First Semester

Mechanical Engineering

كلية الحرس التقنية

(Answers)

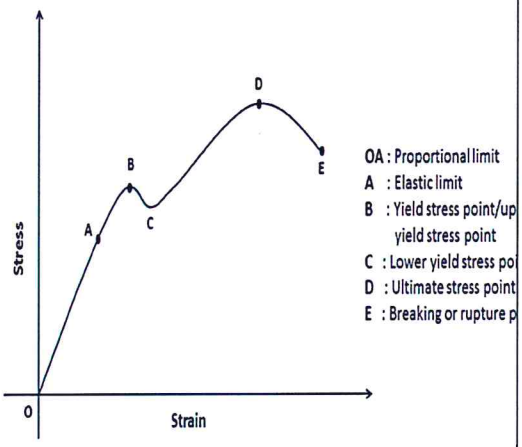
Mechanical Engineering
Royal Guard of Oman Technical Collage
1st Semester - 1st Session
2023-2024

The Answer Scheme

Question #	The Answer	Mark	Page #
1	d. Density	1	4
2	b. Ceramics	1	7
3	a. 0.3% to 0.8%	1	16
4	c. Corrosion	1	17
5	b. Material becomes easy for cutting	1	21
6	d. Pearlite	1	35

Question #		The Answer	Mark	Page #
7	1	Plasticity: If the value of stress is more than a set limit, the material will not regain its original shape and size on removal of stress or force. This type of behavior is known as plasticity.	1	6
	2	Malleability: Materials that can change shape under a compressive force are malleable materials	1	7
8		1. Good insulators of heat and electricity 2. Have moderate strength 3. Corrosion resistant 4.Light in weight 5. Ductile and malleable 6. Have low melting points	2	21
		Note: The student can answer any four of the above each ½ mark		
9		Composites: Composite material is made from two or more materials with significantly different physical or chemical properties that, when combined produce a material with characteristics different from the individual components. Examples: a. Natural Composites: Wood b. Artificial Composites: Cement concrete, fiber glass, Fiber reinforced plastics (FRP), Glass reinforced plastics (Student can answer any one example)	1 1	25

Question #	The Answer	Mark	Page #
10	**Vickers test**: A diamond pyramid is pressed into the material under a set of load and the indentation is measured. **Rockwell test**: A diamond or tungsten carbide ball is pressed into the material under a set load and the indentation is measured.	1 1	12
11	1. Increase strength, hardness and wear resistance 2. Increase ductility and softness 3. Increase toughness 4. Remove internal stresses induced	½ ½ ½ ½	29
12	The white phase is called Ferrite and the black phase is graphite flakes. Grey cast Iron is self-lubricating material because of the presence of graphite flakes in its structure. Graphite acts like oil (lubricant) hence no oil is required to lubricate it when there are contact surfaces. It is one of the reasons why Grey cast iron is suitable for making machine tool beds.	2	35

Question #	The Answer	Mark	Page #
13 (a)	1- Strength, ductility, hardness, toughness. etc. 2- Resistivity, conductivity, dielectric strength 3- Specific heat, thermal conductivity 4- Color, density, Melting point size. Etc	½ ½ ½ ½	4
13 (b)		2	5

Question #	The Answer	Mark	Page #
14 (a)	$\frac{External\ Force}{Cross-sectional\ Area}$ $\sigma = \frac{F}{A}$	½	8
	Strain → $\varepsilon = \frac{\Delta l}{l}$ ← Extension (m Original lengt	½	8
	$\frac{\textbf{Stress}}{\textbf{Strain}}$ $E = \frac{\sigma}{\varepsilon}$	½	8
	$\varepsilon\ (\%) = \frac{L_f - L_0}{L_0} x100$	½	8
14 (b)	**Thermoplastics:** They can be easily softened and reshaped again and again by heating. E.g. Polyethylene, Nylon, PVC etc. **Application**: Cable covers, polyethylene carry bags, PVC pipes, bottles, gears, etc. **Thermosetting plastics**: They cannot be softened and reshaped by re-heating once set into shape by heating and curing. E.g. Polyester, Bakelite etc. **Application**: Furniture, Switches, electric plugs etc.	½ ½ ½ ½	22

Question #	The Answer	Mark	Page #
15 (a)	1. Reduce brittleness. 2. Minimize internal stresses. 3. Reduce crack formation. 4. To make the metal tough to resist shock and fatigue.	2	29
15 (b)	**Normalizing** is defined as a softening process in which iron base alloys are heated. It is a type of heat treatment applicable to ferrous metals only. The purpose of normalizing is to remove the internal stresses induced by heat treating, welding, casting, forging, forming, or machining. **Annealing:** It is a softening process in which iron base alloys are heated above the transformation range, held there for a certain time and then cooled slowly. The cooling method depends on the metal and the properties desired. Some metals are furnace cooled, and others are cooled by burying them in ashes, lime, or other insulating materials.	2	30

End of the Answer Scheme

Mechanical Engineering
Royal Guard of Oman Technical Collage
1st Semester – Second Session
2023-2024

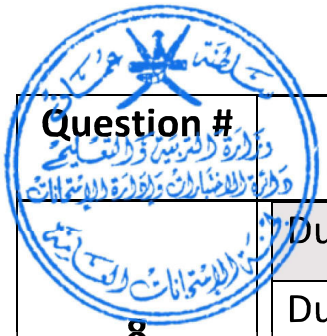
The Answer Scheme

Question #	The Answer	Mark	Page #
1	c. Specific heat.	1	4
2	b. Plasticity.	1	6
3	b. Low thermal and electrical conductivity.	1	19
4	b. Brass.	1	20
5	c. Annealing.	1	30
6	a. Graphite.	1	36

Question #	The Answer	Mark	Page #
7		2	4

Type of property	Examples
Mechanical properties	Strength, ductility, hardness, toughness. etc.
Electrical properties	Resistivity, conductivity, dielectric strength
Thermal properties	Specific heat, thermal conductivity
Chemical Properties	Corrosion resistance, acidity, alkalinity. etc.
Physical Properties	Color, density, Melting point size. etc.

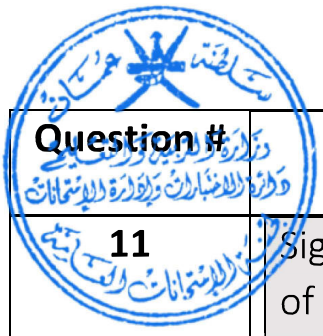
Marking Scheme: 0.5 marks for each correct answer on types and examples selected from above options. 0.5 X 4 = 2 marks



Question #	The Answer	Mark	Page #
8	<table><tr><th>Ductility</th><th>Importance</th></tr><tr><td>Ductility is the ability of the material to deform more before fracturing.</td><td>It is a very important property for making wires.</td></tr></table> **Marking Scheme:** 1 marks for correct definition and 1 mark for stating its importance. 1 X 2 = 2 marks	2	7
9	<table><tr><th>Difference between pure metals and alloys</th><th>Suitability for engineering applications</th></tr><tr><td>Pure Metals are metals in clean form or unmixed form, whereas alloys are mixture of two or more metals.</td><td>Alloys with suitable alloying elements have better properties than pure metals, hence are more suitable for engineering application</td></tr></table> **Marking Scheme:** 1 marks for correct statement on difference and 1 mark for stating correct choice for engineering applications. 1 X 2 = 2 marks	2	14

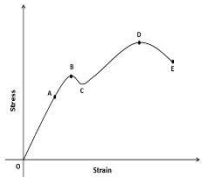


<table>
<tr><th>Question #</th><th>The Answer</th><th>Mark</th><th>Page #</th></tr>
<tr><td>10</td><td>
<table>
<tr><th>Classification of plain carbon steel</th><th>Percentage of carbon</th></tr>
<tr><td>1. Low-carbon</td><td>Less than 0.3%.</td></tr>
<tr><td>2. Medium-Carbon Steels</td><td>Between 0.3% and 0.8%.</td></tr>
<tr><td>3. High-Carbon Steels</td><td>Greater than 0.8%.</td></tr>
</table>
Marking Scheme: 0.5 marks for each correct classification and 0.5 for each correct percentage of carbon.
0.5 X 4 = 2 marks
</td><td>2</td><td>16</td></tr>
</table>

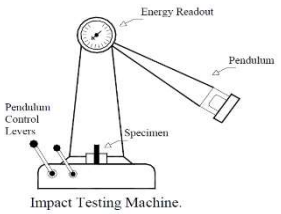


Question #	The Answer		Mark	Page #
11	Significance of heat treatment process	Steps of heat treatment process	2	28
	Heat treatment is done to change the mechanical properties of a material alloying elements.	1. Heating to recrystallization temperature 2. Holding at recrystallization temperature. 3. Cooling to room temperature		
	Marking Scheme: 0.5 marks for significance of heat treatment process. 0.5 for each correct step. 0.5 X 4 = 2 marks			

Question #	The Answer	Mark	Page #
12	Ferrite & pearlite content in low carbon steel 1. low carbon steel: In Low carbon steel the ferrite content is more, and the pearlite content is less, and this is because of the low amount of carbon. 2. In Medium carbon steel both Ferrite content and Pearlite content is equal. **Marking Scheme:** 1 mark for correct statement on ferrite and pearlite range in each case.1 X 2 = 2 marks	2	35

Question #	The Answer	Mark	Page #
13 (a)	Stress strain curve:  Points: A. Elastic limit. B. Upper yield stress point. C. Lower yield stress point. D. Ultimate stress point. E. Rupture point. **Marking Scheme:** 0.75 mark for correct stress strain diagram. 0.25 marks for each correct indication points. 0.75 + 0.25 x 5 = 2 marks	2	5

وزارة التربية والتعليم
وحدة الاختبارات ودائرة الامتحانات
الامتحانات الوطنية

<table>
<tr><th>Question #</th><th>The Answer</th><th>Mark</th><th>Page #</th></tr>
<tr><td>13 (b)</td><td>
<table>
<tr><th>Definition toughness</th><th>IZOD Impact test</th></tr>
<tr><td>The toughness of a material is its ability to absorb energy before fracturing. It is also the resistance of shock loading</td><td>

Impact Testing Machine.

Toughness of materials can be measured by the IZOD TEST. The test material here is first cut with a notch and then placed vertically and hit with a heavy pendulum. The test machine records the amount of energy taken by test piece.</td></tr>
</table>
Marking Scheme: Definition of toughness 0.5 marks. Impact testing machine sketch 0.5 marks. Impact test explanation 1 mark. Breakdown 0.5+0.5+1=2</td><td>2</td><td>10</td></tr>
</table>

Question #	The Answer	Mark	Page #
14 (a)	See table below	2	17

Type of ferrous alloy	Composition	Applications
1. High-speed steel	A typical HSS composition is: 18% tungsten, 4% Chromium, 1% Vanadium, 0.7% carbon and the rest is Iron. It is used in manufacturing cutting tools	1. Lathe cutting tool. 2. Drill bits
2. Stainless steel	Stainless steel is an alloy of iron, chromium, and other elements that resist corrosion from many environments	1. For Vernier calipers 2. For steel rules

Marking Scheme: 0.5 marks for each correct composition. 0.25 marks for each correct application. 0.5 x 2 + 0.25 x 4 = 2 marks

Question #	The Answer	Mark	Page #
14 (b)		2	21-22

Type of polymer	Applications
1. Thermoplastics can be easily softened and reshaped again and again by heating	cable covers, polyethylene carry bags, PVC pipes, bottles,
2. Thermosetting Plastics cannot be softened and reshaped by re-heating once set into shape by heating and curing.	Furniture, Switches, electric plugs

Marking Scheme: 0.5 marks for each correct meaning of polymer. 0.25 marks for each correct application. 0.5 x 2 + 0.25 x 4 = 2 marks

Question #	The Answer	Mark	Page #
15 (a)	Objectives of heat treatment process 1. Increase strength, hardness and wear resistance 2. Increase ductility and softness 3. Increase toughness 4. Remove internal stresses induced **Marking Scheme:** 0.5 mark for each correct objective. 0.5 x 4 = 2 marks	2	29

Question #	The Answer	Mark	Page #
15 (b)		2	30-31

Explanation Annealing process	Advantages
It is a softening process in which iron base alloys are heated above the transformation range, held there for a certain time and then cooled slowly. The cooling method depends on the metal and the properties desired. Some metals are furnace cooled, and others are cooled by burying them in ashes, lime, or other insulating materials.	1. Material becomes soft and uniform grain structure. 2. Material becomes easy for cutting. 3. Material Internal stresses become less. 4. Material Ductility improves

Marking Scheme: 1 mark for each correct explanation of annealing process. 0.25 marks for each correct advantage.

1 + 0.25 x 4 = 2 marks.

End of the Marking Scheme

THE ROYAL GUARD OF OMAN TECHNICAL COLLEGE

PAPER	EXAMINATION	DURATION
FINAL FIRST TERM	***MECHANICAL ENGINEERING***	3 HOURS TOTAL MARKS 100

JANUARY 2023	**SERIES** Technical Education Diploma

YOU SHOULD HAVE THE FOLLOWING FOR THE EXAMINATION

A NON PROGRAMMABLE CALCULATOR

DRAWING INSTRUMENTS

INSTRUCTIONS TO CANDIDATES:

SECTION A : (OBJECTIVE QUESTIONS – 20 QUESTIONS)

ANSWER ALL THE QUESTIONS IN SECTION A

CIRCLE THE CORRECT ANSWER FROM THE ANSWERS GIVEN

EACH QUESTION CARRIES TWO MARKS IN SECTION A

TOTAL 40 MARKS FOR SECTION A

SECTION B (SHORT ANSWER QUESTIONS - 10 QUESTIONS)

ANSWER ALL THE QUESTIONS FROM SECTION B IN THE SPACE PROVIDED.

EACH QUESTION CARRIES 6 MARKS EACH IN SECTION B.

TOTAL 60 MARKS FOR SECTION B

SECTION A

Shade in the bubble the correct answer for each question

Each Question carries two marks each

A1: Which one of the following is an example/quality of a chemical property?

- ☐ Strength
- ☐ Resistivity
- ■ Alkanity
- ☐ Desnity

A2: The material will not regain its original shape and size after removal of force is known as----------

- ☐ Elasticity
- ■ Plasticity
- ☐ Hardness
- ☐ All of the above

A3: Ceramics are example for which one of the following properties?

- ☐ Ductility
- ☐ Malleability
- ☐ Hardness
- ■ Brittleness

A4: ---------- is the ability of material to absorb energy before fracture.

- ☐ Strength
- ☐ Rigidity
- ☐ Microstructure
- ■ Toughness

A5: In charpy test there are ---------- kinds of notches can be used.

- [ ] One
- [ ] Three
- [x] Two
- [ ] Four

A6: Diamond Pyramid pressed into the material is used in ---------- test.

- [ ] Rockwell
- [x] Vicekrs
- [ ] Tungsten
- [ ] Brinell

A7: In plain carbon steel ---------- is less than 1.65%.

- [x] Manganese
- [ ] Carbon
- [ ] Copper
- [ ] Silicon

A8: Which one of the is an application of high carbon steel?

- [ ] Shafts
- [x] Steel axle
- [ ] Nuts
- [ ] Furnitures

A9: In stainless steel---------- is predominant element for corrosion resistance .

- [x] Chromium
- [ ] Nickel
- [ ] Carbon
- [ ] Allof the above

A10: Ferrous alloys with greater than ----------% carbon is called as cast iron.

- [ ] 1
- [ ] 10
- [ ] 0
- [x] 2

A11: Which one of the following is an application of thermosetting plastics?

- [ ] Tubes
- [ ] Gears
- [x] Switches
- [ ] Pvc pipes

A12: Cement is made of crystalline particles of calcium oxide, silica and ----------.

- [ ] Carbon
- [x] Alumina
- [ ] Nitrides
- [ ] None of the above

A13: Tungstan and titanium carbides are very hard materials and they are used for?

- [x] Cutting tools
- [ ] Tables
- [ ] Machines
- [ ] Shafts

A14: Which one of the following is an example of artificial composite?

- [x] Fiber reinforced plastics
- [ ] Wood
- [ ] Lignin
- [ ] Concrete

A15: Identify the heat treatment process from the following options.

- [ ] Surface coating
- [x] Annealing
- [ ] Turning
- [ ] Electroplating

A16: If a material gets hard while working on them like turning is known as ----------

- [ ] Case treatment
- [x] Work hardening
- [ ] Ductility
- [ ] Normalizing

A17: To relieve internal stresses andto reduce brittleness ----------process is applied after hardening treatment.

- [x] Tempering
- [ ] Annealing
- [ ] Drilling
- [ ] Normailizing

A18: Study of the constitution and structure of metals and alloys is known as ----------

- [ ] Mixing
- [ ] Composits
- [x] Metallography
- [ ] All of the above

A19: In microstructure of grey cast iron the white phase is called as ferrite and the black phase is ----------

- [ ] Copper
- [x] Pearlite
- [ ] Martensite
- [ ] None of the above

A20: Grey cast iron is suitable for making ----------

- [ ] Tools
- [ ] Switches
- [x] Machine tool beds
- [ ] All of the aove

SECTION B

ANSWER THE FOLLOWING QUESTIONS **(6X10 = 60 MARKS)**

B1(a). Define the following mechanical properties. **(3 marks)**

a. Elasticity: It is defined as property of the material to regain its original shape and size after deformation when the external forces are removed.

b. Malleability : Materials that can change shape under a compresiveforce are malleable materials.

c. Toughness: It is the ability to absorb energy before fracutringor resistence to shock loading.

Q1(b). Name any three properties of material that can be used to make Coca-cola containers.

(3 marks)

1. Sufficient strength
2. Resistence to the chemical actionof Coca-cola
3. Ability to keep gas
4. Less weight
5. Cheap
6. Easy to shape

B2(a). Write anyone name of test carried out for the property shown in table. **(3 marks)**

Material property	Name of the test
Hardness	Rockwell, Brinell, Vickers test
Toughness	Izod, Charpy test
Tensile strength	Tensile test on UTM

B2(b). Write the carbon content for the following carbon steels. **(3 marks)**

a. Plain carbon steel: Steels having carbon less than 0.3%. These materials are relatively soft.

b. Medium carbon steel: These steels have carbon content 0.3% to 0.8%.

c. High carbon steels: Carbon content is greater than 0.8%

B3(a). Write in brief about stainless steel and give two applications of it.

(3 marks)

Stainless steel is an alloy of iron, chromium and other elements that resist corrosion from many environments. Chromium is predominant element in corrosion resistence. It is also known as corrosion resistant steel.

Applications: Vernier caliper, steel rule.

B3(b). List out any three charecterstics of Aluminum.

(3 marks)

* Light –weight
* High thermal and electrical conductivity
* Excellent corrossion resistence
* Non-toxic
* Soft and ductile

B4. Write the types of polymers and list out the proeprties of polymers. (6 marks)

Types of ploymers:

a. Thermoplastics

b. Thermosetting plastics

c. Elastomers.

Properties:

1. Good insulators of heat and electricity.
2. Have moderate strength
3. corrosion resistant
4. Light in weight
5. Ductile and malleable
6. Have low melting points

B5(a). Write about the following engineering ceramics **(3 marks)**

1. Oxides: Alumina has high thermal and electrical resistance used as a cutting tool and high quality thermal and electrical insulation.

2. Carbides: Tungsten and titanium carbides are very hard materials used for cutting tools.

3. Nitrides: Silicon nitrides and boron nitrides used in engine parts and cutting tools.

B5(b). Write in brief about composites. **(3 marks**

A composite material is made from two or more materials with siginificantly different physical or chemical properties that, when combined produce a material with charecterstics different from the individual coponents. In composites the different materials remain separate through out the processing cycle.

B6(a). List out any three properties of Carbon fiber. **(3 marks)**

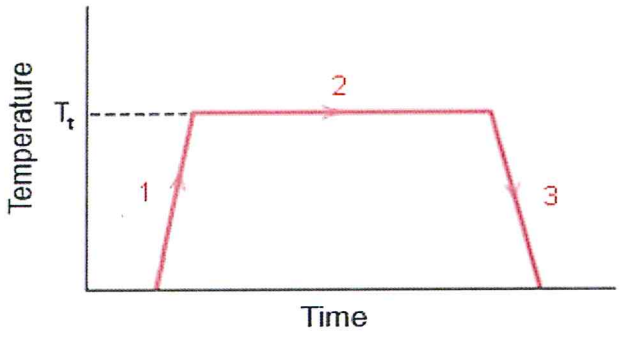
1. High strength

2. Low weight

3. Fire resistance

4. Corrossion resistance

B6(b).Draw the graph which shows the heat treatment process and write the meaning of there stages. **(3 marks)**



1) Heating to T
2) Holding at T
3) Cooling to room temperature

B7. Expalin in brief about annaling process and also state its advantages. (6 marks)

Annaeling :

It is a softening process in which iron base alloys are heated above the transformation range, held there for a certain time and then cooled slowly. The cooling method depends on the metal and the properties desired. Some metals are furnace cooled, and others are cooled by burying them in ashes, lime, or other insulating materials

Advantages of annealing process:

- Material becomes soft and uniform grain structure.
- Material becomes easy for cutting.
- Material Internal stresses become less.
- Material Ductility improves

:

B8(a). Write any three advantages of tempering process. **(3 marks)**

Advantages:

- Reduce brittleness.
- Minimize internal stresses.
- Reduce crack formation.
- To make the metal tough to resist shock and fatigue

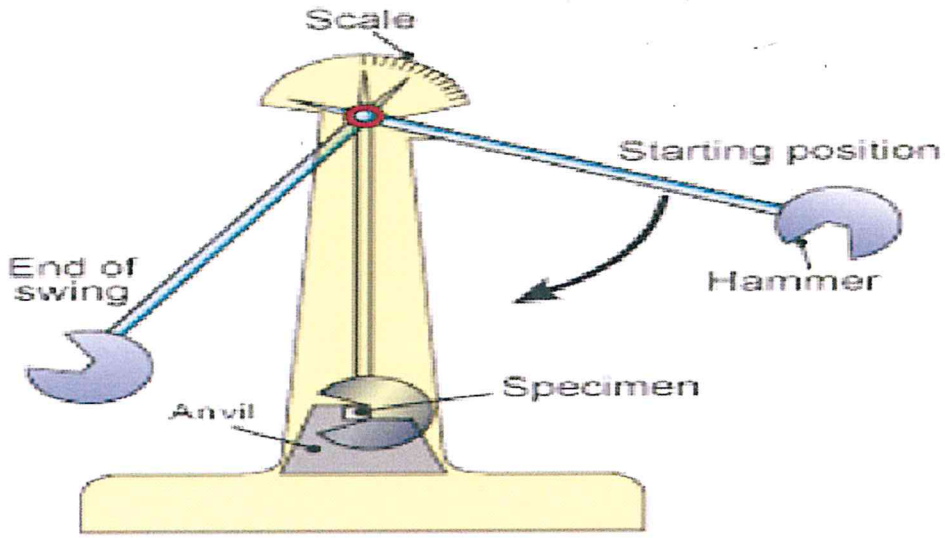
B8(b). Write in brief about microstructure of Grey cast iron. **(3 marks)**

The white phase is called Ferrite and the black phase is graphite flakes. Grey cast Iron is self-lubricating material because of the presence of graphite flakes in its structure. Graphite acts like oil (lubricant) hence no oil is required to lubricate it when there are contact surfaces. It is one of the reasons why Grey cast iron is suitable for making machine tool beds.

B9. List out the six steps for the preparation of specimen to observe microstructure under a microscope. **(6 marks)**

- Material is cut using power hacksaw or cutting machine.
- Rough grinding is done on the surface using bench grinder.
- Intermediate grinding is done on the belt grinder.
- Fine grinding is done on the emery papers.
- Polishing is done on the disc polishing machine with velvet cloth and diamond paste.
- Chemical etchants are applied on the material to see the microstructure.

B10(a). Fill with appropriate names in the blocks given below. This is the image of a Charpy test. **(3 marks)**



B10(b). Write the names of three important copper alloys. **(3 marks)**

- **Brass (copper-zinc alloy)**
- **Bronze (copper-tin alloy)**
- **Gun-metal (copper-tin-zinc alloy)**

END OF EXAMINATION PAPER

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TOTAL 40 MARKS FOR SECTION A

SECTION B (SHORT ANSWER QUESTIONS - 10 QUESTIONS)

ANSWER ALL THE QUESTIONS FROM SECTION B IN THE SPACE PROVIDED.

EACH QUESTION CARRIES 6 MARKS EACH IN SECTION B.

TOTAL 60 MARKS FOR SECTION B

SECTION A

Shade in the bubble the correct answer for each question

Each Question carries two marks each

A1: Identify the thermal property from the following.

- ☐ Resisitivity
- ■ Specific heat
- ☐ conductivity
- ☐ density

A2: Properties of material depends upon ----------

- ■ Product
- ☐ Color
- ☐ Size
- ☐ smell

A3: Tensile strength is measured by ----------

- ☐ Compression test
- ☐ Fatigue test
- ■ Tensile test
- ☐ Strain test

A4: Which one of the followinl is an example for ductile material ?

- ☐ Brick
- ■ Silver
- ☐ Thermoplastics
- ☐ Composites

A5: U-notch is used in which of the following test?

- ☐ Izod test
- ■ Charpy test
- ☐ Tensile test
- ☐ All of the above

A6: In which type of test Diamond pointer is used?

- [x] Vickers test
- [ ] Brinell test
- [ ] Izod test
- [ ] Tensile test

A7: Identify the brittle material from the following.

- [ ] Steel
- [ ] Copper
- [ ] Gold
- [x] Glass

A8: Young modulus (E) is ----------

- [ ] Shear stress/ shear strain
- [x] Stress/ strain
- [ ] Strain / stress
- [ ] Volumetric stress/ Volumetric strain

A9: Which one of the following is an example for non-ferrous metal?

- [x] Copper
- [ ] Brick
- [ ] Thermal steel
- [ ] Glass

A10: Identify from the following an application of medium carbon steel.

- [ ] Springs
- [ ] Axle
- [x] Shafts
- [ ] All of the above

A11: The purpose of normalizing process is to remove ----------

- [ ] Scratches
- [x] Internal stresses
- [ ] Grain structure
- [ ] None of the above

A12: Alumina has high ---------- resistance and used as cutting tool.

- [ ] Magnetic
- [ ] Fluid
- [x] Thermal
- [ ] Strain

A13: Ceramics which are available as a result of biological or geological processes are called as ----------.

- [ ] Engineering ceramics
- [ ] Domestic ceramics
- [ ] Metal ceramics
- [x] Natural ceramics

A14: Which one of the following is an example of natural composite?

- [ ] Fiber glass
- [ ] Concrete
- [x] Wood
- [ ] Glass reinforced plastics

A15: Carbon fibers have high ----------.

- [x] Strength
- [ ] Elasiticity
- [ ] Strain
- [ ] all of the above

A16: The advantage of tempering process is to ---------- .

- [ ] Increase hardness
- [ ] Increase crack formation
- [x] Reduce crack formation
- [ ] Increase in internal stresses

A17: When material gets hard while working on them is known as ----------.

- [ ] Normalizing
- [x] Work hardening
- [ ] Tempering
- [ ] Annealing

A18: Tempering is done after which heat treatment process?

- [ ] Annaeling
- [ ] Normalizing
- [x] Hardening
- [ ] None of the above

A19: Metallography is the study of the ---------- and structure of metals and alloys.

- [ ] Size
- [ ] Strength
- [ ] Ductility
- [x] Constitution

A20: In medium carbon steel both ferrite content and pearlite content is ---------- .

- [ ] Unequal
- [x] Equal
- [ ] Inversly proportional
- [ ] All of the above

SECTION B

ANSWER THE FOLLOWING QUESTIONS **(6X10 = 60 MARKS)**

B1(a). Give two examples/ qualities of the following material properties.

(3 marks)

S.No	Property	Examples/ Qualities
1	Mechanical	Strength, ductility, hardness, toughness. etc.
2	Physical	Color, density, Melting point size. etc.
3	Chemical	Corrosion resistance, acidity, alkalinity. etc.

B1(b). List out six properties of the material that can be used to make Coca - Cola containers.

(3 marks)

- Sufficient strength
- Resistance to the chemical action of Coca-Cola
- Ability to keep the gas
- Less weight
- Cheap
- Easy to shape

B2. Define the following mechancial Properties **(6 marks)**

1. Elasticity : **Defined as property of the material to regain its original shape and size after deformation when the external forces are removed.**

2. Plasticity : **If the value of stress is more than a set limit, the material will not regain its original shape and size on removal of stress or force. This type of behavior is known as plasticity.**

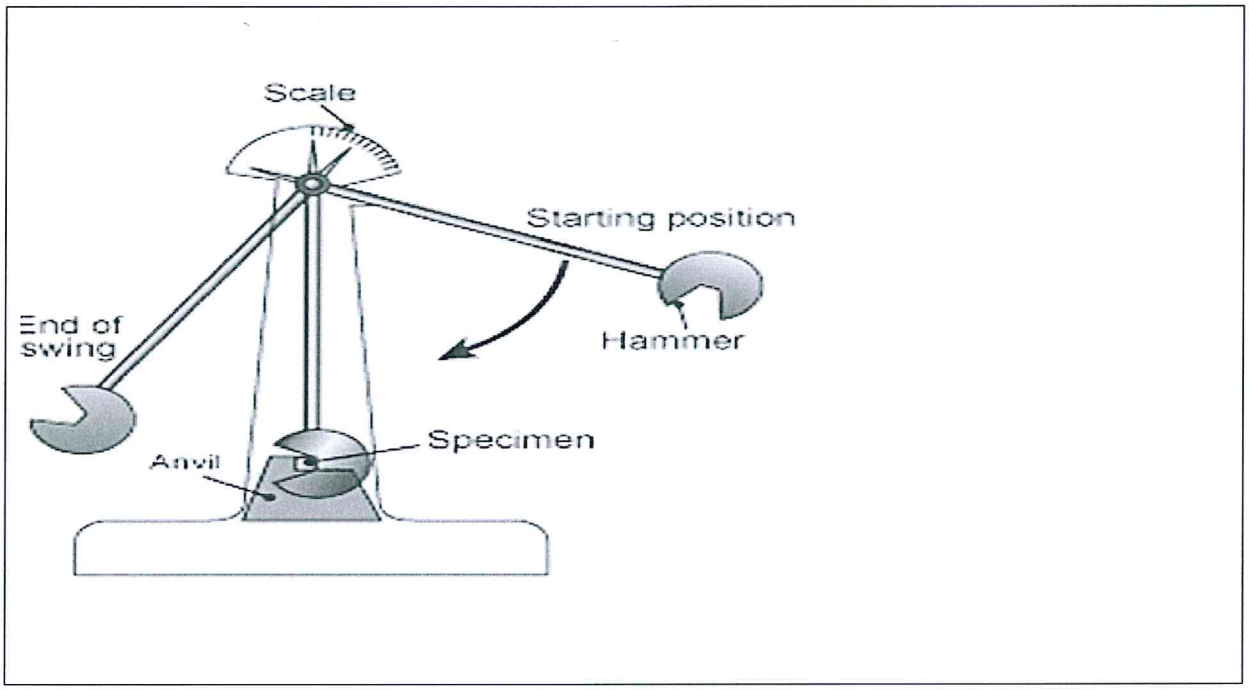
3. Compressive strength **: Resistance of material to fracture during compression.**

4. Malleability : **Materials that can change shape under a compressive force (e.g. being hammered) are malleable materials.**

5. Ductiltiy : **Ductility is the ability of the material to deform more before fracturing. It is a very important property for making wires. E.g. aluminum, gold, silver, copper etc.**

6. Brittle/ Brittleness : **Opposite to ductility where material deform less before fracturing. E.g. ceramics, glass, cast iron, etc.**

B3 (a).The image of a Charpy test is shown below. Write the names of parts in the blocks and also indicate the start and end positions. . **(3 marks)**



B3 (b). Writein brief about the following hardness tests. **(3 marks)**

1. Brinell test: **A hard steel ball is pressed into the material under a set load and the indentation is measured.**

2. Rockwell test: A diamond or tungsten carbide ball is pressed into the material under a set load and the indentation is measured.

B4 (a). Define pure metals and alloys. (3 marks)

1. Pure metals : Pure Metals are metals in clean form or unmixed form. Their properties may not be suitable for many engineering applications

2. Alloys: Alloys are mixture of two or more metals. Alloys with suitable alloying elements have better properties than pure metals, hence alloys with enhanced properties are mostly used in the industry.

B4 (b).Mention the carbon content for the following steels. (3 marks)

1. Low carbon steel: steels have carbon content less than 0.3%. They are also known as mild steel. These materials are relatively soft.

2. Medium carbon steel: have carbon content between 0.3% and 0.8%.

3. High carbon steels: have carbon content greater than 0.8%.

B5 (a). List out any three types of Cast iron. **(3 marks)**

Classification of cast irons:

- **Gray iron**
- **Ductile iron**
- **White iron**
- **Malleable iron**

B5(b). Write in brief about stainless steel and its applications. **(3 marks)**

Stainless steel is an alloy of iron, chromium, and other elements that resist corrosion from many environments. Chromium remains as a predominant element for corrosion resistance. It is also known as corrosion-resistant steel.

Applications: Vernier caliper, Steel rule, etc.

B6(a). Write any three properites of ceramics. **(3 marks)**

Properties of ceramics (any three)

- Very hard compared to other engineering materials
- Brittle materials
- Heat resistant materials / Refractory Materials
- Very high melting points
- Corrosion resistant
- Insulators of heat and electricity

B6 (b). Define the following engineering ceramics. **(3 marks)**

Oxides: Alumina has high thermal and electrical resistance used as a cutting tool and high quality thermal and electrical insulation.

Carbides: Tungsten and titanium carbides are very hard materials used for cutting tools

Nitrides: Silicon nitrides and boron nitrides used in engine parts and cutting tools

B7(a). List out any three properties of carbon fibers. (3 marks)

Properties of Carbon fiber

- High strength
- Low weight
- Fire resistance
- Corrosion resistance

B7 (b). Write down any three properties of concrete. (3 marks)

Properties of Concrete

- Hard material
- compressive strength,
- much lower thermal conductivity than metals

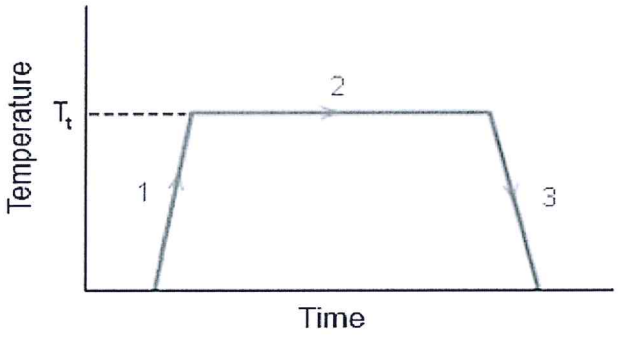
B8 (a). List the three steps of heat treatment process, and also draw the graph on Time – Temperature axis. **(3 marks)**

1) Heating to T

2) Holding at T

3) Cooling to room temperature

NB: heating/cooling speed are important parameters.



B8(b). Mention any three advantages of annealing process. **(3 marks)**

Advantages of annealing process:

- Material becomes soft and uniform grain structure.
- Material becomes easy for cutting.
- Material Internal stresses become less.
- Material Ductility improves

B9. Define hardening process. Also list out the advantages and disadvantages of hardening process. **(6 marks)**

Hardening

Hardening is a hardness inducing kind of heat treatment process.

Advantages:

- **Hardness improves**
- **Strength improves**

Disadvantages of hardening:

- **More inside stresses.**
- **More brittleness.**
- **Cracks form.**

B10. Write the procedure for the preparation of specimen to observe the microstructure under microscope. **(6 marks)**

To observe the microstructure under microscope, material specimens are prepared in a systematic manner as given below:

- Material is cut using power hacksaw or cutting machine.
- Rough grinding is done on the surface using bench grinder.
- Intermediate grinding is done on the belt grinder.
- Fine grinding is done on the emery papers.
- Polishing is done on the disc polishing machine with velvet cloth and diamond paste.
- Chemical etchants are applied on the material to see the microstructure.

END OF EXAMINATION PAPER