BODY FLUID VOLUME AND ELECTROLYTE DERANGEMENTS IN FASTING

Semi Annual Report #2, November, 1965.

FACILITY FORM 602
N66 81136 (ACCESSION NUMBER)
(THRU)
47 (PAGES)
None (CODE)
CR 69423 (NASA CR OR TMX OR AD NUMBER)
(CATEGORY)

1. Period covered by report.

April 1 - September 31, 1965.

2. Personnel engaged in the research.

Terence A. Rogers, Ph.D. Principal Investigator
Bryant T. Sather, Ph.D.
Myrtle L. Brown, Ph.D.

3. Summary of research completed.

As described in the previous semi-annual report, the project comprises a systematic investigation of the fluid and electrolyte changes in early fasting in the rat, particularly as affected by ambient temperature (before and during fasting), and by the level of sodium intake prior to fasting. Also, as previously mentioned, some interesting changes in magnesium balance have been observed.

Method.

In each experiment, 12 male rats weighing approximately 300 g are kept in metabolism cages for 9 days. During the first 3 days, they are fed on a synthetic sodium-deficient diet to which sodium has, or has not been added. During this first 3 days, they are kept at 3°C or at 26°C.

During the next 3 days, the experimental group are fasted and the control group are maintained on their original diet. The groups are kept at 3° or 26°.

During the final 3 days, the experimental group are fed again on the same, or different diet from that during the first (pre-exposure) 3 days. Again, during this time they are kept at 3° or 26°.

The permutations of this experimental design are set out in Table 1. The last column of this table indicates which experiments have been completed.

Throughout the 9 days of the experiment, water and feed intake and urine volumes are measured. The total urinary Na and Mg are determined by flame spectrophotometry.

Results.

The results of the 8 completed experiments are summarized semi-quantitatively in Table II, and in Figs. 1-42.

TABLE I. Outline of Treatments

Expt. No.	Diet* & Temp. Pre-exposure		Exposure		Post-exposure		Completed
1	Purina	26°	Fast	26°	Purina	26°	Yes
2	Purina	26°	Fast	3°	Purina	3°	Yes
3	NBC-2	26°	Fast	26°	NBC-2	26°	Yes
4	NBC-2	26°	Fast	3°	NBC-2	26°	Yes
4A	NBC-3	26°	Fast	3°	NBC-3	26°	Yes
5	NBC-1	26°	Fast	26°	NBC-1	26°	No
6	NBC-1	26°	Fast	3°	NBC-1	26°	Yes
7	NBC-3	3°	Fast	3°	NBC-3	26°	No
8	NBC-3	3°	Fast	3°	NBC-1	26°	No
9	NBC-1	3°	Fast	3°	NBC-3	26°	No
10	NBC-1	3°	Fast	3°	NBC-1	26°	No
11	NBC-3	3°	Fast	3°	NBC-3	3°	No
12	NBC-3	3°	Fast	3°	NBC-1	3°	No
13	NBC-1	3°	Fast	3°	NBC-3	3°	No
14	NBC-1	3°	Fast	3°	NBC-1	3°	No
15	NBC-1	26°	Fast	3°	NBC-1	3°	Yes
16	½ NBC-2 ½ Purina	26°	Fast	3°	½ NBC-2 ½ Purina	26°	Yes

*NBC-1 = Nutritional Biochem. Na-deficient
NBC-2 = Nutritional Biochem. 20.26 mEqNa added/100 g diet
NBC-3 = Nutritional Biochem. 40.46 mEqNa added/100 g diet
Purina Chow = 20.26 mEqNa/100 g diet

TABLE II Results

Expt.	Treat.	Group	WT	Na-bal.	H_2O Bal.	Mg bal.
	Pre	E	+	+	++	
		C	+	+	++	
1	Exp	E	--	+	+	
		C	+	-	++	
	Post	E	+	++	+++	
		C	+	+	++	
	Pre	E	+	+	+	+
		C	+	+	+	+
2	Exp	E	--	-	-	0
		C	-	+	+	+
	Post	E	-	+++	++	+++
		C	-	+	+	+
	Pre	E	-	+	++	+
		C	0	+	++	+
3	Exp	E	-	-	++	0
		C	-	+	+	+
	Post	E	-	+	++	+
		C	±	+	+	+
	Pre	E	0	0	0	+
		C	0	0	0	+
4	Exp	E	--	0	0	-
		C	-	0	0	+
	Post	E	-	0	0	+
		C	-	0	0	+
	Pre	E	+	+	++	+
		C	+	+	++	+
4A	Exp	E	----	-	--	0
		C	0	++	-	++
	Post	E	++	+	++	+
		C	+	+	++	+
	Pre	E	0	0	+	+
		C	0	0	+	+
6	Exp	E	--	0	-	0
		C	-	0	-	+
	Post	E	-	0	+	+
		C	-	0	+	+

TABLE II Results (continued)

Expt.	Treat.	Group	WT	Na-bal.	H_2O Bal.	Mg bal.
	Pre	E	+	-	+	+
		C	+	-	+	+
15	Exp	E	--	0	-	0
		C	-	0	+	+
	Post	E	--	0	+	+
		C	-	0	+	+
	Pre	NBC-2		0	+	
		Purina		+	+	
16	Exp	NBC-2		-	-	
		Purina		-	-	
	Post	NBC-2	Dead	Dead	Dead	Dead
		Purina		+	+	

+ = gain

0 = zero

- = loss

FIG. 1. WEIGHT CHANGES OF FASTED AND CONTROL RATS FED PURINA DIET KEPT AT 26° C. - EXPT 1

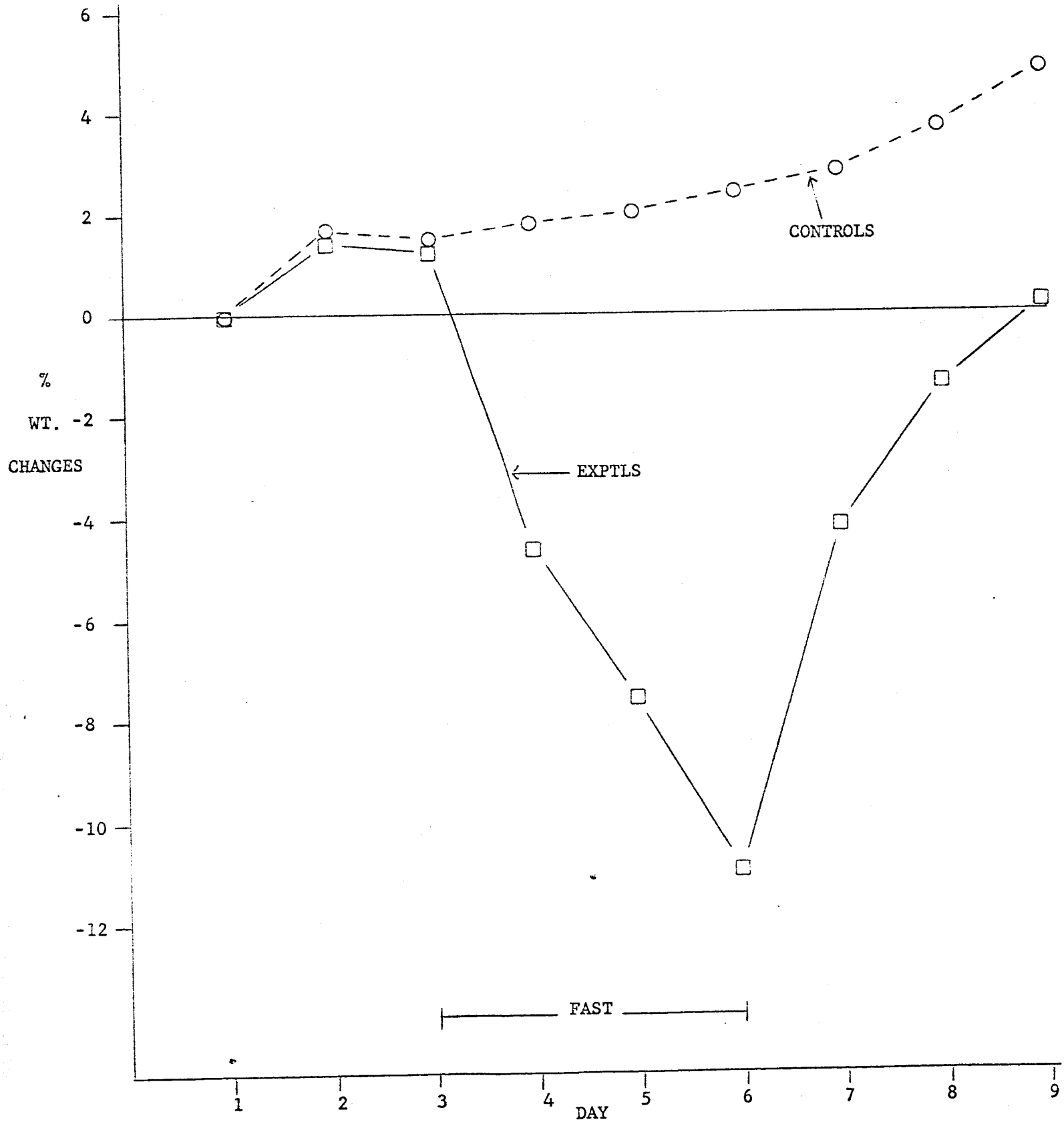


FIG. 2. WATER BALANCE OF FASTED AND CONTROL RATS KEPT AT 26° C AND FED PURINA DIET - EXPT 1

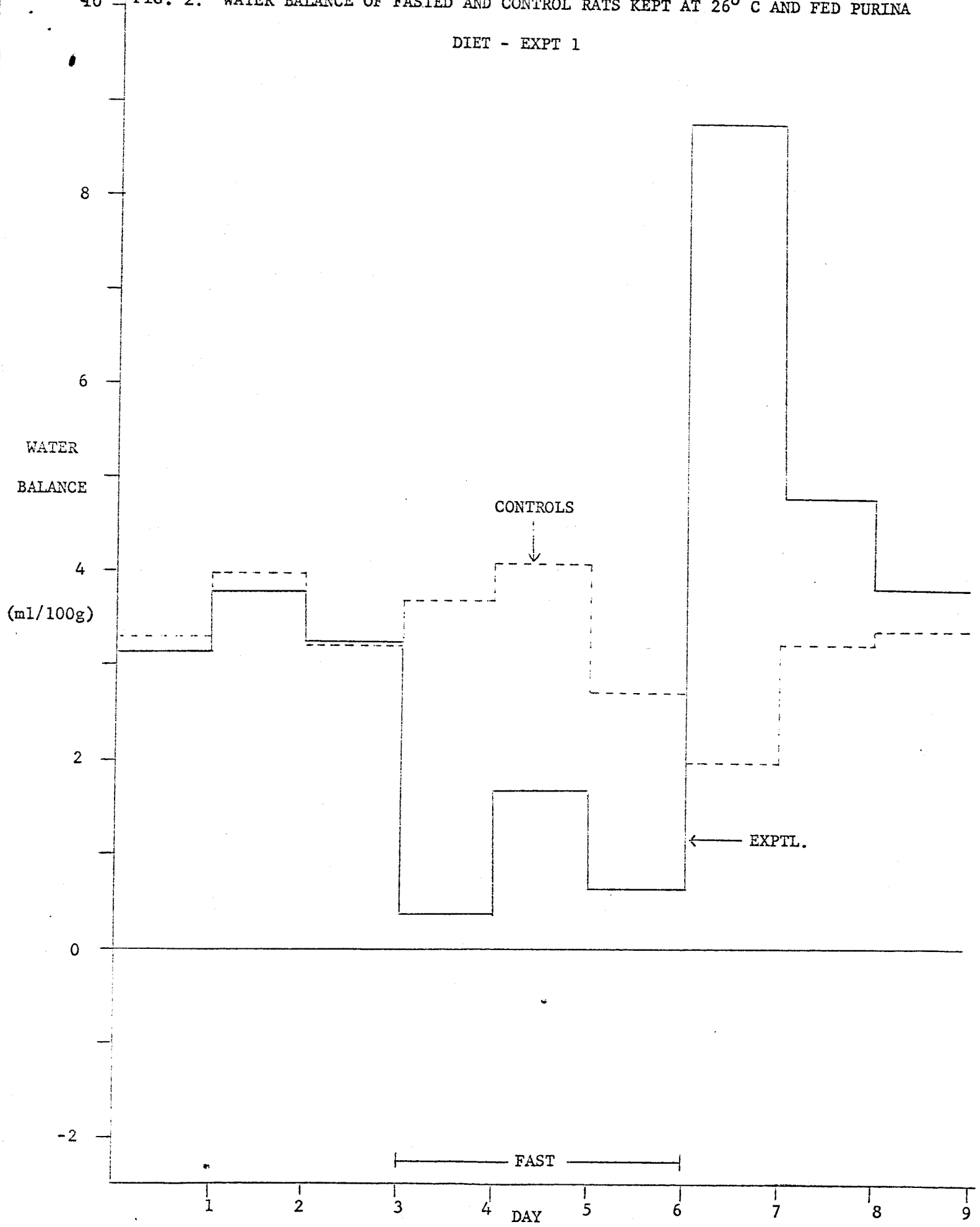


FIG. 3. Na EXCRETION OF FASTED AND CONTROL RATS KEPT AT 26° C AND FED PURINA DIET - EXPT 1

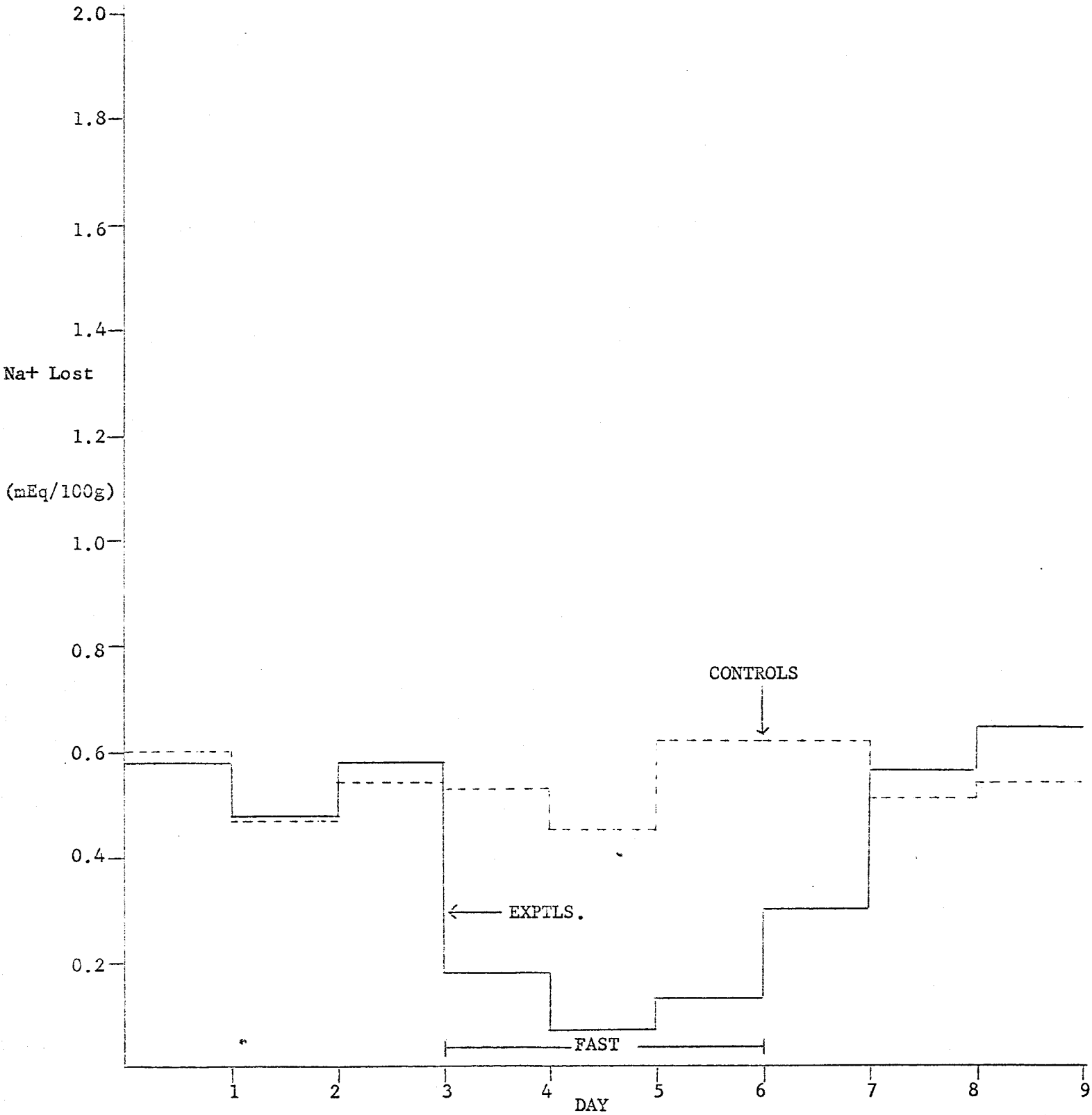


FIG. 4. Na BALANCE OF FASTED AND CONTROL RATS KEPT AT 26° C. AND FED PURINA DIET CONTAINING 20.26 mEq Na/100g FEED - EXPT 1

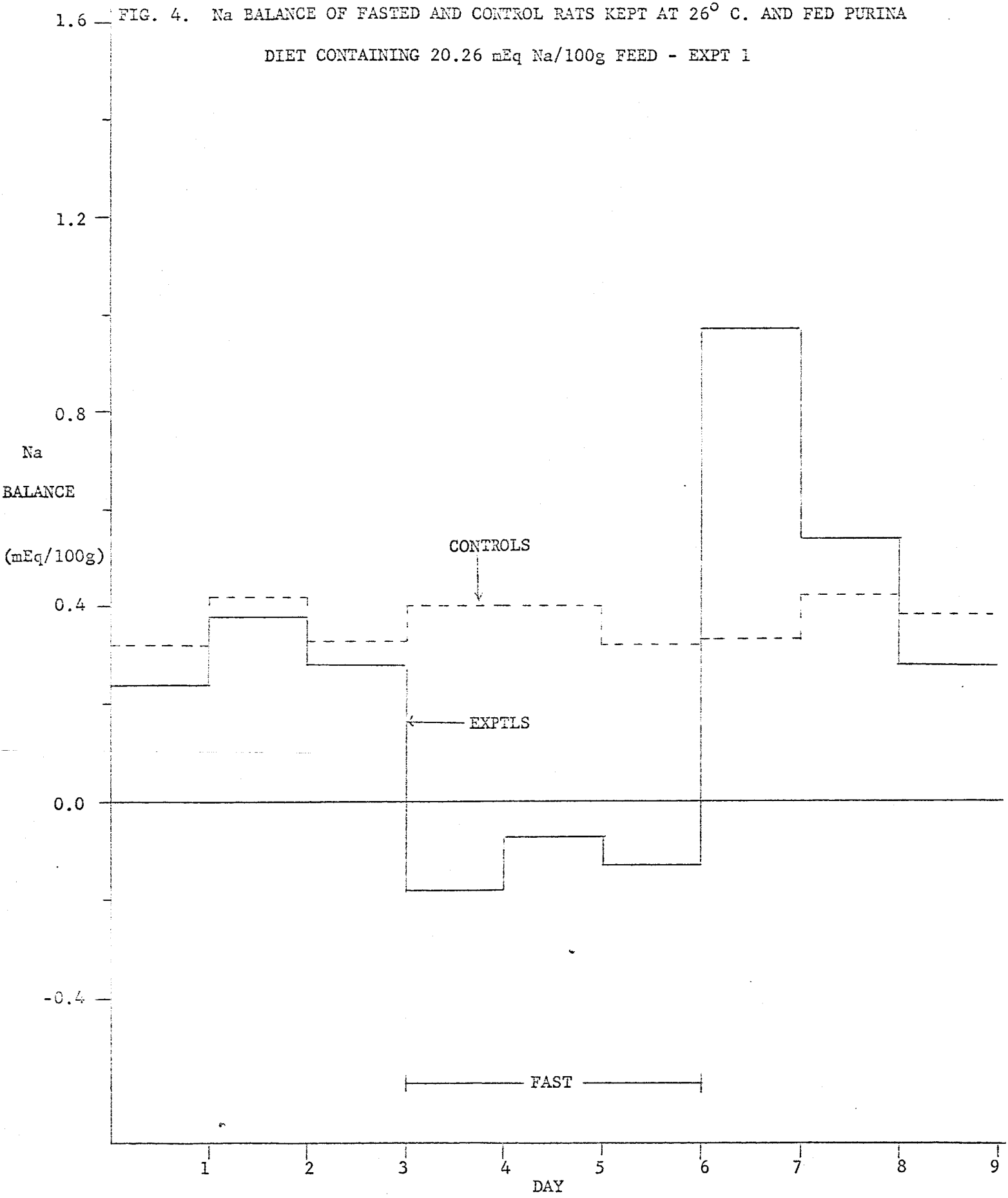


FIG. 5. WEIGHT CHANGES OF FASTED AND CONTROL RATS FED PURINA DIET.

FAST AND RECOVERY AT 3° C.

EXPT 2

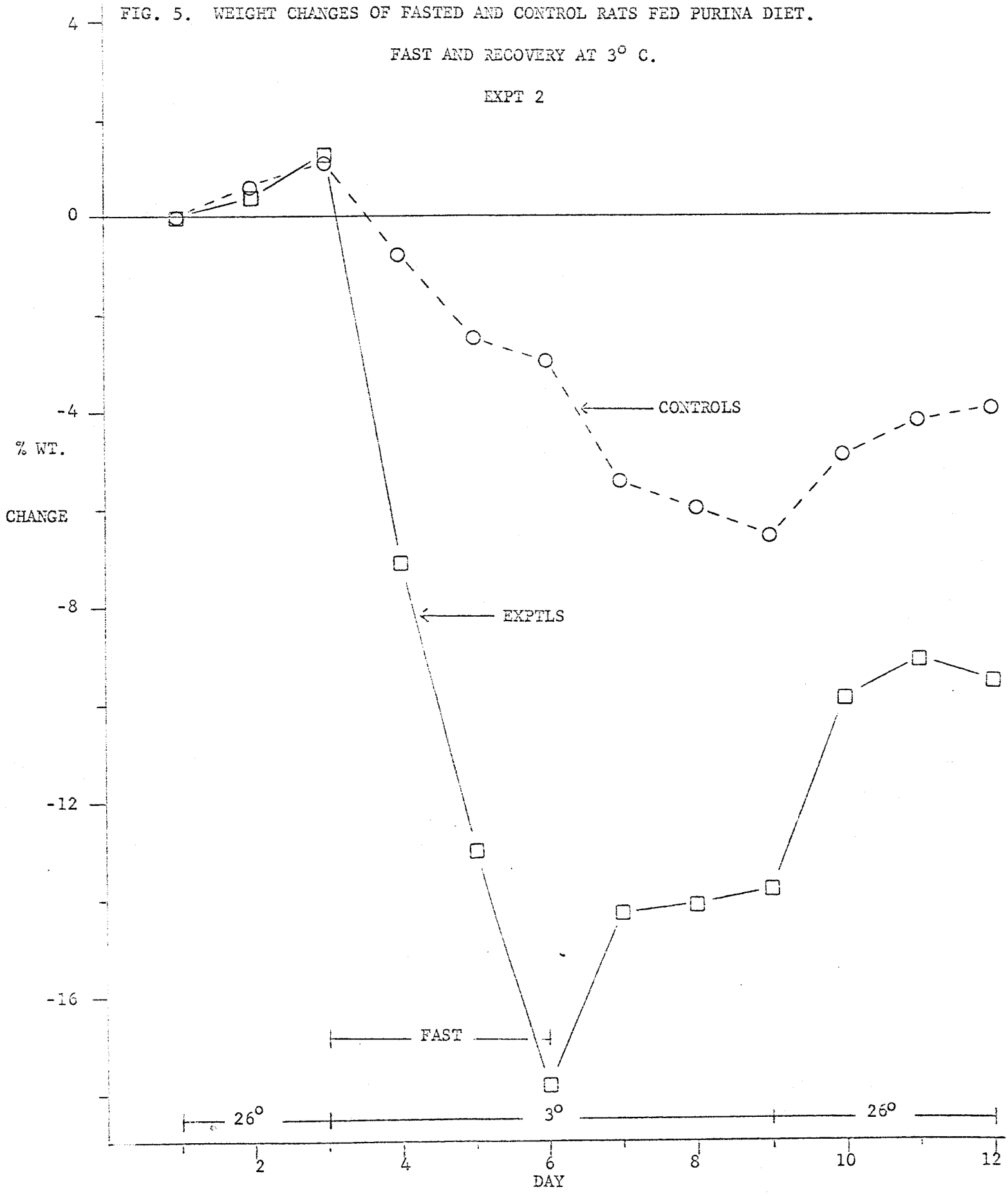


FIG. 6. WATER BALANCE OF FASTED AND CONTROL RATS FED PURINA DIET.

FAST AND RECOVERY AT 3°C.

EXPT 2

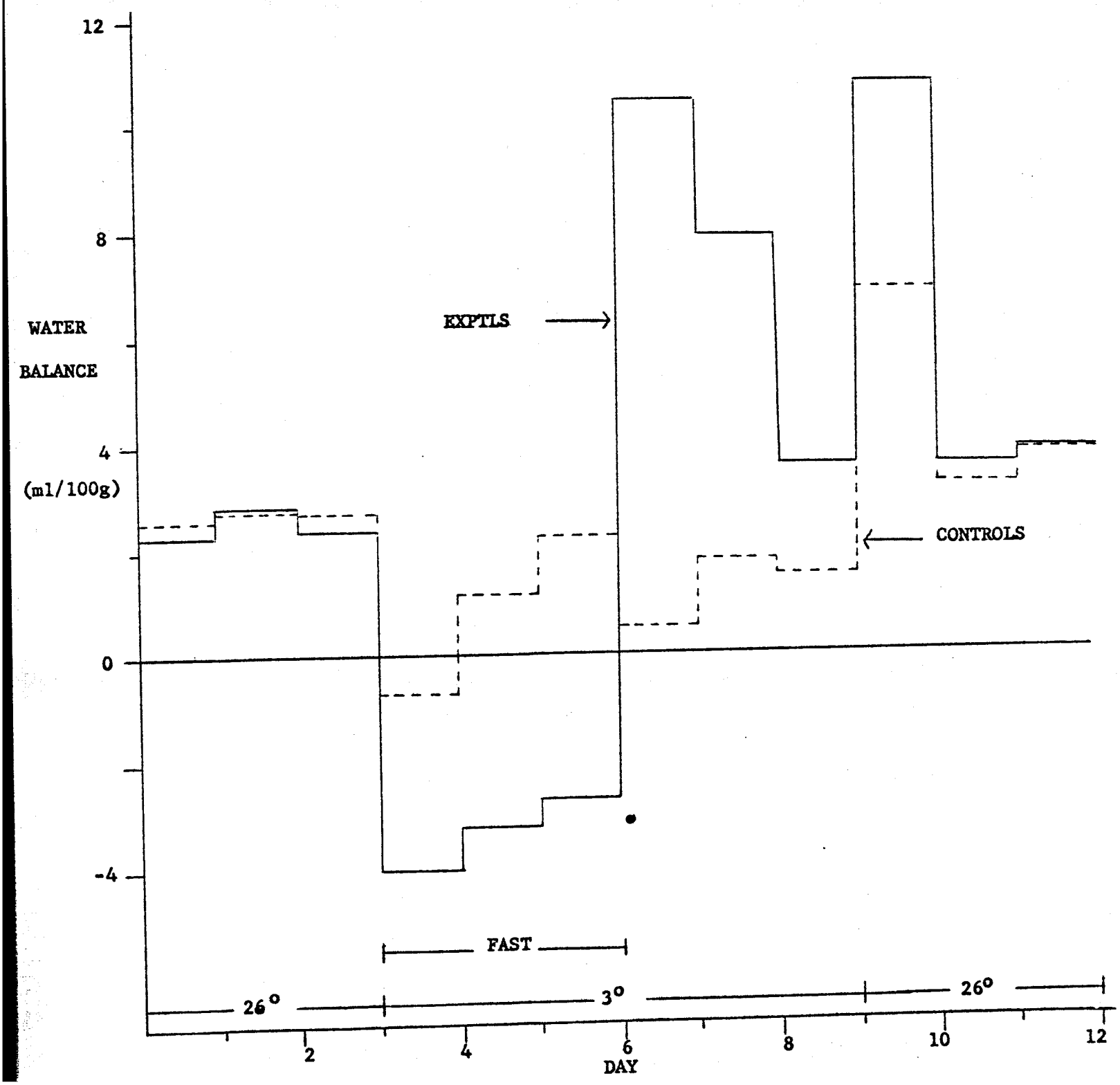


FIG. 7. Na^+ EXCRETION OF FASTED AND CONTROL RATS FED PURINA DIET

FAST AND RECOVERY AT 3° C.

EXPT 2

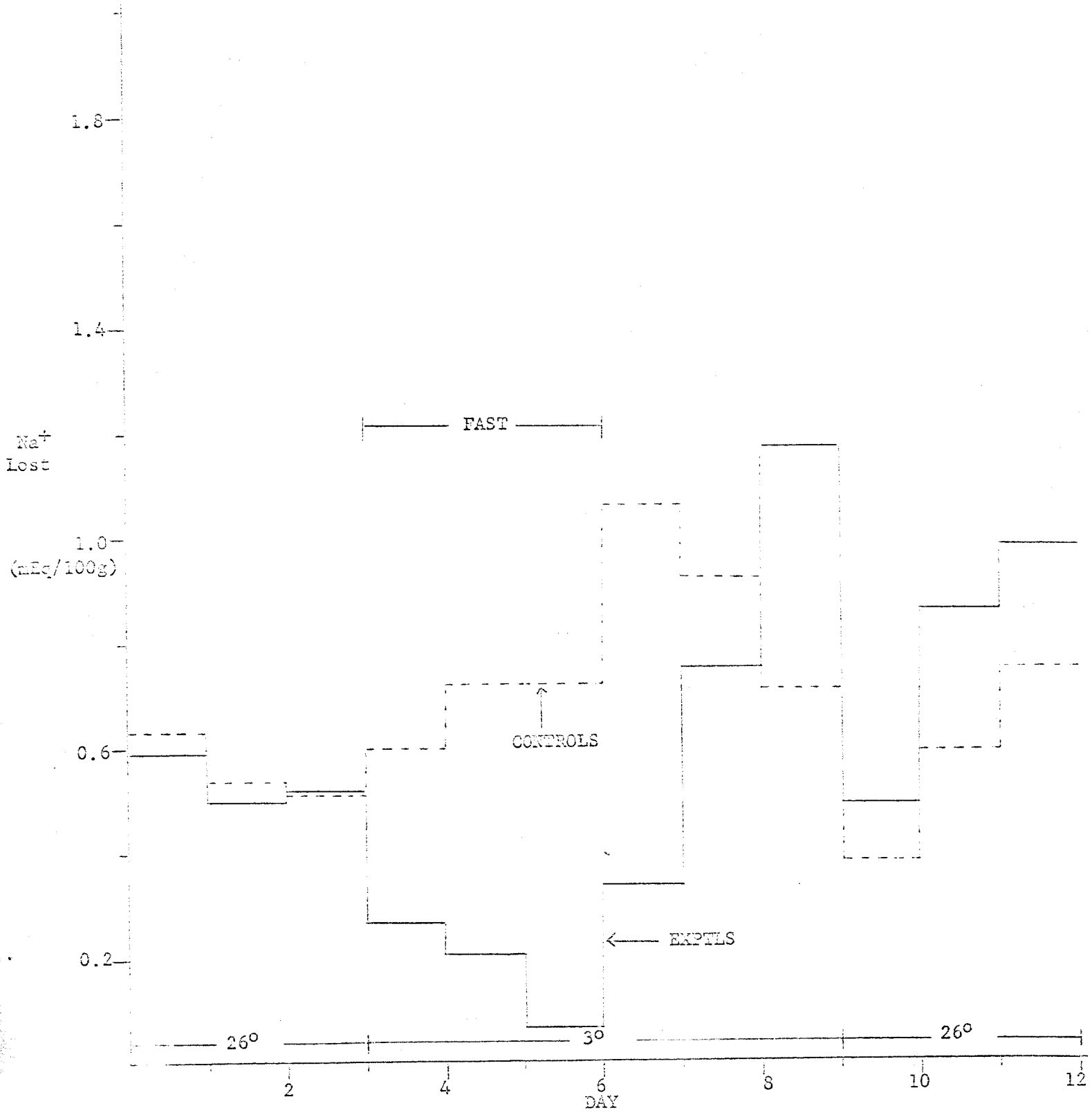


FIG. 8. Na BALANCE OF FASTED AND CONTROL RATS FED PURINA DIET

FAST AND RECOVERY AT 3° C.

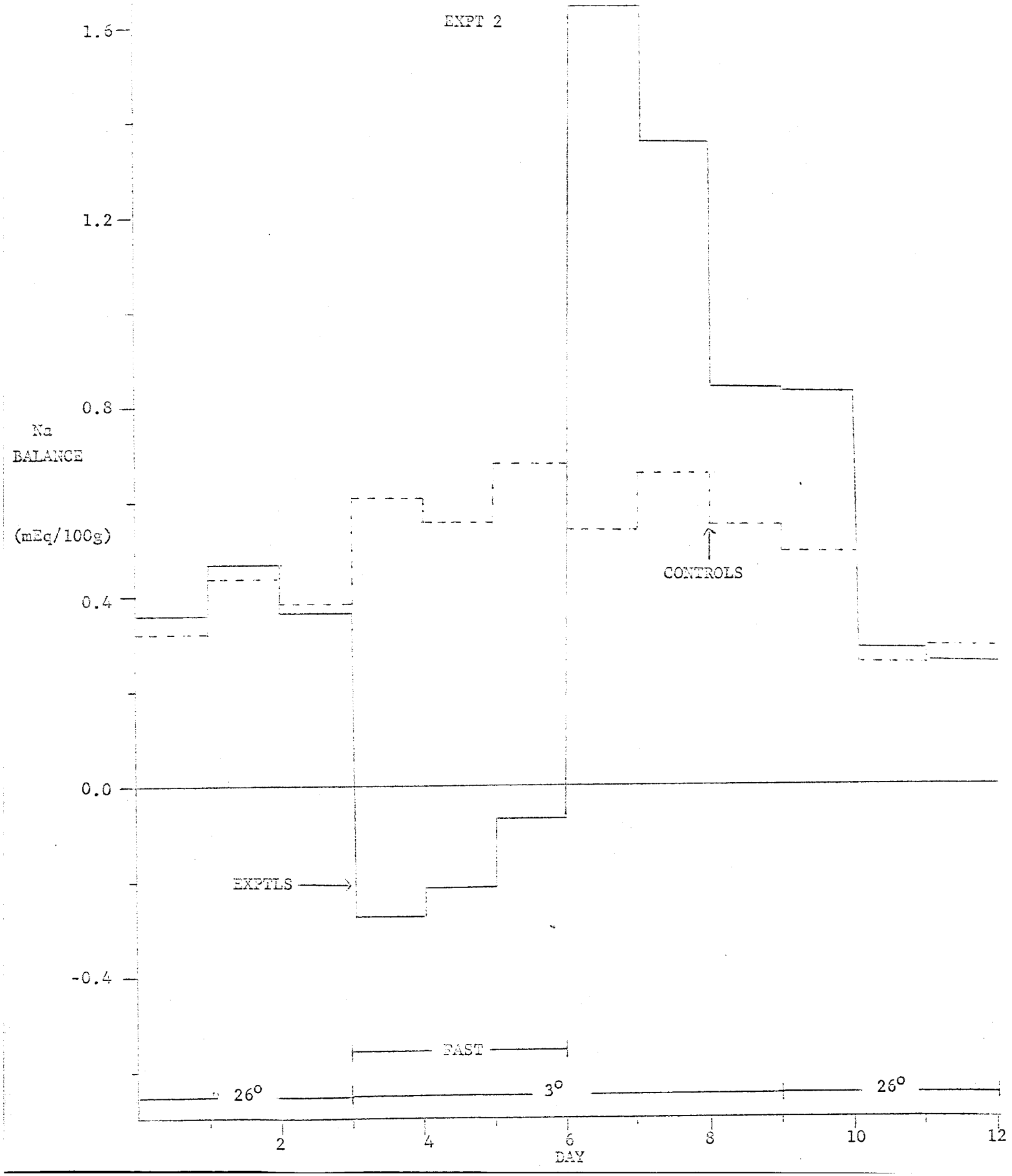


FIG. 9. Mg^{+2} EXCRETION OF FASTED AND CONTROL RATS FED PURINA DIET CONTAINING 72.8 μ Eg Mg/gm Diet.

FAST AND RECOVERY AT 3° C.

EXPT 2

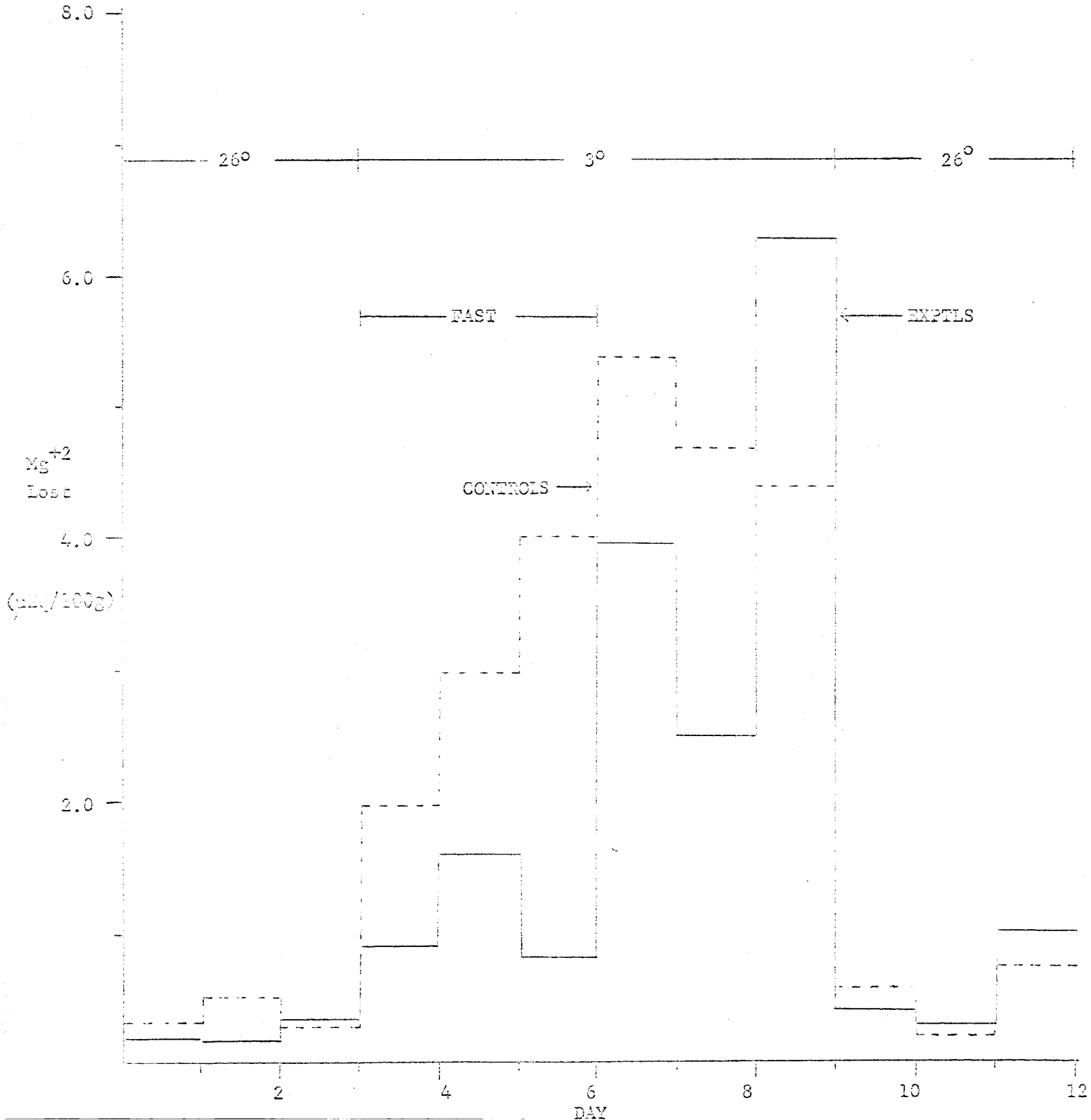


FIG. 10. Mg BALANCE OF FASTED AND CONTROL RATS FED PURINA DIET CONTAINING 73.2 μ Eq Mg/gm DIET.

FAST AND RECOVERY AT 3° C.

EXPT 2

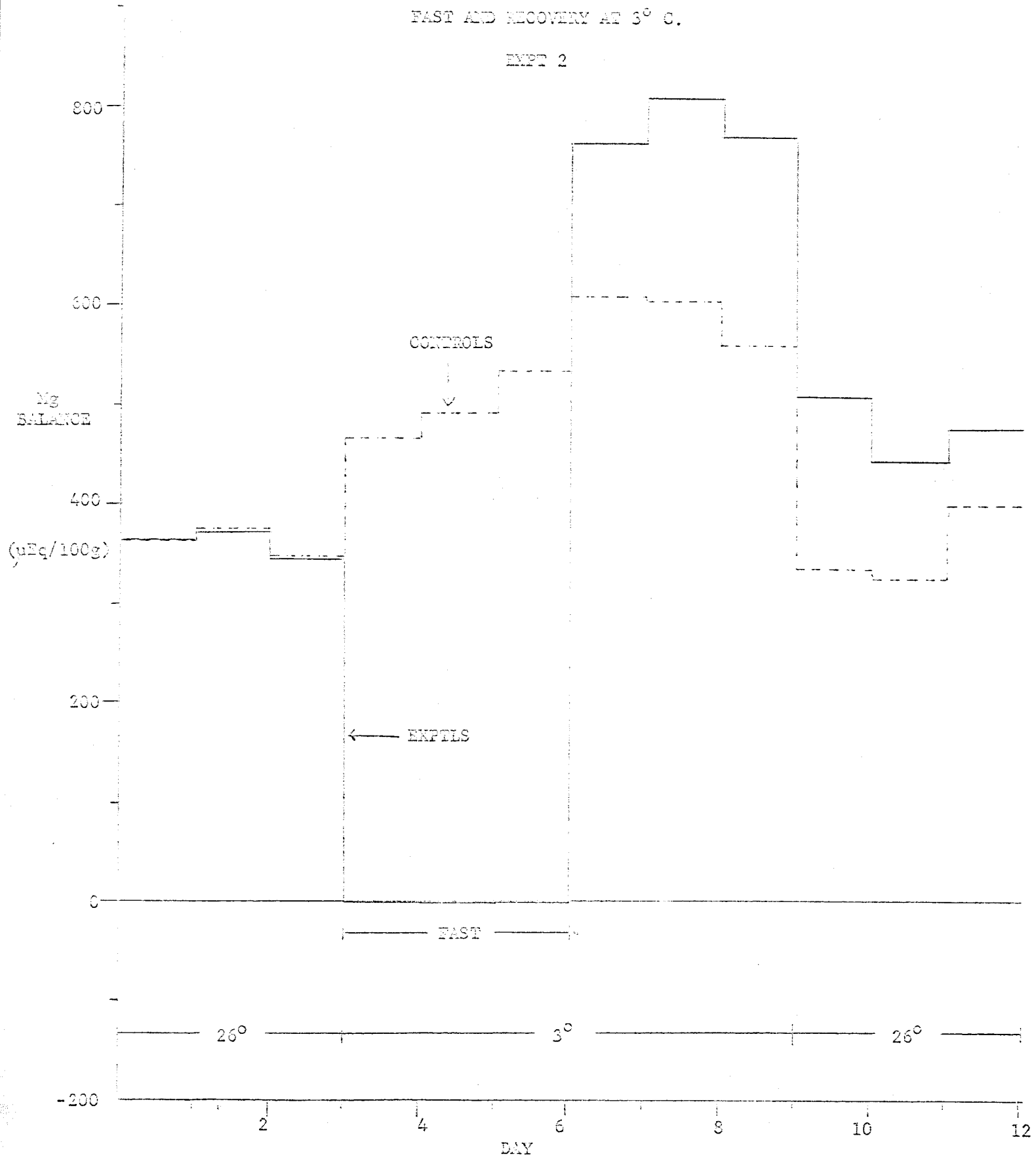


FIG. 11. WEIGHT CHANGES OF FASTED AND CONTROL RATS KEPT AT 26° C AND FED NBC DIET CONTAINING 20.26 mEq Na/100gm DIET.

EXPT 3

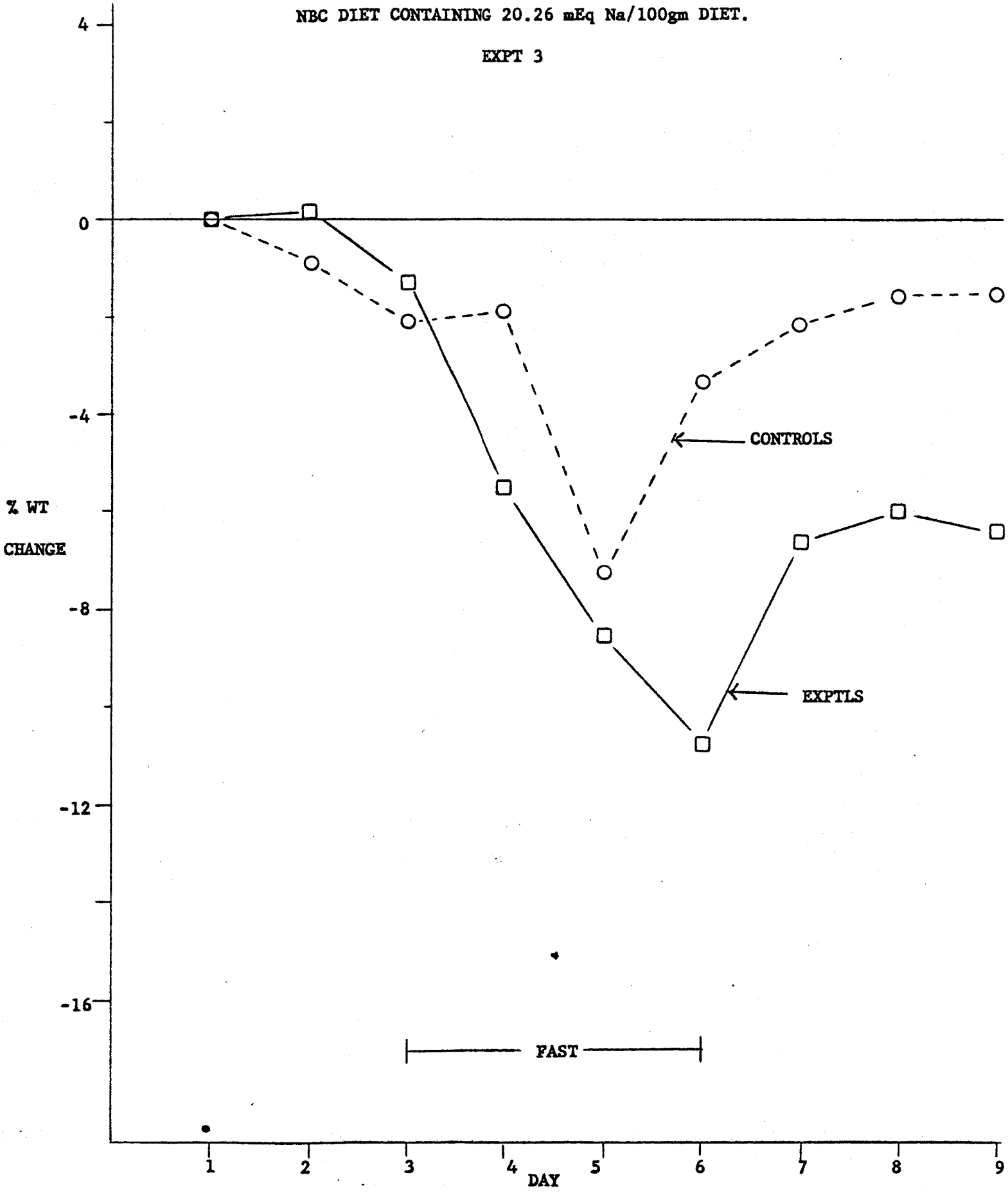


FIG. 12. URINE LOSS OF FASTED AND CONTROL RATS KEPT AT 20° C. AND FED 20.26 mEq Na/100g RDS DIET.

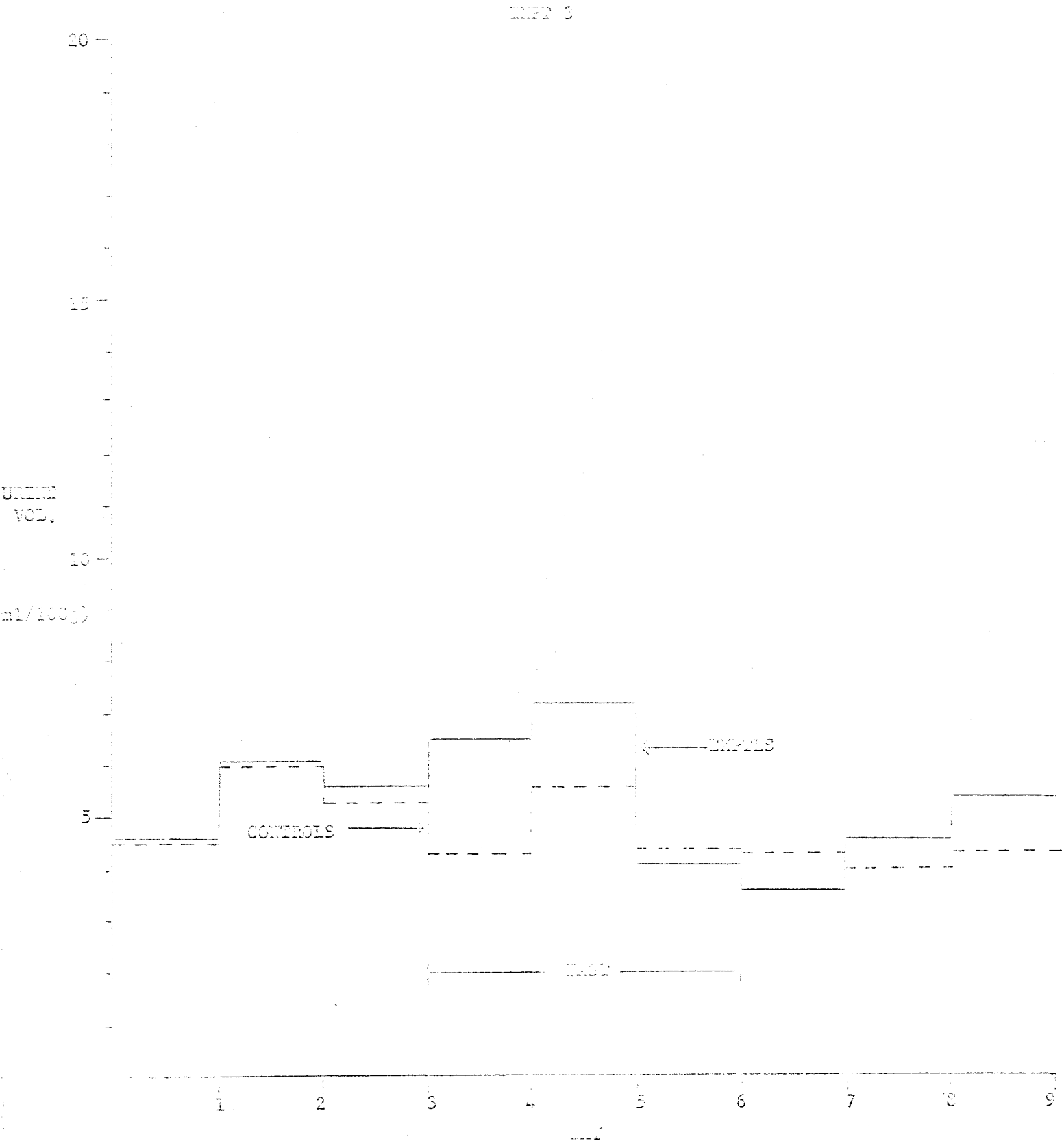


FIG. 15. WATER BALANCE ON FASTED AND CONTROL RATS KEPT AT 26° C AND FED

RICE DIET CONTAINING 20.16 mEq Na/100 gm DIET.

RAT 3

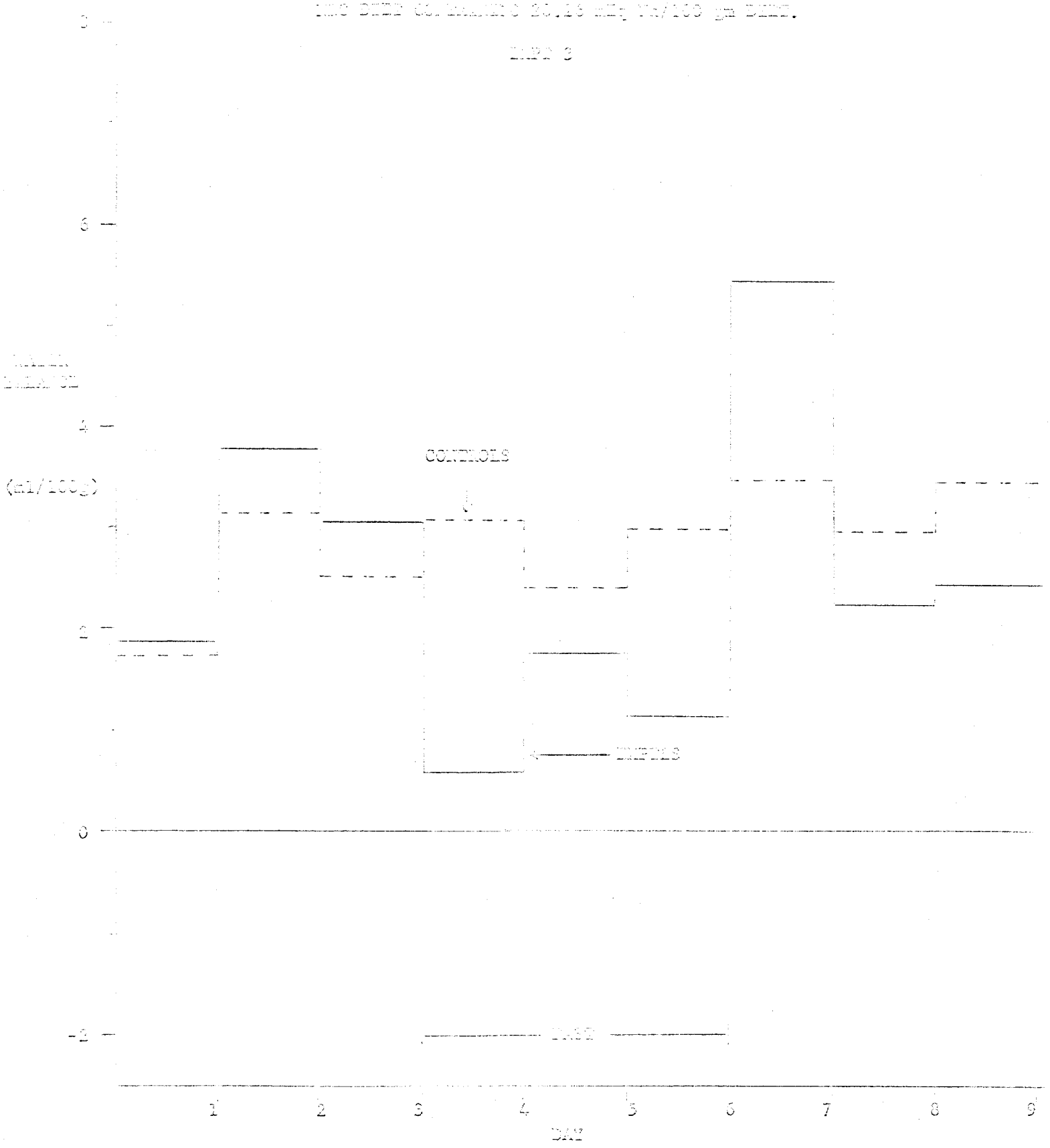


FIG. 14. Fe LOSS OF DISTILLED AND COLLECTED FUELS [illegible] AT 26° C AND [illegible] FUEL SOLUBILITIES 10.26 [illegible] Fe/100 gm DIAL.

LABEL 3

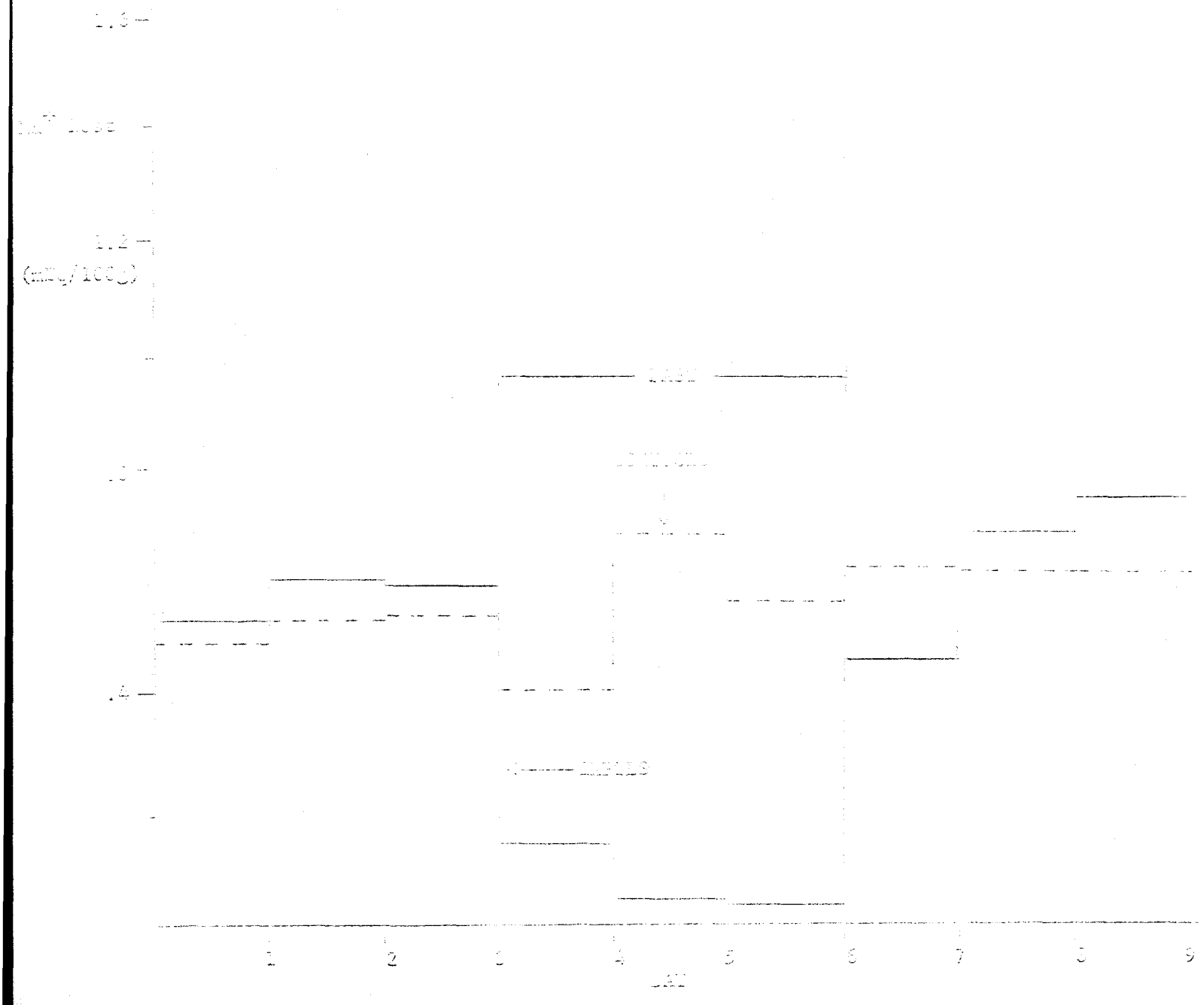


FIG. 15. Na BALANCE OF FASTED AND CONTROL RATS KEPT AT 26° C AND FED NBC DIET CONTAINING 20.26 mEq Na/100gm DIET.

EXPT 3

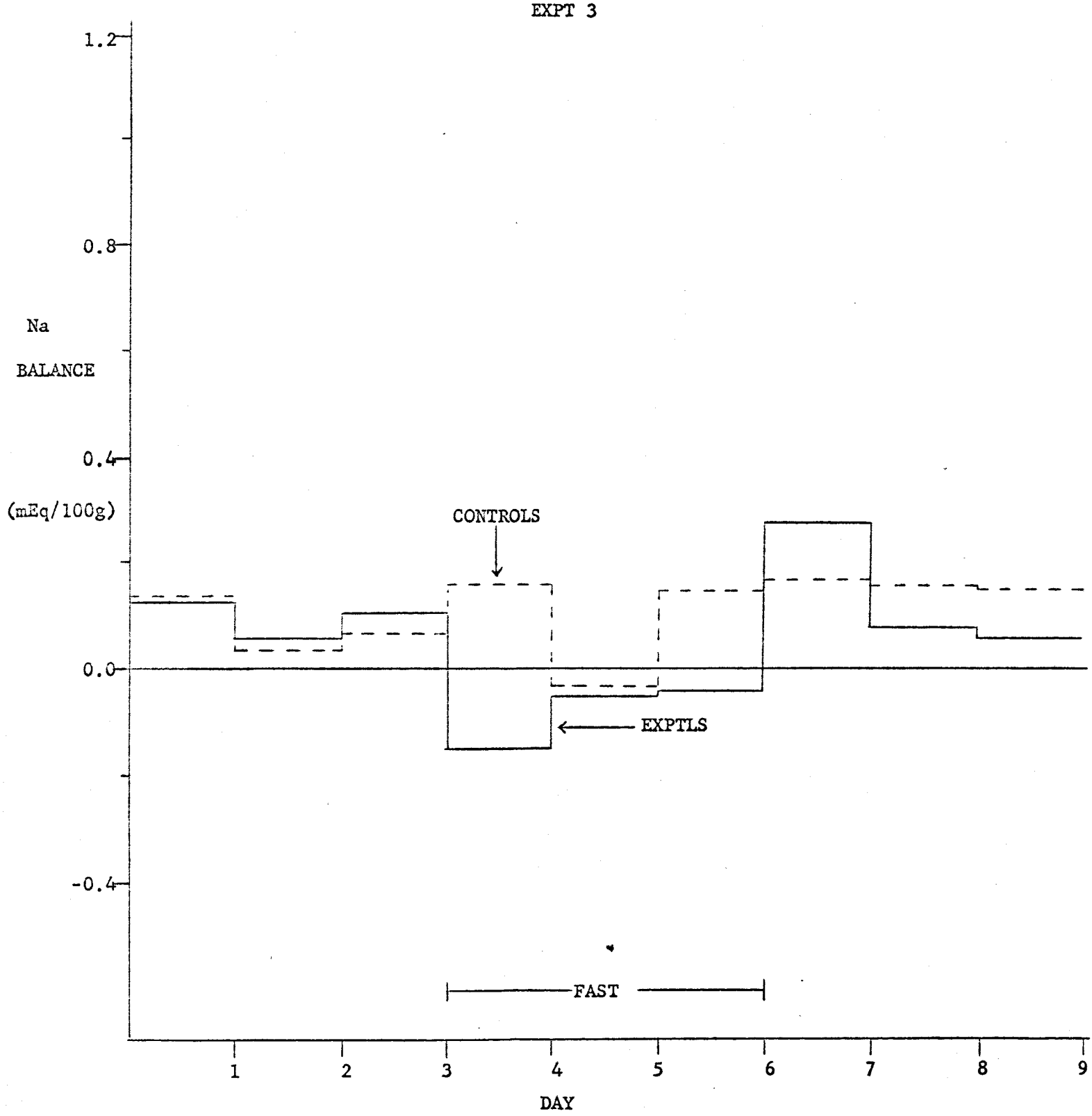


FIG. 16. Mg LOSS OF FASTED AND CONTROL RATS KEPT AT 26° C AND FED NBC DIET CONTAINING 52.5 μ Eq Mg/gm DIET.

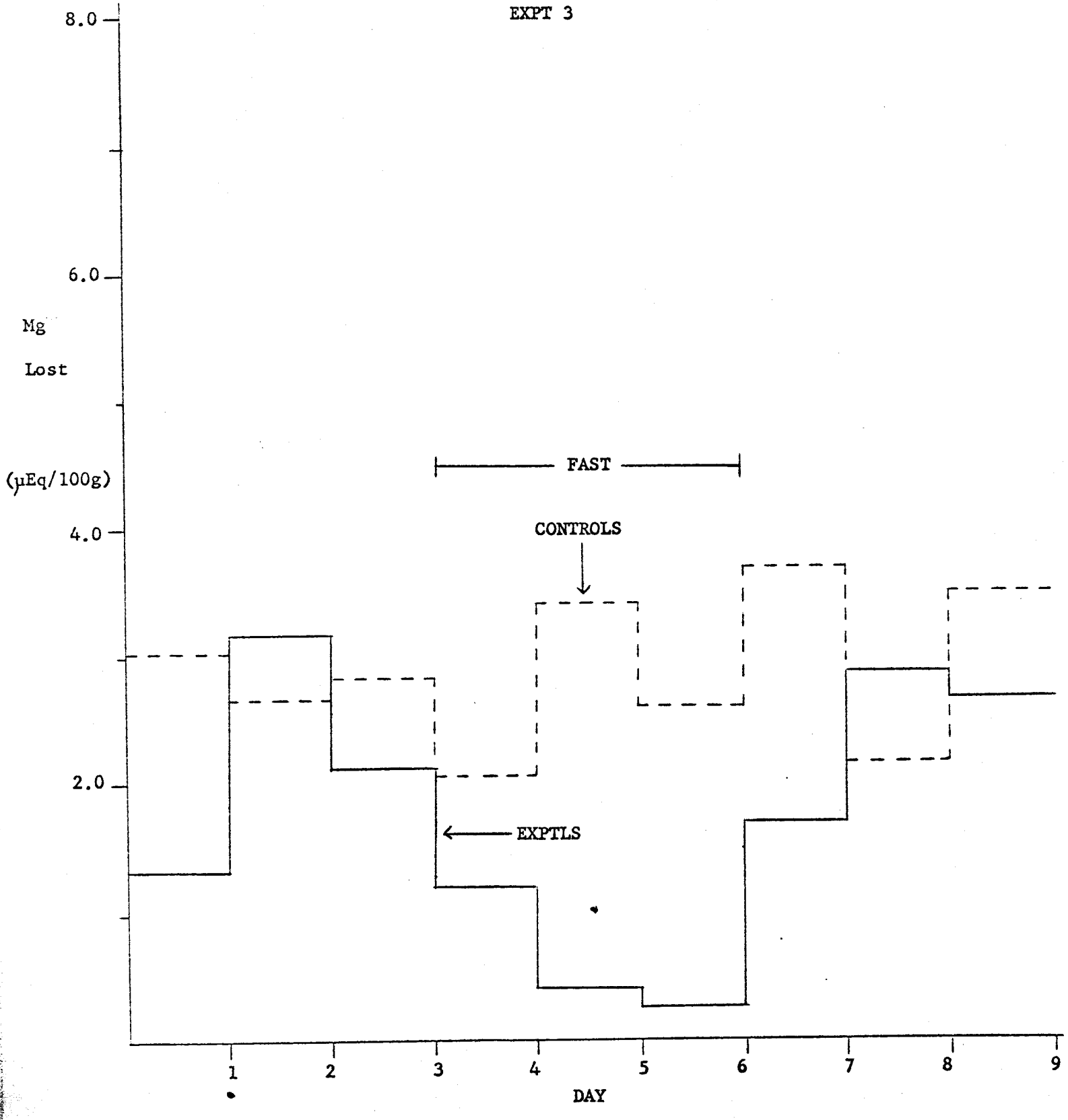


FIG. 17. Mg BALANCE OF FASTED AND CONTROLED RATS KEPT AT 26° C AND FED NBC DIET CONTAINING 52.5 μ Eq Mg/gm DIET.

EXPT 3

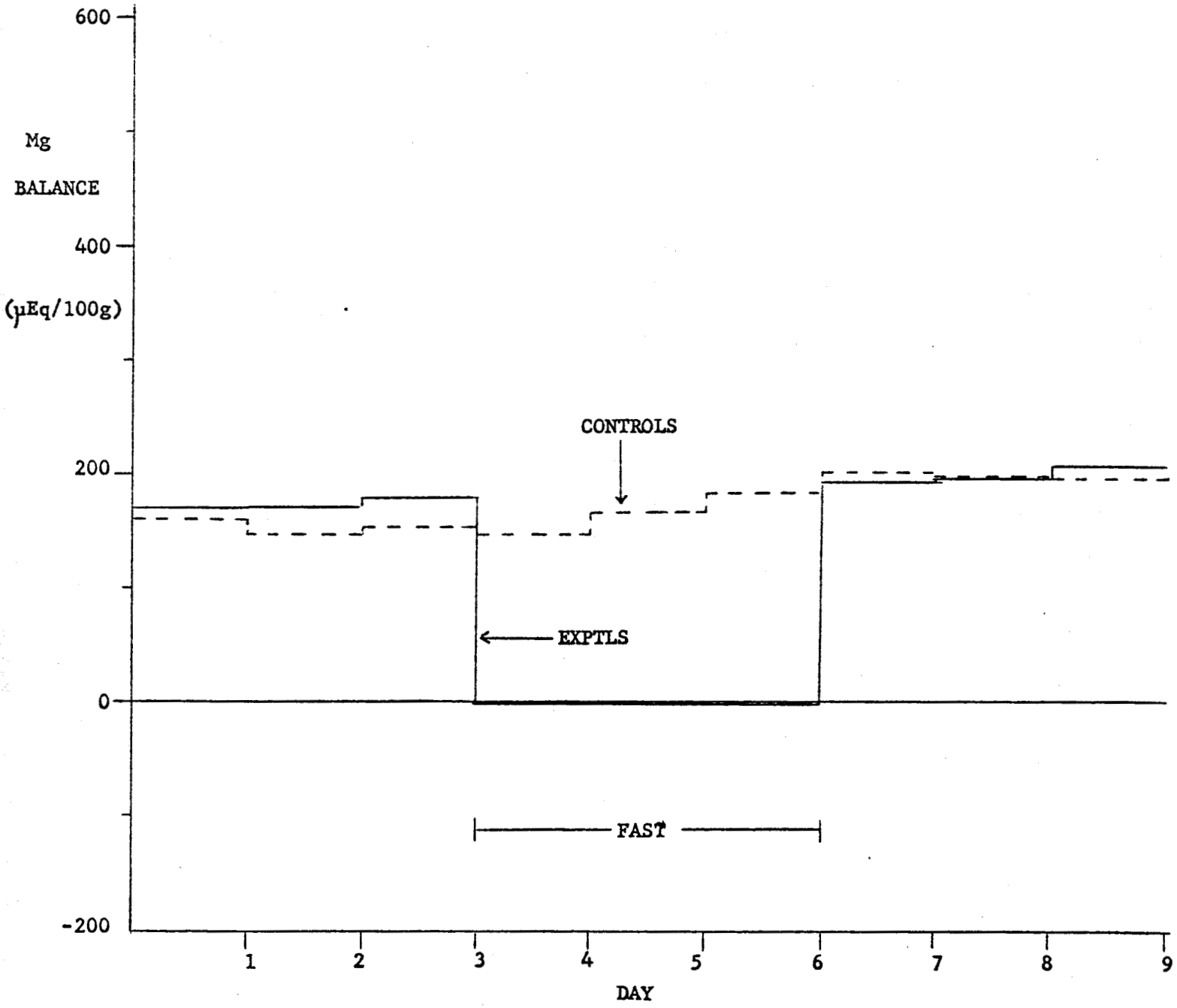


FIG. 18. WEIGHT CHANGES OF FASTED AND CONTROL RATS FED NBC DIET CONTAINING 20.26 mEq Na/100g DIET. FAST AT 3° C.

EXPT 4

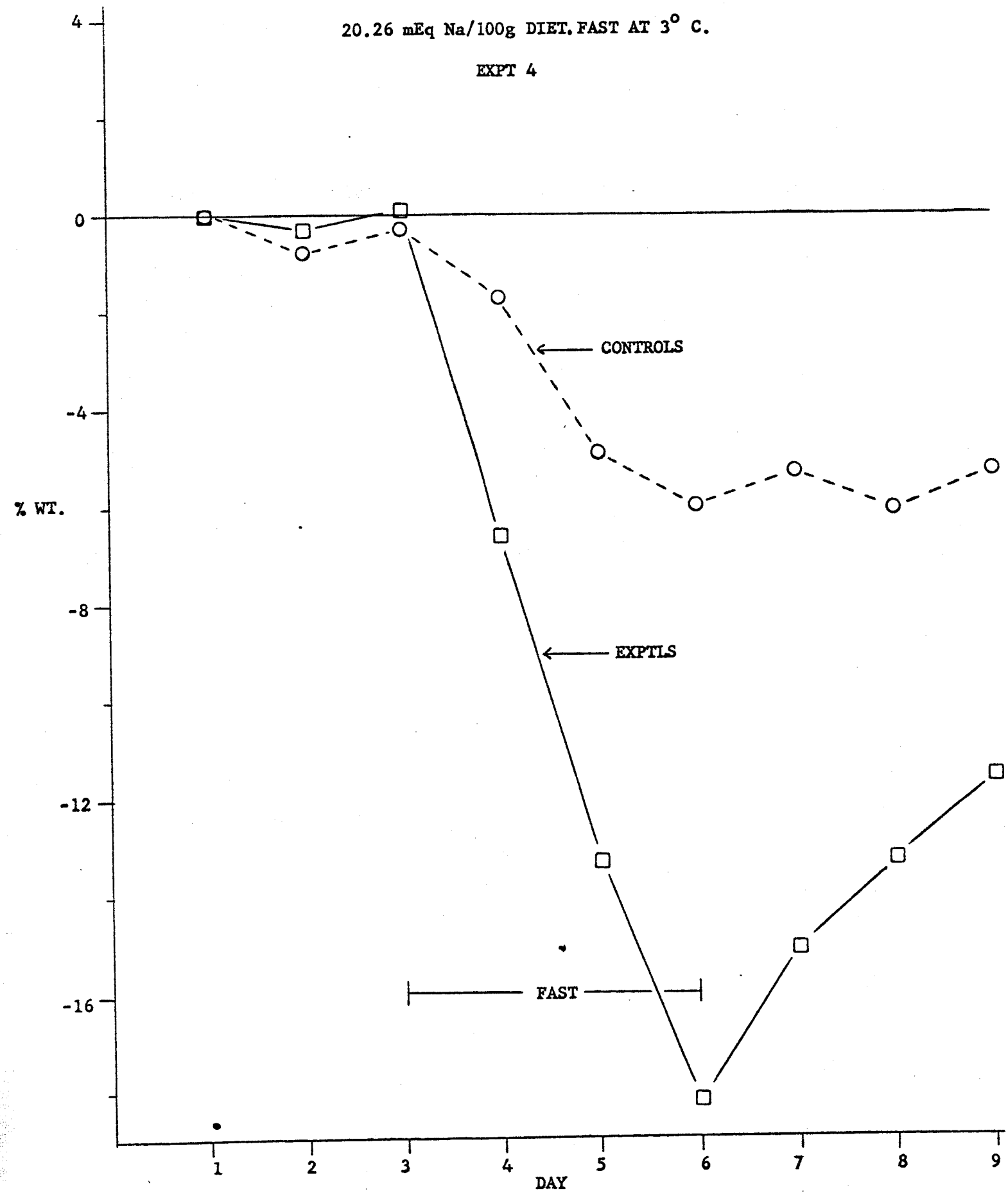


FIG. 19. WATER BALANCE OF FASTED AND CONTROL RATS FED NBC DIET CONTAINING 20.26 mEq Na/100g DIET. FAST AT 3° C.

EXPT 4

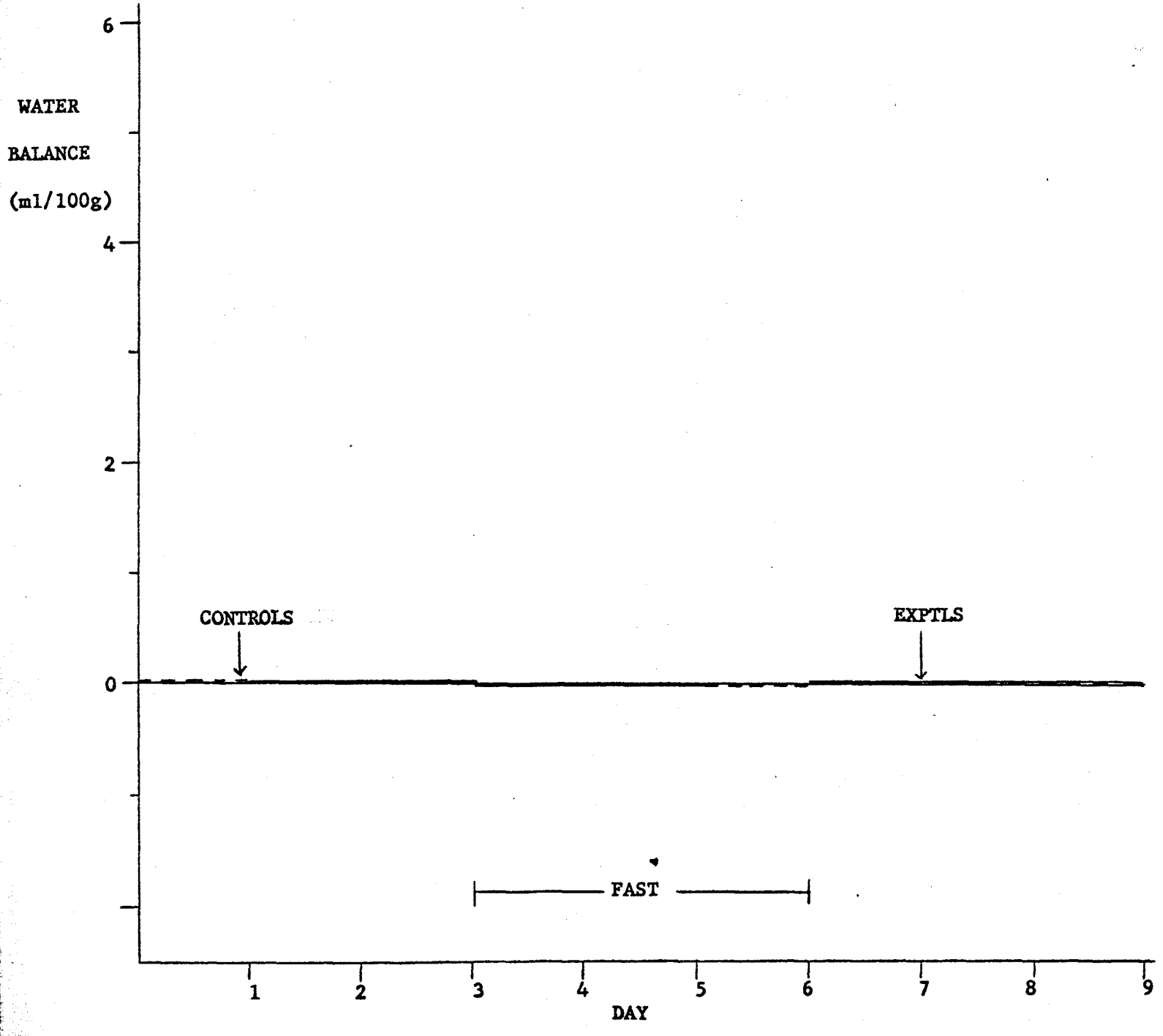


FIG. 20. Na LOSS OF FASTED AND CONTROL RATS FED NBC DIET CONTAINING 20.26 mEq Na/100g DIET. FAST AT 3° C.

EXPT 4

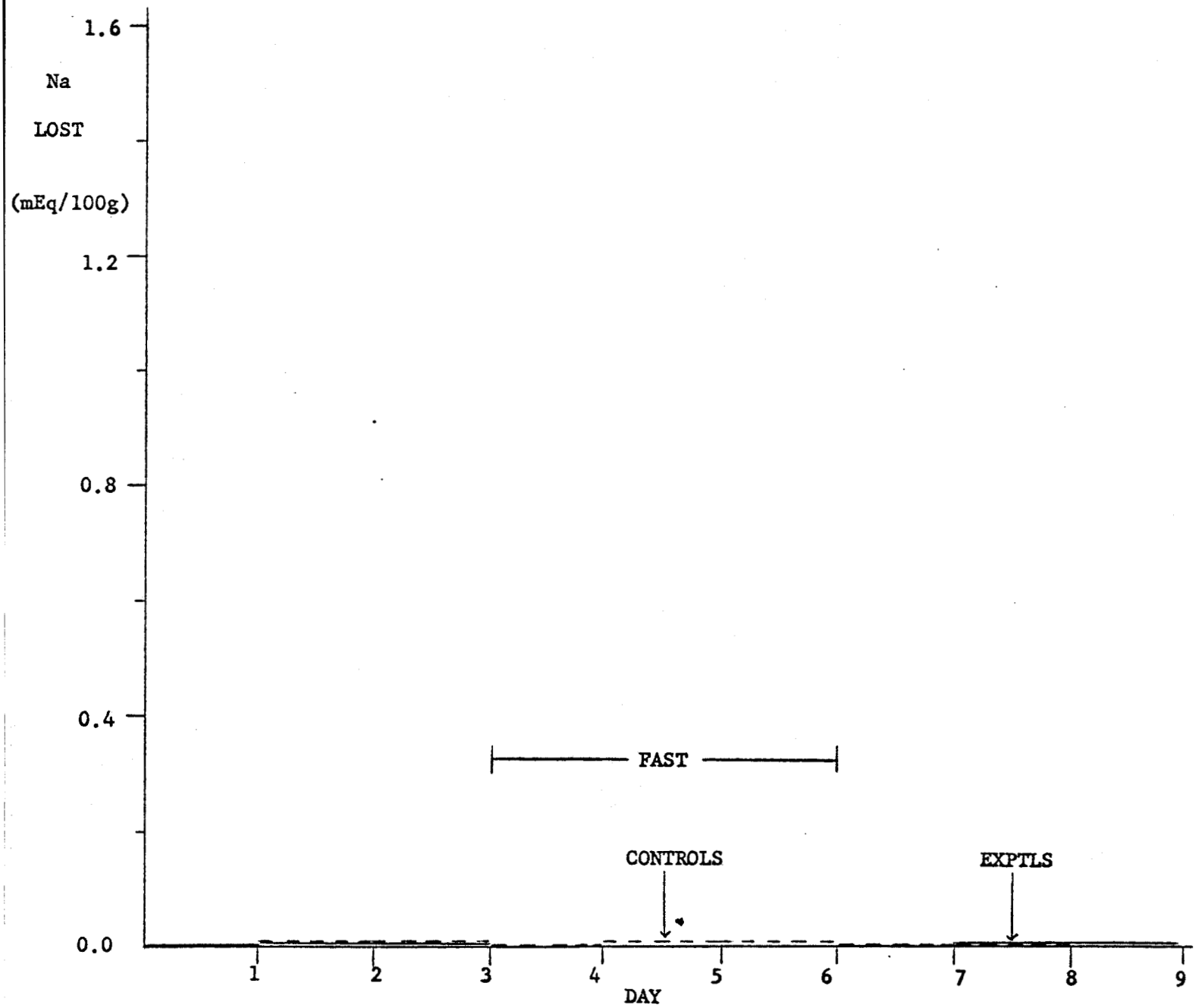


FIG. 21. Na BALANCE OF FASTED AND CONTROL RATS FED NBC DIET CONTAINING 20.26 mEq Na/100g DIET. FAST AT 3° C.

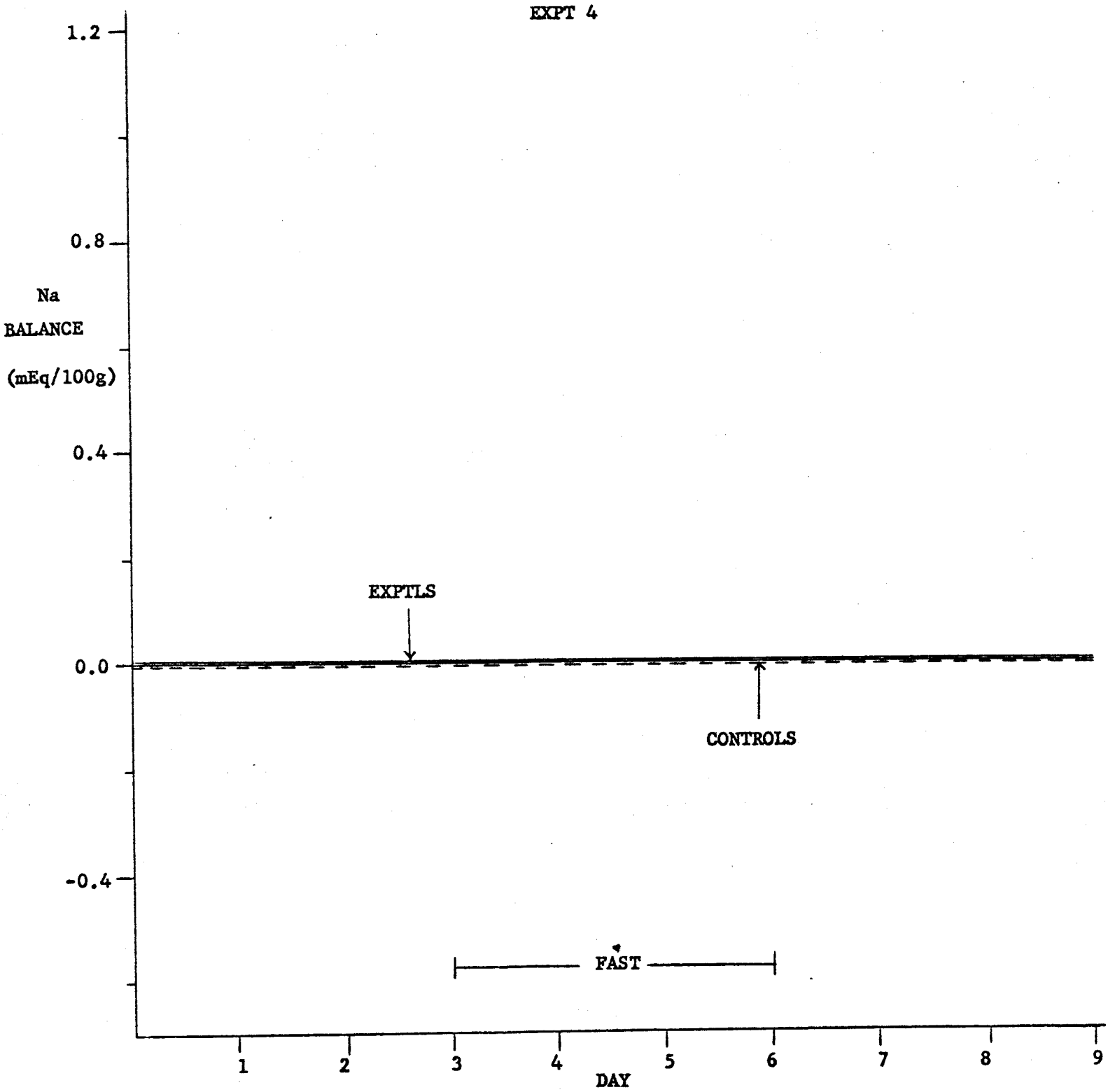


Fig. 22. Weight Changes of Fasted and Control Rats Fed NBC Diet Containing 0.89 mEq Na/100 g.

Fast at 3°C.

Expt 6

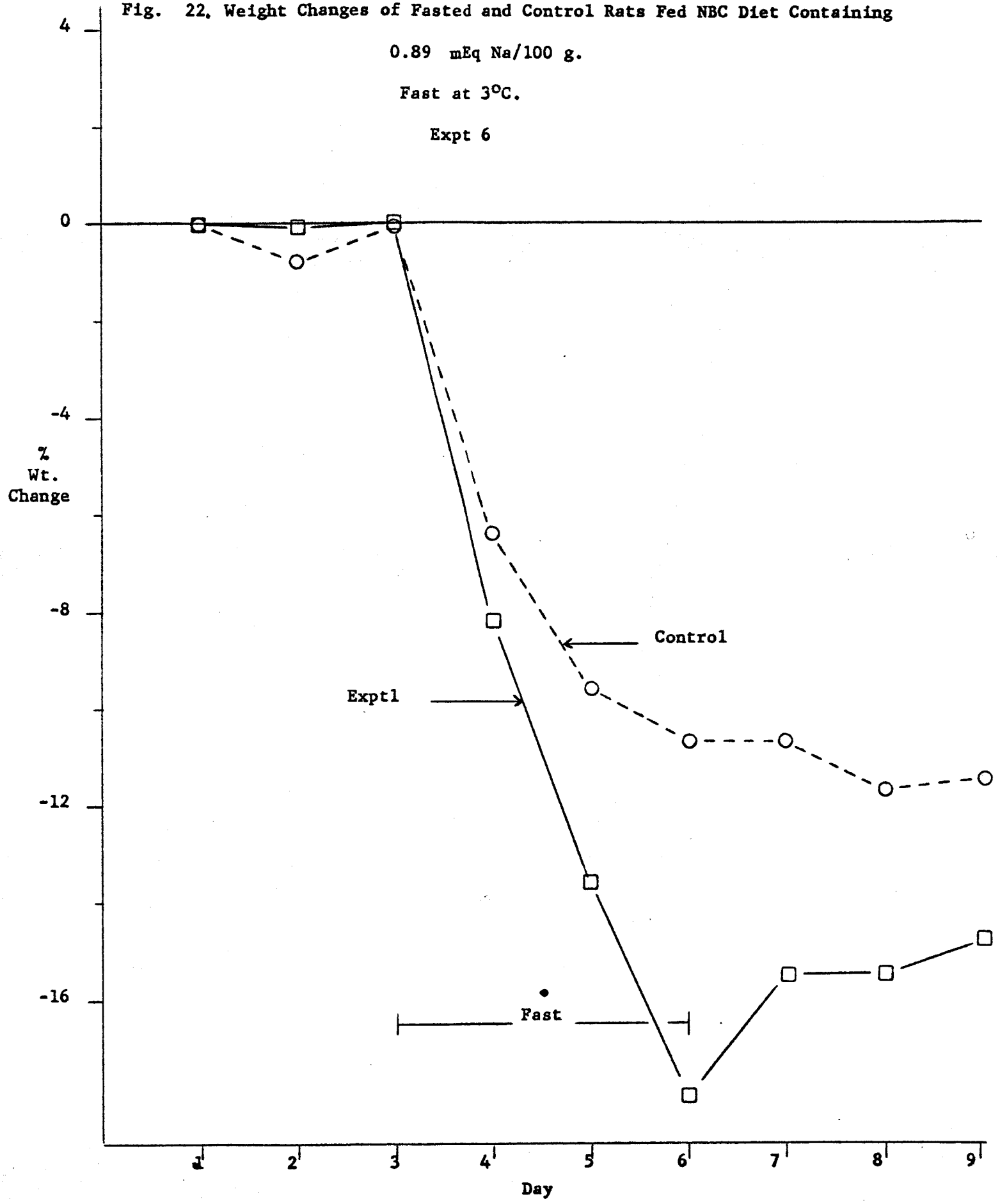


Fig. 23 WATER LOSS OF FASTED AND CONTROL RATS FED 0.89 mEq Na/100 g

NBC DIET

FAST AT 3°C.

EXPT. 6

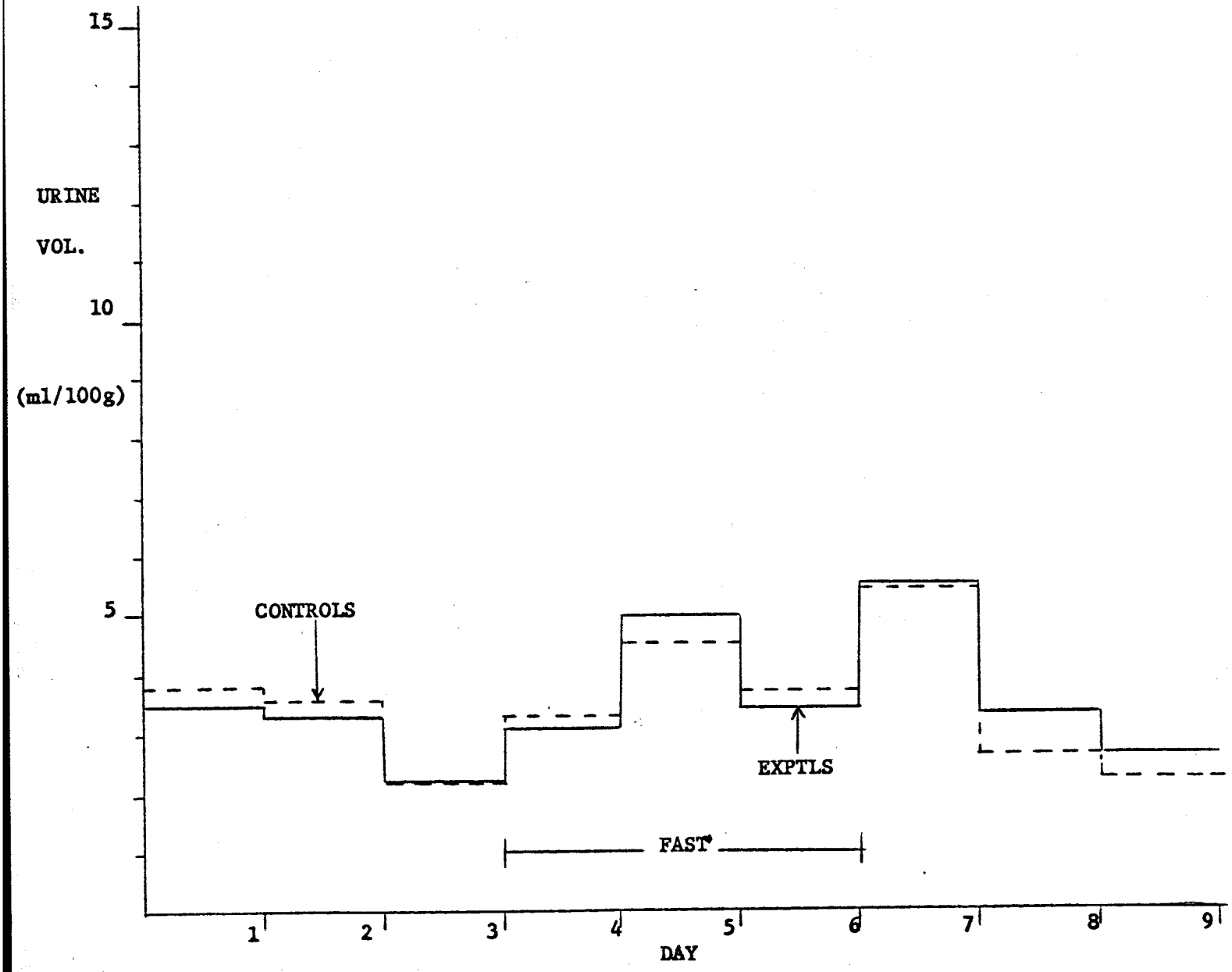


FIG. 24. WATER BALANCE OF FASTED AND CONTROL RATS FED NBC DIET CONTAINING 0.89 mEq Na/100g.

FAST AT 3° C.

EXPT 6

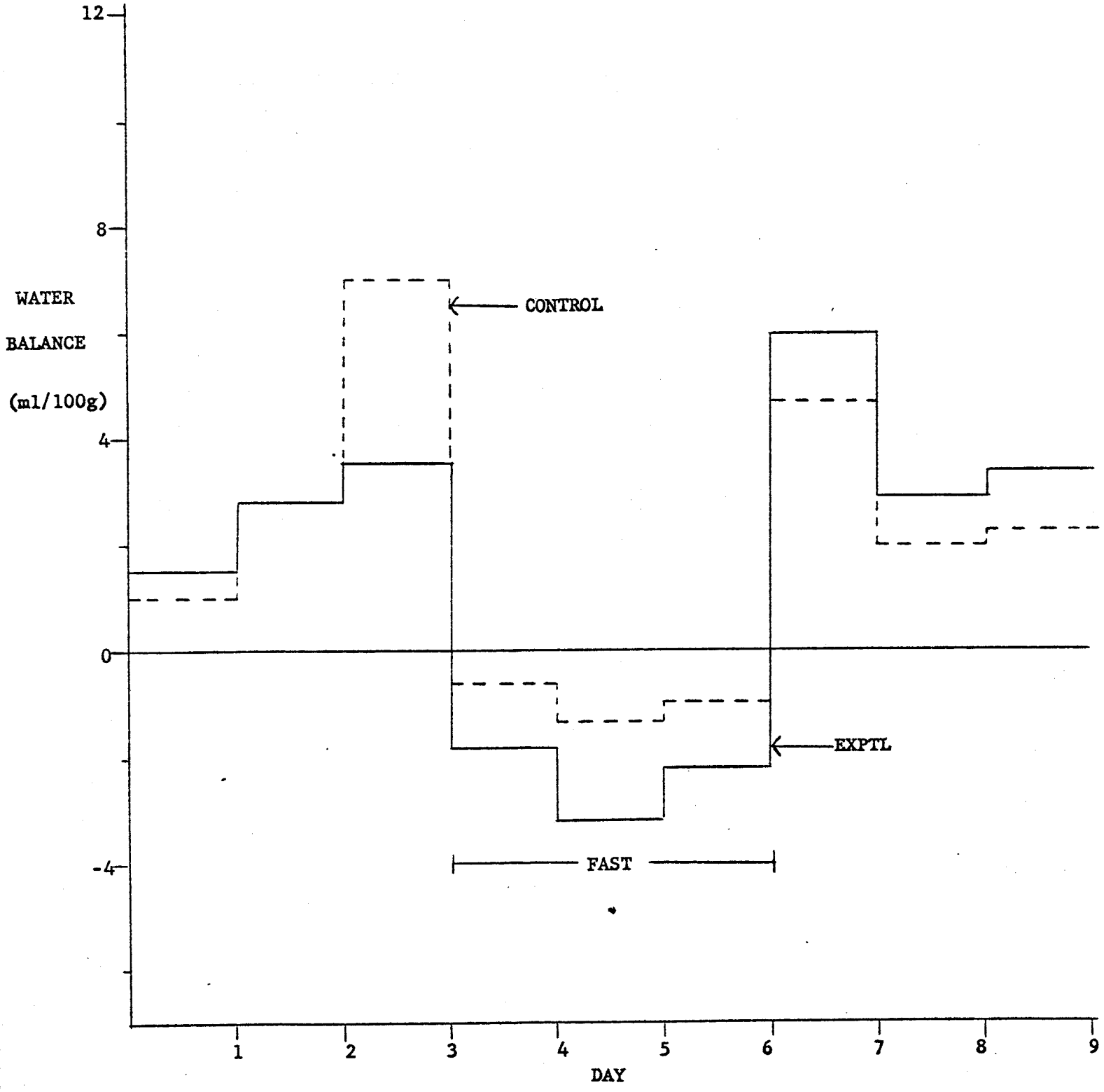


FIG. 25. Na^+ EXCRETION OF FASTED AND CONTROL RATS FED NBC DIET CONTAINING 0.89 mEq Na/100g.

FAST AT 3° C.

EXPT 6

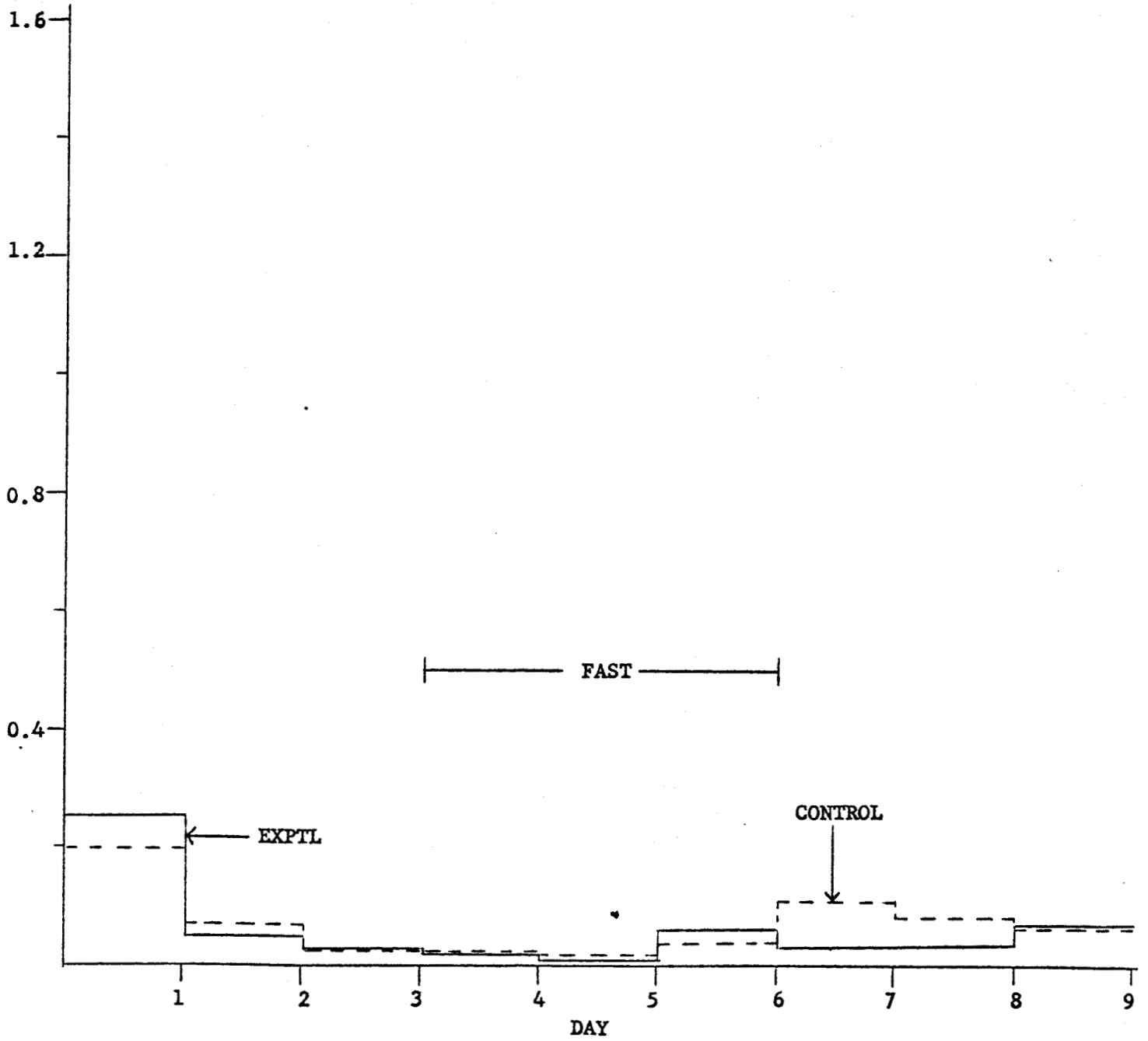


FIG. 26. Na BALANCE OF FASTED AND CONTROL RATS FED NBC DIET CONTAINING 0.89 mEq Na/100g.

FAST AT 3° C.

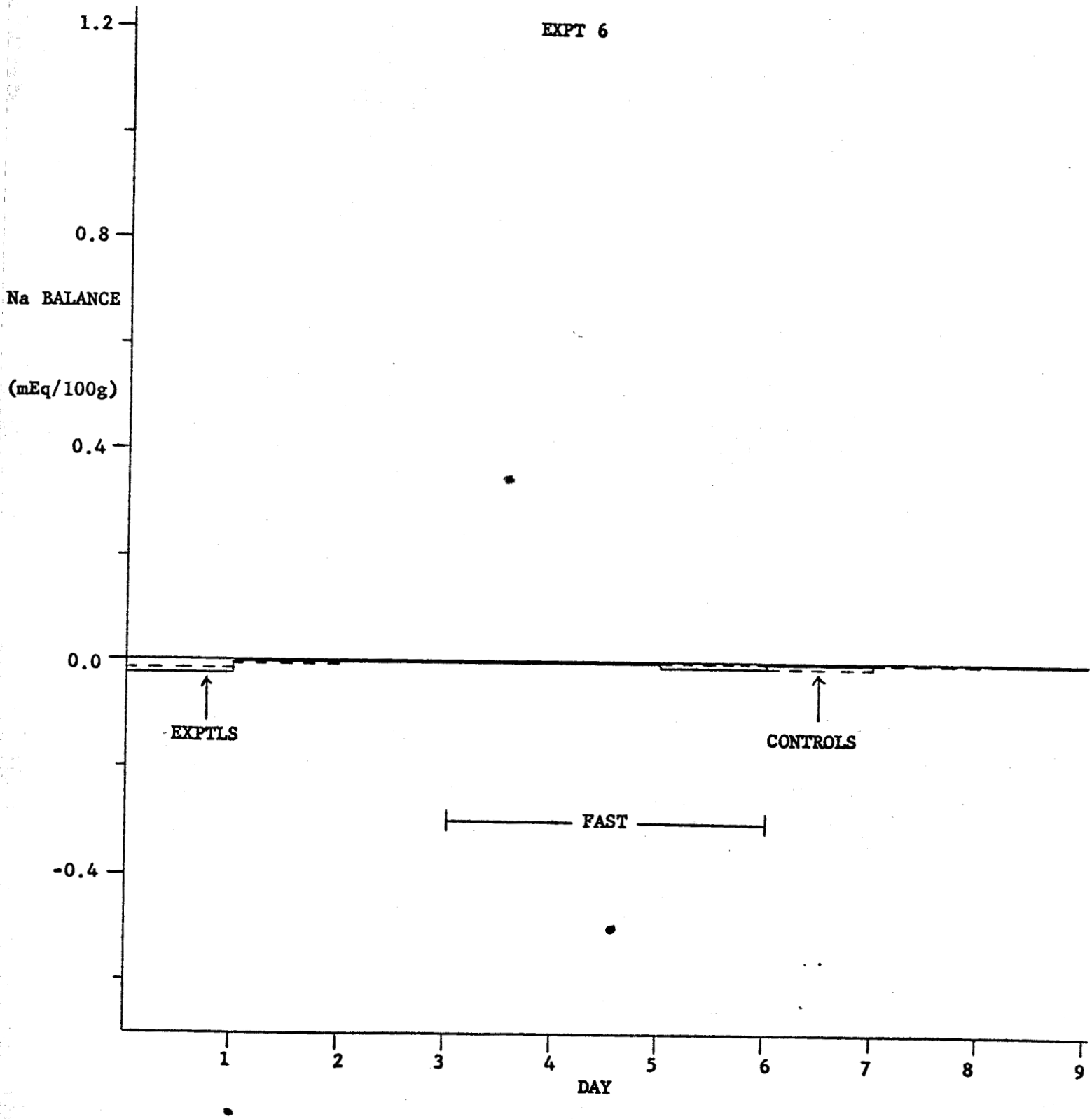


FIG. 27. Mg LOST OF FASTED AND CONTROL RATS FED NBC DIET CONTAINING

52.5 μEq Mg/gm DIET

FAST AT 3° C.

EXPT 6

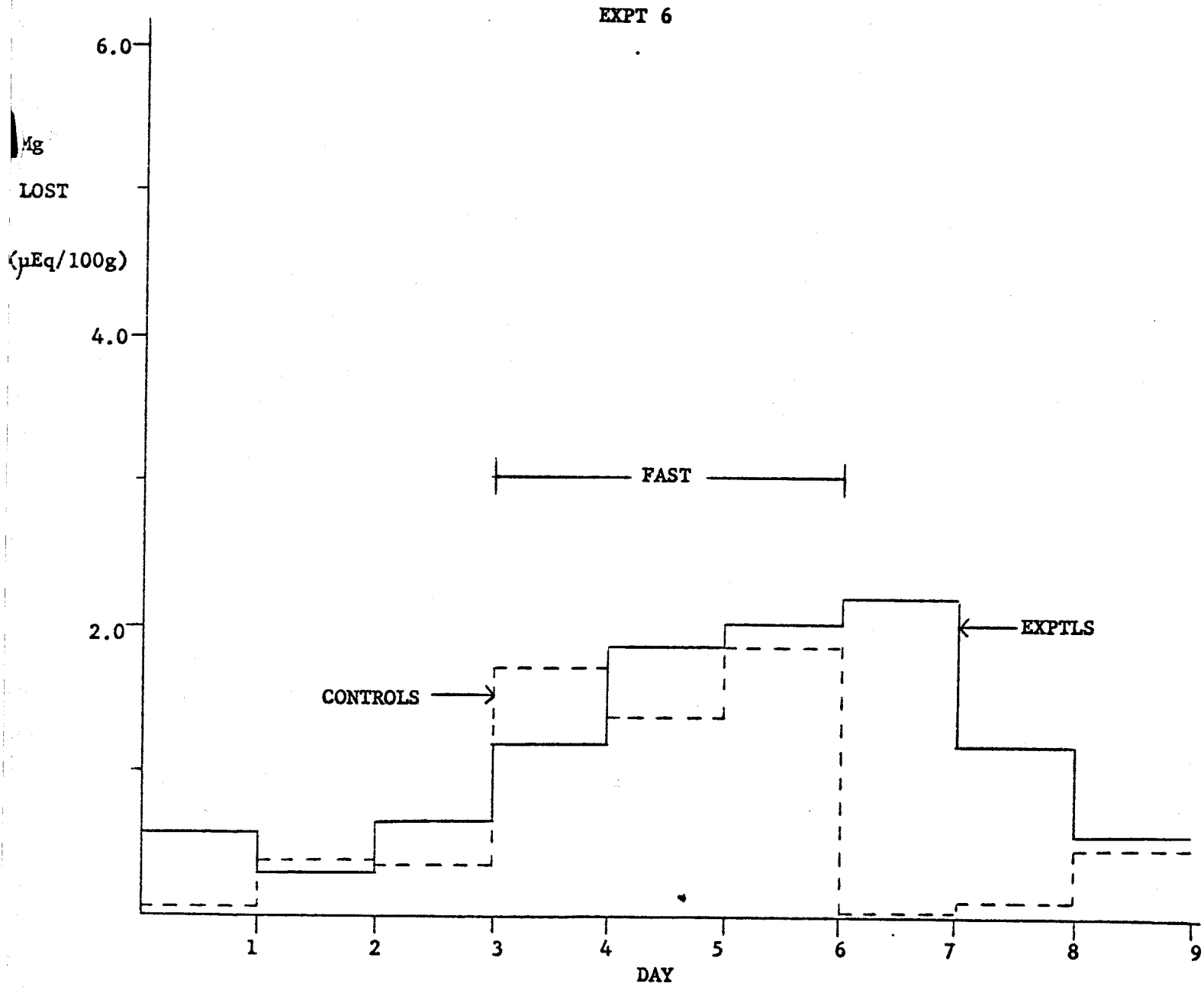


FIG. 28. Mg BALANCE OF FASTED AND CONTROL RATS FED NBC DIET CONTAINING 52.5 μEq Mg/gm DIET

FAST AT 3° C.

EXPT 6

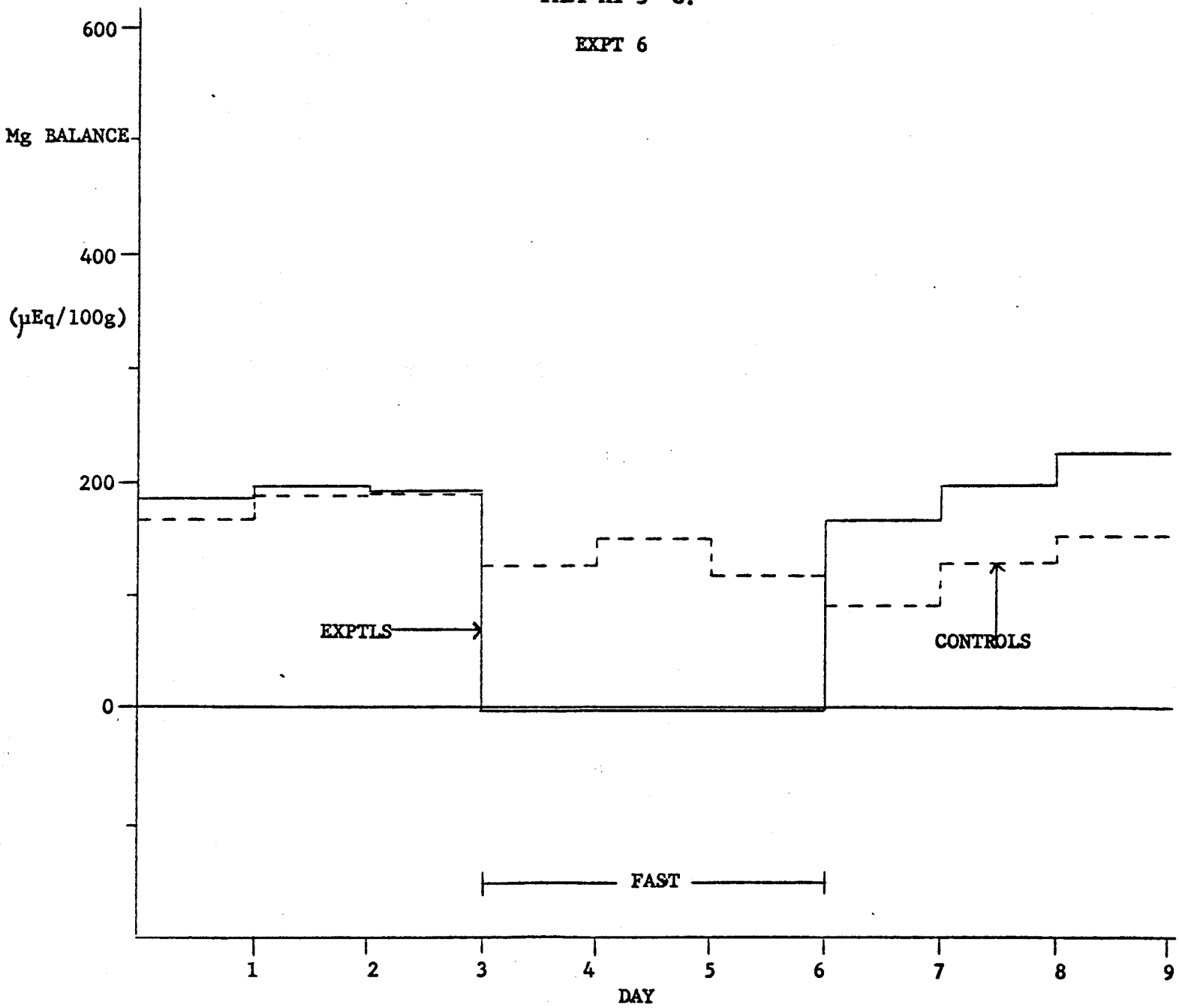


FIG. 29. WEIGHT CHANGES OF FASTED AND CONTROL RATS FED Na-DEFICIENT DIET FOR NINE DAYS AND PURINA LAST THREE DAYS

FAST AND RECOVERY AT 3° C.

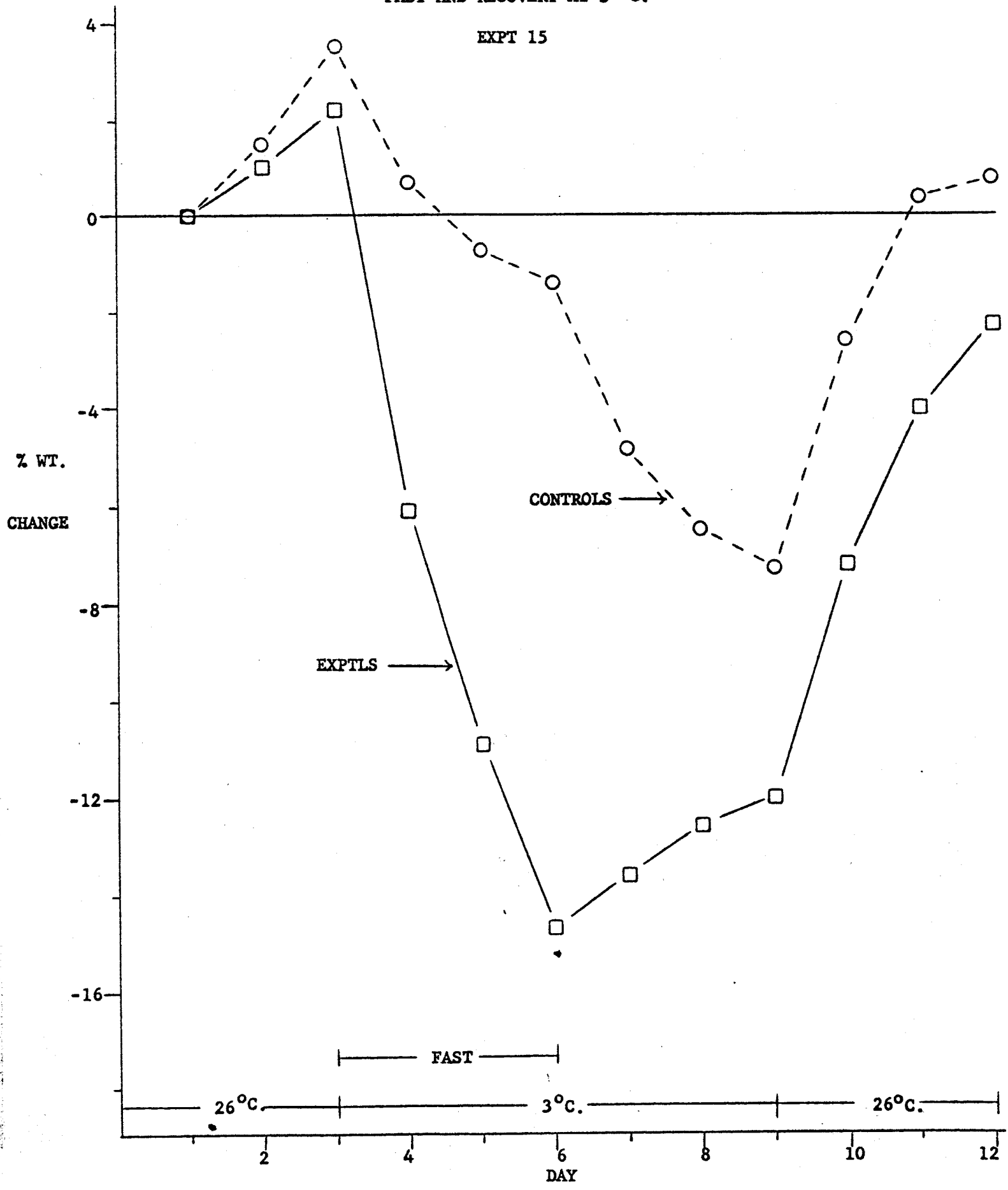


FIG. 30. WATER BALANCE OF FASTED AND CONTROL RATS FED Na-DEFICIENT DIET

FOR 9 DAYS AND PURINA LAST 3 DAYS

FAST AND RECOVERY AT 3° C.

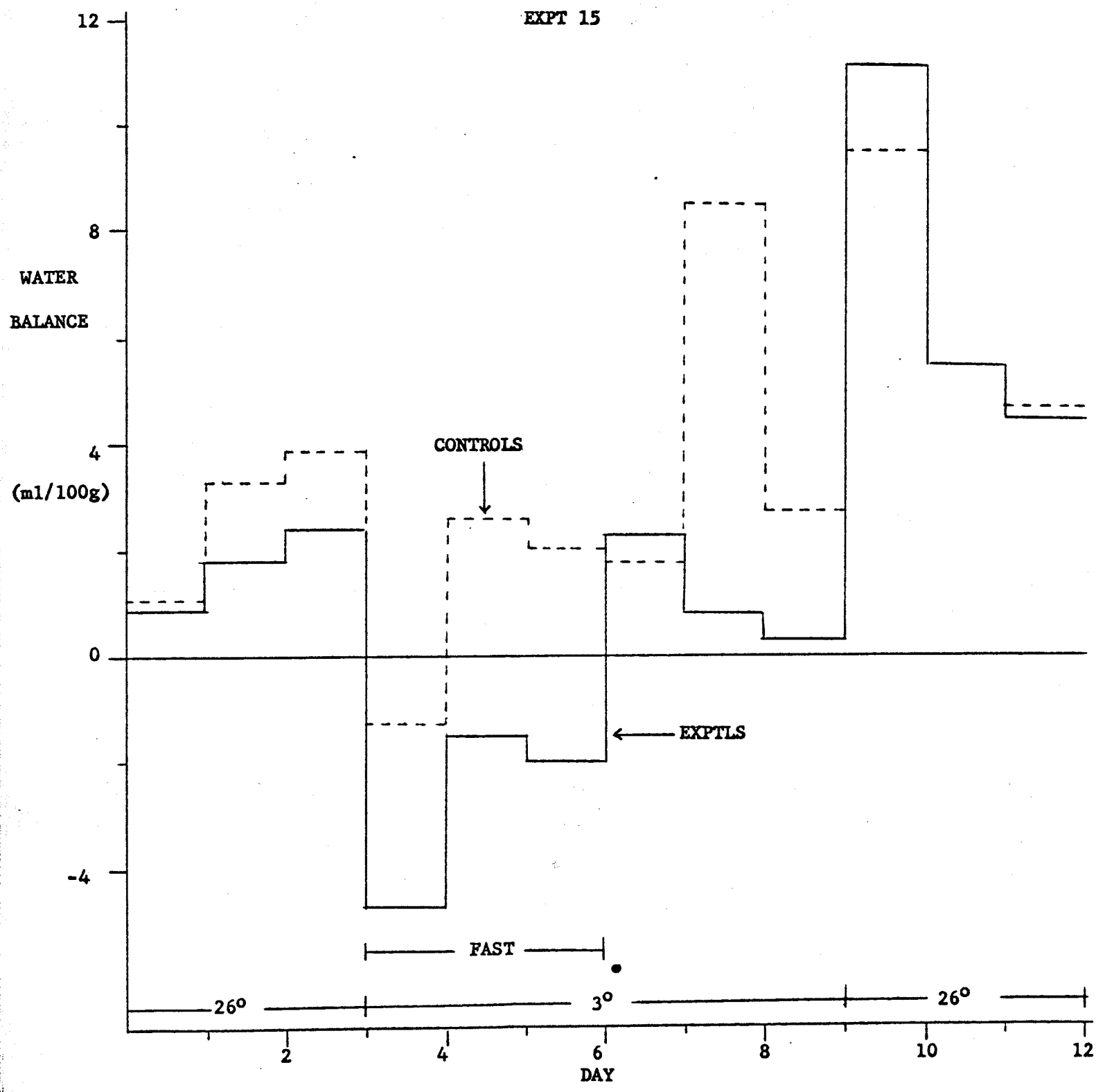


FIG. 31. Na^+ EXCRETION OF FASTED AND CONTROL RATS FED Na-DEFICIENT DIET

FOR FIRST 9 DAYS

FAST AND RECOVERY AT 3° C.

EXPT 15

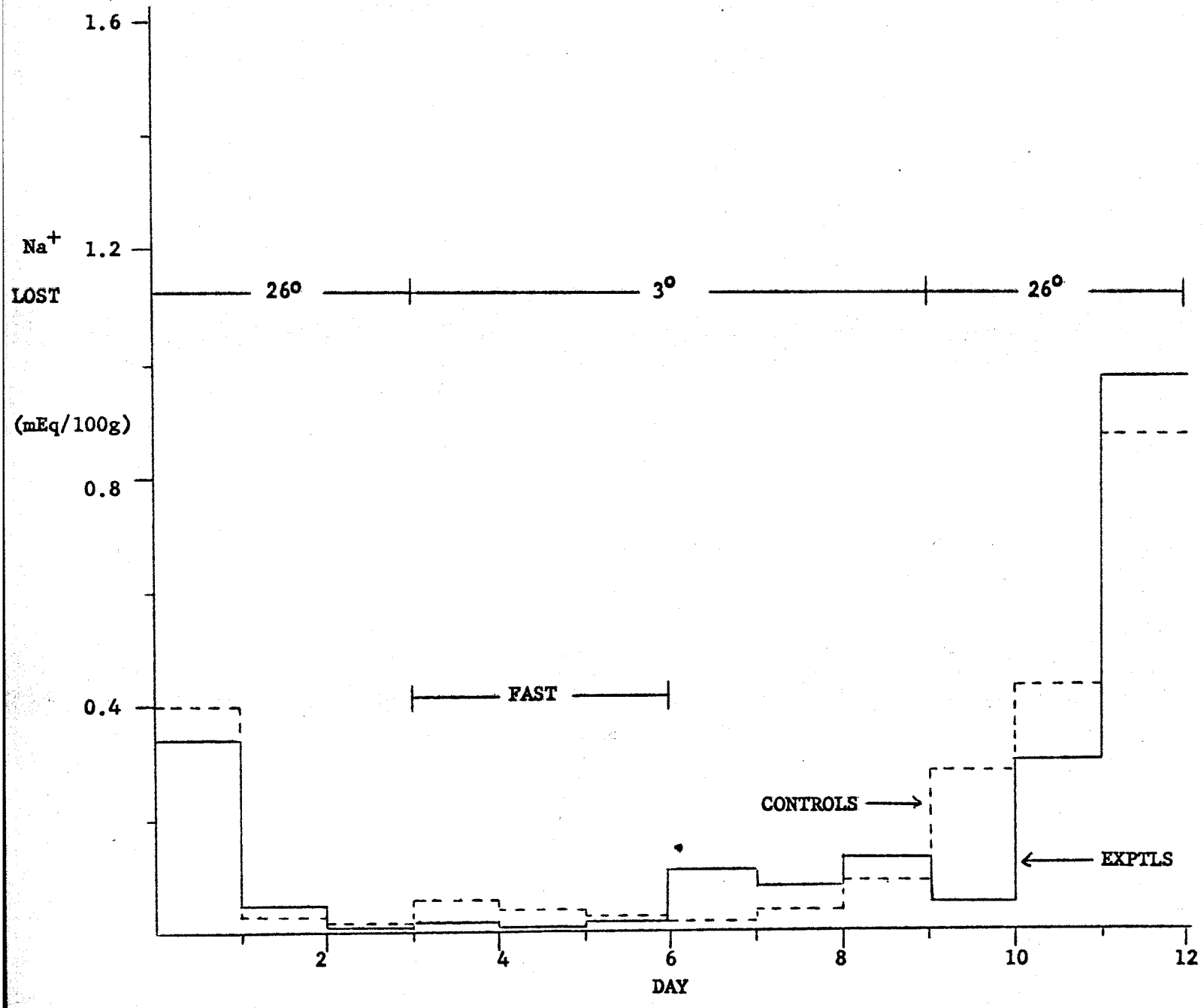


FIG. 32. Na-BALANCE OF FASTED AND CONTROL RATS FED Na-DEFICIENT DIET FOR 9 DAYS AND PURINA THE LAST THREE DAYS

FAST AND RECOVERY AT 3° C.

EXPT 15

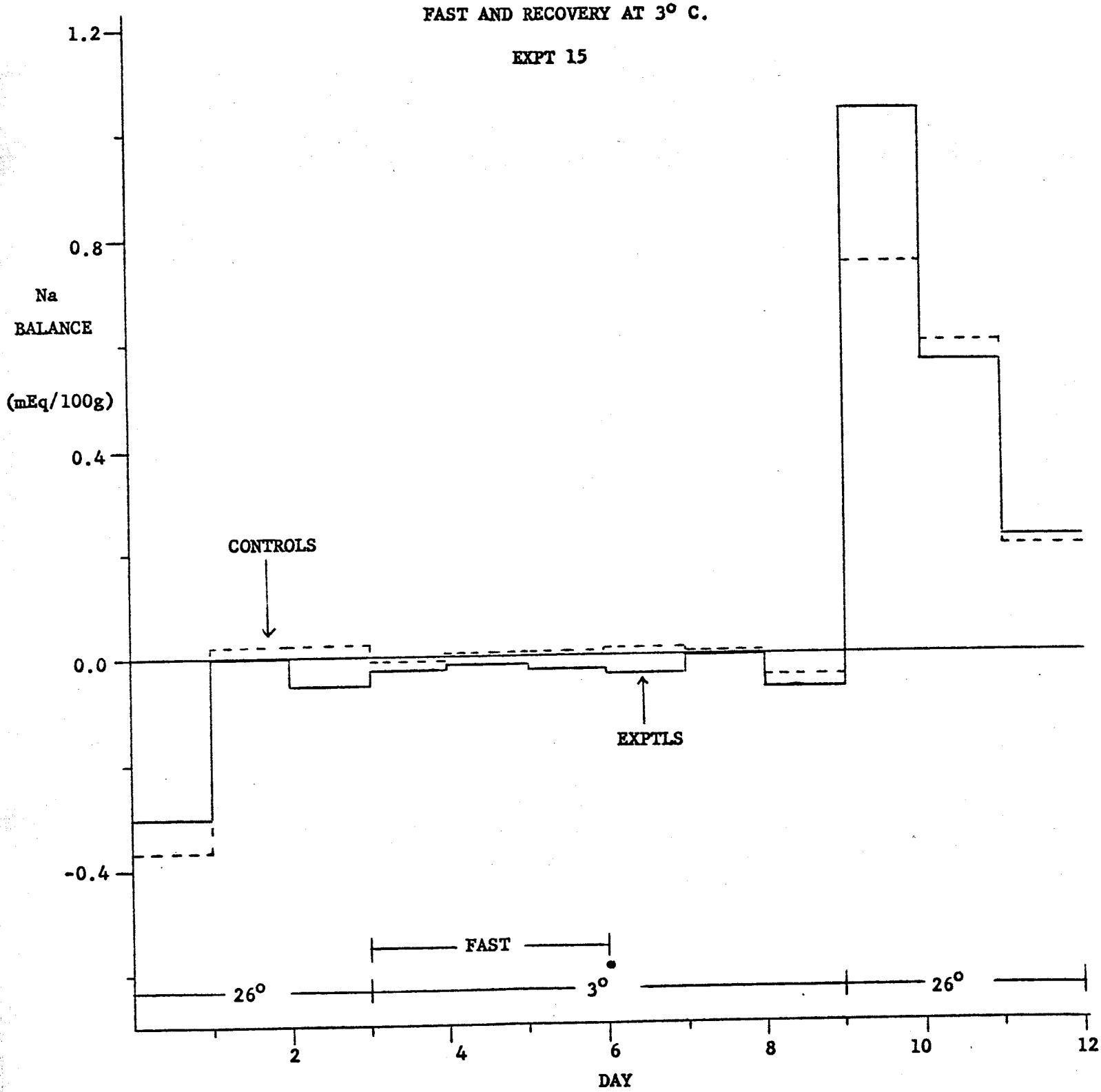


FIG. 33. Mg^{+2} EXCRETION OF FASTED AND CONTROL RATS FED NBC DIET CONTAINING 52.5 μEq Mg/gm DIET FOR FIRST 9 DAYS FAST AND RECOVERY AT 3° C.

EXPT 15

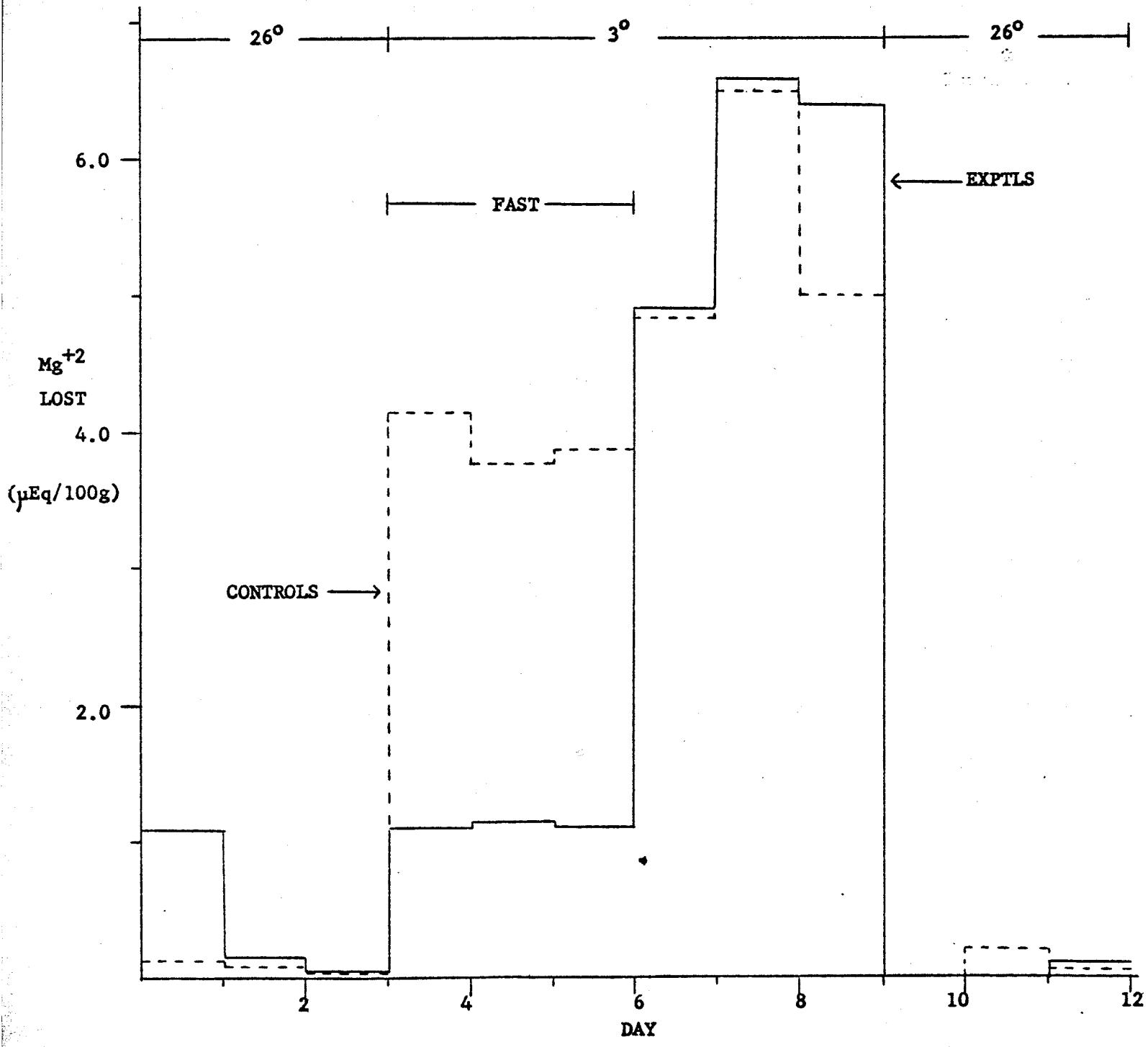


FIG. 34. Mg BALANCE OF FASTED AND CONTROL RATS FED NBC DIET CONTAINING

52.5 μEq Mg/gm DIET

FAST AND RECOVERY AT 3° C.

EXPT 15

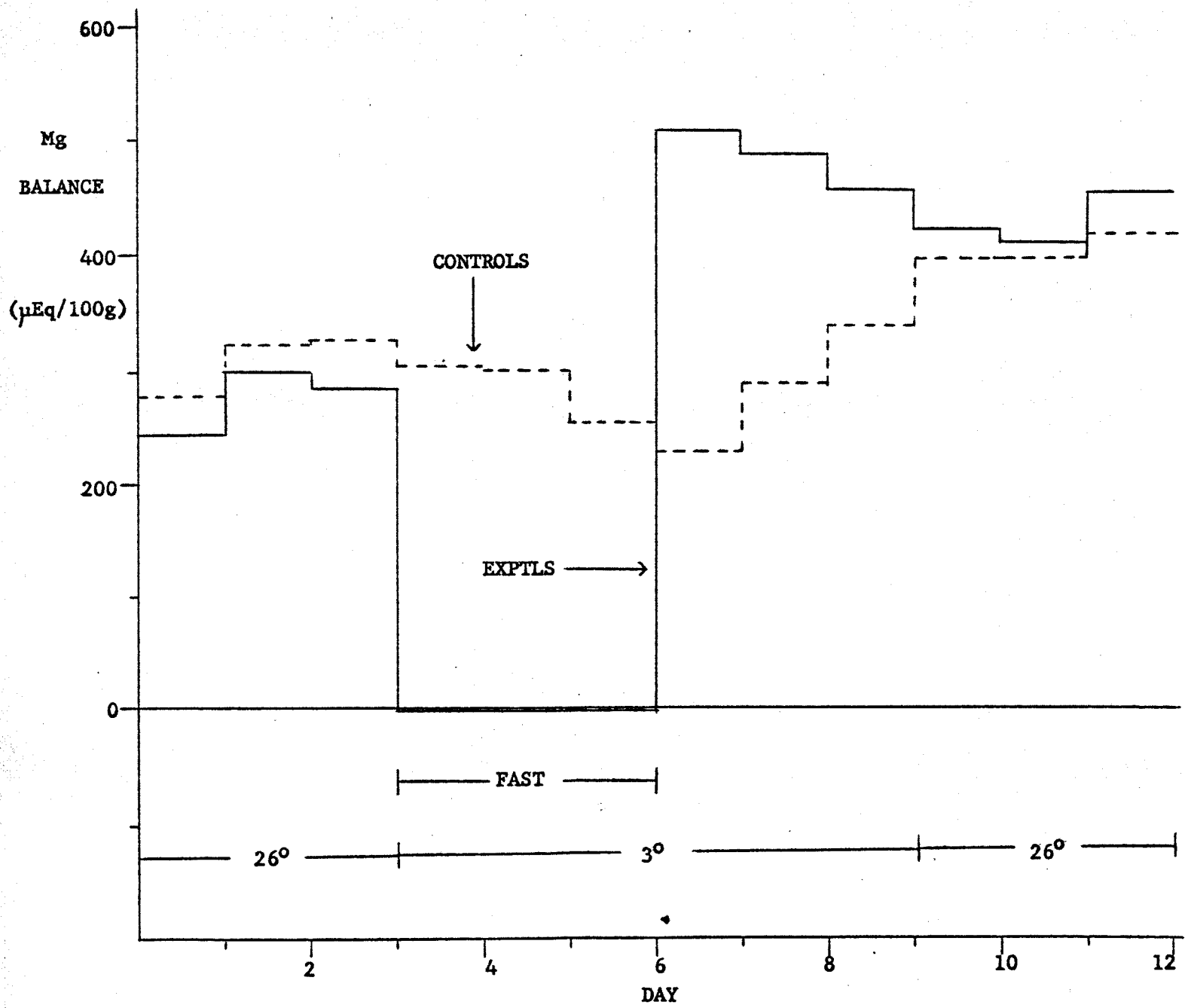


FIG. 35. WEIGHT CHANGES OF FASTED AND CONTROL RATS FED

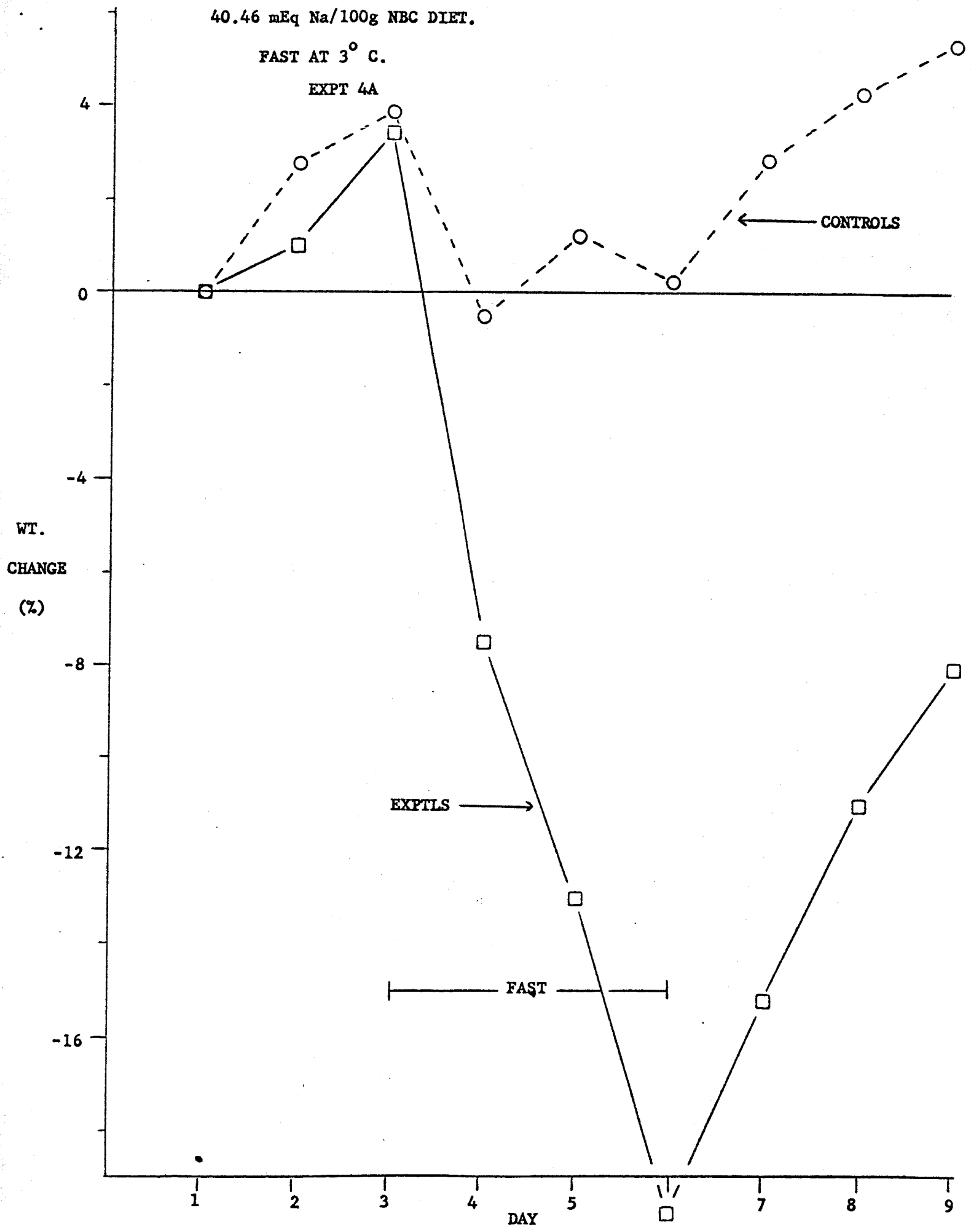


FIG. 36. WATER LOSS OF FASTED AND CONTROL RATS FED 40.46 mEq Na/100g NBC DIET

FAST AT 3° C.

EXPT 4A

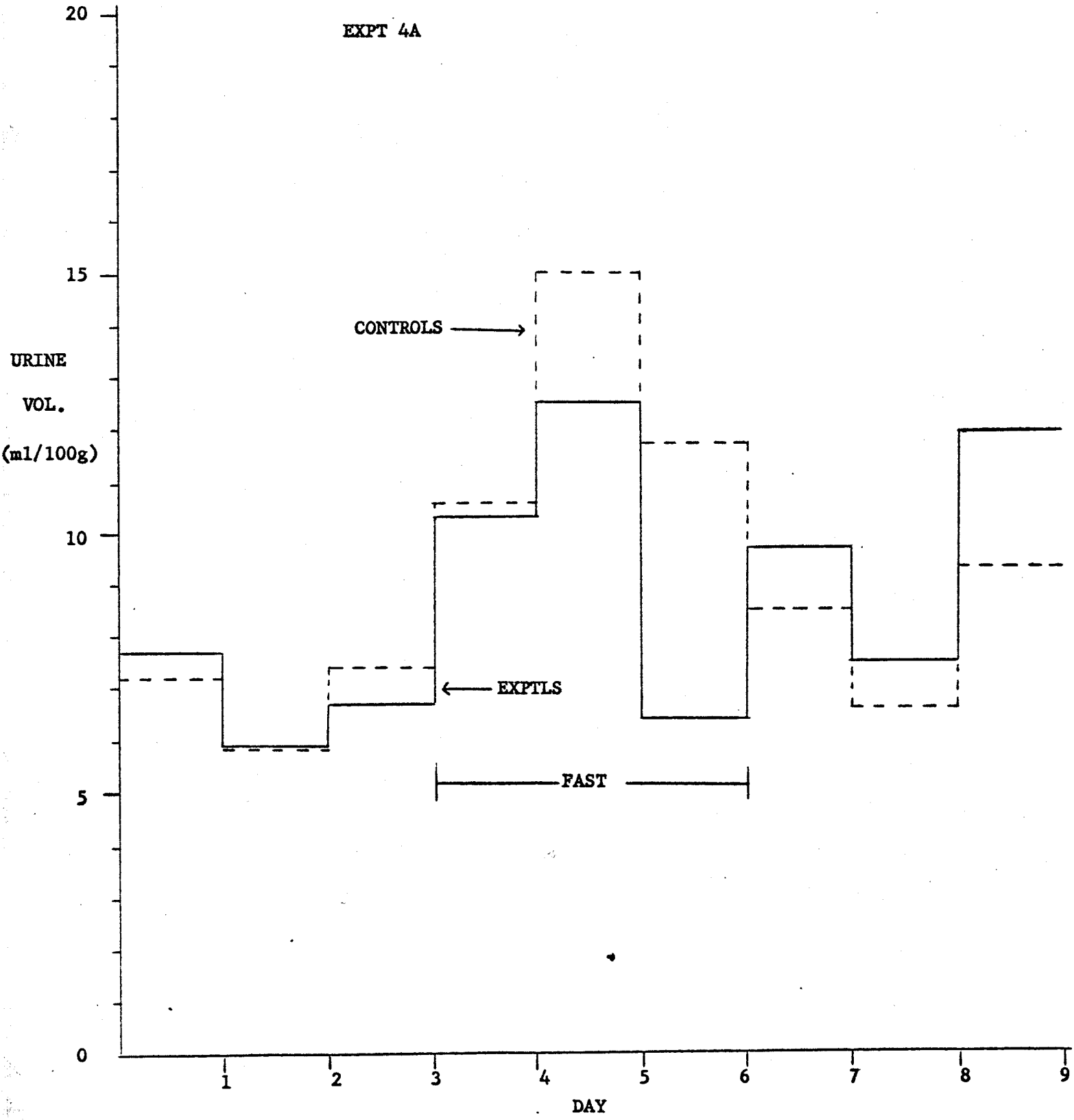


FIG. 37. WATER BALANCE OF FASTED AND CONTROL RATS FED 40.46 mEq Na/100g NBC DIET.

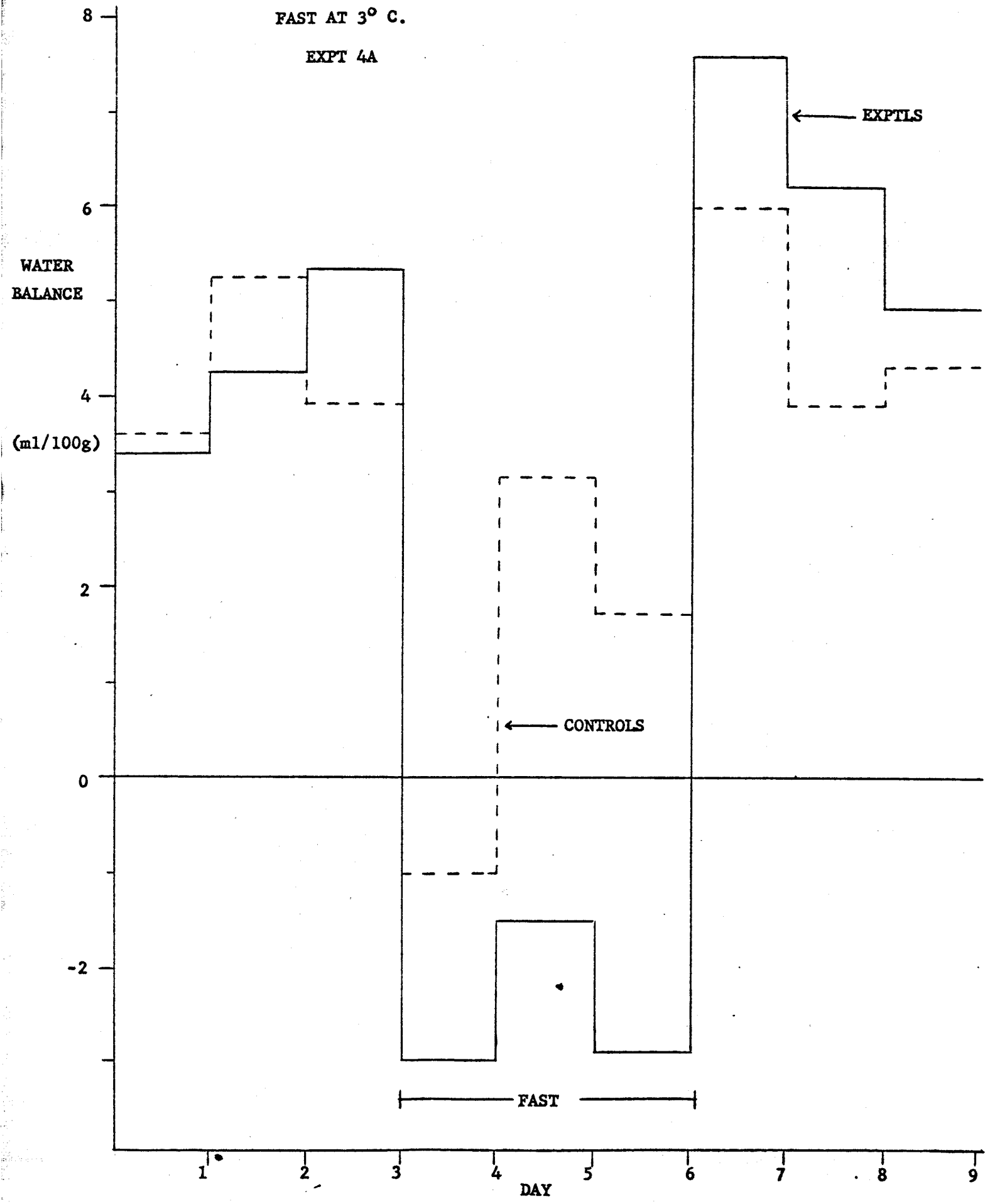


FIG. 38. Na LOSS OF FASTED AND CONTROL RATS FED 40.46 mEq Na/100g

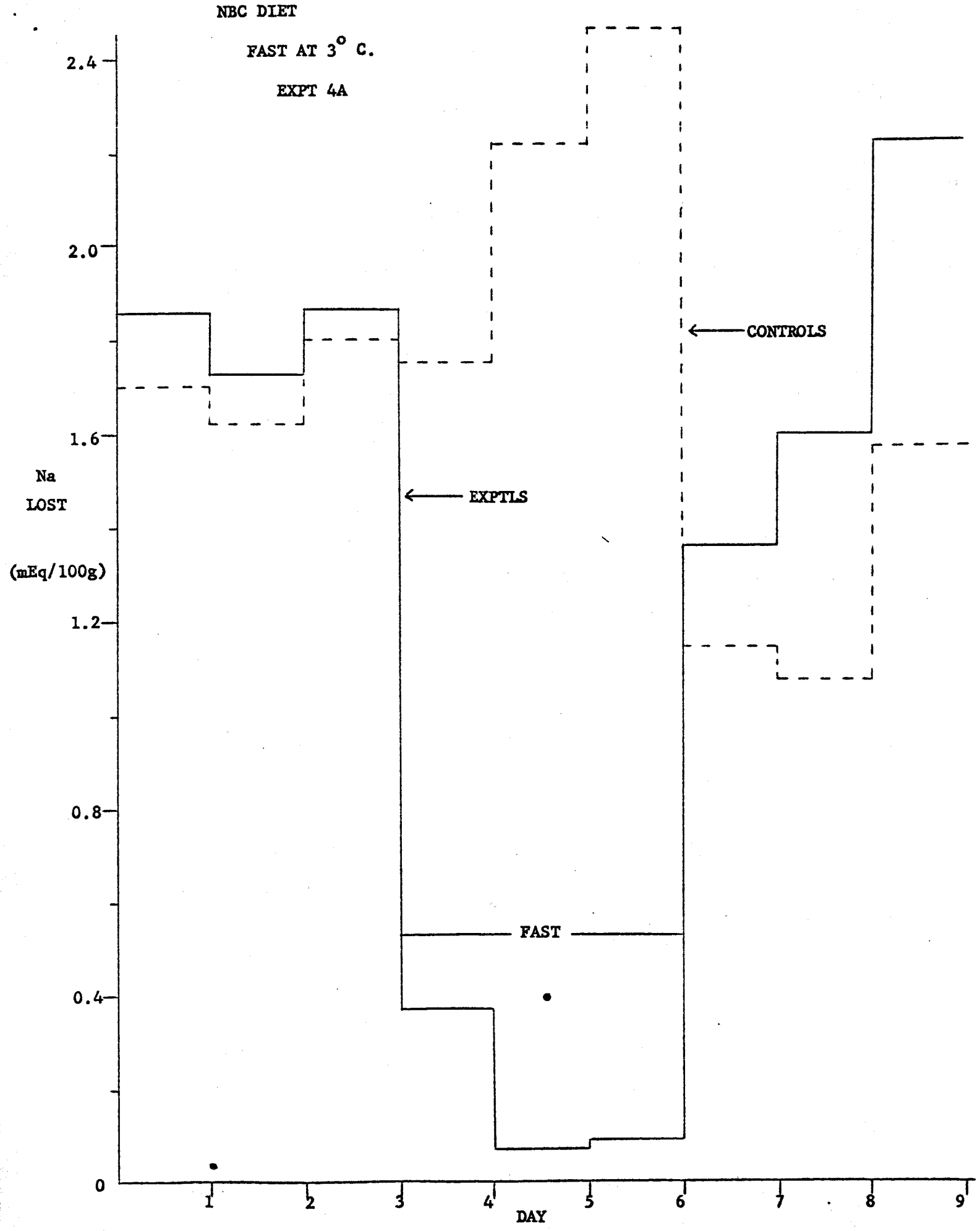


FIG. 39. Na BALANCE OF FASTED AND CONTROL RATS FED 40.46 mEq Na PER 100g NBC DIET

FAST AT 3° C.

EXPT 4A

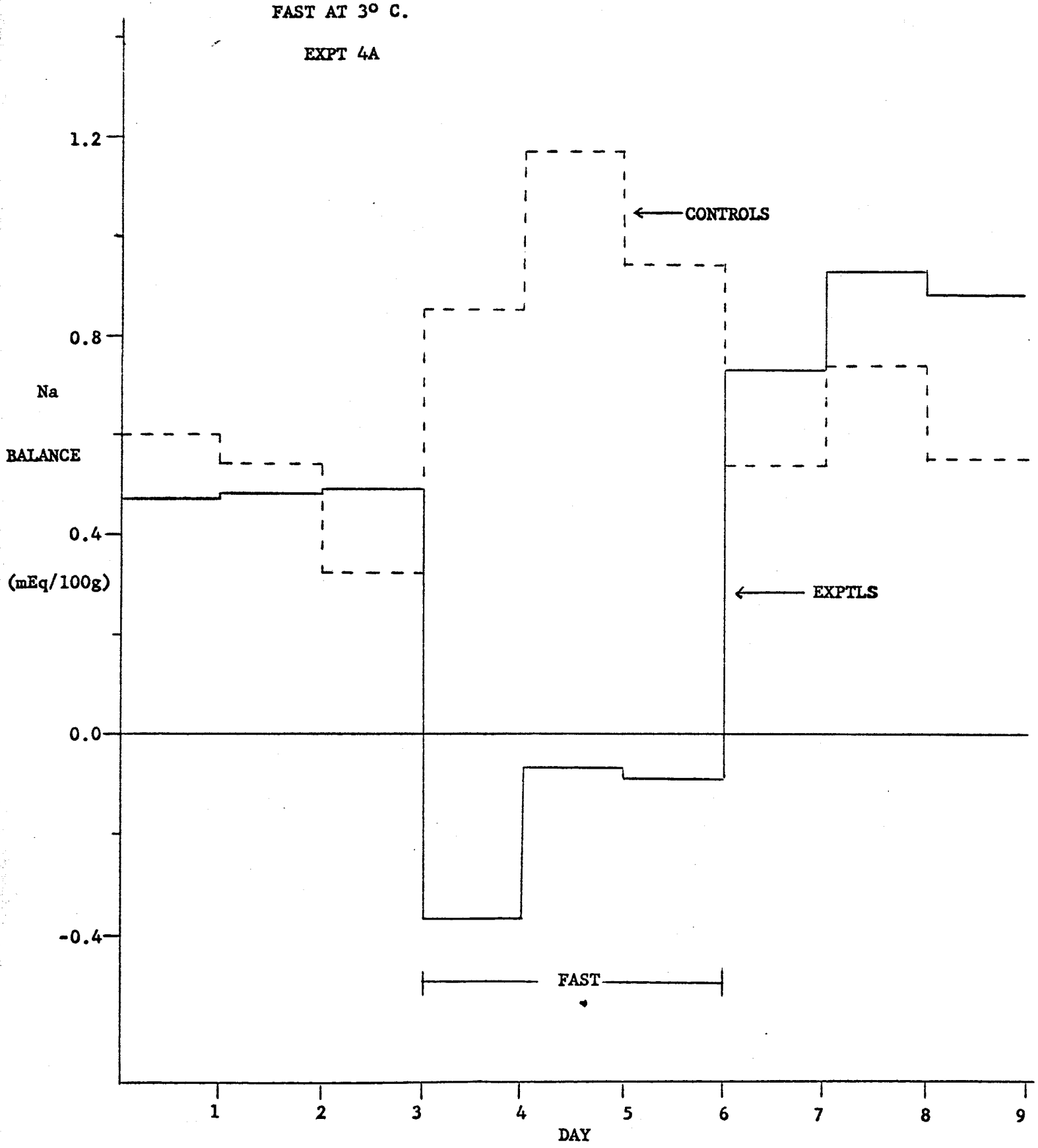


FIG. 40. Mg LOSS BY FASTED AND CONTROL RATS FED 52.5 μEq Mg/gm NBC DIET.

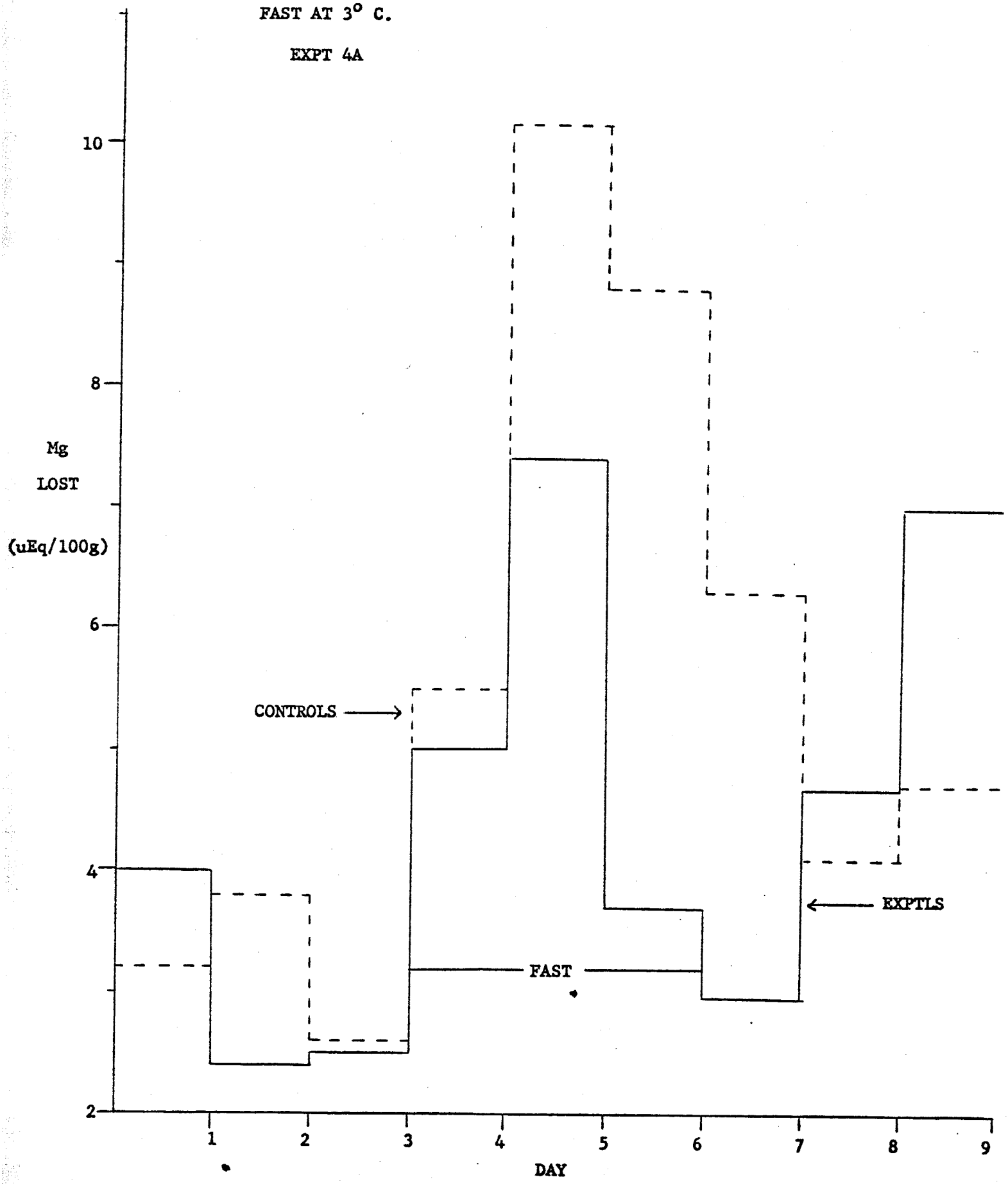


FIG. 41. Mg BALANCE OF FASTED AND CONTROL RATS FED 52.5 μEq Mg/gm NBC DIET.

FAST AT 3° C.

EXPT 4A

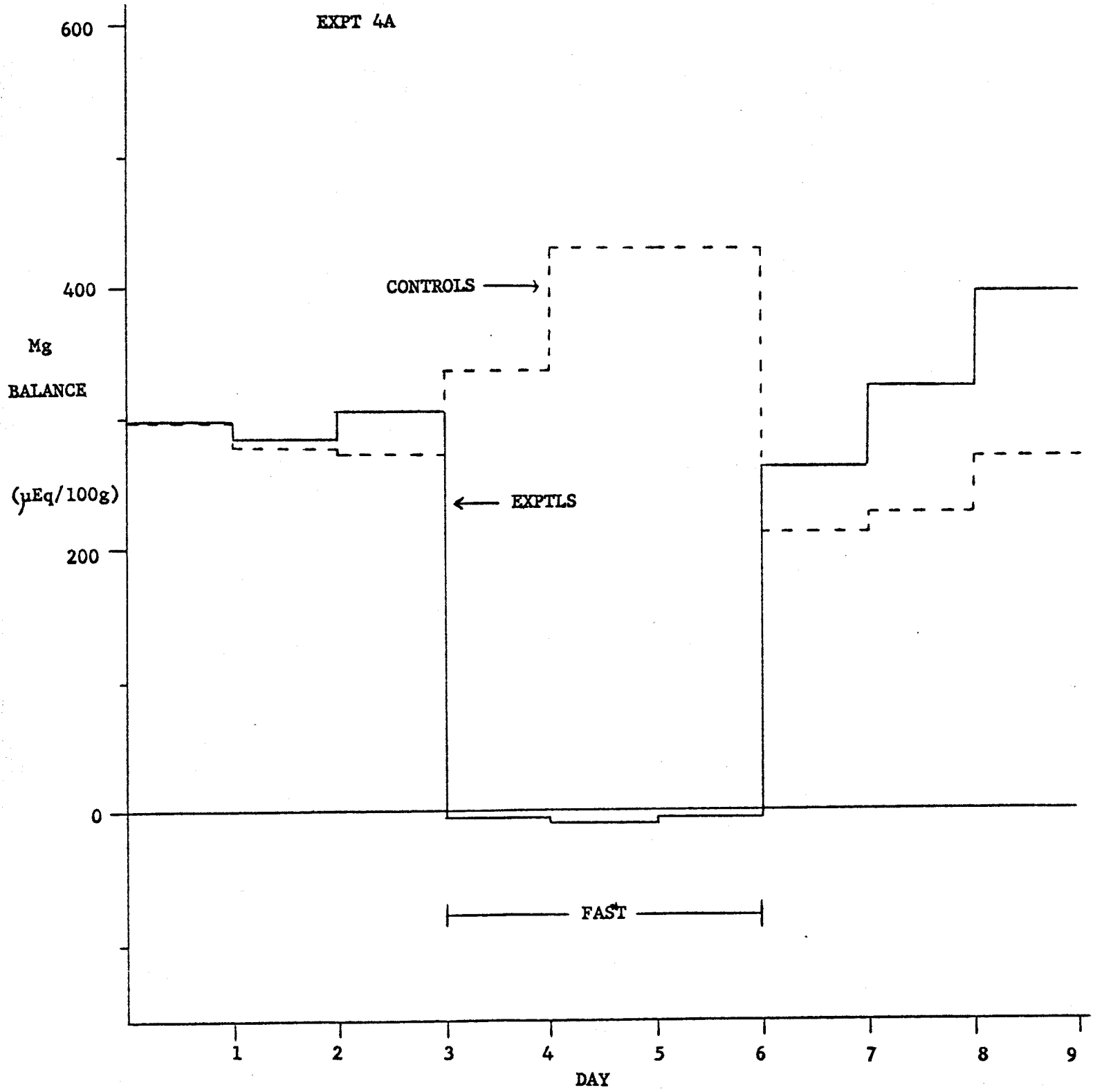
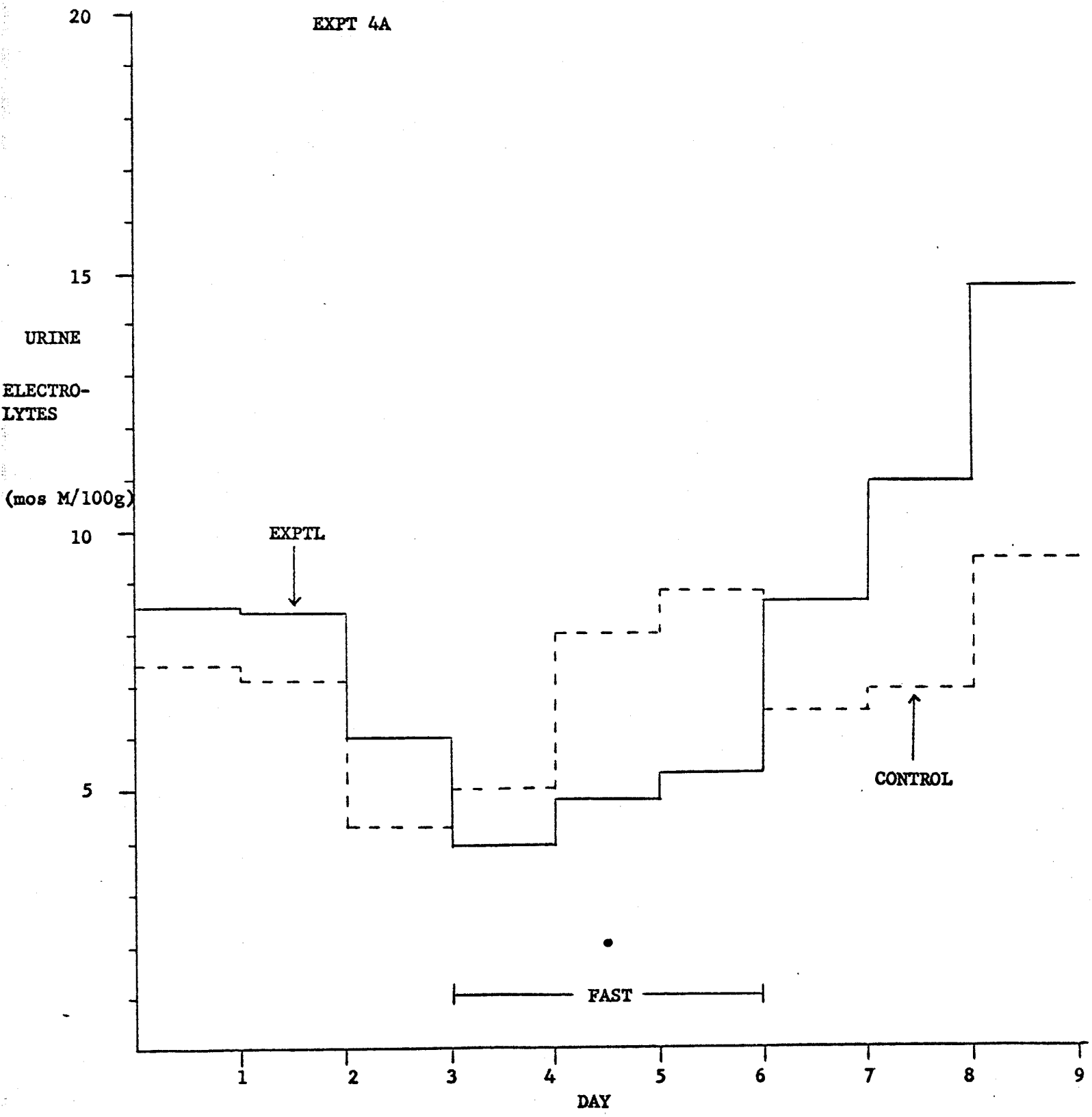


FIG. 42. URINE OSMOLALITY OF FASTED AND CONTROL RATS FED 40.46 mEq Na/100g NBC DIET.

FAST AT 3° C.



COMPARISON OF MEAN Na AND Mg LOST BY RATS FED PURINA AND NBC-2 DIETS.

FAST AT 3° C. EXPT. 16

	Pre-Exposure		Exposure	
Diet	Na Lost (mEq/100g)	Mg Lost (uEq/100g)	Na Lost (mEq/100g)	Mg Lost (uEq/100g)
Purina	0.87	2.58*	0.19*	2.59*
NBC-2	0.83	2.25	0.12	2.14

* = Significant difference at or less than the 0.05 level.

Purina = 20.26 mEq Na and 7.82 mEq Mg/100g diet.

NBC-2 = 20.26 mEq Na and 5.25 mEq Mg/100g diet.