

Problem Set 3

for the ENS161 B5-1 and B6 classes offered in A.Y. 2025-2026 S1

Instructions. Write your full solutions and answers in white A4 sheets of paper, in portrait orientation. You may write à la pen-and-paper or using a document processing program. Staple your submission, with a duly accomplished summary of answers as the front page.

Problem No.	Parameters	Values	
		B5-1	B6
1	$w_1, w_2, w_3,$ L_1, L_2	50 lb/ft, 100 lb/ft, 300 lb/ft, 365.76 cm, 274.32 cm	25 N/cm, 50 N/cm, 150 N/cm, 144 in, 108 in
2	$\omega_1, \omega_2,$ L_1, L_2	5 kip/ft, 3 kip/ft 3 ft, 4 ft	5 kN/m, 4 kN/m, 11 m, 12 m
3	$F_1, F_2, \theta,$ d_w, d_1, d_2, d_3, d_4	30 lb, 40 lb, 55°, 8 in, 7 in, 7 in, 21 in, 17 in	40 N, 30 N, 65°, 12 cm, 8 cm, 8 cm, 17 cm, 21 cm

Unless otherwise specified, angles and vector directions are in degrees. Express downward forces, leftward forces, and clockwise moments as negative quantities. Report final answers in five (5) decimal places and enclosed in boxes. For non-integer values, this means rounding up to the said number of decimal places. For integer values, include five (5) zeros after the decimal point. Be sure to include appropriate units in your answers. Maintain cleanliness and comeliness in your submission (especially when erasure is unavoidable).

You obviously are not prohibited from dishonestly accomplishing this problem set, but you are expected to study the topics covered herein.

Summary of Answers to Problem Set 3
for the ENS161 B5-1 and B6 classes offered in A.Y. 2025-2026 S1

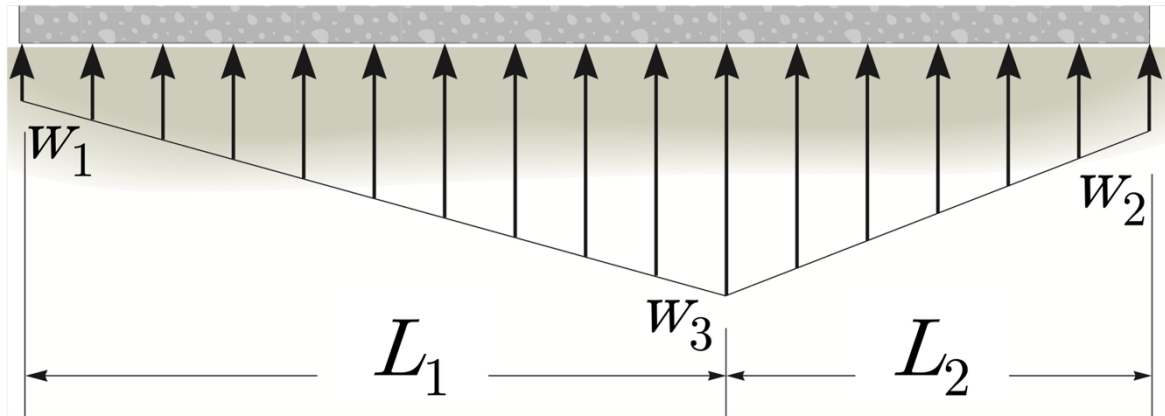
Name: _____

ID no.: _____

Section: _____

Problem 1	a.	b.
	c.	d.
	e.	f.
	g.	h.
	i.	
Problem 2	a.	b.
	c.	d.
	e.	f.
	g.	h.
	i.	j.
Problem 3	k.	
	a.	b.
	c.	d.
	e.	f.
	g.	h.
	i.	j.
	k.	l.
	m.	n.
	o.	p.
	q.	r.
	s.	t.
u.	v.	
w.	x.	

Score: _____



Problem 1. A concrete beam is anticipated to experience a force distributed along its span as shown.

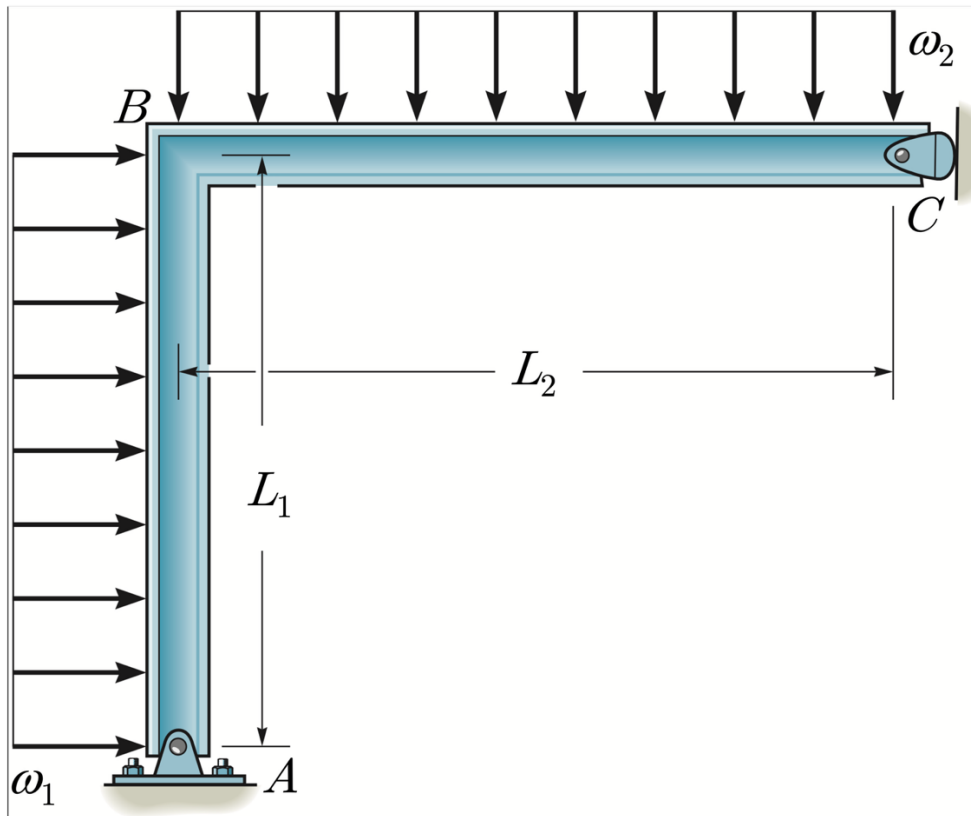
Replace the distributed force by an equivalent force-couple system at the left end of the beam. Determine (a) the force and (b) the couple moment.

Replace the distributed force by an equivalent force-couple system at the right end of the beam. Determine (c) the force and (d) the couple moment.

Replace the distributed force by an equivalent force-couple system at the midspan. Determine (e) the force and (f) the couple moment.

Replace the distributed force by an equivalent resultant force. Determine (g) the location (from the left end of the beam) of said resultant.

The effect of the upward force is to be counteracted by placing a steel ball on the top side of the beam. Determine (h) the weight of the steel ball and (i) its location measured from the right end of the beam.



Problem 2. A frame, supported by a pin at A and a rocker at C , is loaded by two distributed loads as shown.

Replace the loading by an equivalent force-couple system at A . Determine (a) the force and (b) the couple moment.

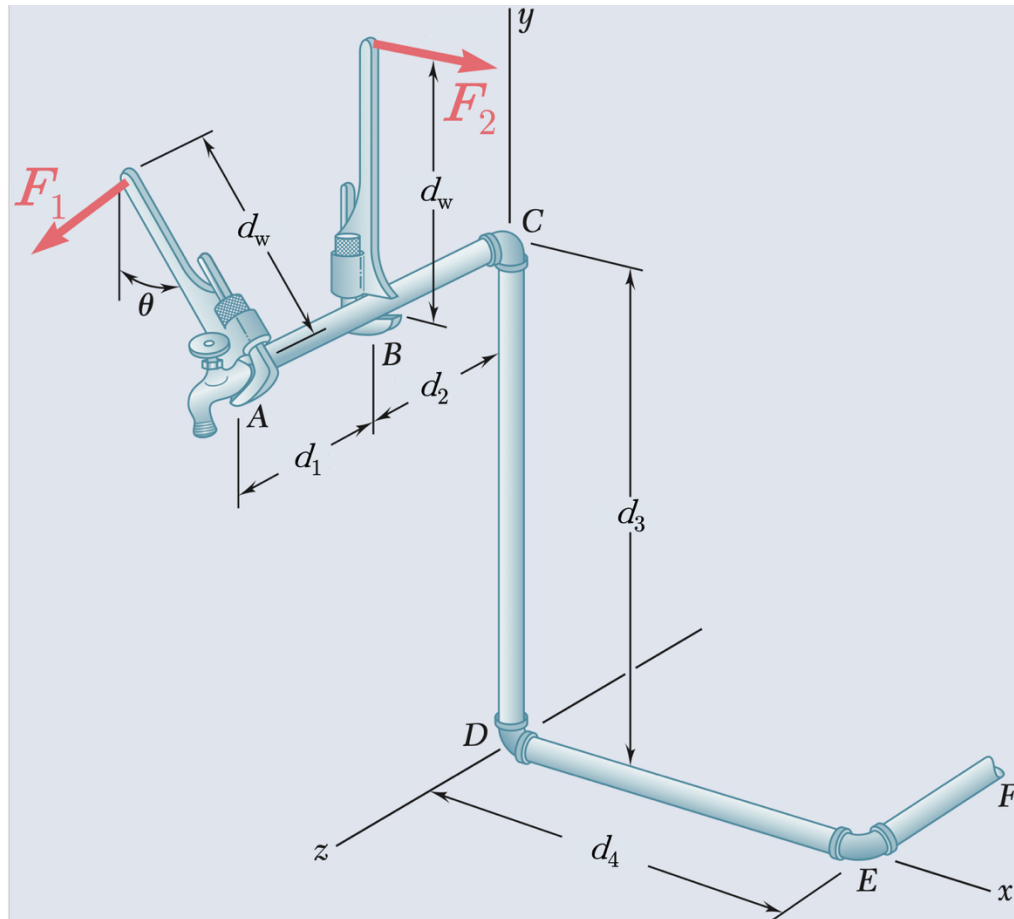
Replace the loading by an equivalent force-couple system at B . Determine (c) the force and (d) the couple moment.

Replace the loading by an equivalent force-couple system at C . Determine (e) the force and (f) the couple moment.

Replace the loading by an equivalent resultant. Determine (g) how far from C does the resultant intersect the horizontal member of the frame.

Replace the loading by an equivalent resultant. Determine (h) how far from A does the resultant intersect the vertical member of the frame.

To build the free-body diagram of the frame, the rocker at C is represented as a horizontal force \mathbf{C} acting at C , while the pin at A is represented as a horizontal force \mathbf{H} and a vertical force \mathbf{V} both acting at A . Determine (i) \mathbf{C} , (j) \mathbf{H} , and (k) \mathbf{V} .



Problem 3. A plumber uses two pipe wrenches in such a way that on each wrench is exerted a force perpendicular to the wrench and to the pipe.

Consider the moment of the left force about E . What are its (a) x -, (b) y -, and (c) z -components?

Consider the moment of the right force about E . What are its (d) x -, (e) y -, and (f) z -components?

Consider the total moment of the forces about E . What are its (g) x -, (h) y -, and (i) z -components?

Consider the moment of the left force about the line joining B and E . What are its (j) x -, (k) y -, and (l) z -components?

Consider the moment of the right force about the line from E to A . What are its (m) x -, (n) y -, and (o) z -components?

Consider the moment of the right force about the line connecting C to E . What are its (p) x -, (q) y -, and (r) z -components?

Replace the wrench forces by an equivalent force-couple system at the midpoint between A and E . Determine the (s) x -, (t) y -, and (u) z -components of the resultant force, and the (v) x -, (w) y -, and (x) z -components of the couple moment.