Q5 (d) Pb ⟷ Sn

UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 2 Examination in Engineering: July 2022

Module Number: ME2302

Module Name: Introduction to Materials Science and Manufacturing Engineering

[Three Hours]

[Answer **all questions,** each question carries 10 marks]

Q1. a) Describe the following.

i) Lathe dog

ii) Steady rest

iii) Follower rest

[3.0 Marks]

b) Name the parts A to G in (i) **Figure Q1-a** and (ii) **Figure Q1-b**.

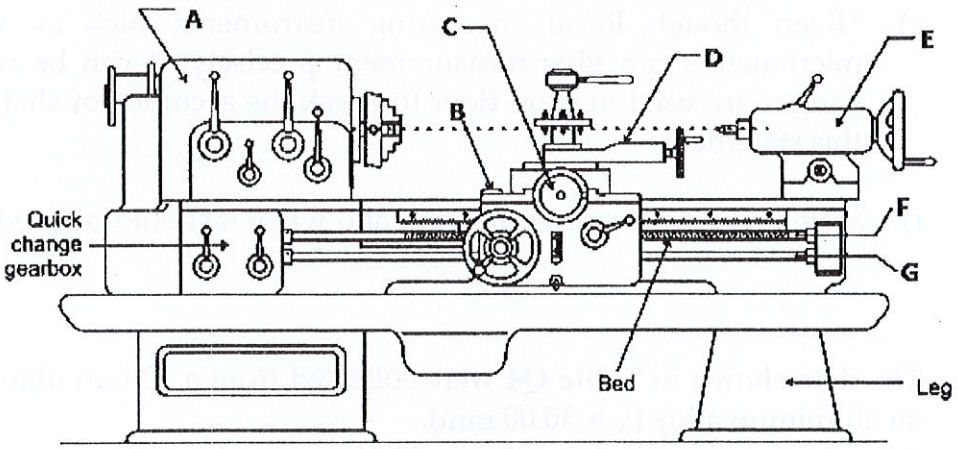

Figure Q1-a

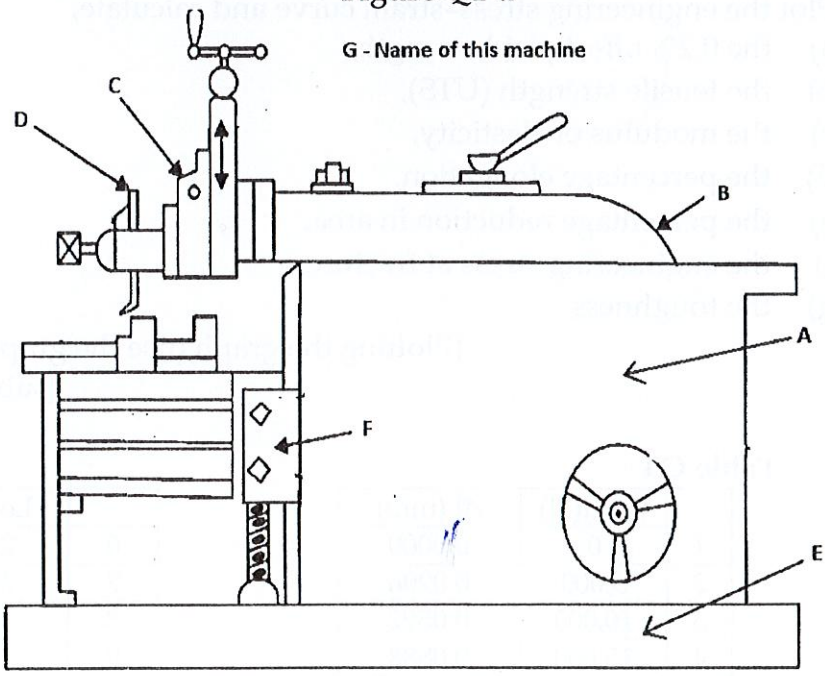

Figure Q1-b

[7.0 Marks]

Q2. a) Name and draw three milling cutters.

[3.0 Marks]

b) Discuss the difference between up-milling and down milling (state 4 points each)

[4.0 Marks]

c) Explain the gear hobbing (gear cutting) process with a neat sketch.

[3.0 Marks]

Q3. a) What is the chisel use to make a 'key-way'?

[1.0 Mark]

b) State the use of diamond point chisels.

[1.0 Mark]

c) Briefly explain when a bottoming tap is used.

[1.0 Mark]

d) With simple sketches explain the following machining operations.

I. Boring

II. Reaming

[2.0 Marks]

e) "Even though linear measuring instruments such as vernier calipers and micrometers can give measurement precisely, it can be seen that special ring gauges are used in shop floor to check the accuracy of shaft diameters." Explain this statement.

[2.0 Marks]

f) State three protective equipment and when it should be used in the workshop.

[3.0 Marks]

Q4. The data shown in **Table Q4** were collected from a 12 mm diameter test specimen of an aluminum alloy (l_o = 30.00 mm).
After fracture, the total length was 32.61 mm, and the diameter was 11.74 mm.
Plot the engineering stress–strain curve and calculate,

a) the 0.2% offset yield strength,
b) the tensile strength (UTS),
c) the modulus of elasticity,
d) the percentage elongation,
e) the percentage reduction in area,
f) the engineering stress at fracture,
g) the toughness.

[Plotting the graph (use the graph sheet provided): 3 Marks]
[sub parts I to VII: each 1 Mark]

Table Q4

	Load(N)	Δl (mm)
1	0	0.0000
2	5,000	0.0296
3	10,000	0.0592
4	15,000	0.0888
5	20,000	0.1500

	Load (N)	Δl (mm)
6	25,000	0.5100
7	26,500	0.9000
8	27,000	1.5000 (Max)
9	26,500	2.1000
10	25,000	2.7900

Q5. Use the Lead (Pb) and Tin (Sn) phase diagram as shown in **Figure Q5** to answer the following questions.

a) Estimate the melting points of pure Lead (Pb) and pure Tin (Sn).

[1.0 Mark]

b) Using the data available in the figure, write down the equation for "Eutectic Reaction" and define all terms used in your answer.

[1.0 Mark]

c) Find the Eutectic Temperature and composition of Pb and Sn alloy system

[1.0 Mark]

d) Consider an alloy consist of 30% of Pb - 70% of Sn at 200°C (point A) and estimate the followings:

i) Weight fraction (or Percentage) of each phase exist

ii) Composition of each phase present [4.0 Marks]

e) Sketch the microstructure of the alloy containing 90% of Pb - 10% of Sn under equilibrium cooling at 200°C and 100°C. Name all the phases. [3.0 Marks]

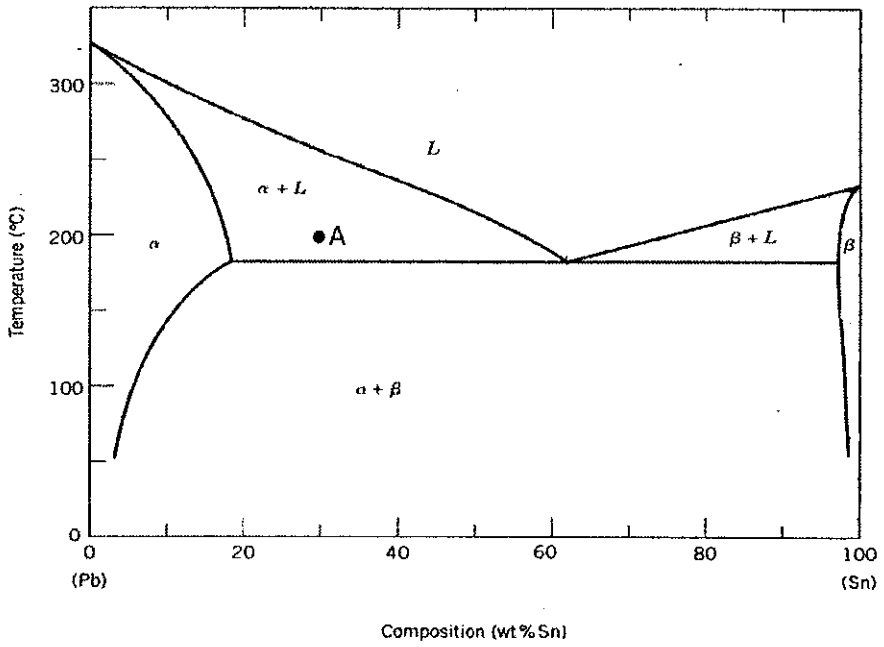

Figure Q5 Note: X axis: 1cm =10 wt% Y axis: 1cm = 50 °C

Q6. a) A composite material is a material which is produced from two or more constituent materials.

i) Categorize the composite materials according to the reinforcement geometry and give example for each.

[3.0 Marks]

ii) Briefly discuss the applications of composite materials.

[2.0 Marks]

iii) Composite material consists of two main components named as *fibers* and *matrix*. Briefly explain the functions of each

[2.0 Marks]

b) Write short notes on followings:

i) Grey cast iron

ii) White cast iron [3.0 Marks]