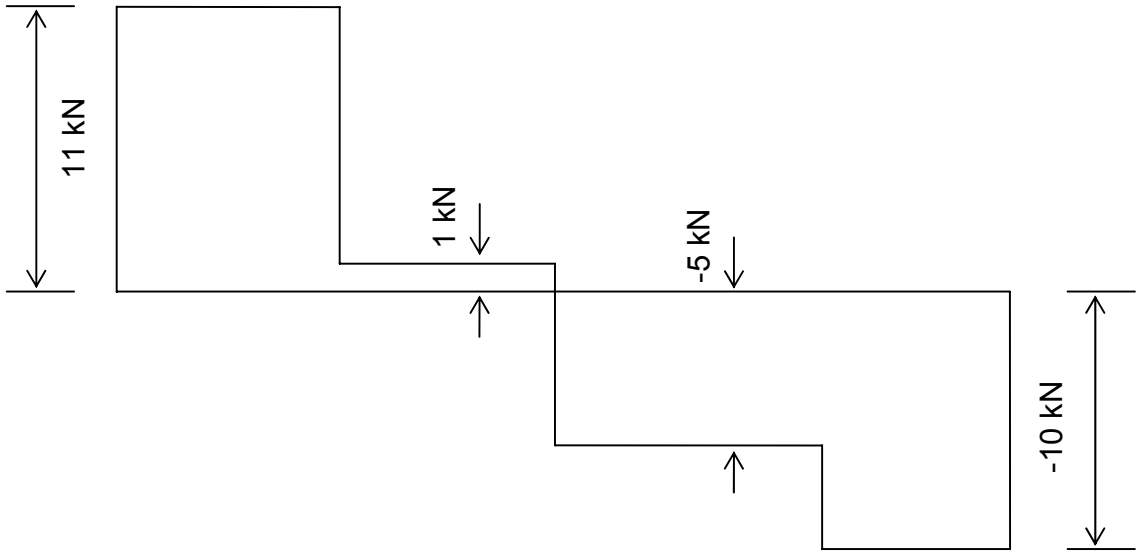
BM (B) = P × a
= 11 × 1,5
= 16,5 kN.m √

BM (C) = (P × a – b) – (B – b)
= (11 × 2,5) –(10 – 1)
= 27,5 – 10
= 17,5 kN.m √

BM (D) = Q × d
= 10 × 1
= 10 kN.m √

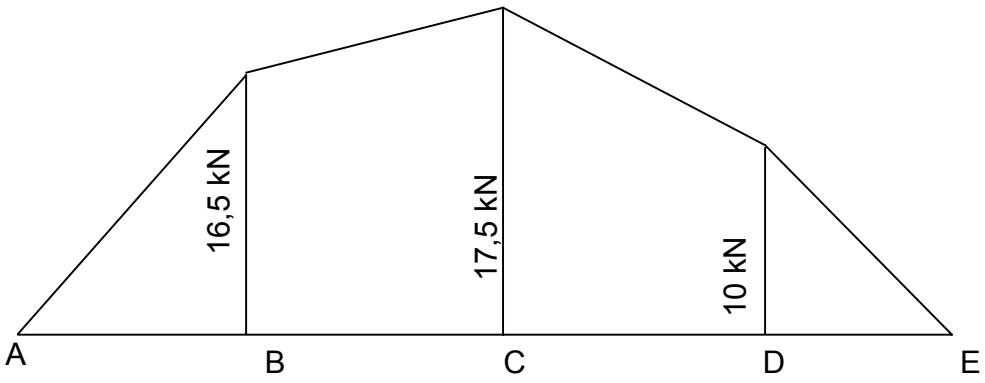
BM (E) = Q × Distance
= 10 × 0
= 0 kN.m √ (5)

2.1.5 Shear force diagram:



SF - DIAGRAM (5)

2.1.6 Bending moment diagram:



BM – DIAGRAM

(5)

2.2 2.2.1 Load: This is an external force acting upon a matter (2)

2.2.2 Safety factor: Is the number of times with which the maximum stress is decreased to obtain a safe stress. (2)

2.2.3 Breaking stress: Is the maximum stress in a material which is exceeded to cause a bar to yield and break. (2)

2.2.4 Change in length: Is the length with which a bar is shorten or lengthened when an external load is applied. (2)

2.2.5 Original length: Is the exact length of a bar before an external load is applied. (2)

2.3 Calculate stress:

$$\text{Stress} = \frac{\text{load}}{\text{cross sectional area}}$$

$$\text{Area} = \frac{\prod \times d^2}{4}$$

$$S = \frac{50\ \text{kN}}{\frac{\prod \times d^2}{4}}$$

$$S = \frac{50 \times 10^3}{\frac{\prod (40 \times 10^{-3})^2}{4}} \quad \surd$$

$$S = \frac{50\,000}{\frac{\prod (0{,}04)^2}{4}} \quad \surd$$

$$S = \frac{50\,000}{0{,}00125}$$

$\underline{\text{Stress} = 40 \times 10^6 \text{N.m}^{-2}(\text{Pa})}$ $\surd$ (3)

2.4 Calculate strain:

$$\text{Strain} = \frac{\text{Change in length}}{\text{Original length}}$$

S = ?
X = 0,12 mm
L = 0,5 m (convert to mm)

$$S = \frac{0{,}12}{500} \quad \surd$$

$\underline{S = 0{,}00024}$ $\surd$ (2)

2.5 Calculate Young's Modulus:

A Stress:

Stress = z ?

Load = 56 ×10³ N

$$\text{Stress} = \frac{\mu.10^2}{4x10^6}$$

$$S = \frac{50 \times 10^3}{\frac{\mu.10^2}{4x10^6}} \quad \surd$$

$$\text{Stress} = \frac{56x10^3 x4x10^6}{\mu.10^2}$$

$$\text{Stress} = \frac{224x10^9}{\mu.100} \quad \surd$$

Stress = 713,01 MPa √

B Calculate strain:

$$\text{Strain} = \frac{\text{Change in length}}{\text{Original length}}$$

S = ?

X = 0,6 mm

L = 20 m (convert to mm)

$$\text{Strain} = \frac{0,6}{20\,000} \quad \surd$$

Strain = 0,00003 √

C Calculate Young's Modulus:

$$E = \frac{\text{Stress}}{\text{Strain}}$$

$$E = \frac{713,01x10^6}{0,00003} \quad \surd$$

E = 23,77 TPa √ (7)

[50]

QUESTION 3 TOOLS AND EQUIPMENT

(Learning Outcome 3: Assessment Standard 2)

3.1 Procedure

- Run the engine until it reaches normal operating temperature.
- Remove the high tension leads and take out all the spark plugs, unplug the low tension connections to the coil or to the distributor
- Screw the gauge into cylinder 1 and crank the engine
- Open the throttle fully by pressing the accelerator
- Crank the engine until the gauge stops rising and count the revolutions
- Write down the final reading
- Repeat the procedure for the other three cylinders
- If any cylinders are low then a ”wet” test can be done – if satisfactory, stop test (6)

3.2 Leakage test

- Listen at the carburettor for wind noise (inlet valve leaking)
- If there is a noise at the exhaust tail pipe (exhaust valve leaks)
- Pull the dipstick out to hear if there is a noise (piston rings are worn)
- Remove the oil filler cap to hear if there is a noise (rings are worn)
- Open the radiator cap to see if the water is bubbling (blown cylinder head gasket)
- If there are bubbles in the radiator water (cylinder block is cracked) (6)

3.3 Brinell hardness tester

1 Hand pump
2 Plunger
3 Cylinder
4 Ball
5 Screw
6 Material under test
7 Ram
8 Force measure (8)

[20]

QUESTION 4 MATERIAL

4.1 Material

	Non-Ferrous metals	Composition	Properties	Uses	Marks
4.1.1	Phosphor bronze	Tin and phosphorous	Corrosion resistant	Hot, wet and corrosive conditions	3
4.1.2	Duralumin	Copper and Manganese	High tensile strength	Forging and stampings	3
4.1.3	Solder	Tin and lead	Low melting point	Unions of petrol pipes for aircraft engines	3

(9)

4.2 By looking at the quenching colour after the metal has been cleaned first (polished) and then heated. Colours will appear in sequence on the surface. Quenching colour will be the determining hardening temperature. (2)

4.3 4.3.1 Annealing: By heating the steel to above the critical point and cool off normally – as slow as possible.

4.3.2 Normalising: To remove porosity that was caused by the hardening process. Heat metal to below the third critical point and allow cooling normally.

4.3.3 Tempering: Heat metal to a temperature below third critical point, maintain for some time and quench in suitable quenching substance.

4.3.4 Case hardening: This is a surface hardening process. The aim is to create a tough centre. Carbon content is increased by heating the metal to the third critical point and thereafter immersing in a carbon rich substance. Metal then porous to absorb carbon. (4x2) (8)

4.4 Gas-Reinforced plastic (GRP) (1)

[20]

QUESTION 5 SAFETY AND TERMINOLOGY

5.1 SAFETY PRECAUTIONS — POWER SAW

- See that all guards are in place
- Make sure no oil, grease or obstacles are around the machine
- Select the right blade for the material to be cut
- Do not adjust guides while machine is in motion
- All material must be clamped properly before cutting is started
- Long pieces of material must be supported
- Always stop the machine when you leave it unattended
- Remove or replace blades very gently Any (5)

5.2 SAFETY PRECAUTIONS — WELDING

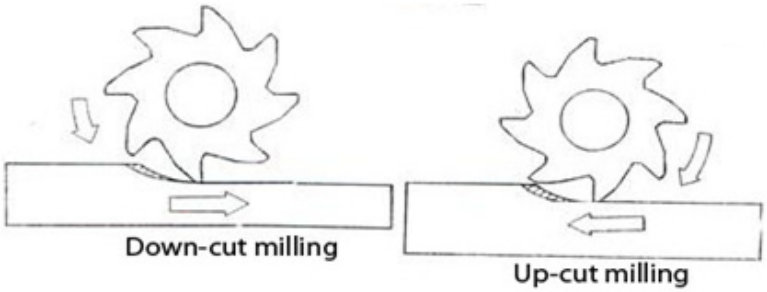
- The use of the machine
- Workplace is effectively partitioned off
- The use of protective equipment
- Effective lighting essential, gloves
- Mask and hoods are supplied and used by operator for safe inhalation of air
- Insulation of electrical leads must be satisfactory
- The electrode holder is completely insulated
- The operator is using safety clothes
- No vessel or container with flammable substances must be in the welding area Any (6)

5.3 SAFETY PRECAUTIONS — CYLINDERS

- Store full cylinders separately from empty ones
- Keep cylinders in a cool place/protected from sunlight
- Always store a cylinder in an upright position
- Store oxygen cylinders apart from acetylene cylinders
- Never stack more than four cylinders
- Do not bang or work on cylinders
- Never allow cylinders to fall from any height
- Do not allow oil or grease to come into contact with oxygen
- Keep the caps on the cylinders for protection
- The thread on the oxygen cylinders is a right-hand thread
- The thread on the acetylene cylinders is a left-hand thread Any (5)

5.4
5.4.1 H
5.4.2 J
5.4.3 E
5.4.4 F
5.4.5 A
5.4.6 I
5.4.7 C
5.4.8 B
5.4.9 G
5.4.10 D (10)

5.5



(4)

5.6 INDEXING
- simple indexing
- rapid indexing
- angular indexing
- differential indexing (4)

5.7
A Facing
B Turning
C Cutting screw thread
D Boring a hole (4)

5.8
1 Gas shroud
2 Nozzle
3 Continuous feed electrode wire
4 Arc
5 Inert shielding gas
6 Molten weld pool
7 Parent metal (7)

5.9
- Prolongs the tool's life
- Ensures a better finish
- Enables a higher cutting speed
- Washes away cutting and keep edges clean
- Protects the machine and equipment
- Protects the operator from dust
- Increases the production rate
- Prevents corrosion Any (5)

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QUESTION 6 JOINING METHODS

6.1 6.1.1 Incomplete Penetration

Causes

- Incorrect sequence
- Speed too fast
- Electrode too large
- Current too low
- Faulty preparation — Any (1)

Prevention

- Use enough current to obtain desired penetration and weld slowly
- Calculate the electrode penetration
- Select an electrode according to welding groove size
- Leave enough free space at the bottom of the weld for penetration — Any (2)

6.1.2 Lack of fusion

Causes

- Wrong weld
- Current improperly adjusted
- Faulty penetration
- Improper electrode size — Any (1)

Prevention

- Adjust electrode and V-sizes
- Weave must be sufficient to melt sides of joints
- Proper current will allow deposition and penetration
- Prevent weld metal from curling away from plates — Any (2)

6.1.3 Undercutting

Causes

- Faulty electrode manipulation
- Faulty electrode usage
- Current too high — Any (1)

Prevention

- Use a uniform bead in butt welding
- Avoid using too large an electrode
- Avoid excessive weaving
- Use moderate current and weld slowly — Any (2)

6.1.4 Slag inclusion

Causes

- Using either too high or too low a welding current
- Too long an arc
- Too high a speed travel
- Carelessness in slag removal prior to putting down another run of weld in a multi-run weld
- Slag inclusion Any (1)

Prevention

- Use moderate current
- Use a moderate travel speed
- Use the correct size electrode for the job at hand
- Remove slag after each run of weld in a multi-run weld
- Adjust to proper arc length Any (2)

6.1.5 Spatter

Causes

- Arc blow
- Current too high
- Arc too long
- Faulty electrode Any (1)

Prevention

- Adjust current to need
- Adjust to proper arc length
- Lighten arc blow
- Choose a suitable electrode Any (2)

6.2 Functions of the flux coating

- It enables the arc to be struck and maintain easily
- It provides a shield of gases such as hydrogen and carbon dioxide to shield the molten metal
- It provides a slag which helps to protect the metal in transit across the arc gap
- It serves as an isolator to the metal core of the electrode
- It ensures good penetration (4x2) (8)

6.3 6.3.1 Destructive and non-destructive

OR

Mechanical and non-mechanical (2)

6.3.2

Destructive/mechanical	Non-destructive/non-mechanical
(a) *Nick-break test	(b) *Liquid dye penetrant
(c) *Free-bend test	(d) *X-ray test
	(e) *Ultrasonic test (5)

6.4 6.4.1
- Can weld thin and thick sections
- No pre-heating is required
- Suitable for down hand, vertical and overhead welding positions
- Can weld almost any metal
- Automatic arc length control
- Faster method of welding
- Clean welds
- No flux needed
- No slag to remove after welding
- There is less distortion
- The joint is strong
- An excellent method for welding aluminium Any (6)

6.4.2 Basic component of the MIG welding machine
- A wire feed control unit (1)
- Transformer/Rectifier weld unit (1)
- Air or water cooled welding gun (1)
- Inert gas supply unit (1)

[40]

TOTAL: 200