higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T650(**E**)(A1)T
AUGUST 2012

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N3

(15070413)

1 August (X-Paper)
09:00 – 12:00

REQUIREMENTS: Properties of water and steam (BOE 173)

NO graph paper will be issued.

Candidates need drawing instruments.

Calculators may be used.

This question paper consists of 7 pages, a 2-page formula sheet and an information sheet.

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NATIONAL CERTIFICATE
ENGINEERING SCIENCE N3
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. ALL the calculations should consist of at least the following THREE steps:
   - 3.1 The formula used or manipulation thereof
   - 3.2 Substitution of the given data in the formula
   - 3.3 The answer with the correct SI unit
4. The constant values, as they appear on the attachment information sheet, must be used wherever possible.
5. Number the answers correctly according to the numbering system used in this question paper.
6. Keep subsections of questions together.
7. Rule off across the page on completion of each question.
8. Drawing instruments must be used for ALL drawings/diagrams. ALL drawings/diagram must be fully labelled.
9. Use $g = 9{,}8\ m/s^2$.
10. Answers must be rounded off to THREE decimal places.
11. Write neatly and legibly.

QUESTION 1: MOTION, POWER AND ENERGY

1.1 Name TWO effects of a force on an object. (2)

1.2 A vehicle decreases its velocity from 80 km/h to 60 km/h over a distance of 18 metres. Determine the following:

1.2.1 The deceleration of the vehicle (2)

1.2.2 The time taken, in seconds, to decrease the velocity of the vehicle (2)

1.3 FIGURE 1 below shows a graph which represents the motion of a train initially at rest.

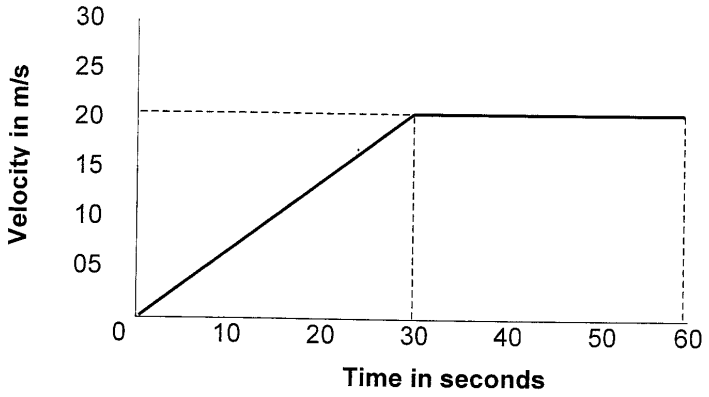

FIGURE 1

1.3.1 Determine the acceleration of the train during the first 30 seconds. (2)

1.3.2 Determine, from the graph, the total distance the train has travelled after 60 seconds. (3)

1.4 The driver pulley of a diesel motor has a diameter of 400 mm and rotates at 300 r/min. The flat belt has a thickness of 4 mm. The tension in the tight side is 1 400 N and the tension ratio is 3 : 1.

Consider the belt thickness and calculate the following:

1.4.1 The tension in the slack side (2)

1.4.2 The belt velocity in m/s (2)

1.4.3 The power transmitted in kW (2)

[17]

QUESTION 2: MOMENTS

2.1 Explain what is meant by the *equilibrant of a system of forces*. (2)

2.2 FIGURE 2 below shows a horizontal beam resting on two supports L and R.

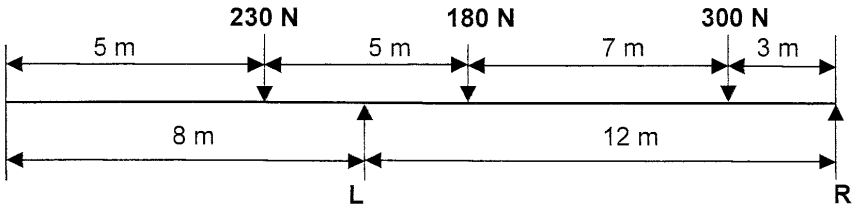

FIGURE 2

2.2.1 Determine the reactions at both supports. (4)

2.2.2 Draw a shear force diagram and show ALL the main values on the diagram. (6)

[12]

QUESTION 3: FORCES

3.1 Define the *resultant of forces*. (2)

3.2 3.2.1 Calculate the magnitude of the forces R and L in FIGURE 3 below. (4)

3.2.2 Calculate the magnitude and nature of the component AE by using a graphical or analytical method. (4)

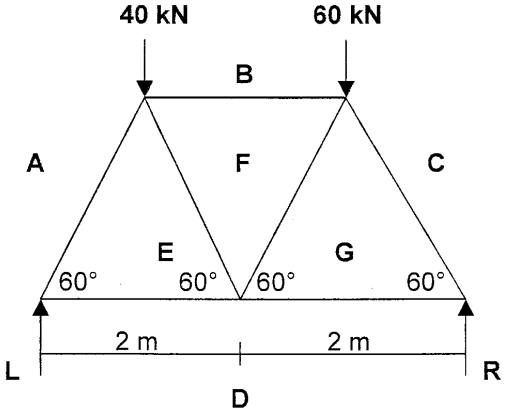

FIGURE 3 **[10]**

QUESTION 4: FRICTION

A body with a mass of 60 kg is sliding at a constant velocity down an incline without any external forces acting on it. The angle of inclination is 20°.

Calculate the following:

4.1 The weight component perpendicular to the sliding plane (2)

4.2 The weight component parallel to the sliding plane (2)

4.3 The friction force (1)

4.4 The coefficient of friction of the plane (2)

4.5 The external force required to pull the body up the plane at constant velocity (3)
[10]

QUESTION 5: HEAT

5.1 Define, or explain in your own words, what is meant by the heat value of a fuel. (2)

5.2 Water with a mass of 150 kg and a temperature of 25 0 C gains 40 MJ of heat energy. Determine the final temperature of the water. (3)

5.3 A copper pipe is 6 m long at a temperature of 15 °C. Steam, at a temperature of 120 °C, is now flowing through the pipe so that the temperature of the pipe reaches the temperature of the steam. Determine the change in length of the copper pipe. Express the answer in millimetres. (2)

5.4 Steam is developed under a pressure of 680 kPa and wet steam is formed with a dryness fraction of 0,9. This wet steam now flows to a superheater where it is dried and superheated to a temperature of 220 °C.

If the specific heat capacity of superheated steam is 2,5 kJ/kg °C, calculate the enthalpy of 1 kg steam ...

5.4.1 in the wet steam (h_{wet}). (2)

5.4.2 in the dry steam (h_g). (1)

5.4.3 required to dry the wet steam (h). (2)

5.4.4 required to superheat the dry steam (h_{ss}). (3)
[15]

QUESTION 6: HYDRAULICS

6.1 Define the term *density*. (2)

6.2 A single-acting suction pump has a diameter of 160 mm and a delivery stroke length of 90 mm and has to pump water 15 m vertically to a reservoir.

Calculate the following:

6.2.1 The volume of the water which is being pumped per delivery stroke (2)

6.2.2 The mass of the water pumped per delivery stroke (1)

6.2.3 The work done per delivery stroke length (2)

6.3 A hydraulic press has a plunger diameter of 30 mm. The force acting on the plunger is 50 N while the ram has a diameter of 120 mm.

Calculate the following:

6.3.1 The mass in kilogram that can be raised (3)

6.3.2 The pressure in the fluid (2)
[12]

QUESTION 7: ELECTRICITY

7.1 Define *Joule's law*. (1)

7.2 State TWO factors influencing the resistance of an electrical conductor. (2)

7.3 Two resistors of 30 Ω and 45 Ω are connected in parallel. A 12 Ω resistor is now connected in series with the parallel connection. An ammeter is connected in the circuit and a voltmeter is connected across the 12 Ω resistor. A battery of 9 volt is used in the circuit and connected in series.

Calculate the following:

7.3.1 The total resistance of the connection (4)

7.3.2 The reading on the ammeter (2)

7.3.3 The reading on the voltmeter (2)

7.4 A single-phase transformer has a supply voltage of 240 V. The turn ratio, primary:secondary is 10 : 1. The secondary current at full load is 2 A and the secondary coil has 42 windings.

Calculate the following:

7.4.1 The secondary voltage (2)

7.4.2 The primary current (2)
[15]

QUESTION 8: CHEMISTRY

8.1 List TWO conditions where painting metals would not be a suitable precaution against corrosion. (2)

8.2 Name ALL the components of an atom and state the electrical charge of each component. (3)

8.3 Explain what a molecule of a substance or element is. (2)

8.4 The periodic chart includes metals and non-metals. List TWO metals that can be found on the chart. (2)
[9]

TOTAL: 100