



# education

Department of  
Education  
FREE STATE PROVINCE

**PROVINCIAL TEST**

**GRADE 10**

**TECHNICAL SCIENCES**

**SEPTEMBER 2016**

**MARKS: 100**

**TIME: 2 HOURS**

**This paper consists of 12 pages, one data sheet and one answer sheet.**

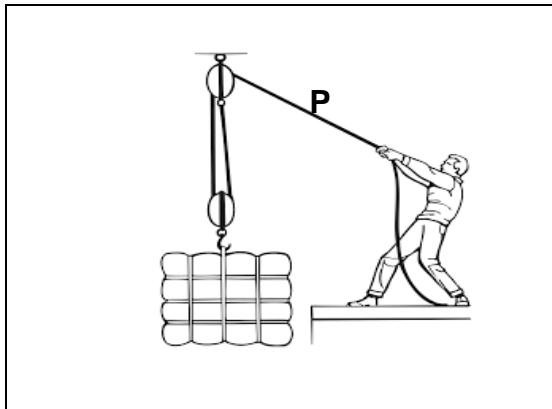
## **INSTRUCTIONS AND INFORMATION**

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of FIVE questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave one line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable pocket calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a minimum of TWO decimal places where applicable.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legibly.

### QUESTION 1: MULTIPLE CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A, B, C or D) next to the question number (1.1–1.10) in the ANSWER BOOK.

- 1.1 A man uses a pulley system to lift a heavy load as shown in the diagram below.



What type of force is applicable at point **P** in the rope?

- A Force of friction
  - B Normal force
  - C Tension
  - D Force of gravity (2)
- 1.2 Which one of the following is the correct SI unit of torque (force moment)?
- A N
  - B N·m
  - C  $\text{N}\cdot\text{m}^{-1}$
  - D  $\text{N}\cdot\text{m}^2$  (2)

- 1.3 Which one of the following pairs of statements is correct about weight and mass?

	<b>WEIGHT ...</b>	<b>MASS ...</b>
A	is a force.	is a force.
B	is a force.	is not a force.
C	is not a force.	is a force.
D	is not a force.	is not a force.

(2)

- 1.4 Which one of the following is the best description of a beam?

- A A horizontal bar supported by one fulcrum and used to lift heavy objects.
- B A single rigid length of material supported horizontally to carry vertical loads.
- C A vertical bar used to support heavy buildings.
- D A curved structure that supports the entrances to buildings.

(2)

- 1.5 Which one of the following is the best description of a cantilever?

- A A beam of which only one end is attached to a wall.
- B A beam supported at both ends.
- C A beam supported in the middle.
- D A beam supported at both ends and in the middle.

(2)

- 1.6 Consider the following statements about the frictional force.

- i) It opposes the motion of an object.
- ii) It acts parallel to the surface on which the object is.
- iii) In some cases, it acts perpendicular to the surface on which the object is.

Which of the statements is/are true?

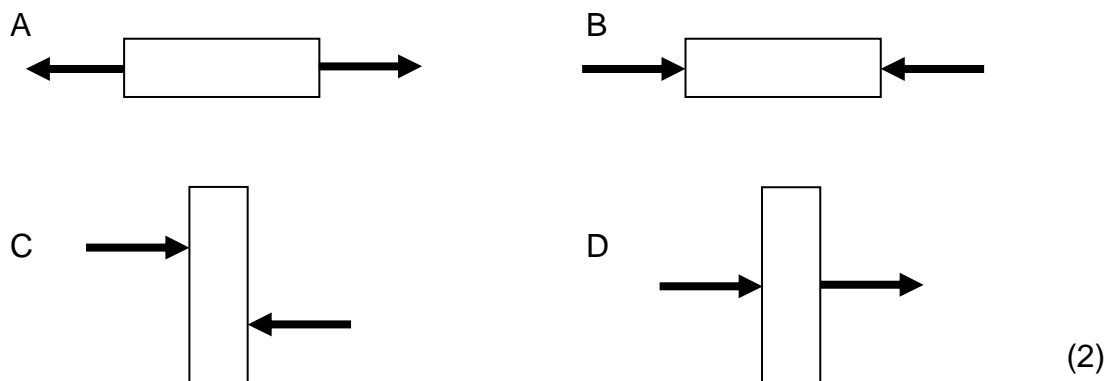
- A (i) only
- B (ii) only
- C (i) and (ii)
- D (ii) and (iii)

(2)

1.7 The resultant of two or more forces acting on a body is a single force that ...

- A produces the same effect as the original forces acting together.
- B acts in the same direction as one of the original forces.
- C acts in the opposite direction to one of the original forces.
- D is equal in magnitude to the equilibrant and acts in the same direction as the equilibrant. (2)

1.8 Which one of the following diagrams represents shear forces?



1.9 What happens to the load distance and the magnitude of the effort if the load is moved further from the fulcrum in the case of a class 1 lever?

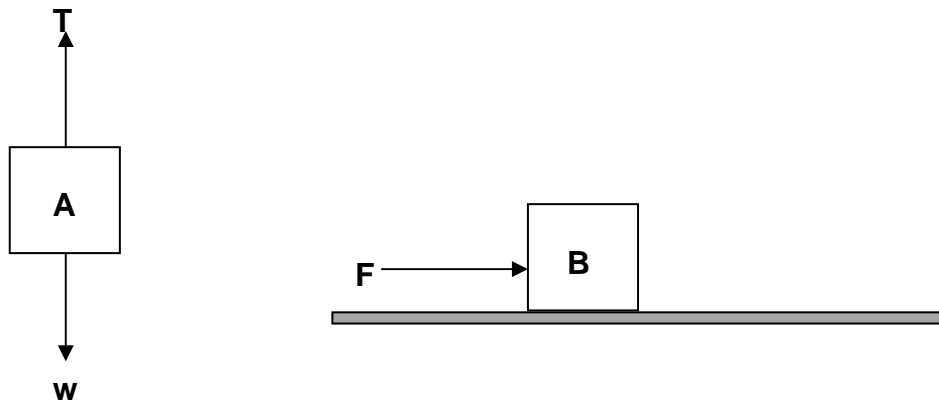
- A The load distance decreases and the effort must decrease.
- B The load distance decreases and the effort must increase.
- C The load distance increases and the effort must decrease.
- D The load distance increases and the effort must increase. (2)

1.10 Which one of the following is true about a class 2 lever?

- A The effort and load are on the same side of the fulcrum and act in the same direction.
  - B The effort and load are on the same side of the fulcrum and act in opposite directions.
  - C The effort and load are on either side of the fulcrum and act in the same direction.
  - D The effort and load are on either side of the fulcrum and act in opposite directions. (2)
- [20]**

## QUESTION 2

The diagrams show two objects on which forces are applied. **A** represents a car engine being pulled out of the car by means of a chain. **B** represents a fridge being pushed along a ROUGH horizontal floor.



- 2.1 Give the NAMES of forces  $T$  and  $w$  in the case of **A**. (2)
- 2.2 Draw a labelled free-body diagram for object **B**, showing all the forces acting on it while it is being pushed. (4)
- 2.3 For the two objects **A** and **B**, identify:
  - 2.3.1 ONE non-contact force; and (1)
  - 2.3.2 TWO contact forces. (2)
- 2.4 The magnitude of force  $w$  of the engine is 1 550 N. If the engine is kept stationary after it has been lifted, write down the magnitude of:
  - 2.4.1 force  $T$ ; (1)
  - 2.4.2 the resultant of  $T$  and  $w$ ; and (1)
  - 2.4.3 the equilibrant. (1)

- 2.5 Thabang and Neo are pushing a trolley. Thabang is pushing with a horizontal force of 35 N and Neo is pushing with a horizontal force of 37 N in the same direction. Ignore any rotational effects of the trolley and assume it is moving in a straight line.

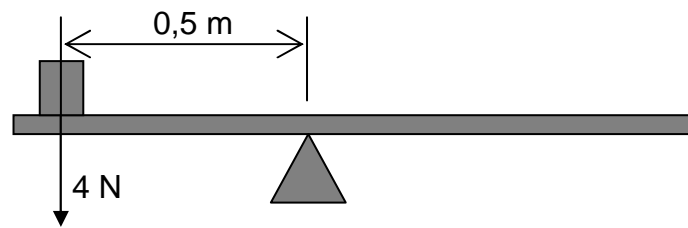


- 2.5.1 Calculate the magnitude of the horizontal resultant force on the trolley if friction is ignored. (2)

- 2.5.2 Calculate the horizontal resultant force on the trolley if a force of friction of 15 N is also acting on the trolley. (3)  
**[17]**

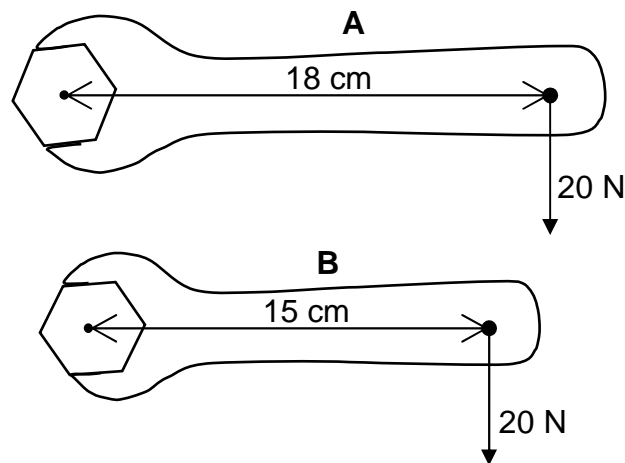
### QUESTION 3

3.1 Calculate the torque (moment of force) of the 4 N force in the diagram below.



(4)

3.2 A motor mechanic uses two spanners to tighten a bolt. She applies a force of 20 N. The distance between the centre of the bolt and the point of application of the force is 18 cm for one spanner and 15 cm for the other spanner. In each case, the angle between the applied force and the spanner's handle is  $90^\circ$ .



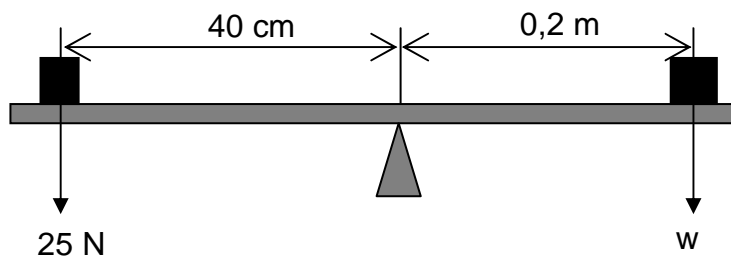
3.2.1 Define the term *torque* in words. (2)

3.2.2 Determine by means of a calculation which spanner produces more torque. Express the torque in basic SI units. (5)

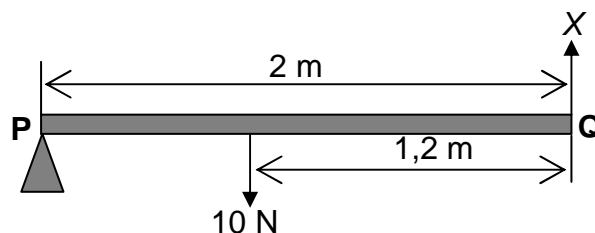
3.2.3 The mechanic uses another spanner to loosen a nut. This time a torque of  $700 \text{ N}\cdot\text{m}$  is required. Calculate the length of the spanner if she applies a force of 140 N perpendicular to the length of the instrument. (2)



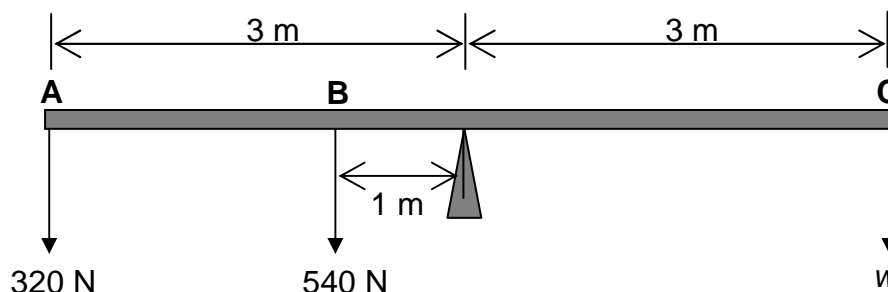
- 3.3 The figure shows a balanced metre rule. A 25 N force, acting at a distance of 40 cm from the pivot, is balanced by an unknown force  $w$ , which is acting at a distance of 0,2 m from the pivot. Ignore the mass of the metre rule.



- 3.3.1 State the *law of moments* in words. (2)
- 3.3.2 What are the TWO conditions for equilibrium? (4)
- 3.3.3 Calculate the magnitude of  $w$ . (4)
- 3.4 The figure below shows a rod of length 2 m supported at one end (P). A weight of 10 N is suspended from the rod at a distance of 1,2 m from the other end (Q). The rod is balanced by an upward force  $X$ , which is applied at Q. Ignore the mass of the rod.



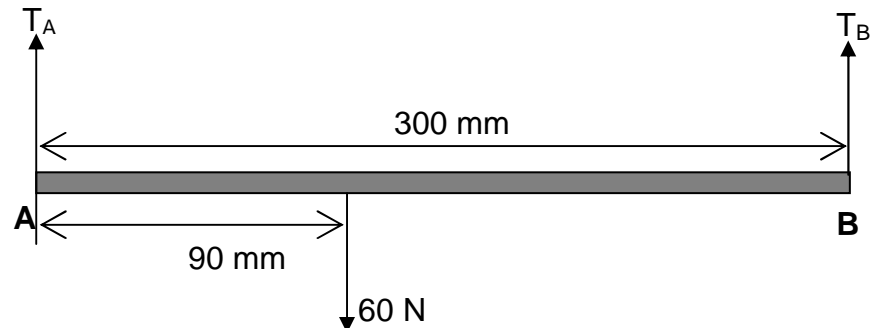
- Calculate the magnitude of force  $X$ . (2)
- 3.5 The see-saw in the figure below is balanced when San, with a weight of 320 N, sits at A, Tom, with a weight 540 N, sits at B and Sue, with an unknown weight  $w$ , sits at C.



- Calculate Sue's weight  $w$ . (4)
- [29]

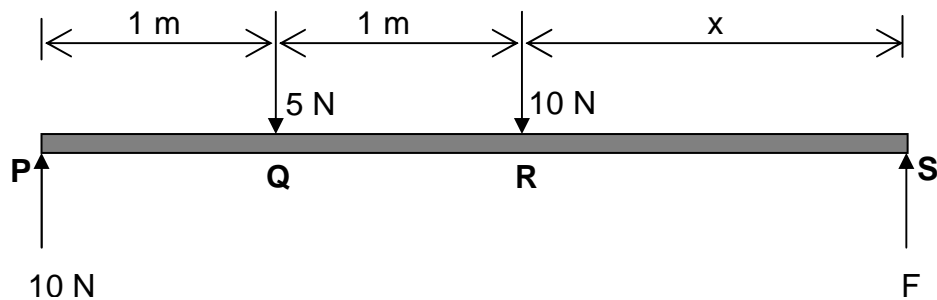
### QUESTION 4

- 4.1 A horizontal, rigid rod, 300 mm long, is supported at its ends by two vertical ropes. A weight of 60 N is attached to the rod at a distance of 90 mm from **A**. Ignore the weight of the rod as well as the mass of the ropes.



Calculate the tension in EACH string. (7)

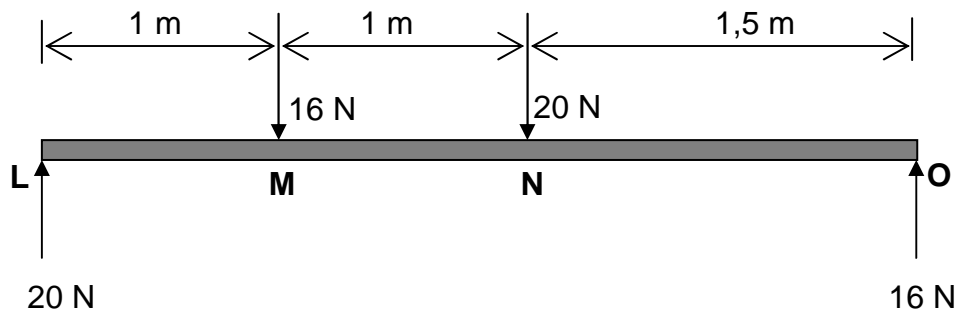
- 4.2 A beam is supported at points **P** and **S** by two forces of 10 N and  $F$  respectively. Two other forces of 5 N and 10 N are acting at points **Q** and **R** respectively. The beam is in equilibrium. Ignore its weight.



Calculate:

- 4.2.1 length  $x$ ; and (4)
- 4.2.2 the magnitude of force  $F$ . (4)

- 4.3 The following forces are applied to a beam as shown in the diagram below. The beam is in equilibrium. Ignore its mass.



Use the answer sheet attached at the end of the question paper to draw the following diagrams for this beam:



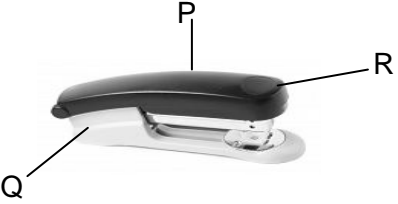

4.3.1 Shear force diagram (5)

4.3.2 Bending moment diagram. (5)

**Remember to HAND IN your answer sheet with the rest of your answers.**  
**[25]**

## QUESTION 5

The table shows different types of levers that we commonly use.

<p><b>A</b></p> 	<p><b>B</b></p> 
<p><b>C</b></p> 	<p><b>D</b></p> 

5.1 To which class does each of the following levers belong? Only write 1, 2 or 3.

5.1.1 **A** (1)

5.1.2 **B** (1)

5.1.3 **D** (1)

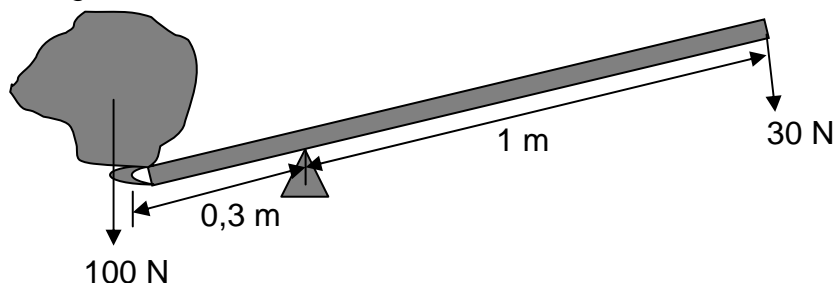
5.2 Write down the letter (**P**, **Q** or **R**) that represents each of the following in the case of lever **C**:

5.2.1 Load (1)

5.2.2 Effort (1)

5.2.3 Fulcrum (1)

5.3 The diagram below shows a crowbar used to lift a rock.



Calculate the mechanical advantage of the crowbar. Assume that the forces are perpendicular to the crowbar. (3)

[9]

**GRAND TOTAL: 100**

**DATA FOR TECHNICALSCIENCES GRADE 10  
CONTROLTEST 2**

**GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 10  
KONTROLETOETS 2**

**TABLE 1: FORMULAE/TABEL 1: FORMULES**

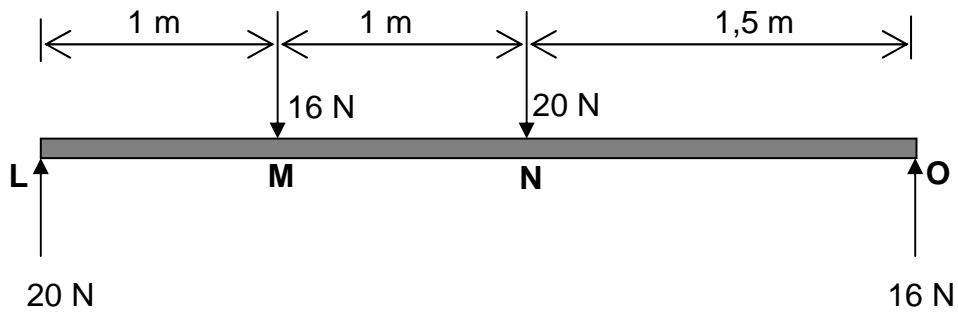
<p>Torque / Moment of force</p> <p><i>Draaimoment / Wringkrag / Kragmoment</i></p>	<p><math>\tau = F \times d_{\perp}</math></p> <p>OR / OF</p> <p>Moment = Force x perpendicular distance <i>Moment = Krag x loodregte afstand</i></p>
<p>Weight / Gewig</p>	<p><math>w = mg</math></p>
<p>Mechanical advantage (MA)</p> <p><i>Meganiese voordeel (MV)</i></p>	<p> <math>MA = \frac{\text{Load}}{\text{Effort}}</math>    OR    <math>MA = \frac{\text{Output force}}{\text{Input force}}</math>  OR  <math>MA = \frac{\text{Effort distance}}{\text{Load distance}}</math>  OR  <math>MA = \frac{\text{Input arm distance}}{\text{Output arm distance}}</math> </p> <p> <math>MV = \frac{Las}{Krag}</math>    OF    <math>MV = \frac{Uitsetkrag}{Insetkrag}</math>  OF  <math>MV = \frac{Kragafstand}{Lasafstand}</math>  OF  <math>MV = \frac{Insetkragafstand}{Uitsetkragafstand}</math> </p>

DO YOUR SHEAR FORCE AND BENDING MOMENT DIAGRAMS ON THIS SHEET. REMEMBER TO **HAND IT IN WITH YOUR ANSWER BOOK.**

Name of learner: \_\_\_\_\_

Class: \_\_\_\_\_

4.3



4.3.1


(5)

4.3.2


(5)