

CEL&ETL - Technical Drawing and  
Knowledge of Materials

T128

Thursday, 19/11/2015

08:30 - 11:30

WORKFORCE DEVELOPMENT AUTHORITY



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**ADVANCED LEVEL NATIONAL EXAMINATIONS, 2015,  
TECHNICAL AND PROFESSIONAL TRADES**

**EXAM TITLE:** Technical Drawing and Knowledge of Materials

**OPTIONS:** - Computer Electronics (CEL)

- Electronics and Telecommunication (ETL)

**DURATION:** 3 hours

**INSTRUCTIONS:**

The paper is composed of **three (3) main Sections** as follows:

Section I: Fifteen (15) questions, all **Compulsory**. 55marks

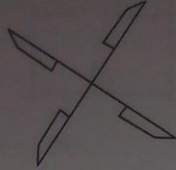
Section II: Five (5) questions, **Choose any Three (3)**. 30marks

Section III: Three (3) questions, **Choose any One (1)**. 15marks

**Every candidate is required to strictly obey to the above instructions. Punishment measures will be applied to anyone who ignores these instructions.**

**Marking guides**

01. Using the following diagram, how many lines of symmetry does the figure in the diagram have? Explain why? 2marks



Answer:


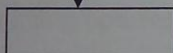
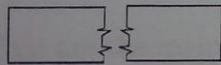
A line of symmetry is a line that divides an image into two mirror images. The image in the question has only one line of symmetry.

02. What is ductility property of material? 2marks

Answer:

The term ductility is defined as the property of a metal by the virtue of which it can be drawn into wires or elongated before rupture take places (1). It depends upon the grain size of the metal crystals (1). The measures of the ductility of a metal are its percentage elongation and percentage reduction in the cross sectional area before rupture (1).

03. Identify the names for the following types of lines? 6marks

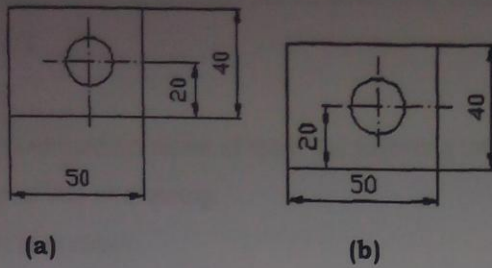
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. 
5. 
6. 

Answer:

- |                |                   |                    |
|----------------|-------------------|--------------------|
| 1. Outline     | 3. Centre line    | 5. Pointer line    |
| 2. Dotted line | 4. Dimension line | 6. Long break line |

04. Which of the following representation is correct and why?

2marks



Answer:

(a) is correct because all Dimensions are placed outside the View whereas in figure (b) the dimensions are placed inside the View. As far as possible dimensions should be placed outside the view.

05. Describe ferrous metal with supporting examples and list its characteristics which make it extensively used in engineering industry.

6marks

Answer:

The metals which contain iron as their main constituent are called ferrous metal. Pig iron cast, wrought iron and steel are examples of ferrous metals. Ferrous metals have the following characteristics which make them extensively used in engineering industry:

- Ease of fabrication process like casting, rolling, welding, machining
- Resistance to corrosion
- Magnetic properties and
- Weight

06. What are the main features of Lettering?

3marks

Answer:

Features of lettering are:

- a. Uniformity
- b. Legibility/Neatness
- c. Rapidity of execution.

**07.** The title block is an important feature in the drawing because it gives all the information of the prepared drawing. List four (4) items contained within the title block.

**4marks**

Answers:

The block should contains at least the following information

1. Name of title of drawing.
2. Drawing number.
3. Scale
4. Symbols denoting the method of projection
5. Initials with dates, staff who have designed, drawn, checked standards and approved the drawing

**08.** Identify the different types of cast iron.

**3marks**

Answers:

- Grey Cast Iron
- Chilled Cast Iron
- Nodular Cast Iron
- White Cast Iron
- Malleable Cast Iron
- Alloy Cast Iron

**09.** Explain the different types of stresses.

**6marks**

Answer:

**Tensile stress:** when a section of any ductile material is subjected to two equal and opposite forces as a result of which the body tends to increase its length, the stress induced is called tensile stress and the corresponding strain is called tensile strain. 2marks

**Compressive stress:** when a section of any ductile material is subjected to two equal and opposite pushes as a result of which the body tends to decrease its length, the stress induced is called compressive stress and the corresponding strain is called compressive strain. 2marks

**Shear stress:** when a section of any ductile material is subjected to two equal and opposite forces as a result of which the body tends to shear of across the section, the stress induced is called shear stress and the corresponding strain is called shear strain. 2marks

10. A steel bar 6.00 m long and with rectangular cross section of 5.00 cm x 2.50 cm supports a mass of 2000 kg. How much is the bar stretched? The young's modulus  $Y$  for steel is  $20.0 \times 10^{10} \text{ N/m}^2$ . **4marks**

Resolution:

Solving for  $\Delta L$ , we get  $\Delta L = FL/YA$  and  $F = m \times a$

$$\Delta L = FL/YA = (2000) \times (9.80) \times (6.00) / (20.0 \times 10^{10}) (0.050 \times 0.025)$$
$$= 4.70 \times 10^{-4} \text{ m} = 0.47 \text{ mm Ans.}$$

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11. What is meant by elasticity? **2marks**

Answer:

Any material or body can be deformed by an applied force. If it returns to its original shape after the force is removed, it is said to be elastic.

12. Identify five (5) among different chemical properties of materials. **5marks**

Answer:

The chemical properties of materials include: atomic weight, equivalent weight, molecule weight, acidity, chemical composition, corrosion etc.

13. What is technical drawing? State its main role. **2marks**

Answer:

Technical drawing is a graphical means of communication which is internationally understood. It is therefore often called the universal language of technology.

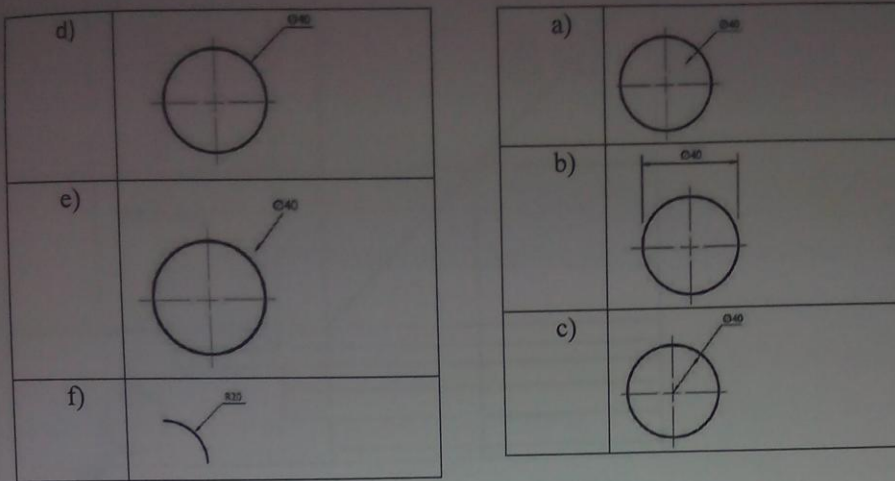
Technical drawing has the role of communicating ideas by means of pictures, Drawings, graphs and symbols.

14. Identify five (5) among different thermal properties of materials. **5marks**

Answer:

The thermal properties of materials include: specific <sup>heat</sup> heat, thermal conductivity, thermal expansion, <sup>latent</sup> latent heat, thermal stresses, thermal <sup>shock</sup> shock etc.

15. Determine the correct and incorrect dimensioning in the following: **3marks**



Answer:

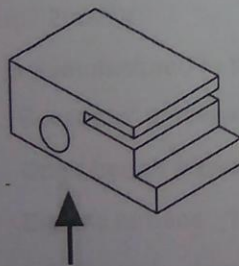
- |                |                |            |
|----------------|----------------|------------|
| a) Correct     | c) Correct     | e) Correct |
| b) Not Correct | d) Not correct | f) Correct |

*totally different  
to the answers  
questions*

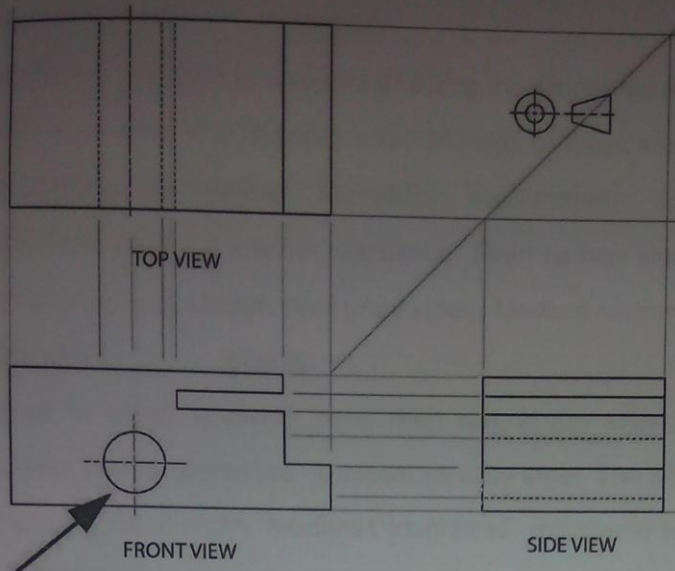
**Section II. Answer any three (3) among the following questions on your own choice (do not go beyond the three questions in this section). **30marks****

16. In the following figure the arrowhead shows the direction of the front view, draw the elevation looking from the front view, the top view and the side view.

**10marks**



**Resolutions:**



17. A) Describe steel and list different methods of manufacturing the steel.

**6marks**

B) Explain the two types of Steel.

**4marks**

Answer:

A) Steel is an alloy of iron and carbon with carbon content up to a maximum of 1.4 %. The carbon occurs in the form of iron carbide ( $\text{Fe}_2\text{C}$ ), because of its ability to increase the hardness and the strength of the steel. Other elements like Silicon, Sulphur, Phosphorus and manganese are also present in great lesser amount to impart certain properties to it. 2marks

Steel is manufactured in the following method:

- Bessemer process 1mark
- Open hearth process 1mark
- Electric furnace 1mark
- L.D Process 1mark

B) Two types of Steel are:

Plain Carbon steel: 2marks

Carbon is the main constituent affecting the properties of plain carbon steel. The content of carbon decides the strength and hardness of steel. However, increase in carbon content decreases the ductility, formability, machinability, Weldability, thermal and electrical conductivity and corrosion resistance. Plain carbon steel are classified according to their carbon into low carbon steel (mild steel), Medium carbon steel and high carbon steel.

Alloy steel: 2marks

Steel in which elements other than carbon are added in sufficient quantity in order to obtain special properties, is known as alloy steel. The alloying of steel is generally done to increase its strength, hardness toughness, resistance to abrasion and wear and improve electrical and magnetic properties. The various alloying elements are nickel, chromium molybdenum, cobalt, vanadium, manganese silicon and tungsten.

18. A) What is stainless steel?

2marks

B) List different types of stainless steels and state where they can be used.

8marks

Answers:

A) Stainless steel is a steel, which when correctly heat-treated and finished, resists oxidation and corrosive attack from corrosive media. 2marks

B) Types of stainless steels: Ferritic

i. Ferritic stainless steel 2marks

ii. Marten stainless steel 2marks

iii. Austenite stainless steel 2marks

Martensitic  
~~Austenitic~~

Uses

Stainless steels are used for making bearings, springs shafts, medical instruments, sheet, wire, utensils and chemical industry appliances, storage and transport tanks. 2marks



19. A) Give the expression for the terms 'tensile stress', 'tensile strain' and 'Young Modulus', and state the S.I. units of each term. **6marks**

B) Determine the drawing instrument used to perform the following tasks: **4marks**

1. To draw lines at 30°, 60° and 45° to the vertical and horizontal.
2. To mark or measure angles between 0 and 360°.
3. To fix the Drawing sheet on the Drawing board.
4. To draw circles and arcs of circles.

Answers:

A) Tensile stress = Tensile force / Cross-sectional area. Pascal, Pa. 2marks

Tensile strain = Extension / length. This is a ratio, so there are no units. 2marks

Young's Modulus = Tensile stress / tensile strain. Units: Pascal, Pa. 2marks

B)

1. To draw lines at 30°, 60° and 45° to the vertical and horizontal. Set squares  
1mark
2. To mark or measure angles between 0 and 360°. Protractor 1mark
3. To fix the Drawing sheet on the Drawing board. Clamps, thumbnails (board pins), spring clip or using drawing tape (Cello tape). 1mark
4. To draw circles and arcs of circles. Compass, French curves 1mark

20. A) Identify different types of thermoplastics. **4marks**

B) What are the main properties of thermoplastics and their uses? **6marks**

Answers:

A) The types of thermoplastics are

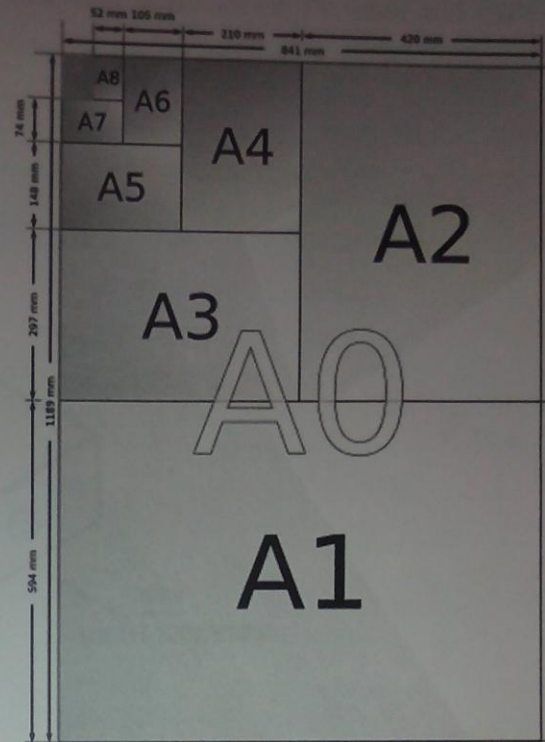
- Polyethylene 1mark
- Polypropylene 1mark
- Polyvinyl Chloride (PVC) 1mark
- Poly tetra fluorooethylene 1mark



Answer: Table of sheets sizes

1 mark each correct size.

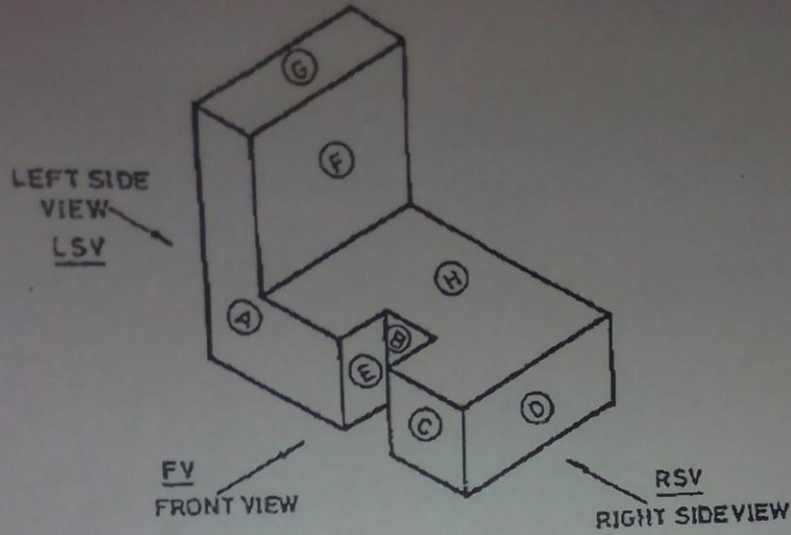
Format	Measurements in mm
A0	841 x 1189
A1	594 x 841
A2	420 x 594
A3	297 x 420
A4	210 x 297
A5	148 x 210
A6	105 x 148
A7	74 x 105
A8	52 x 74



B)

- A material is said to behave elastically if the strain caused by the application of load disappear when the load is removed – it returns to its original state. 1.5mark
- The largest value of stress for which the material behaves elastically is called the elastic limit (essentially the same as  $\sigma_y$  in materials with a well-defined yield point). This is indicated by a point D. 2.5marks
- Once the yield stress has been obtained, when the load is removed, the stress and strain decrease linearly but do not return to their original state. 1mark
- This indicates plastic deformation. 1mark
- When a material does not have a well-defined yield point, the elastic limit can be closely approximated using the offset method. 1mark

22. Draw the elevation looking from the direction of the arrow FV, plan and right side view, left side view and the top view for the pictorial view shown in figure below.



**Resolutions:**

