

# Homework 1

Math 109 / Music 109A, Spring 2009

Due Monday, January 26.


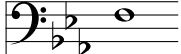


- For the following pairs of integers  $m, n$ , find the numbers  $q$  and  $r$  whose existence is asserted in the division algorithm:
  - $7, 37$  ;
  - $8, -43$  ;
  - $11, 11^{14} + 16$  ;
  - $4, 20k + 9$ , where  $k$  is some integer.
- Sketch the graphs of these functions, and indicate how each is obtained by geometric transformations (shifts and/or stretches) of simpler functions:
  - $f(x) = \frac{3}{2}x - 1$
  - $f(x) = 2x^2 + \frac{1}{2}$
  - $f(x) = 1 - \sin(4x)$
- For each of the following sets and relations determine whether or not an equivalence relation has been defined. Explain why or why not. If so, describe the set of equivalence classes.
  - The set of people having a single residence in the Missouri; “lives in the same county as as”.
  - $\mathbb{Q}; \geq$ .

(c)  $\mathbb{Z}$ ; for a fixed positive integer  $n$ ,  $\equiv$  defined by  $k \equiv \ell$  if and only if  $n \mid k - \ell$ .





(d) The set of keyboard note classes;  $\sim$  defined by  $N \sim N'$  if and only if the modular interval between  $N$  and  $N'$  is either the unison interval or a major third (up or down).

4. For the set  $\{(a, b) \in \mathbb{Z}^2 \mid b \neq 0\}$  show that the relation  $\sim$  defined by  $(a, b) \sim (a', b')$  if and only if  $ab' - a'b = 0$  is an equivalence relation and that the set of equivalence classes is in one-to-one correspondence with  $\mathbb{Q}$ .

5. Identify these notes by letter and subscript (e.g.,  $D_3$  or  $A_1^\sharp$ ):

(a)  (b)  (c)  (d) 

6. Identify these intervals by name and by measurement in semitones:

(a)  (b)  (c)  (d) 

7. Choosing an appropriate clef, write on staff paper, and name with subscript, the note which is:

(a) a major third above  $B_4^b$ .

(b) a fourth above  $F_3^\sharp$ .

(c) a major ninth below  $A_6^\sharp$ .

(d) a tritone above  $D_2$ .

8. Notate all the key signatures on a line of staff paper. Order the keys using flats by ascending number of flats and similarly for those using sharps. For each indicate the major key and the minor key it denotes.

