

## MAT 120

## Midterm Exam Part 1

Fall 2018

1. Which of the following are rational numbers? (Note: the first one terminates, the second one has a continuing pattern.)

i) .212112111

ii) .212112111...

iii)  $\sqrt{8}^6$

- a) all of them      b) i) and ii) only      c) iii) only      d) i) only      e) i) and iii) only

Correct Answer: i) and iii) only

2. Which of the following numbers are complex non-real? Here  $i$  is the square root of  $-1$ . (Hint: simplify first, where possible.)

i)  $\sqrt{-8} + \sqrt{8}$

ii)  $(1 + i)(1 + i)$

iii)  $\sqrt{-2}^5$

- a) all of them      b) i) and ii) only      c) i) only      d) iii) only      e) i) and iii) only

Correct Answer: all of them

3. The number  $2 - \left( \frac{9}{10} + \frac{9}{100} + \frac{9}{1000} + \dots \right)$  can be simplified to which of the following?

a)  $\frac{11}{10}$

b) 2

c)  $\frac{19}{10}$

d) 1

e)  $\frac{1}{10}$

Correct Answer: 1

4. Suppose that  $0 < r < 1$ . Simplify  $(1 - r^2)(1 + r + r^2 + r^3 + \dots)$ :

a) 1

b)  $r$

c)  $1 + r$

d)  $r^2$

e)  $\frac{1}{1-r}$

Correct Answer:  $1 + r$

5. Which frequency ratio is closest to the interval of a tritone? (A tritone is the same as a diminished fifth or an augmented fourth.)

a)  $\frac{40}{27}$

b)  $\frac{45}{32}$

c)  $\frac{32}{27}$

d)  $\frac{39}{27}$

e)  $\frac{7}{5}$

Correct Answer:  $\frac{45}{32}$

6. In the Just Major Scale, suppose we replace the first and last occurrence of a major whole with a minor whole tone, but we keep the major whole tone in the middle. Suppose that we also keep the perfect fourth at  $4/3$  and perfect fifth at  $3/2$  frequency ratios above the tonic. What should we use for the semitone frequency ratio so that this scale still covers exactly one octave?

a)  $29/28$

b)  $29/27$

c)  $27/25$

d)  $13/12$

e)  $25/24$

Correct Answer:  $27/25$

7. Same scale as in the previous question. What is the cent value, to the closest cent, of the frequency ratio for the semitone?

- a) 61                      b) 124                      c) 133                      d) 139                      e) 71

Correct Answer: 133

8. A frequency ratio of 12 corresponds to a just interval of three octaves plus which interval?

- a) major whole tone      b) minor whole tone      c) minor third      d) major third      e) perfect fifth

Correct Answer: perfect fifth

9. A frequency ratio of 12 is about how many semitones?

- a) 46                      b) 45                      c) 42                      d) 43                      e) 44

Correct Answer: 43

10. Approximately how many keys on an equal-tempered keyboard would a dog need in order to cover its entire frequency range, if the dog can hear frequencies from 80 Hz to 40000 Hz?

- a) 80                      b) 120                      c) 108                      d) 100                      e) 140

Correct Answer: 108

### The Meantone Major (Diatonic) Scale

$$\frac{1}{1} \rightarrow \sqrt{\frac{5}{4}} \rightarrow \frac{5}{4} \rightarrow \frac{\sqrt{2}}{\left(\frac{5}{4}\right)^{\frac{1}{4}}} \rightarrow \sqrt{2} \left(\frac{5}{4}\right)^{\frac{1}{4}} \rightarrow \sqrt{2} \left(\frac{5}{4}\right)^{\frac{3}{4}} \rightarrow \sqrt{2} \left(\frac{5}{4}\right)^{\frac{5}{4}} \rightarrow \frac{2}{1}$$

$$\left(\sqrt{\frac{5}{4}}\right) \quad \left(\sqrt{\frac{5}{4}}\right) \quad \left(\frac{\sqrt{2}}{\left(\frac{5}{4}\right)^{\frac{5}{4}}}\right) \quad \left(\sqrt{\frac{5}{4}}\right) \quad \left(\sqrt{\frac{5}{4}}\right) \quad \left(\sqrt{\frac{5}{4}}\right) \quad \left(\frac{\sqrt{2}}{\left(\frac{5}{4}\right)^{\frac{5}{4}}}\right)$$

### The Just (Natural) Chromatic Scale

$$\frac{1}{1} \rightarrow \frac{16}{15} \rightarrow \frac{9}{8} \rightarrow \frac{6}{5} \rightarrow \frac{5}{4} \rightarrow \frac{4}{3} \rightarrow \frac{64}{45} \rightarrow \frac{3}{2} \rightarrow \frac{8}{5} \rightarrow \frac{5}{3} \rightarrow \frac{16}{9} \rightarrow \frac{15}{8} \rightarrow \frac{2}{1}$$

$$\left(\frac{16}{15}\right) \left(\frac{135}{128}\right) \left(\frac{16}{15}\right) \left(\frac{25}{24}\right) \left(\frac{16}{15}\right) \left(\frac{16}{15}\right) \left(\frac{135}{128}\right) \left(\frac{16}{15}\right) \left(\frac{25}{24}\right) \left(\frac{16}{15}\right) \left(\frac{135}{128}\right) \left(\frac{16}{15}\right)$$