Answers to Sample 1 Final Exam

Question 1 not released

Question 2a) A=C>E>B=D

Question 2b) a) 3430 Pa, b) 0.16 m/s, 0.343 m

Question 3

a) A_A=0.40 m A_B=0.40 m T_A= 3.0 s, T_B = 4.0 s

b) ϕ_A=0 rad, ϕ_B= ± π

$$x_1(t) = (0.40m)\cos(\frac{2\pi}{3}t)$$

c) $$x_2(t) = (0.40m)\cos(\frac{2\pi}{4}t + \pi)$$

d) 2.62 rad

e) 0, 2s, 4s, ..

f) 3s

Question 4a

i) 1, 4, 5, ii)4>1>2=6>3=5 iii) 4>1>6>2>3=5

iv) (2cm)sin(4x-3t) v) (2cm) sin(4x+3t+π)

Question 4b)

i) constructive, ii) 85 Hz, iii)constructive for f=85Hz, iv) Yes constructive inteference becomes destructive interference for all frequencies

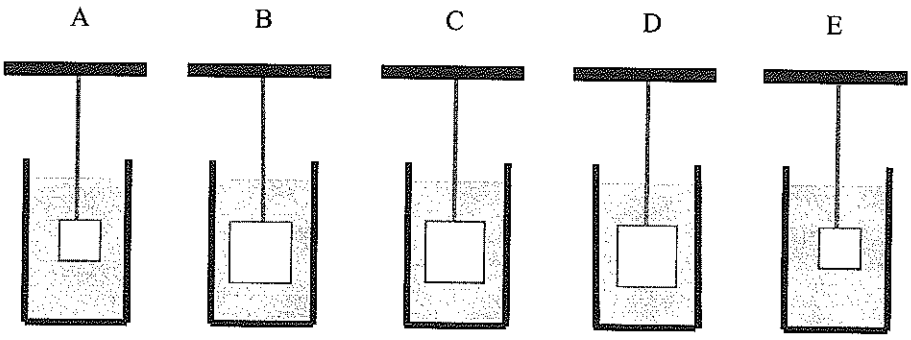
Question 5a

i) π rad, ii) 0 rad, iii) 2nt=(m+0.5)λ, 395 nm

Question 5b

i) 2.5 mm, ii) 10 mm, iii) 7

Question 2 a – Ranking test: Blocks suspended in water **(5 marks)**



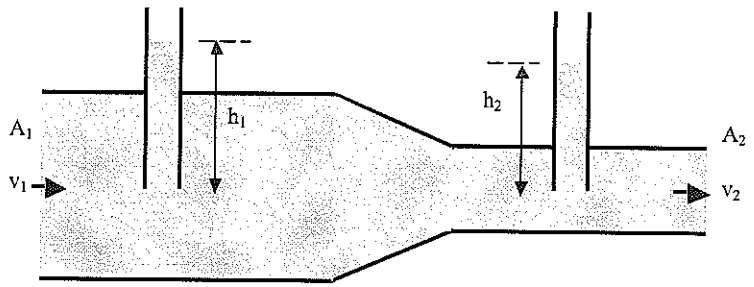
The six containers above each contain the same volume of water. Blocks of various solid materials are suspended in the containers by being hung from a supporting rod. The blocks vary in both size and mass as given in the diagram, note the mass given is in grams. Rank these situations from the greatest to the least on the basis of the tensions in the strings. Point out situations where the string tensions are equal.

_____ _____ _____ _____ _____

Largest Tension Smallest Tension

Question 2b (10 marks)

Two open–ended glass tubes inserted into a horizontal pipe are often used together to measure flow velocity in a pipe. This configuration is called a Venturi meter. Consider the arrangement below, where $A_1 = 0.500\ m^2$ and $A_2 = 0.200\ m^2$. The two vertical tubes are open to the atmosphere and the fluid is water.

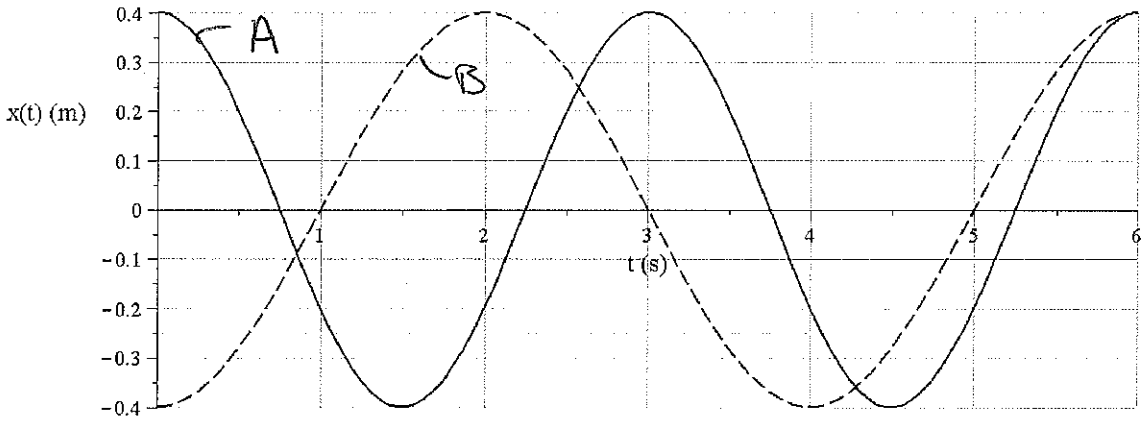


a) If $h_1 = 0.350$ m, what is the gauge pressure P_1 in the horizontal pipe on the left?

b) If $v_2 = 0.40$ m/s, calculate the velocity v_1 and the height h_2

Question 3 (15 marks)

The position versus time plots of two simple harmonic oscillators, A (represented by the solid curve) and B (represented by the dash curve) are shown in the figure below.



(a) What are the amplitudes and time period for these oscillators?

Amplitude of A = Amplitude of B =

Time Period of A = Time Period of B =

(b) What are the phase constants of these oscillators?

Phase constant of A = Phase constant of B =

(c) For each oscillator write an equation that gives position as a function of time, evaluate all constants.

(d) What is the phase difference between the two oscillators at $t = 1.0$ s?

(e) For oscillator B, at what time(s), less than $t = 6$ s, does it have zero velocity?

(f) For oscillator B, at what time(s), less than $t = 6$ s, is it moving with maximum speed in the negative x-direction?

Question 4a (8 marks)
Six waves are described by the following equations, (distances in cm, time in seconds).

$$D_1 = 2\sin(3x - 4t) \qquad D_2 = 2\sin(4x + 3t)$$
$$D_3 = 2\sin(-6x - 2t) \qquad D_4 = 2\sin(-2x + 6t)$$
$$D_5 = 2\cos(6x - 4t) \qquad D_6 = 2\sin(4x + 4t - \pi)$$

i) Which of these waves are traveling in the negative x-direction?

ii) Rank the waves according to their wavelength (Use = if appropriate)

Greatest _____ _____ _____ _____ _____ _____Smallest

iii) Rank the waves according to their wave speed. (Use = if appropriate)

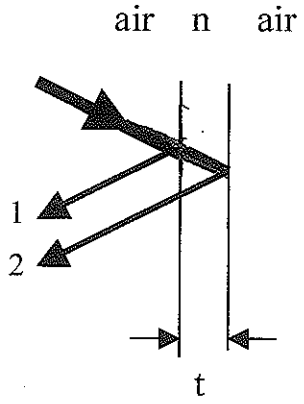
Greatest _____ _____ _____ _____ _____ _____Smallest

iv) Write the equation of the wave which when combined with wave 2 will give a standing wave.

v) Write the equation of a wave which interferes destructively with wave 2.

Question 5a (7 marks)

A thin film of material of thickness t and refractive index n=1.33 is suspended in air. Light of wavelength λ is incident normally onto the film.



i) What is the phase change on reflection for beam 1?

ii) What is the phase change on reflection for beam 2?

iii) Write down an equation for constructive interference of the two beams.

iv) Light of two wavelengths $\lambda_1 = 420$ nm and $\lambda_2 = 700$ nm are incident on the film. What is the minimum thickness when both wavelengths are reflected with maximum intensity?

Question 5b (8 marks)

i) Coherent light of wavelength 500 nm is incident normally on two very fine slits separated by 0.30 mm. Interference fringes are viewed on a screen distant 1.5 m from the slits. What is the separation of the bright fringes close to the centre of the pattern?

ii) The two slits are replaced by another pair also separated by 0.30 mm, but with a finite slit width of 0.075 mm. At what position at either side of the central point is the first diffraction minimum?

iii) For the pair of slits in ii), how many bright fringes are in the central diffraction peak? Sketch the intensity for this pair of slits