

Physics 222
Spring 2004
Homework and Notes 3
Due 5pm, Friday, February 13, 2004

Reading Assignment: Nakahara, pp. 97–120. Again, I recommend Frankel, pp. 333–354.

1. Nakahara, problem 3.1, p. 120 (p. 87 in the first edition).
2. Nakahara, problem 3.2, p. 120 (p. 88 in the first edition).

Notes. Nakahara's Chapter 3 has many defects in its details, which you will see if you read the chapter carefully. If you find yourself confused by something he says, don't assume that it is your fault. Ask me about it if you want to be sure.

Note that Nakahara often writes 0 when he means $\{0\}$, that is, the Abelian group containing just one element. This leads to confusing looking things like $0/0$, when he means $\{0\}/\{0\}$. The latter is perfectly well defined. Each group, the numerator and the denominator, has one element, the identity, so the quotient group has just one element, too, the coset which is the whole group. The quotient group is also the trivial Abelian group, so $\{0\}/\{0\} \cong \{0\}$.

Nakahara writes \oplus when I would write \times , for example, his $\mathbb{Z} \oplus \mathbb{Z}$ is what I would write as $\mathbb{Z}^2 = \mathbb{Z} \times \mathbb{Z}$ (it is the set of ordered pairs of integers, (n_1, n_2)).

Nakahara's Lemma 3.2 and Theorem 3.2 (p. 97) are confusing because he never mentions that you have to change basis to bring the generators in the form he discusses, nor does he discuss the nonuniqueness in the generators. This was all taken care of by last week's notes. Some of the other theorems in the chapter are awkwardly done, for example, Theorem 3.5, p. 110.