Q1 MC 1
2 Points
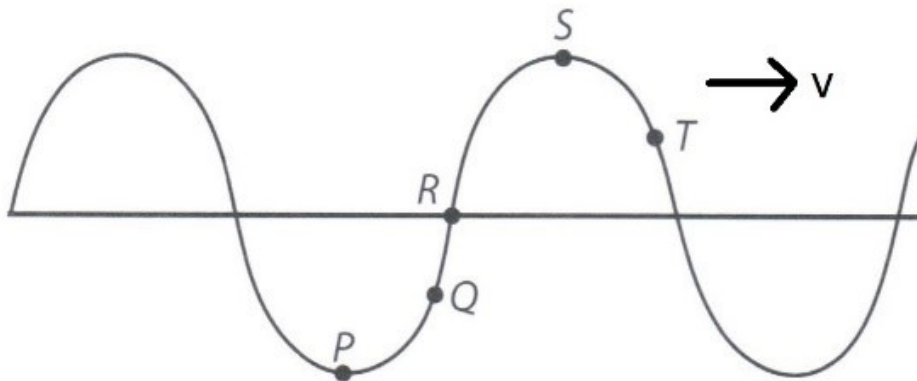
A hollow steel ball of diameter 3 m barely floats in water. What is the wall thickness of the ball? ($\rho_{Fe} = 7.87 \ g/cm^3$

- ◉ 6.6 cm
- ○ 37 cm
- ○ 131 cm
- ○ 79 cm

Q2 MC 2
2 Points

A transverse wave is moving to the right as shown. Which particle moves fastest at this moment?
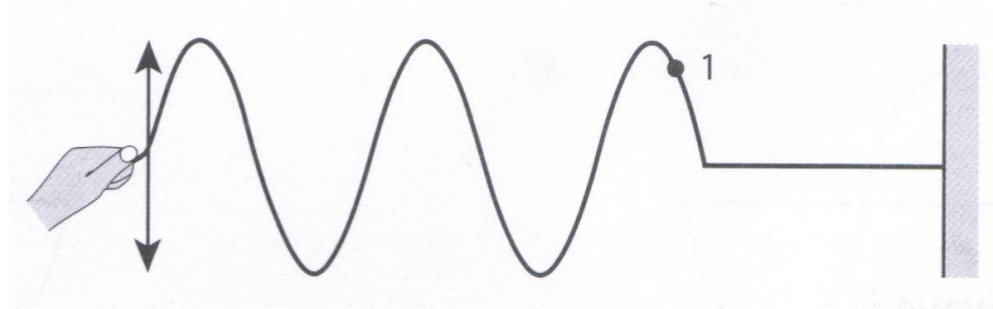

- ○ P & S
- ○ Q
- ◉ R
- ○ T
- ○ They all moves at the same speed

Q3 MC 3
2 Points

A rope is attached to a wall at one end and the other end is held by the hand of a student as shown below. The student moves the rope up and down periodically and a wave is produced in the rope.

Which of the following statement(s) concerning wave is/are true?
(1) The wave is a transverse wave.
(2) The particle at position 1 on the rope moves to the wall.
(3) Energy is propagated from position 1 to the wall.
(4) The wave will be inverted when it reflects at the wall.

○ (1), (2), and (3)

◉ (1), (3), and (4)

○ (2), (3), and (4)

○ All are true

Q4 MC 4
2 Points

20°C water flows at an average speed of 4.0 m/s through a 10 m long garden hose, 2.5 cm in diameter that is lying flat on the ground. What is the pressure of the water where it enters the hose? The viscosity of water at 20°C is 1.0 x 10^{-3} Pa s.

⊙ 2.048 x 10^3 Pa

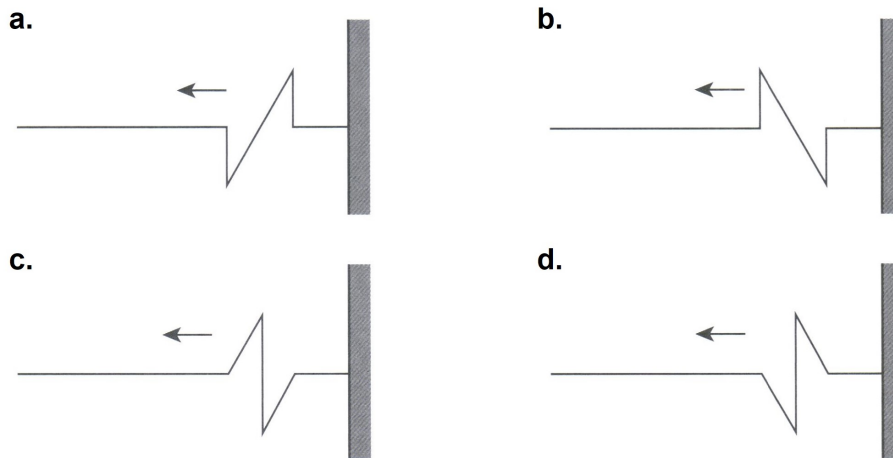◯ 1.013 x 10^5 Pa

◯ 1.018 x 10^5 Pa

◯ 1.033 x 10^5 Pa

Q5 MC 5

2 Points

A pulse is sent along a string towards the fixed end as shown in the following diagram.
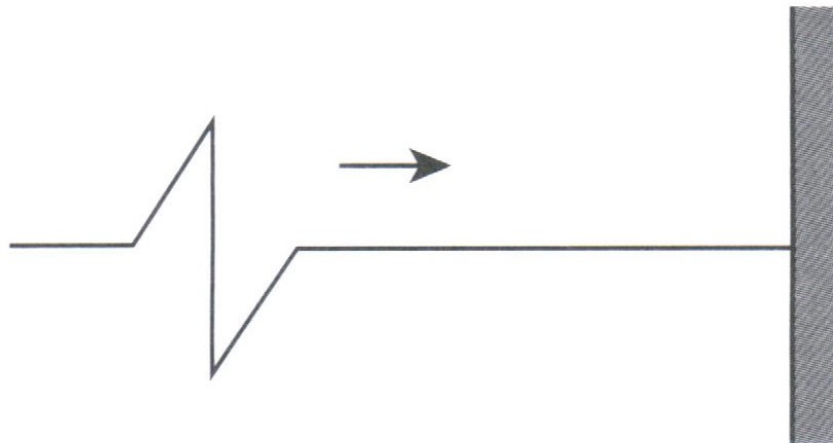
Which one of the following diagrams correctly shows the reflected pulse from the fixed end ?

a.

b.

c.

d.

○ a

○ b

◉ c

○ d

Q6 MC 6
2 Points

An ambulance is approaching a vehicle from behind. Its siren emits sound at a frequency of 700 Hz. If the driver of the vehicle heard the frequency of the siren to be 705 Hz. What is the speed of the ambulance if the vehicle is moving at 16 m/s same direction as the ambulance? The speed of sound is 343 m/s.

○ 13.5 m/s

◉ 18.3 m/s

○ 18.6 m/s

○ 13.7 m/s

Q7 MC 7
2 Points

A parent is pushing a young child on a swing at the playground. When the parent stops pushing, the child's swinging motion continues without assistance. Assume the chain on the swing has negligible mass and any friction is negligible. Which of the following would need to be true in order for the child's motion on the swing to be considered simple harmonic motion?

I.　　The mass of the child is not too large

II.　　The child is not swinging too high, so the angle is not too big

III.　　The tension in the chain of the swing is negligible

○ I only

◉ II only

○ III only

○ I and II

○ I, II, and III

Q8 MC 8
2 Points

The sound intensity from a speaker is 2.0 W/m^2 at a distance of 2.0 m from the speaker. If you move to a distance 63.2 m from the speaker, what would be the perceived loudness compare to that at 2 m from the speaker?

○ Increase by a factor of 1000

○ Decrease by a factor of 1000

○ Increase by a factor of 8

◉ Decrease by a factor of 8

Q9 MC 9
2 Points

What is the range of weight that a 50 kg person could lift by standing on one piston of a hydraulic jack, if the jack's pistons are circular and

have radii of 3.5 m and 10 m?

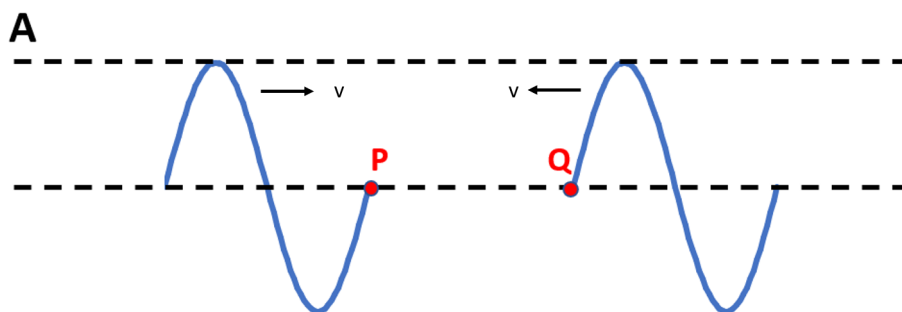○ Greater than or equal to 171 N

○ Greater than or equal to 1400 N

○ Less than or equal to 1400 N

○ Greater than or equal to 4000 N

◉ Less than or equal to 4000 N
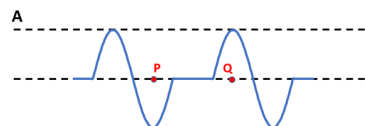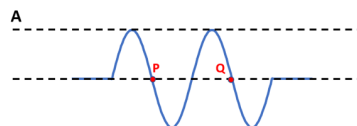
Q10 MC 10
2 Points

Two identical waves with amplitude A approach each other in the same rope at the same time (t=0) as shown below. PQ is equal to the wavelength of the waves.

At t = 3T/4, the shape of the rope will look like

a)

b)
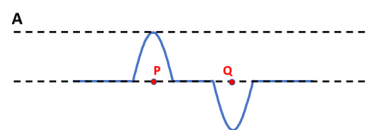
c)
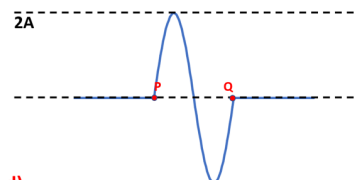
d)

- ○ (a)
- ○ (b)
- ◉ (c)
- ○ (d)

Q11 Prob 1
30 Points

Normal atmospheric pressure is $1.013 \times 10^5\,Pa$. The approach of a storm causes a decrease in the atmospheric pressure. You have a device as shown below to determine the atmospheric pressure. The glycerin within the tube flows to the right with a volume flow rate of $1.05 \times 10^{-2}\ m^3/s.$ $\rho_{glycerin} = 1260\ kg/m^3.$
Answer in 3 significant figures (Show your work)

Q11.1 Prob 1a
5 Points

What is the speed of the glycerin flowing at point A ?

Answer in 3 significant figures

12.5 m/s

Q11.2 Prob 1b
20 Points

What is the absolute pressure at point B?

Answer in 3 significant figures

1.06*10^5 Pa

Q11.3 Prob 1c
5 Points

What is the atmospheric pressure in atm?

Answer in 3 significant figures

0.973 atm

Upload your work for the whole problem:

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FRQ (Q1) $)^{30}$

a) $Q = 1.05 \times 10^{-2} \, m^3/s$

$P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$

Q12 Prob 2
25 Points

A 3.8 kg block is attached to a vertical spring with spring constant 18 N/m. At one instant, the block is at 5.4 cm above equilibrium position and has velocity 30 cm/s.

Answer in 3 significant figures (Show your work)

Q12.1 Prob 2a
6 Points

Determine the amplitude of the oscillation.

Answer in 3 significant figures

> 14.8 cm

Q12.2 Prob 2b
9 Points

One end of a 60 g string is tied to the block and the other end to a pole as shown in the above figure. The string is 8.0 m long. The oscillation of the ball produces a wave of wavelength 0.6 m travels in the +x direction along the sting. What is the tension of the string?

Answer in 3 significant figures

> 3.23*10^-4 N

Q12.3 Prob 2c
10 Points

At x = 0.80 m and t = 0, D(0.8,0) is a crest. Write a complete expression (in terms of **sine** function) for the displacement of the
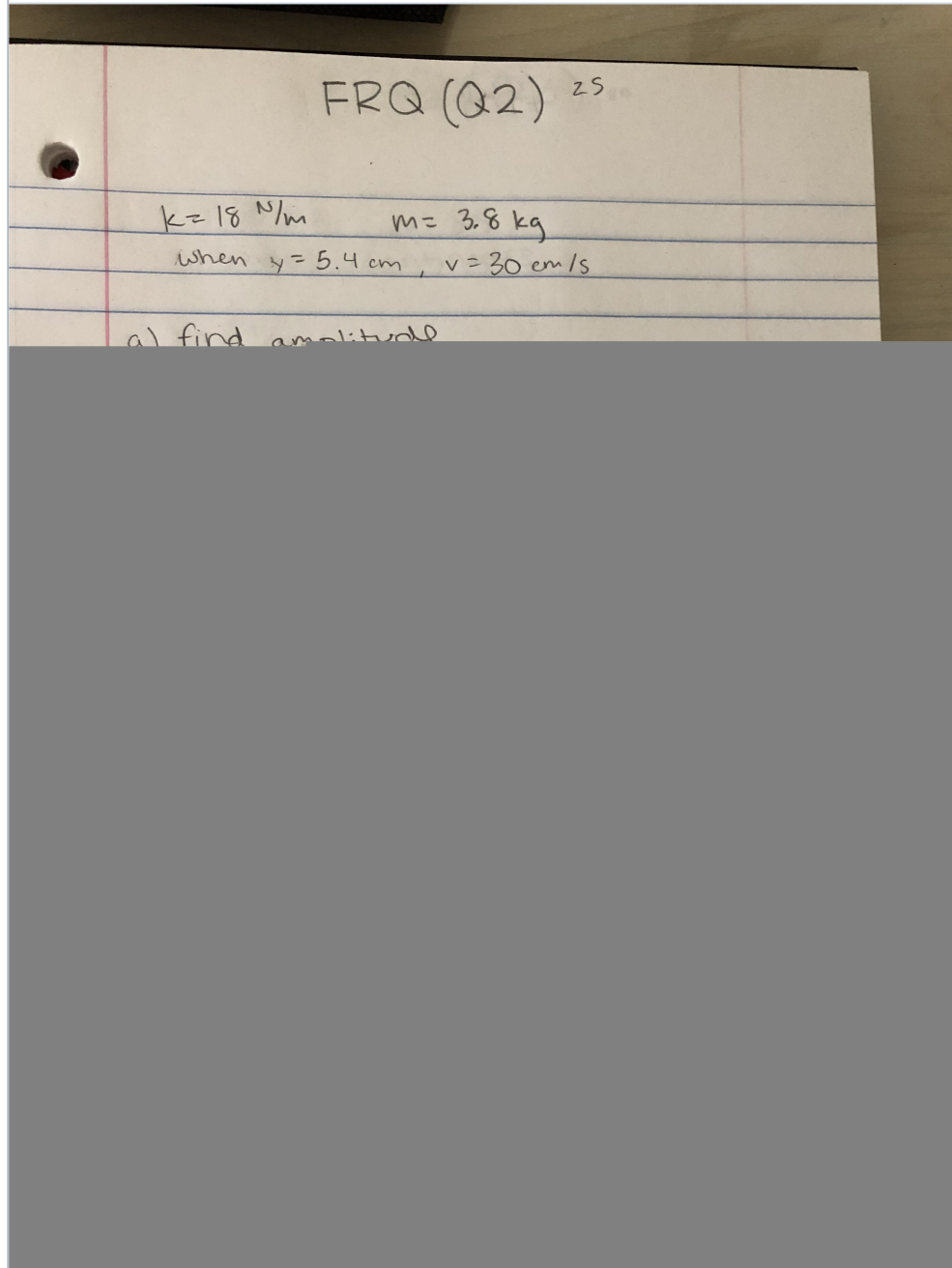
string as a function of position x and t in SI units.

Answer in 3 significant figures

d(x,t) = 0.148 * sin ((2pi/0.6)*x - 2.18*t - 0.524)

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FRQ (Q2) ²ˢ

$k = 18 \ N/m$ $m = 3.8 \ kg$

when $y = 5.4 \ cm$, $v = 30 \ cm/s$

a) find amplitude

Q13 Prob 3
20 Points

A bar produce the note A at a frequency of 440 Hz when struck vibrates a transverse standing wave having two nodes and two anti-nodes. The speed of transverse waves on the bar is 85 m/s.

Answer in 3 significant figures (**Show your work**)

Q13.1 Prob 3a
8 Points

How long is the bar?

Answer in 3 significant figures

> 0.193 m

Q13.2 Prob 3b
7 Points

In order to enhance the loudness of the emitted sound, you can place a pipe directly under the bar. You have a 0.50 m PVC pipe, how much length you need to cut the pipe in order to make it in resonance with the bar when the temperature is at 32°C?

Answer in 3 significant figures

> cut off 0.301 m

Q13.3 Prob 3c
5 Points

Sketch the standing wave pattern of the pipe. Indicate what kind of wave you use for the sketch,
pressure wave or displacement wave?
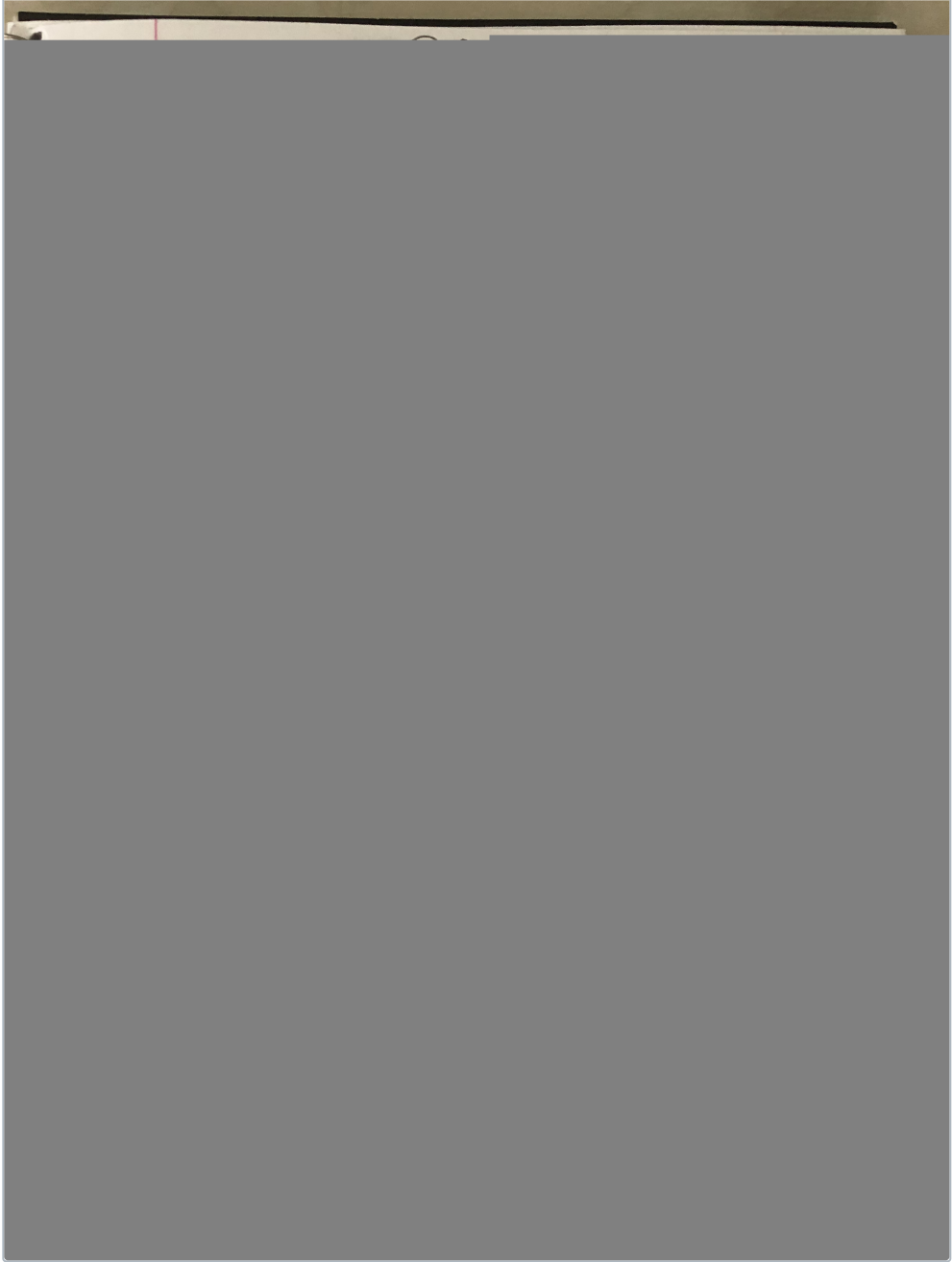
What kind of wave is your sketch:

displacement wave

Upload your work for the whole problem:

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Q14 Prob 4
25 Points

700 nm light passes through a pair of slits and creates an interference pattern on a screen 1.4 m behind the slits. The figure below shows the light intensity on the screen.

Answer in 2 significant figures (Show your work)

Q14.1 Prob 4a
8 Points

What is the separation between the slits?

Answer in 2 significant figures

> 4.5 * 10^-4 m

Q14.2 Prob 4b
11 Points

The 60th bright red fringe from double slits overlaps the 1st bright fringe of 560 nm yellow light through a diffraction gratings placed at the same spot of the double slits. How many lines per mm does this grating have?

Answer in 2 significant figures

> 170 lines per mm

Q14.3 Prob 4c
6 Points

How many yellow fringes can be observed on the screen using this diffraction grating?

Answer in 2 significant figures

> 1.1 * 10^-5

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FRQ (Q4) 25

a) seperation of slits
$\Delta y = \frac{\lambda L}{d}$ solve for d
$\Delta y = \frac{0.024 \, m}{11 \, fringe \, spaces}$
$\Delta y = 0.00218 \, m$
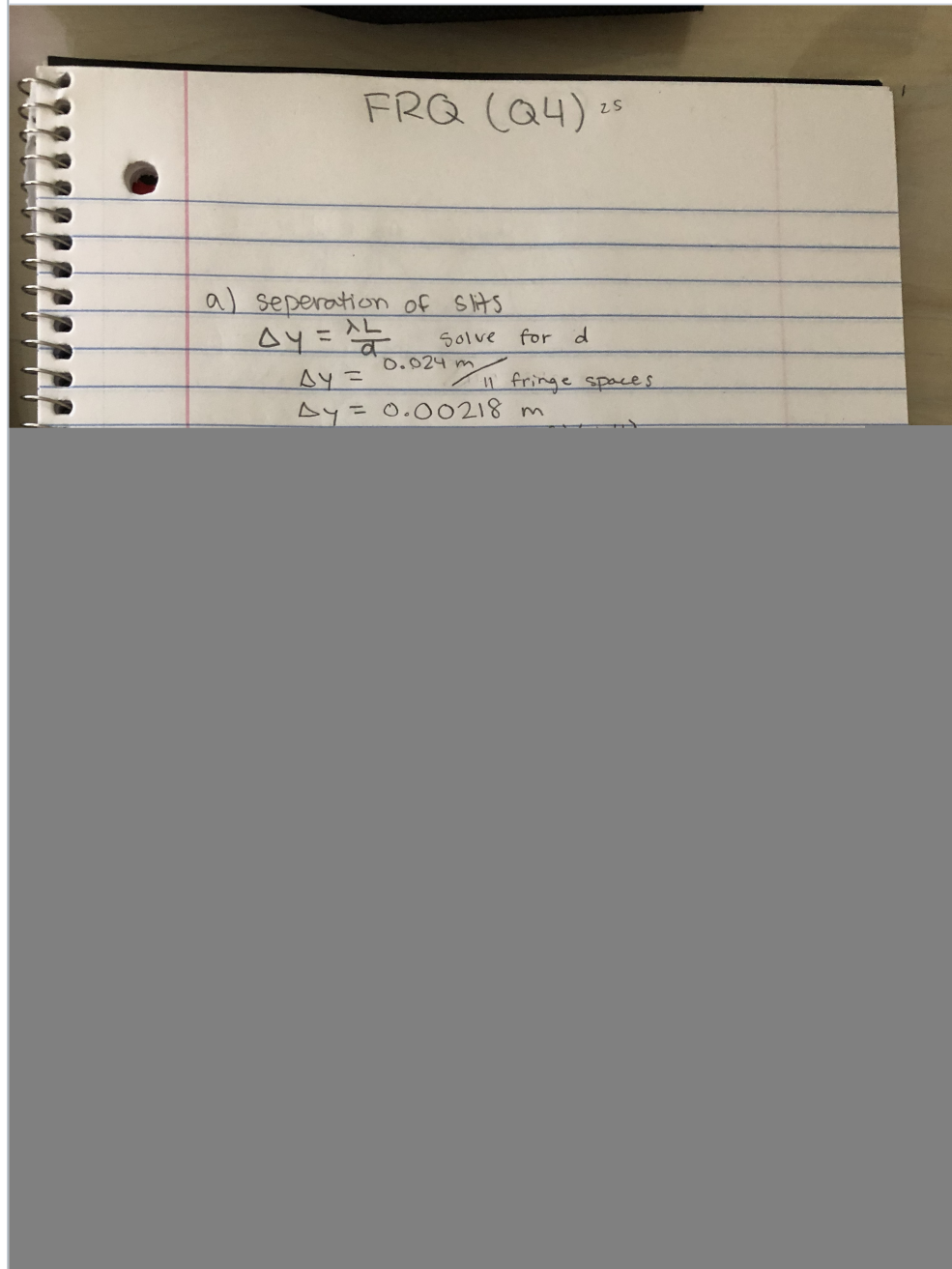
Q15 Prob 5
25 Points

Two speakers emit identical sinusoidal waves. The speakers are placed 6.5 m apart. You are standing at position A and heard a loud pitch when the speakers are both playing a 850 Hz tone. You start walk towards position B, directly in front of speaker 1, along a line

parallel to the two speakers. Then, you turn right and keep walking towards point C as shown in the figure. From B to C, you hear a loud-soft-loud-soft, and loud at position C.   Take the speed of sound 340 m/s.

Answer in 2 significant figures (Show your work)

Q15.1 Prob 5a
17 Points

What is the distance between B and C?

Answer in 2 significant figures

> 0.80 m

Q15.2 Prob 5b
8 Points

Both speakers emit the same amount of output power. What is the output power for the speaker if the intensity sound level received at position B when both speakers are on is 99 dB?

Answer in 2 significant figures

> 1.5 W

Upload your work for the whole problem:

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Final 2021 C

● **GRADED**

STUDENT

CHRISTINA KILKEARY

TOTAL POINTS

113.5 / 145 pts

QUESTION 1

MC 1

2 / 2 pts

QUESTION 2

MC 2

2 / 2 pts

QUESTION 3

MC 3

2 / 2 pts

QUESTION 4

MC 4

0 / 2 pts

QUESTION 5

MC 5

2 / 2 pts

QUESTION 6

MC 6

2 / 2 pts

QUESTION 7

MC 7

2 / 2 pts

QUESTION 8

MC 8

2 / 2 pts

QUESTION 9

MC 9

2 / 2 pts

QUESTION 10

MC 10

2 / 2 pts

QUESTION 11

Prob 1

22 / 30 pts

11.1   Prob 1a

5 / 5 pts

11.2   Prob 1b

12 / 20 pts

11.3   Prob 1c

5 / 5 pts

QUESTION 12

Prob 2   **24** / 25 pts

12.1   Prob 2a   **6** / 6 pts

12.2   Prob 2b   **9** / 9 pts

12.3   Prob 2c   **9** / 10 pts

QUESTION 13

Prob 3   **14.5** / 20 pts

13.1   Prob 3a   **5.5** / 8 pts

13.2   Prob 3b   **6** / 7 pts

13.3   Prob 3c   **3** / 5 pts

QUESTION 14

Prob 4   **20** / 25 pts

14.1   Prob 4a   **6** / 8 pts

14.2   Prob 4b   **11** / 11 pts

14.3   Prob 4c   **3** / 6 pts

QUESTION 15

Prob 5   **15** / 25 pts

15.1   Prob 5a   **7** / 17 pts

15.2   Prob 5b   **8** / 8 pts