Multiple Choice Questions – 2 marks for each, assume g = 9.8 m/s^2
Please enter your answers on the front page

MC1 An object is suspended vertically from an ideal spring. After pulling down and releasing the object, it oscillates about the equilibrium position. The elastic potential energy of the system

a) is greatest when the spring has its minimum length.

b) is greatest at the equilibrium position.

c) is greatest when the spring has its maximum length.

d) is greatest when the spring is moving the fastest.

e) is the same everywhere.

MC2 Light with wavelength λ_0 and frequency f_0 enters a medium with refractive index 1.5. Inside this medium the wavelength and frequency are:

	wavelength	**frequency**
a)	$1.5\lambda_0$	f_0
b)	$\lambda_0/1.5$	$1.5f_0$
c)	λ_0	$f_0/1.5$
d)	$\lambda_0/1.5$	f_0
e)	λ_0	f_0

MC3 The density of salt water is $\rho = 1030$ kg/m^3. What is the absolute pressure at a depth of 500 m below the ocean's surface?

a) 4.90×10^6 Pa b) 5.00×10^6 Pa c) 5.05×10^6 Pa

d) 5.15×10^6 Pa e) other _____

MC4 A single pipe with cross-sectional area A divides into three smaller pipes each with cross-sectional area A/16. If the speed of the fluid in the larger pipe is 10 m/s, then the speed of the fluid in one of the smaller pipes is:

a) 1.9 m/s b) 3.3 m/s c) 10 m/s d) 53 m/s

e) 160 m/s f) other _____

MC5 On Earth a mass is hung from an unstretched spring, it is released and the mass oscillates vertically. This same mass and spring are taken to the Moon where the acceleration due to gravity is 1/6 of that on Earth. The mass again is hung from the unstretched spring and released.
Does the amplitude and frequency of the oscillation change?

a) the amplitude would increase but the frequency of oscillation would remain the same
b) the frequency of oscillation would increase but the amplitude would remain the same
c) the amplitude of oscillation would decrease but the frequency would remain the same
d) the frequency of oscillation would decrease but the amplitude would remain the same
e) both amplitude and frequency would increase
f) both amplitude and frequency would decrease

MC6 At t = 0, a mass-spring system begins to oscillate with amplitude A. The system is damped with $b/2m = 1$. What is the amplitude at t = 3 s?

a) 3A b) A/2 c) A/3 d) A/4 e) less than A/4

MC7 A listener measures the sound intensity from a loud source of sound and finds that the sound intensity is 90 dB. She moves 10 times further away from the source of the sound. The sound intensity level measured by the listener is now most nearly:

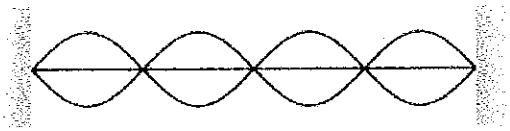
a)80 dB b) 70 dB c) 60 dB d) 50 dB e) 40 dB

MC8 Which of the following waves has the greatest wavespeed? *(x is in meters and t is in seconds)*

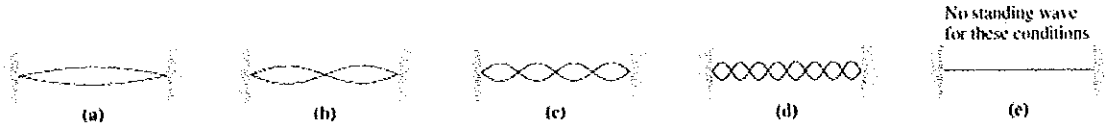
a) $D_a = (3.0\text{cm})\sin(3x - 3t)$ b) $D_b = (1.0\text{cm})\sin(x + 2t)$ c) $D_c = (2.0\text{cm})\sin(4x - 5t)$

d) $D_d = (5.0\text{cm})\sin(12x - 3t)$ e) $D_e = (5.0\text{cm})\sin(2x - 12t)$

MC9 A standing wave on a string vibrates as shown.



Suppose the tension is quartered, i.e. to T/4, while the frequency and the length of the string is held constant. Which standing wave pattern is produced?



MC10 Young's double-slit experiment is performed using laser light of 600 nm, resulting in a series of interference fringes illuminating a screen some distance L away. Then the entire apparatus (laser, double slits, and screen) are ALL submerged in water. What will happen to the interference pattern?

a) The fringes will move closer together.

b) The fringes will move farther apart.

c) The pattern will not change.

d) The central bright fringe will become a dark fringe.

e) All the dark fringes will become bright fringes and vice a versa.

MC11 Two violin strings are tuned to the same fundamental frequency, 294 Hz. The tension in one string is then decreased by 2.0 percent. What will be the beat frequency when the two strings are played together?

a) 2 Hz b) 3 Hz c) 4 Hz d) 6 Hz

e) Greater than 6 Hz

MC12 Which of the following actions will improve the resolving power of a microscope

a) increase the wavelength of the light used

b) decrease the wavelength of the light used

c) increase the diameter of the lenses

d) decrease the diameter of the lenses

e) both b) and c) f) both b) and d)

g) both a) and c) h) both a) and d)

MC13 When at rest a source produces a 800 Hz sound. When it moves towards you at 30 m/s, and you approach it at 20 m/s, what tone (frequency) do you hear? Assume the speed of sound is 340 m/s.

a) 692 Hz b) 778 Hz c) 822 Hz d) 826 Hz

e) 925 Hz f) 929 Hz g) 955 Hz

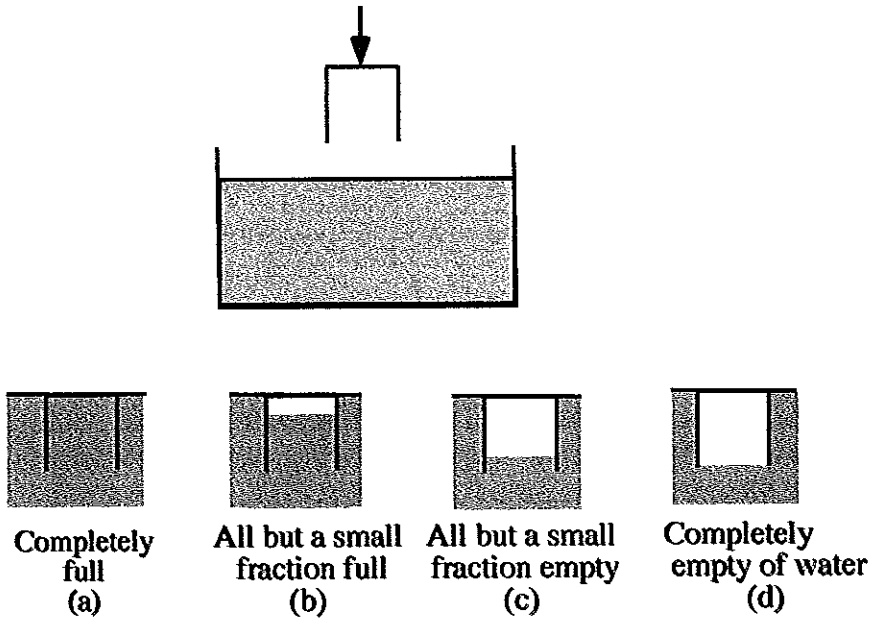
M14 Light with wavelength 600 nm, illuminates a diffraction grating. If the first order (m=1) maximum occurs at an angle of 10°, at what angle will the fourth (m=4) order maximum occur?

a) 40.0° b) 42.0° c) 44.0 ° d) more than 45.0°

MC15 A spring when compressed 20 cm has 10 J of elastic energy. The spring is then cut in half. If one of the halves is compressed by 20 cm. How much potential energy is stored in the half spring?

a) 5J b) 10 J c) 14 J d) 20 J e) 40 J

MC16 An empty glass is lowered, open end first into a sink full of water until the bottom of the glass is level with the surface of the water. The lowering is done very carefully so that no air escapes. Which of the diagrams given (a to d) best shows how far up the inside of the glass the water will go.



MC17 A wave on a string is described, in SI units, by the equation:

$$D(x,t) = (0.004m)\sin(300t - 15x).$$

What is the maximum speed of a particle on the string?

a) 20.0 m/s b) 8.37x10-5 m/s c) 1.20 m/s d) 0.060 m/s

e) 5.56m/s

MC18 Two big boxes are sitting on the floor. One of them weighs 10 N and has a base which is 1m by 1m. The other is bigger – it weights 40 N and has a base of 2m by 2m. Comparing the two, which exerts more pressure on the floor and by how much.

a) The smaller one exerts 4 times the pressure.

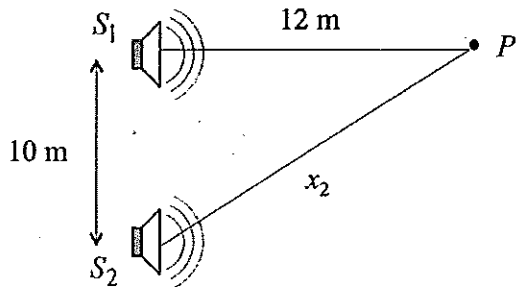
b) The smaller one exerts twice the pressure.

c) The larger one exerts 4 times the pressure.

d) The larger one exerts twice the pressure.

e) They both exert the same pressure.

MC19 Two loud speakers, S1 and S2, are 10.0 m apart. The speakers emit the same frequency of sound wave, but are out-of-phase by π. A person standing at point P (as shown in the figure) hears a maximum. What is the lowest possible frequency emitted by the speakers? *(use v =340 m/s for the speed of sound).*



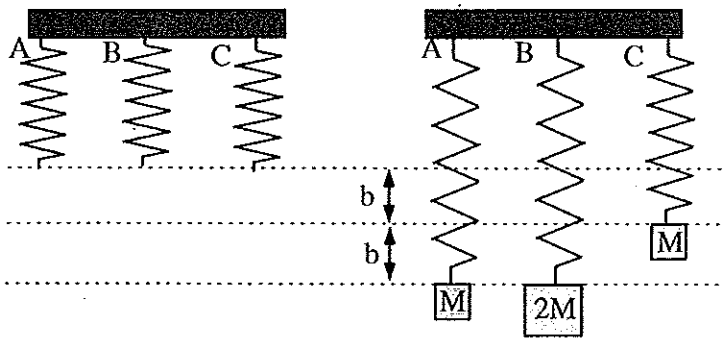
a) 170 Hz b) 94 Hz c) 85 Hz d) 47 Hz

e) less than 20 Hz

MC20 The period of a simple pendulum in a grandfather clock on another planet is 1.36 s. What is the acceleration due to gravity on this planet? Assume that the length of the pendulum is 1.00 m.

a) 19.8 m/s^2 b) 21.3 m/s^2 c) 23.4 m/s^2 d) 25.6 m/s^2

Question 2a *(5 marks)*
Three different springs, A, B and C, are suspended from the same support. All the springs have the same unstretched length.
Masses (M or 2M) are hung motionless from the springs and rest at their equilibrium positions as shown.



i) Rank the springs according to their spring constants, use = if appropriate

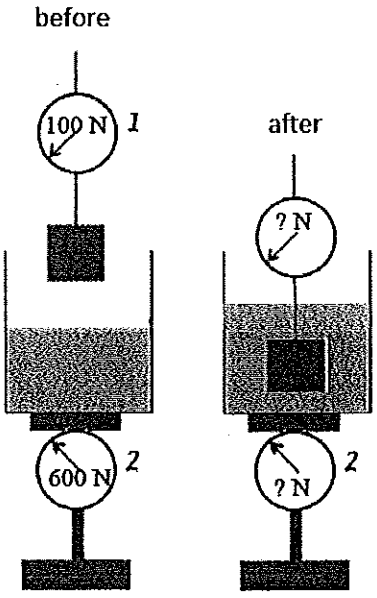
_____ _____ _____
smallest k largest k

ii) Rank the springs according to their period of oscillation

_____ _____ _____
smallest T largest T

Question 2b *(6 marks)*
A block with density 2.00×10^3 kg/m^3 hangs from **Scale 1**which reads 100 N.
A large beaker of water sits on **Scale 2**, which reads 600N.

The block is then lowered into the water. When the block is totally submerged but **not** sitting on the bottom of the beaker. What do the 2 scales read?

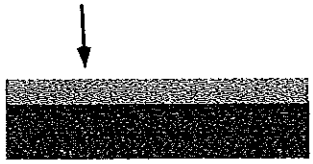


i) **Scale 1** reads _____N

ii) **Scale 2** reads _____N

Question 3 *(7 marks)*

Visible light (400-750 nm) is incident normally on a piece of glass with a film of water on top – see diagram (not to scale). The water is 700 nm thick.



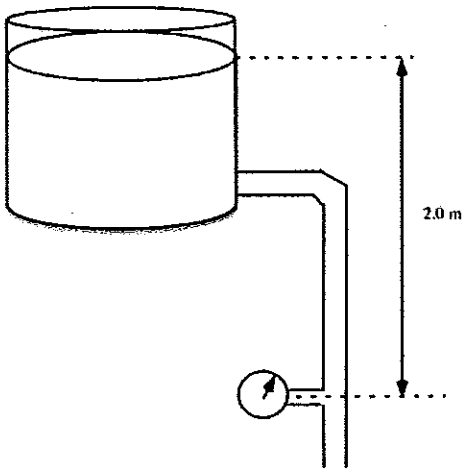
i) For which wavelength(s) will the reflected light be the brightest (interferes constructively). Clearly show your reasoning. *You can ignore reflections from the bottom of the glass layer.*

Wavelength(s) _____

ii) For which wavelength(s) will there be no reflected light (interferes destructively)?

Wavelength(s) _____

Question 4 *(6 marks)*
The figure shows a large uncovered container used to brew beer (ρ_{beer}=1015 kg/m^3). The cross-sectional area of the container is 4.00 m^2.
On one side of the container is a pipe used to take samples of the beer. Attached to this pipe is a pressure gauge.

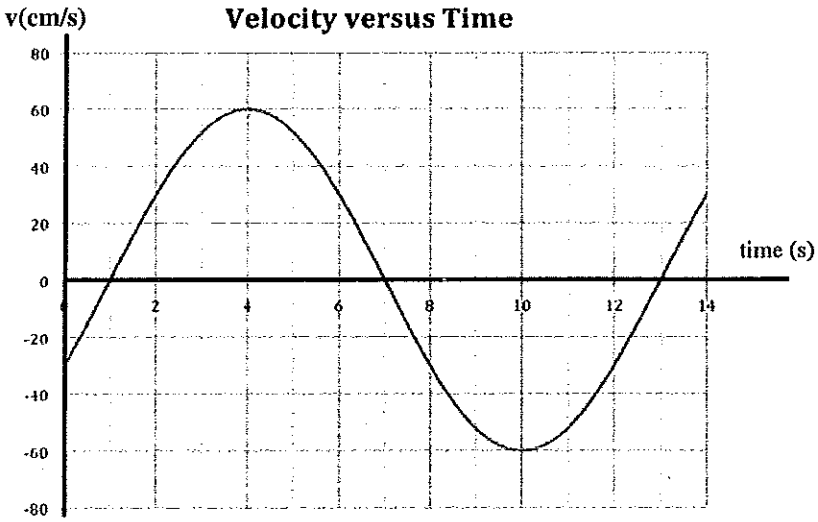


At a given **instant** in time when the beer level is 2.00 m above the pressure gauge, the level of the beer in the container is dropping at a rate of 1.00 cm/s and the speed of beer moving past the pressure gauge is at 50.0 cm/s.

Determine the absolute pressure reading of the gauge at this instant.

Pressure gauge reads _____

Question 5 *(11 marks)*
A mass on a spring is undergoing simple harmonic. A plot of its **velocity** as a function of time is shown.



a) What is the maximum speed and period of oscillation?

V_m = _____

T= _____

b) Find the amplitude, A, of the oscillation (i.e. the maximum displacement of x)

A= _____

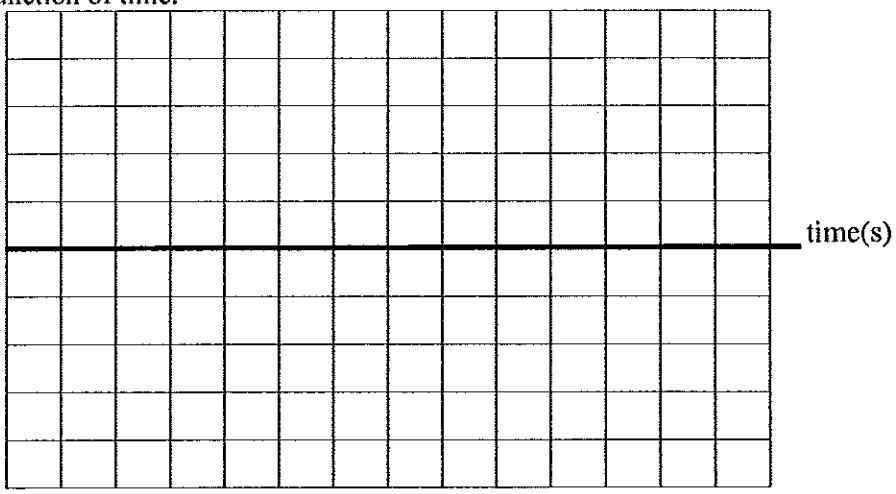
c) Find the phase constant, explain how you determined this.

ϕ_0 = _____

d) Find the position at t = 0s

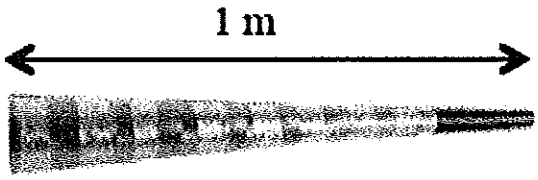
x(t=0) = _____

e) Sketch the **displacement** as a function of time.



Question 6 *(7 marks)*

A basic horn, like the one in the figure, became popular during the 2010 World Cup in South Africa. The horn, called a "vuvuzela" can be described as a tube open at one end and closed at the other.



a) If the horn is 1.00 m long, what is its fundamental frequency? Assume the speed of sound is 340 m/s.

Fundamental frequency _____

b) What are the frequencies for the next two resonances (standing waves)?

Frequencies are _____ and _____

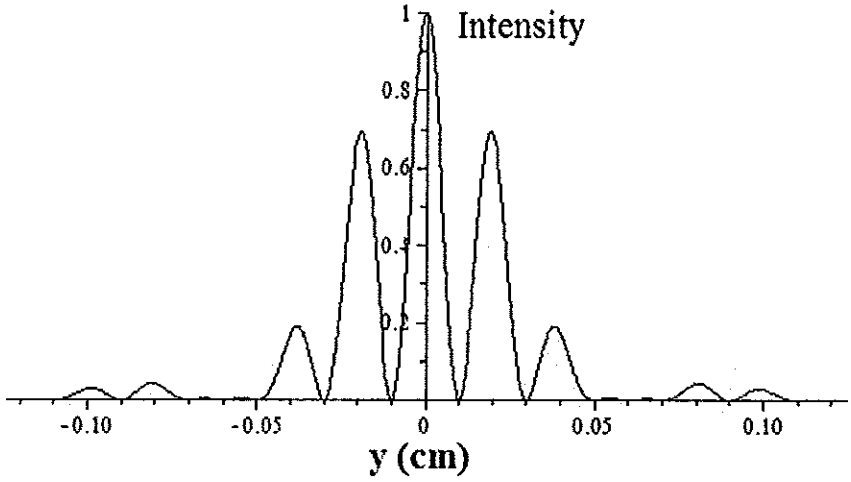
c) In order to increase the fundamental frequency by 20 Hz, you have to do what to the length of the horn?

shorten it / lengthen it

d) By how much do you need to change the length?

Question 7 *(8 marks)*

The intensity graph for light of wavelength 400 nm emerging from two sits of equal and finite widths is shown in the figure. The distance from the slits to the screen is 3.00 m. The first diffraction minima occurs at y = ± 0.060 cm from the central axis, as shown in the graph.



a) Calculate the width of the slits.

Slit width = _____

b) What is the distance between the two slits?

Slit separation = _____

c) What is the path difference between the waves emerging from the two slits that interfere at y= + 0.020 cm.

Path difference = _____

d) If the slit width is doubled, how many bright fringes will be seen between y= – 0.06 cm and y = + 0.06 cm? Explain your answer.

Number of bright fringes = _____

End of Exam - please ensure your answers to Question 1 are entered on the cover page.