NOTE: The exam will have many more questions than these examples.

5 Points Each, *Circle the best answer*

Assume a fluid with mass density of ρ=2000 kg/m^3 and compressibility of κ=10^{-6} Pa^{-1} for the questions below.

1. The phase velocity of a 1 kHz acoustic wave in the fluid in m/s is v_p=

   a) 200 b) 500 c) 1000 d) 2000 e) none above

2. The wavelength of a 1 kHz acoustic wave in the fluid is λ=

   a) 0.01 m b) 0.5 m c) 1 m d) 2 m e) none above

3. The wavenumber, or spatial frequency, of a 1 kHz acoustic wave in the fluid in rad/m is β=

   a) 0.12 b) 2.2 c) 4.3 d) 12.6 e) none above

4. The characteristic impedance of a 1 kHz acoustic wave in the fluid in N s/m^3 is Z_0=

   a) 2000 b) 5000 c) 8000 d) 10^4 e) none above

5. A valid pressure plane wave in the fluid would be $p(x,y,z,t)= [1\ 0\ 0]^T\ e^{-j12.6z}\ e^{-j2000\pi t}$.

   a) True b) False

6. For a mechanical mass+spring+dashpot parallel mechanical oscillator with parameters mass m=2 kg, compliance n=0.125 m/N, and damper mechanical resistance r=0.5 N/(m/s), the Q of the system is Q=

   a a) 1/4 b) 1/2 c) 1 d) 8 e) none above

7. For the scalar pressure field $p(x,y,z,t)=2y^3z$ the gradient is ∇p =

   a) $[0 \;\; 6y^2z \;\; 2y^3]^T$ b) $[3x^3z \;\; 0 \;\; y^3]^T$ c) $[y^3z \;\; xy^2 \;\; z]^T$ d) $[0 \;\; 3y^2z \;\; y^3]^T$ e) none above

8. For the two vectors $\mathbf{v_1}=[2\ 2\ 2]^T$ and $\mathbf{v_2}=[3\ 2\ 1]^T$ the inner product , or dot product, is

   a) $[2\ -4\ 6]^T$ b) 10 c) 20 d) 32 e) none above

Assume a mechanical wave mass+spring transmission line with mass density of m_R=2 kg/m and compliance-per-unit-length of n_R=0.5 N^{-1} for the questions below.

9. The phase velocity of a 1 kHz mechanical wave in the systemin m/s is v_p=

   a) 1 b) 4 c) 40 d) 400 e) none above

10. The wavelength of a 1 kHz mechanical wave in the transmission line is λ=

    a) 0.001 m b) 0.04 m c) 0.1 m d) 0.2 m e) none above

Assume a 2 m longpiston of 0.001 m^2 area is filled with fluid with mass density of ρ=4 kg/m^3 and compressibility of $\kappa=10^{-6}$ Pa^{-1} for the questions below.

11. The piston is equivalent to a spring with compliance in m/N of n=

    a) 0.001 b) 0.004 m c) 0.04 d) 0.02 e) none above