S5 Music Practice Paper I Intervals and tuning, tempo and duration, transposition, chords, dynamics and form

S5 Music I Time allowed: 75 minutes I Total: 100 marks I 24 questions

Part A Intervals, frequency ratios and cents

Question 1 (17 marks)

1. The standard pitch A4 is 440 Hz. Find the frequency of A5 and state the frequency ratio and the size of an octave in cents. (4 marks)

> **Answer:** An octave has a 2:1 ratio, so A5 = 440 x 2 = 880 Hz and the size is 1200 x log2 2 = 1200 cents.

2. In just intonation a perfect fifth has a 3:2 ratio. Find the frequency of E5 above A4 and the size of this interval in cents. (4 marks)

> **Answer:** E5 = 440 x 3 / 2 = 660 Hz; the interval is 1200 x log2(660 / 440) = 701.96 cents, slightly wider than 700.

3. In equal temperament E5 = 440 x 2^(7/12) = 659.26 Hz. Find its deviation from the just fifth in cents and say whether the difference is audible. (4 marks)

> **Answer:** The deviation is 1200 x log2(660 / 659.26) = 1.96 cents, well below 10 cents, so it is not normally audible.

4. Using A4 = 440 Hz, compare the frequency of a just major third (5:4) with an equal tempered major third in Hz and cents, and explain why pianos use equal temperament. (5 marks)

> **Answer:** Just third = 440 x 5 / 4 = 550 Hz; equal tempered third = 440 x 2^(4/12) = 554.37 Hz, which is 13.69 cents wider (the syntonic comma). Equal temperament splits the octave into twelve equal 100 cent semitones, so every key carries the same small error and no retuning is needed when modulating, which is why pianos use it.

Part B Beat values and total duration

Question 2 (17 marks)

5. A passage is in 4/4 with a crotchet = 120. Find the length of one bar in seconds and the playing time of a 32 bar piece. (4 marks)

> **Answer:** One beat is 60 / 120 = 0.5 s, so a four beat bar lasts 2 s; 32 bars = 64 s, that is 1 minute 4 seconds.

6. A waltz in 3/4 with a crotchet = 60 has 48 bars. Find the length of one bar and the total duration. (4 marks)

> **Answer:** Each beat is 1 s, so a bar lasts 3 s; 48 bars = 144 s, that is 2 minutes 24 seconds.

7. An introduction in 4/4 with a crotchet = 96 is 24 bars long. Find its duration, and the reduction in seconds if the tempo becomes crotchet = 120. (4 marks)

> **Answer:** At crotchet = 96 a bar lasts 2.5 s, so 24 bars = 60 s; at crotchet = 120 a bar lasts 2 s, so 24 bars = 48 s, a reduction of 12 s.

8. In a 4/4 passage at crotchet = 80, how many seconds does a dotted crotchet and a dotted minim each last? (5 marks)

> **Answer:** One beat is 60 / 80 = 0.75 s; a dotted crotchet is 1.5 beats = 1.13 s and a dotted minim is 3 beats = 2.25 s.

Part C Transposition and key signatures

Question 3 (16 marks)

9. How many sharps are in the key signatures of D major and A major, and which notes are they? (4 marks)

> **Answer:** D major has two sharps, F sharp and C sharp, and A major has three, F, C and G sharp. The order of sharps is always F, C, G, D, A, E, B.

10. A melody spans D4 = 293.66 Hz to B4. Find the frequency of B4, the name of the interval and the number of semitones. (4 marks)

> **Answer:** B4 = 293.66 x 2^(9/12) = 493.88 Hz. D4 to B4 is a major sixth, nine semitones or 900 cents.

11. If the melody is transposed up a perfect fifth into A major, find the transposition in cents and the frequency of the new lowest note. (4 marks)

> **Answer:** A perfect fifth is seven semitones or 700 cents, so the new lowest note is A4 = 293.66 x 2^(7/12) = 440 Hz.

12. After transposition the highest note is F sharp 5. Find its frequency and explain why accidentals must be rewritten to match the new key signature. (4 marks)

> **Answer:** F sharp 5 = 440 x 2^(9/12) = 739.99 Hz. The interval pattern is unchanged but the scale degrees are new, so the accidentals must be rewritten or the intervals will be wrong in performance.

Part D Scale and chord frequencies

Question 4 (16 marks)

13. Taking C4 = 261.63 Hz as the tonic, find the frequency of G4, the fifth degree of C major, and state how many semitones above C4 it lies. (4 marks)

> **Answer:** G4 = 261.63 x 2^(7/12) = 392.00 Hz, seven semitones above C4, which is a perfect fifth.

14. A just major triad has the frequency ratio 4:5:6. If the root is 264 Hz, find the three frequencies. (4 marks)

> **Answer:** The root is 264 Hz, the third is 264 x 5 / 4 = 330 Hz and the fifth is 264 x 6 / 4 = 396 Hz, so the ratio is 4:5:6.

15. In equal temperament with a root of 264 Hz, find the major third and perfect fifth, and give the deviation from just intonation in cents. (4 marks)

> **Answer:** The major third is 264 x 2^(4/12) = 332.62 Hz, 13.69 cents wider than 330 Hz, and the perfect fifth is 264 x 2^(7/12) = 395.55 Hz, 1.96 cents narrower than 396 Hz.

16. A G7 chord is built on G, B, D and F. Given G4 = 392.00 Hz, find the frequency of F5 and give the interval and semitone count from G to F. (4 marks)

> **Answer:** G to F is a minor seventh, ten semitones, so F5 = 392.00 x 2^(10/12) = 698.46 Hz. The minor seventh gives the dominant seventh chord its tendency to resolve.

Part E Dynamics, decibels and hearing protection

Question 5 (17 marks)

17. A full ensemble plays at about 100 dB while a solo plays at about 60 dB. Find the difference in decibels and the ratio of sound intensity. (4 marks)

> **Answer:** The difference is 40 dB, and the intensity ratio is 10^(40 / 10) = 10,000 times.

18. For the same 40 dB difference, what is the ratio of sound pressure amplitude? (4 marks)

> **Answer:** The pressure ratio is 10^(40 / 20) = 100 times. Decibels use 20 log10 for pressure, so every 20 dB means ten times the amplitude.

19. If the maximum safe exposure at 88 dB is 4 hours, and the allowed time halves for every 3 dB increase, find the limit at 94 dB. (4 marks)

> **Answer:** 94 - 88 = 6 dB, two 3 dB steps, so the limit is 4 / 2 / 2 = 1 hour.

20. A Chinese orchestra rehearsal lasts 2 hours at an average of 91 dB. Does it exceed the 88 dB / 4 hour standard, and what should be done? (5 marks)

> **Answer:** The limit at 91 dB is 4 / 2 = 2 hours, so a 2 hour rehearsal sits exactly at the limit. Use mutes, spread the seating, and schedule breaks to keep exposure below it.

Part F Musical form and playing time

Question 6 (17 marks)

21. A sonata form movement has a 96 bar exposition, 64 bar development, 96 bar recapitulation and 24 bar coda. Find the total bars and the percentage taken by the exposition. (4 marks)

> **Answer:** The total is 96 + 64 + 96 + 24 = 280 bars, and the exposition takes 96 / 280 x 100 = 34.3 per cent.

22. If the climax is placed at 61.8 per cent of the movement, the golden ratio, at which bar does it fall? (4 marks)

> **Answer:** The climax falls at 280 x 0.618 = 173.04, so about bar 173, at the end of the development just before the recapitulation.

23. The movement is in 4/4 at a crotchet = 132. Find the total playing time in seconds and in minutes. (4 marks)

> **Answer:** One bar lasts 60 / 132 x 4 = 1.82 s, so 280 bars = 509.1 s, that is 8 minutes 29 seconds.

24. If the exposition is repeated as marked, what are the new total bars and playing time? (5 marks)

> **Answer:** The total becomes 280 + 96 = 376 bars, so the playing time is 376 x 1.82 = 683.6 s, that is 11 minutes 24 seconds.
