higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

APPLIED ENGINEERING TECHNOLOGY
NQF LEVEL 4

(6021024)

21 November 2023 (X-paper)
09:00–12:00

Nonprogrammable calculators may be used.

This question paper consists of 7 pages.

179Q1N2321

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

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APPLIED ENGINEERING TECHNOLOGY
NQF LEVEL 4
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. All sketches must be neat, clear and in good proportion.
5. Use $g = 9{,}81\ m/s^2$.
6. Round off answers to THREE decimals where applicable.
7. Use only a black or blue pen.
8. Write neatly and legibly.

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QUESTION 1

1.1 Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.10) in the ANSWER BOOK.

1.1.1 Torque can be defined as the …

A rate of change of velocity.
B distance between two points linked by a straight line.
C product of mass and acceleration.
D product of the perpendicular force and the distance of the force from the turning point.

1.1.2 A system of forces is in equilibrium if …

A the two forces acting on the same side of the fulcrum are equal.
B two equal forces are acting on a beam at different angles.
C the sum of the clockwise moments is equal to the sum of the anticlockwise moments.
D two equal forces acting on either side of a beam move the beam clockwise.

1.1.3 Which force is required to accelerate a mass of 5 kg from rest to 2 m/s^2?

A 2,5 N
B 0,4 N
C 10 N
D 10 kg

1.1.4 Which ONE of the following frictional factors has a positive effect on crawling machines?

A Energy losses
B Ability to grip on the floor
C Wear on mating parts
D Generation of heat

1.1.5 Friction …

A is opposite to the direction of motion of an object.
B increases the speed of the object
C is in the same direction as the object.
D Is greater than the force causing the object to move.

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1.1.6 Which ONE of the following is not a positive displacement pump?

A Reciprocating pump
B Centrifugal pump
C Gear pump
D Diaphragm pump

1.1.7 In a fluid coupling … is/are used to transmit torque.

A air
B gears
C chains
D oil

1.1.8 In a refrigeration cycle … is used as refrigerant.

A ammonia
B water
C oxygen
D hydrochloric acid

1.1.9 Pallets used to load finished products from a production line are normally made of …

A metal.
B plastic.
C wood.
D cardboard.

1.1.10 Which ONE of the following shapes indicates a regulatory sign?

A Rectangular
B Triangular
C Square
D Round

(10 × 1) (10)

1.2 State FOUR functions of a coupling. (4)

1.3 An object with a mass of 90 kg is made of cast iron. It is dragged along on a flat surface made of aluminium. The static coefficient is 1,1 and the kinetic coefficient is 0,15.

Calculate:

1.3.1 The force required just before motion starts (4)

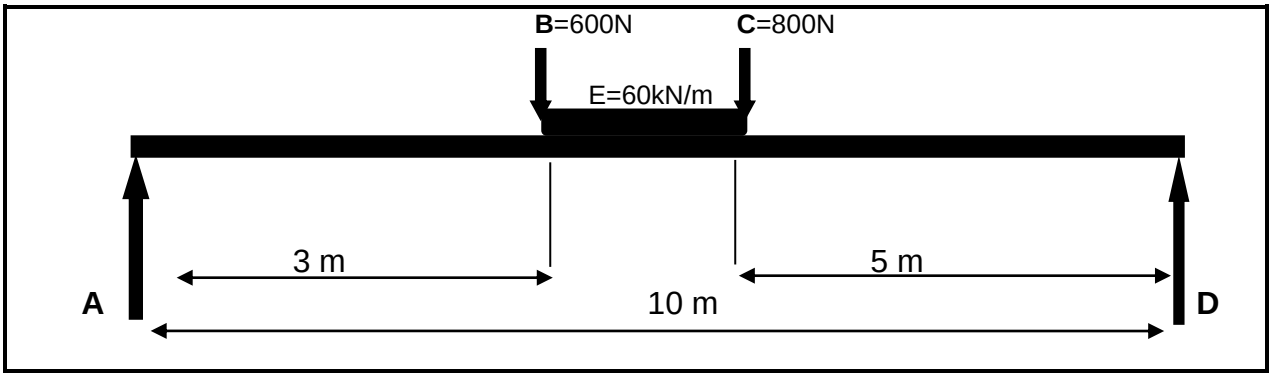
1.3.2 The force required to keep the object moving (2)

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QUESTION 2

A loaded beam is given as follows:



The uniform distributed load is spread between points B and C.

2.1	2.1.1	Redraw, to scale 1 cm:1 m, the beam and:	(2)
	2.1.2	Calculate the reactions A and D	(10)
	2.1.3	Prove that the upward forces are equal to the downward forces	(2)
2.2		Draw the shear-force diagram and show all values.	(2)
2.3		Calculate the bending moment at B and C.	(2)
2.4		Draw the bending-moment diagram and show all values.	(2)
2.5		What is the magnitude and position of the maximum bending moment?	(2)

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QUESTION 3

3.1 Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–L) next to the question number (3.1.1–3.1.10) in the ANSWER BOOK.

COLUMN A		COLUMN B	
3.1.1	Component that acts as a transformer in an ignition system	A	backlash
3.1.2	Temporary magnet made by coiling live wire around an iron core	B	subsystem
3.1.3	System that is part of a larger system	C	dressing
3.1.4	Device used to control mechanisms in a system	D	caustics
3.1.5	Distance that a gear will move without the connected parts moving	E	point load
3.1.6	Preparing a grinding stone	F	yield stress
3.1.7	Substances that corrode materials through chemical reactions	G	illustrations
3.1.8	Force concentrated on a single point	H	ignition coil
3.1.9	Maximum stress at which a material will fail	I	impeller
3.1.10	Rough sketches of a design	J	actuator
		K	shear stress
		L	electromagnetic

(10 × 1) (10)

3.2 List FOUR components of a control system. (4)

3.3 Name TWO parts of a DC motor. (2)

3.4 State TWO basic purposes of an illustration. (2)

[18]

QUESTION 4

4.1 4.1.1 Name the THREE states of matter (3)

4.1.2 Explain briefly the working principle of the thermostat switch in the refrigeration cycle (4)

4.1.3 Name the THREE methods of heat transfer. (3)

4.2 List FOUR types of functionally dependent mechanisms. (4)

4.3 Briefly describe the operating principle of the following and give ONE example of each:

4.3.1 Reciprocating motion (2+1)

4.3.2 Oscillating motion (2+1) (6)

4.4 What is a Digital signal in a control system as in engineering? (1)

4.5 Explain the terms *vacuum* and *matter*. (2 + 2) (4)

[25]

QUESTION 5

5.1 Draw and label a diagrammatic representation of a closed-loop control system with one input and two outputs. (5)

5.2 List THREE factors that will inform the decision for a certain type of control system to be used. (3)

5.3 Explain the term: prototype. (2)

5.4 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (5.4.1–5.4.5) in the ANSWER BOOK.

5.4.1 Downtime can result in more products being produced by a machine.

5.4.2 It is not necessary to know how a control system works when you have to maintain it.

5.4.3 Good communication is very important for everyone to work effectively.

5.4.4 Ergonomics refers to the ease of handling tools.

5.4.5 A connecting rod is an engine part.

(5 × 1) (5)

[15]

TOTAL: 100

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