



Province of the  
**EASTERN CAPE**  
EDUCATION

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 11**

**NOVEMBER 2020**

**MECHANICAL TECHNOLOGY  
WELDING AND METALWORK  
MARKING GUIDELINE  
(EXEMPLAR)**

**MARKS: 200**

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This marking guideline consists of 13 pages.

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**QUESTION 1: MULTIPLE-CHOICE QUESTIONS.**

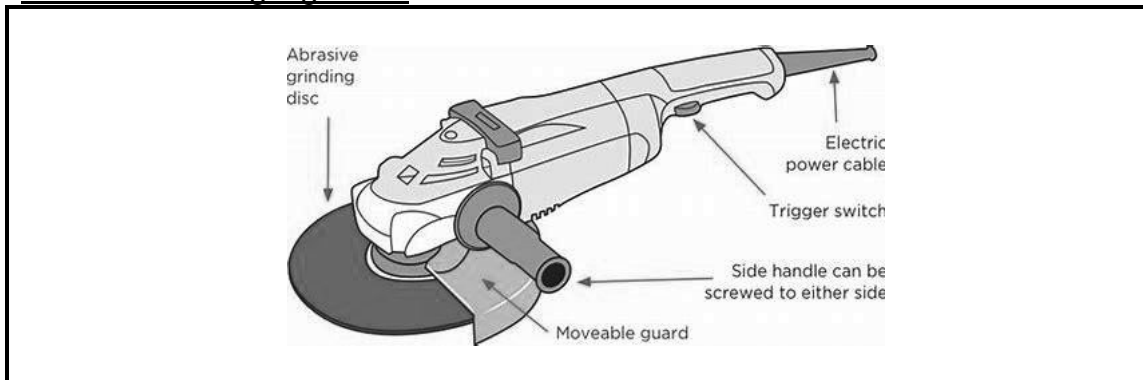
- 1.1 C ✓  
 1.2 B ✓  
 1.3 D ✓  
 1.4 C ✓  
 1.5 A ✓  
 1.6 B ✓  
 1.7 D ✓  
 1.8 B ✓  
 1.9 C ✓  
 1.10 A ✓  
 1.11 B ✓  
 1.12 B ✓  
 1.13 B ✓  
 1.14 C ✓  
 1.15 D ✓  
 1.16 C ✓  
 1.17 A ✓  
 1.18 C ✓  
 1.19 A ✓  
 1.20 B ✓

(20 x 1) [20]

**QUESTION 2: SAFETY (GENERIC)**

- 2.1 TWO categories that the OHS Act is divided into. (2)  
 Conditions ✓ and Actions ✓

- 2.2 Labels of the angle grinder.



(5)

- A – Abrasive grinding disc ✓  
 B – Electric cord ✓  
 C – Switch ✓  
 D – Side handle  
 E – Moveable guard ✓

- 2.3 The main factors that need to be undertaken before welding or flame cutting operations

- An operator must have knowledge and be instructed how to use the equipment safely. ✓
- The workplace must be effectively partitioned off ✓
- The operator must use protective clothing ✓

(3)

- 2.4 Name any FOUR important particulars needed to be visible on the cylinders.
- Name of the manufacturer ✓
  - Country of origin ✓
  - Year of manufacture ✓
  - Manufacturer serial number ✓
  - Name, number and date of the standard of design.
  - Design gauge pressure in Pascal.
  - Maximum permissible operating pressure in Pascal.
  - Operating temperature.
  - Mark of an approved inspection authority (Any 4) (4)
- 2.5 TWO basic rules that apply to machine guards in the workshop.
- All moving parts on all machines must be covered by guards. ✓
  - Automatic switches must be fitted where moving parts can be accessed. ✓
  - No machine may be operated if any guards are missing or broken. ✓
  - Machines with foot-operated pedals should have either a stir up guard over the pedal with only enough space for the operator's foot. (Any 2) (2)
- 2.6 Why workers should NOT wear loose clothing in the workshop.  
The loose clothing can get caught in moving machines ✓ or stationary objects. ✓ (2)
- 2.7 ONE safety precaution you should observe before pressing a bearing from a shaft on a hydraulic press.
- The predetermined pressure must not be exceeded. ✓
  - Pressure gauges must be tested regularly. ✓
  - The platform on which the work piece rests must be rigid and square. ✓
  - The platform must rest on the supporting pins.
  - Place objects to be pressed in or out of the suitable jigs.
  - Special tools and holding devices must be used to prevent damage to soft material.
  - Ensure that the direction of pressure is always 90° to the platform.
  - Relieve pressure after use by opening the return valve. (Any 1 x 1) (1)

2.8 ONE safety rule one must adhere to before switching on the band saw.

**Band saw**

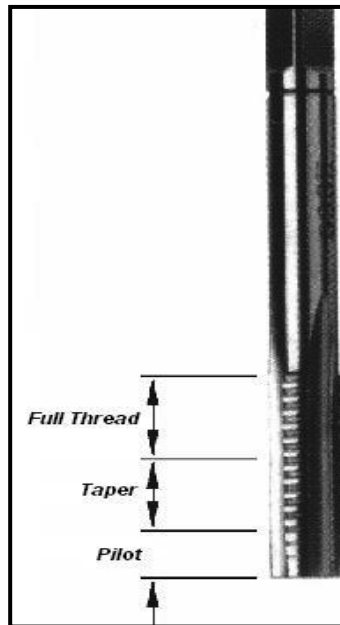
- Ensure there is no oil or grease around the machine. ✓
- Ensure that all guides are in place before work commences. ✓
- Ensure that the entire blade is guarded except at the cutting point. ✓
- Ensure that the machine is switched off when changing blades or guides.
- Wear eye protection.
- Ensure that the blade is fitted in the correct cutting direction.
- Round material must be clamped in a vice or holding device.
- Always use pusher against the work piece whenever possible. (Any 1 x 1) (1)

[20]

**QUESTION 3: TOOLS (GENERIC)**

3.1

Labels of tap



A – Full thread ✓

B – Taper ✓

C – Pilot ✓

(3)

- 3.2 Precautions when using taps and dies
- Taps must be used in the correct order (taper tap first). ✓
  - A tap must be entered squarely in the tap wrench. ✓
  - The correct size tapping drill must be used. ✓
  - A tap is at a right angle to the stock once cutting has started.
  - Take care not to bear too heavily on only one handle of the tap wrench or to force the tap as it is likely to break off in the hole. (Any 3 x 1) (3)
- 3.3 Why a pedestal drill has a depth gauge  
To indicate the depth of the hole to be drilled. (2)
- 3.4 What is a surface grinder?  
It is machine basically used to grind flat surface. ✓ (1)
- 3.5 THREE different cutting machines for cutting steel  
Abrasive cut-off machine ✓  
Guillotine ✓  
Band saw ✓  
Laser cutter  
Plasma cutter  
Gas cutting  
Lathe (3)
- 3.6 Why should a guillotine blade be adjustable?  
There should be allowance for metal thickness. ✓ (1)
- 3.7 Describe the working principle of a guillotine  
Metalworking guillotines operate by a clamp securing the sheet of material. ✓ Similar to the action of scissors, the blade shears the material, ✓ starting at one side of the sheet. ✓ (3)
- 3.8 What should be checked before using a grinder?  
Electric insulation  
Blades  
Covers/guards  
Workpiece clamped (Any 2 x 1) (2)
- 3.9 What type of blades can be used on an angle grinder?  
Metal – grinding and cutting  
Stone  
Diamond blade (Any 2 x 1) (2)

**[20]**

**QUESTION 4: MATERIALS (GENERIC)**4.1 Properties of metals:1. **Toughness**

- is the ability of a metal to withstand shock loads. ✓✓

2. **Elasticity**

- the ability of a metal to return to its original shape after the load has been removed. ✓✓

3. **Malleability**

- It is the ability of a metal to be hammered or rolled without breaking or cracking. ✓✓

(6)

4.2 The difference between iron ore and pig-iron

(2)

**Iron ore** – is found in the earth's crust, and it comes from mines. Iron ore must go through processing that is costly and intricate. Iron ore is smelted in the blast furnaces to obtain iron. ✓

**Pig-iron** – is the first step in purifying the iron. The iron ore becomes pig-iron when the impurities are burned out in a blast furnace ✓

**OR**

Pig-iron is obtained from iron core.

(4)

4.3 How a blast furnace is charged.

A blast furnace is charged with alternate layers of iron ore, coke and limestone. ✓

The raw materials are supplied at the top as rapidly as needed to provide sufficient hot liquid metal for tapping at set intervals. ✓

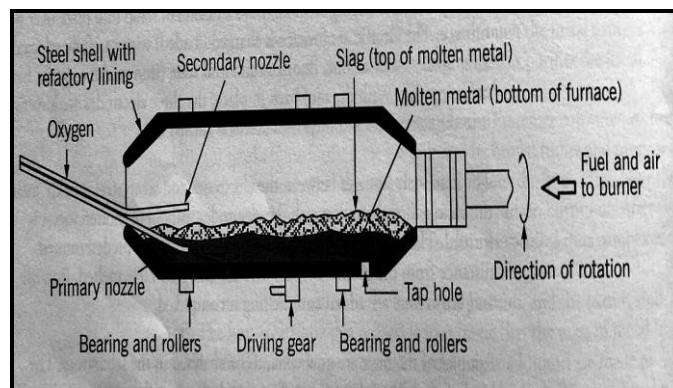
The hot air from the stoves is blown through the nozzles known as ruyéres. ✓

These ruyéres are located near the base of the blast furnace. ✓

The carbon in the coke and the oxygen in the air combine to form a toxic carbon monoxide gas at a temperature of about 1648 °C and reduces the iron ore to metallic iron. ✓

(5)

4.4 Labels of the rotor plant(furnace)



- A – Oxygen
- B – Steel shell with refractory lining
- C – Secondary nozzle
- D – Slag (top of molten metal)
- E – Molten metal(bottom of furnace)
- F – Fuel and air to burner
- G – Bearing and rollers
- H – Driving gear
- I – Bearing and rollers
- J – Primary nozzle

(10)  
[25]

**QUESTION 5: MAINTENANCE (SPECIFIC)**

5.1 The effect of excessive friction.

It generates excessive heat, ✓ which softens and consequently dulls the cutting tip of the drill bit being used. ✓

(2)

5.2 Do bench grinders need to be lubricated?

The bearing on the spindle shaft is factory lubricated ✓ and is sealed with an oil seal to prevent leakage. ✓

(2)

5.3 TWO examples of machines where friction is not a relative factor.

- Guillotine ✓
- Punching & Shearing machine ✓
- Hydraulic press
- Rolling machines

(2)

5.4 The effects of preventive maintenance on power saws

It will enhance cutting performance ✓ and attain optimum life expectancies by decreasing the need to replace dull and breakable blades. ✓

(2)

5.5 Safety precautions – lockout and tagging large power machines.

- Ensure that the isolation switches are switched off. ✓
- Ensure that the switches are locked out and tagged to inform others that maintenance work is being done. ✓
- Ensure that the only key to the lock is in the possession of the person carrying out the maintenance. ✓

(Any 2 x 1) (2)  
[10]

**QUESTION 6: TOOLS AND EQUIPMENT (SPECIFIC)**

6.1 Function of the punching machine:

- To cut steel profiles ✓
- To punch holes into steel plates ✓

(2)

6.2 Advantages of a plasma cutter compared with an oxy-acetylene cutter:

- High speed ✓
- Precision cutting ✓
- Low cost ✓
- Cuts thin and thick materials ✓
- Cuts smoothly ✓

(Any 2 x 1)

(2)

6.3 Principles of arc welding:

An arc welding-/inverter machine uses an electronic circuit to convert AC to DC by inverting the sine wave signal. ✓ This enables them to weld a much wider variety of materials than a traditional machine. ✓ They are primarily used in annual metal are welding mild-steel, stainless steel, cast iron etc. ✓

(3)

6.4 Type of material best suited for cutting with a cut-off machine:

It is best for mild-steel up to 10 mm thick depending on the type of cut. ✓

(1)

6.5 Labels of oxy-acetylene equipment:

- A** – Oxygen cylinder valve ✓
- B** – Oxygen regulator ✓
- C** – Acetylene cylinder valve ✓
- D** – Acetylene regulator. ✓
- E** – Acetylene hose ✓
- F** – Cylinder support ✓
- G** – Acetylene cylinder ✓
- H** – Oxygen cylinder ✓
- I** – Torch with nozzle
- J** – Torch valve – oxygen

(10)

6.6 Identify the machine:

Cut off saw ✓

(1)

6.7 The purpose of the cut off saw.

To cut hard materials such as steel. ✓

(1)

**[20]**



**QUESTION 7 FORCES (SPECIFIC)**

7.1 Horizontal components ✓

$30 \cos 45^\circ = 21,21^\circ$  ✓

$60 \cos 30^\circ = 51,96^\circ$  ✓

(3)

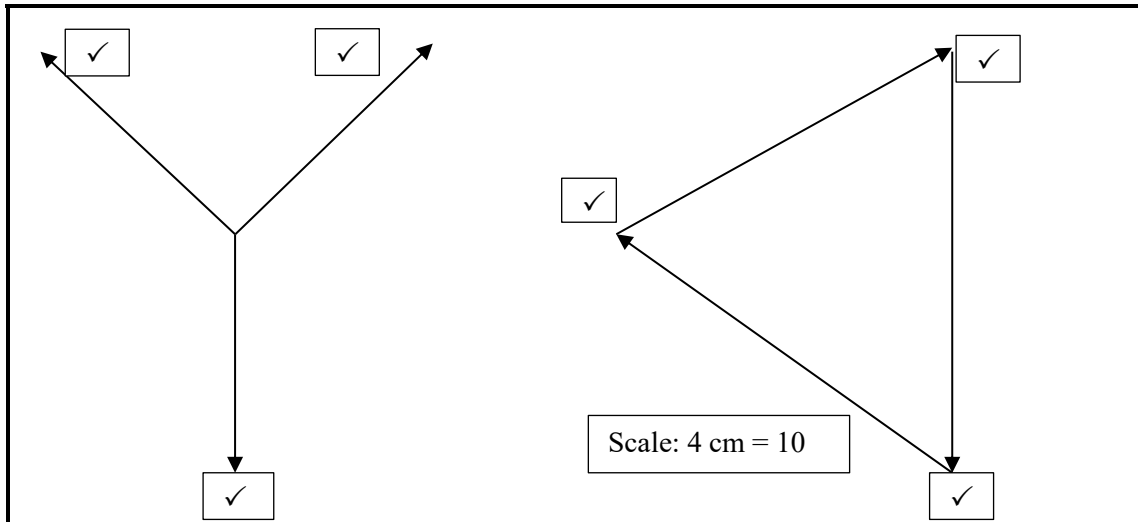
Vertical components ✓

$30 \sin 45^\circ = 21,21^\circ$  ✓

$60 \sin 30^\circ = 30^\circ$  ✓

(3)

7.2



(6)

7.3

FORCE	HORIZONTAL COMPONENTS	VERTICAL COMPONENTS
45 N	$45 \cos 0 = 45 \text{ N}$ ✓	$45 \sin 0 = 0$
50 N	$75 \cos 90 = 0$	$75 \sin 90 = 75 \text{ N}$ ✓
30 N	$60 \cos 45$ OR $60 \cos 135 =$	$60 \sin 45$ OR $60 \sin 135 =$
	<b>- 42,42 N</b> ✓	<b>42,42 N</b> ✓
TOTAL	<b>2,58 N</b> ✓	<b>117,42 N</b> ✓

(6)

7.4 Take moments about RR

$LR \times 8 \text{ m} = (40 \times 6 \text{ m}) + (60 \times 4 \text{ m})$  ✓

$8LR = 240 + 240$  ✓

$LR = 60 \text{ N}$  ✓

Take moments about LR

$RR \times 8 \text{ m} = (60 \times 4 \text{ m}) + (40 \times 2 \text{ m})$  ✓

$8RR = 240 + 80$  ✓

$RR = 40 \text{ N}$  ✓

(6)

- 7.5 A tensile force of 50 kN is exerted onto a round bar with a diameter of 50 mm and an original length of 3 m.

Calculate the stress in the material:

$$1 \sigma = \frac{F}{A}$$

$$A = \frac{\pi d^2}{4}$$

$$= \frac{\pi(0,05)^2}{4} \checkmark$$

$$A = 0,00196375m^2 \checkmark$$

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

$$= \frac{50 \times 10^3}{0,00196375} \checkmark$$

$$\sigma = 2,5461489,5 \text{ Pa} \checkmark \text{ OR}$$

$$\sigma = 25,4 \text{ MPa}$$

(5)

- 7.6  $Y = 8.96 \times 10^{11} \text{ Pa}$ ;  $F = 120 \text{ N}$ ;

$$L = 8 \text{ m}; A = 1.77 \times 10^{-6} \text{ m}^2$$

$$F = 120 \text{ N}; DL = ?$$

$$= \frac{\Delta y}{\Delta x} \checkmark \checkmark$$

$$= \frac{(120 \text{ N} \times 8 \text{ m})}{(1.77 \times 10^{-6} \text{ m}^2)(8.96 \times 10^{11} \text{ Pa})} \checkmark \checkmark$$

$$\text{Increase in length: } DL = 0.605 \text{ mm} \checkmark \checkmark$$

(6)

**[35]**

### QUESTION 8: WELDING TERMINOLOGY (SPECIFIC)

- 8.1 What is a *template*?

It is an identical replica of a project or part of a project ✓ that is used to mark out multiple components in production. ✓

(2)

- 8.2 Define the term *backmark* as used in the fabrication workshop.

Backmarks are the standard distances measured from the corner or back of steel profiles ✓ such as angle iron and channel iron, to the centre of the hole, depending on the size of the profile. ✓

(2)

- 8.3 Identify the labels as depicted in the illustration.

**A** – Leg

**B** – Toe

**C** – Actual throat

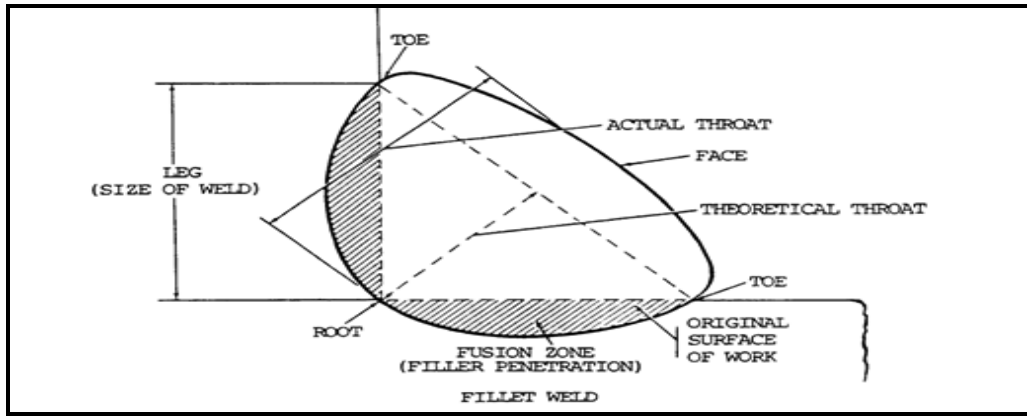
**D** – Face

**E** – Theoretical Throat

**F** – Original surface of work

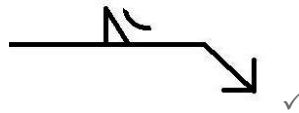
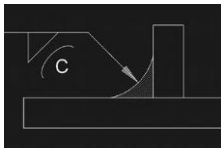
**G** – Fusion zone

(7)



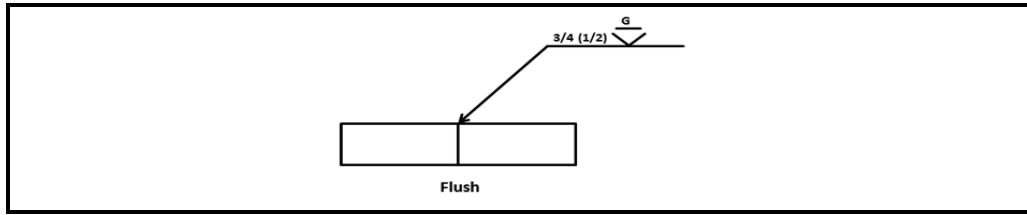
8.4 Supplementary symbols by means of sketches.

8.4.1 Concave



(1)

8.4.2 Flush



8.5 Fusion welding symbols below:

8.5.1



Square Butt weld ✓

(1)

8.5.2



Spot weld ✓

(1)  
[15]

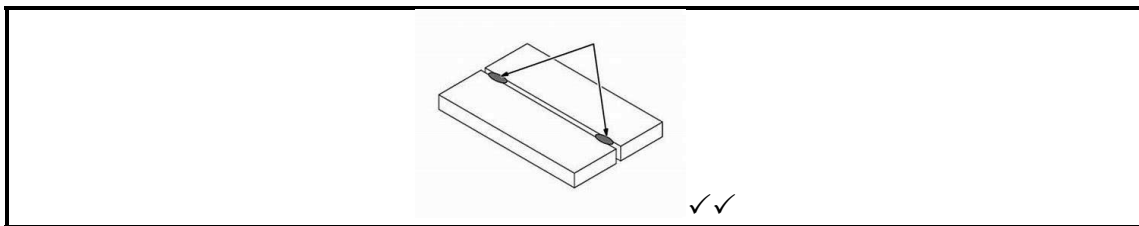
**QUESTION 9: JOINING METHODS (SPECIFIC)**

9.1 THREE types of welding joints.

- But welds ✓
- Lap welds ✓
- Corner welds ✓

(3)

9.2 Sketch of a tack welded butt-weld.



✓✓

(2)

9.3 Explain how to strike an arc during the arc welding process.

The electrode first touches the base metal. ✓

Withdraw it from the metal slightly and maintain that length for the duration of the weld. ✓

(3)

9.4 FOUR main things that need to be controlled by a welder to run a good bead

- Arc length ✓
- Speed of electrode ✓
- Bead width ✓
- Electrode angle and position ✓

(4)

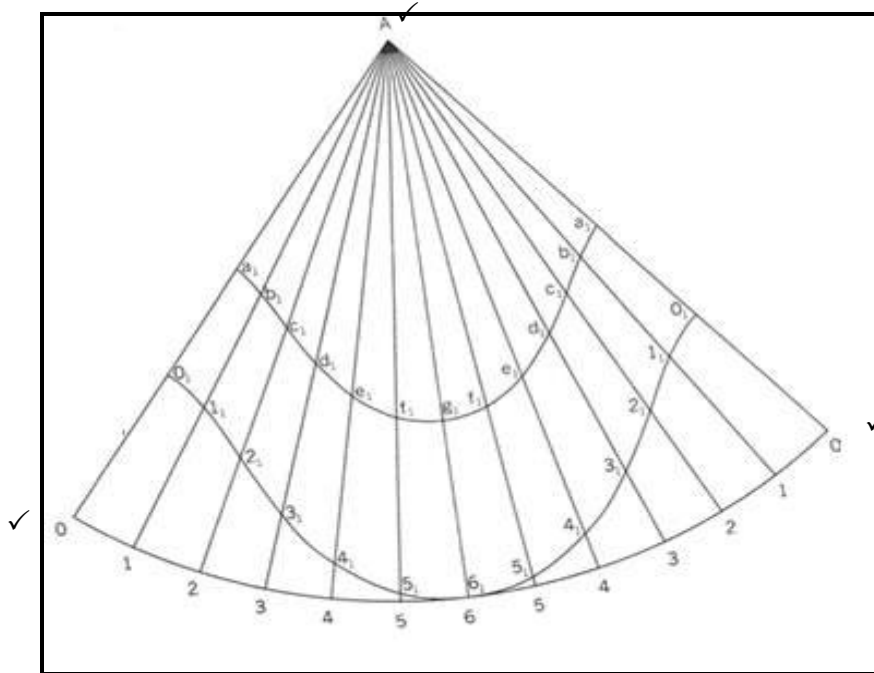
9.5 THREE factors that reduce and increase the hardness when welding carbon steel.

- Rate of cooling ✓
- Porosity ✓
- Shape and size of the weld and parent metal. ✓
- The composition of parent metal and filler material.

(Any 3 x 1) (3)  
[15]

**QUESTION 10: TERMINOLOGY (DEVELOPMENT) (SPECIFIC)**

10.1



Neatness 4 marks;  $\frac{1}{2}$  mark for every point of the development =  $26 \div 2 = 13$   
3 Marks for Point A, O AND O.

DEVELOPMENT(PATTERN)

[20]

TOTAL: 200