higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MATERIAL TECHNOLOGY
NQF LEVEL 3

(6021013)

13 November 2024 (X-paper)
09:00–12:00

Non-programmable calculators may be used.

This question paper consists of 8 pages.

143Q1N2413

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)
MATERIAL TECHNOLOGY
NQF LEVEL 3
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer all the questions.
2. Read all the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Use only a black or blue pen.
5. Write neatly and legibly.
6. Non-programmable calculators must be used.

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QUESTION 1

1.1 Various options are given as possible answers to the following questions. Choose the correct answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 The ability of metal to change shape without fracturing when it is deformed by being hammering, rolling or pressing:

A Malleability
B Ductility
C Compressive strength
D Tenacity

1.1.2 The ability of a material or metal to resist being broken, bent, scratched or cut:

A Stress
B Brittleness
C Hardness
D Toughness

1.1.3 The ability of a material or metal to resist breaking when a pulling force is applied:

A Plasticity
B Strain
C Elasticity
D Tensile strength

1.1.4 Temperature at which a metal changes from a solid state to a liquid state:

A Boiling point
B Melting point
C Thermal conductivity
D Electrical conductivity

1.1.5 Grey cast iron is used to manufacture one of the following:

A High tensile wire
B Crushing equipment
C Wear plates
D Machine beds

(5 × 1) (5)

1.2 Differentiate between each of the following metals:

1.2.1 Ferrous metals

1.2.2 Non-ferrous metals (2 × 2) (4)

1.3 List FIVE non-ferrous metals commonly used in industry. (5)

1.4 Name TWO uses of each of the following steels:

1.4.1 Molybdenum

1.4.2 Nickel

1.4.3 Chromium (3 × 2) (6)

1.5 List FIVE different types of machining processes that are used to change the shape and size of metals. (5)

[25]

QUESTION 2

2.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (2.1.1–2.1.5) in the ANSWER BOOK.

2.1.1 Asbestos is used in brake lining, clutch lining, roofing sheets and heater panels.

2.1.2 Extrusion are materials that are made up of long chains.

2.1.3 All non-metals have low melting points and low boiling points.

2.1.4 Bromine is almost chemically inert at normal temperatures.

2.1.5 Ceramics are hard, brittle, heat resistant and corrosion resistant materials. (5 × 1) (5)

2.2 Name FIVE characteristics of non-metals. (5)

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2.3 FIGURE 1 below shows a sketch of a steel belt radial tyre. Identify the parts by writing only the answer next to the letter (A–D) in the ANSWER BOOK. (4)

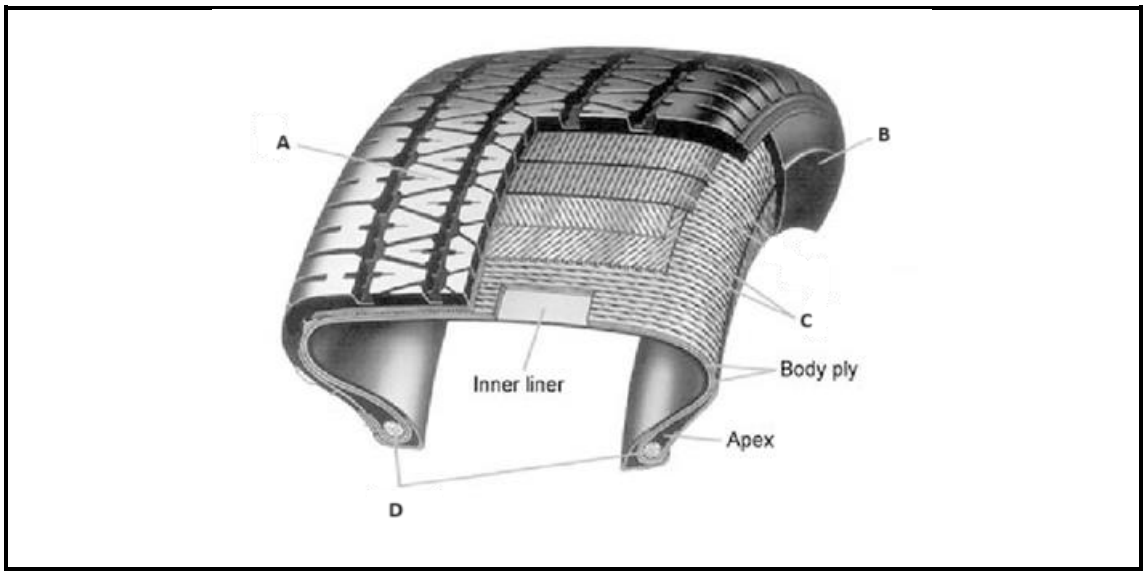

FIGURE 1

2.4 Explain THREE common applications of carbon as non-metals. (3 × 2) (6)

2.5 State TWO properties of each of the following:

2.5.1 Oxygen

2.5.2 Tellurium (2 × 2) (4)

2.6 Name ONE type of synthetic rubber. (1)

[25]

QUESTION 3

3.1 Choose a word from COLUMN B that matches a description in COLUMN A. Write only the letter (A–G) next to the question number (3.1.1–3.1.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
3.1.1	Steel must be kept in the furnace at the correct temperature for a specific time	A	cupola
3.1.2	A technique mainly used to soften metals	B	blast
3.1.3	An ordinary furnace consists of an upright steel shell that is lined with refractory bricks	C	soaking
3.1.4	Provide hardened steel with increased ductility with only a slight loss of strength	D	scale
3.1.5	The high temperature of annealing may cause oxidation of the metal's surface	E	annealing
		F	normalising
		G	tempering

(5 × 1) (5)

3.2 State TWO disadvantages of each of the following:

3.2.1 Blast furnace (4)

3.2.2 Cupola furnace (4)

3.2.3 Bessemer converter (4)

3.3 Name the different types of furnaces that are manufactured when using the following types of steel:

3.3.1 High-grade alloy steel

3.3.2 Pig iron to steel

3.3.3 High quality steel (3 × 1) (3)

3.4 State THREE reasons of heat treatment for annealing. (3)

3.5 Name TWO advantages of tempering. (2)

[25]

QUESTION 4

4.1 Complete the following sentences by choosing the correct missing word from the list below. Write only the answer next to the question number (4.1.1–4.1.5) in the ANSWER BOOK.

deformation; impact; bending; metal tension; compressive; jig; shear; surface area

4.1.1 A … test is used to determine the malleability of metals.

4.1.2 The BHN is calculated by dividing the applied force by the … of the indentation.

4.1.3 Hardness means resistance to … which forms the basis of the hardness test.

4.1.4 Standard shapes, lengths and diameters are usually used when doing a … test.

4.1.5 … strength is the ability of material to withstand a crushing load without breaking. (5 × 1) (5)

4.2 Explain THREE important reasons for the testing of materials (3 × 2) (6)

4.3 The following results were obtained during a tensile test that was performed on a test piece with a diameter of 16 mm and gauge length of 80 mm.

- Load at yield point = 55 kN
- Length between gauge points with broken ends put together = 95 mm
- Diameter at fracture = 14,5 mm
- Maximum load = 85 kN

Given:

$$Area = \frac{\pi d^2}{4}\ (mm^2)$$

$$\sigma = \frac{F}{A}$$

$$\%\ ELONGATION = \frac{change\ in\ length}{gauge\ length}\ x100\%$$

$$\%\ REDUCTION\ OF\ AREA = \frac{D^2 - d^2}{D^2}\ x\ 100\%$$

Use the given formula above to calculate the following:
Answers must be to the 2nd decimal.

4.3.1 Percentage elongation (2)

4.3.2 Percentage reduction area (2)

4.3.3 Strength at yield (2)

4.3.4 Maximum strength (2)

4.4 FIGURE 2 below shows a graph that accompanies test results.

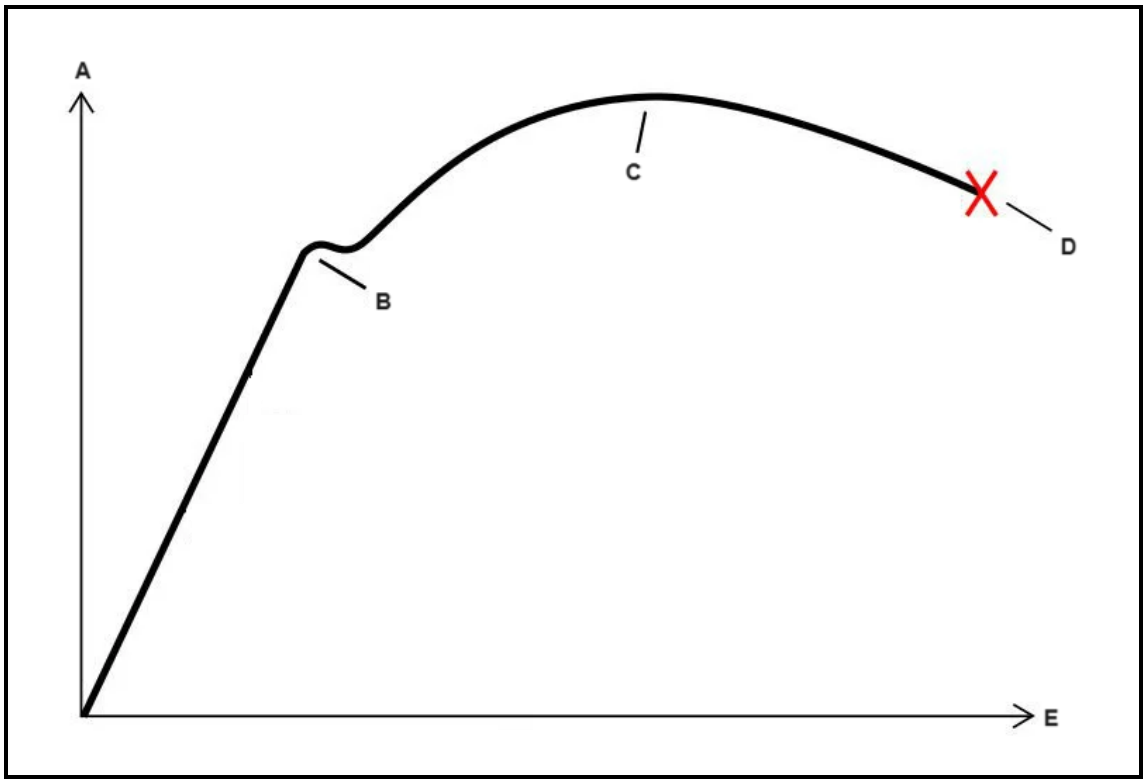

FIGURE 2

4.4.1 Name the graph in FIGURE 2. (1)

4.4.2 Identify the different labels in FIGURE 2 above by writing only the answer next to the letter (A–E) in the ANSWER BOOK. (5)

[25]

TOTAL: 100

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