**Practice test for material after midterm 2 (after chapter 12)**

**Chapters 13, 14, 15, 16, 17**

In preparation for the Midterm exam go through this practice test, go through the homework problems and through the problems we did in class.

***Understand* the concepts and what the formulas mean!!**

**We skipped chapter 13, so ignore these problems.**

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**Chapter 13. The law of gravity, Kepler's laws of planetary motion**

 **3.** A 50-kg satellite circles planet Cruton every 5.6 h in an orbit with a radius of 12 x 106 m. What is the magnitude of the gravitational force on the satellite by planet Cruton?

 **a.** 63 N

 **b.** 58 N

 **c.** 68 N

 **d.** 73 N

 **e.** 50 N

**9.** Three 5.0-kg masses are located at points in the *xy* plane, as shown. What is the magnitude of the resultant force (caused by the other two masses) on the mass at
*x* = 0.40 m, *y* = 0?

 

 **a.** 2.2 x 10–8 N

 **b.** 1.9 x 10–8 N

 **c.** 1.4 x 10–8 N

 **d.** 1.6 x 10–8 N

 **e.** 2.5 x 10–8 N

**Also go through the HW problems involving Kepler's laws**

**A satellite is 20,000 km above the earth of surface. How fast does it have to move so that its centripetal force is equal to the gravitational pull it experiences.**

**What is a geosynchronous satellite? How far above earth does it have to be for this to work?**

**Chapter 14 Fluid Mechanics**

 **9.** A blimp is filled with 200 m3 of helium. How much mass can the balloon lift? The density of helium and air are given on the first page.

 **a.** 115 kg

 **b.** 215 kg

 **c.** 315 kg

 **d.** 415 kg

 **e.** 37 kg

 **15.** The water level in a reservoir is maintained at a constant level. What is the exit velocity in an outlet pipe 3.0 m below the water surface?

 **a.** 2.4 m/s

 **b.** 3.0 m/s

 **c.** 5.4 m/s

 **d.** 7.7 m/s

 **e.** 49 m/s

 **17.** Water pressurized to 3.5 x 105 Pa is flowing at 5.0 m/s in a pipe which contracts to 1/3 its former area. What is the pressure and velocity of the water after the contraction?

 **a.**  2.5 x 105 Pa, 15 m/s

 **b.** 3.0 x 105 Pa, 10 m/s

 **c.** 3.0 x 105 Pa, 15 m/s

 **d.** 4.5 x 105 Pa, 1.5 m/s

 **e.** 5.5 x 105 Pa, 1.5 m/s

 **20.** The pressure inside a commercial airliner is maintained at 1 ATM (105 N/m2). What is the outward force exerted on a 1 m x 2 m cabin door if the outside pressure (at 10 km height) is 0.3 ATM?

 **a.** 1.4 x 102 N

 **b.** 1.4 x 103 N

 **c.** 1.4 x 104 N

 **d.** 1.4 x 105 N

 **e.** 7.0 x 103 N

**25.** A cube of wood having a side dimension of 18.6 cm and a density of 653 kg/m3 floats on water.

 (a) What is the distance from the horizontal top surface of the cube to the water level?

 (b) How much lead weight must be placed on top of the cube so that its top is just level with the water?

**26.** What must be the contact area between a suction cup (completely exhausted) and a ceiling if the cup is to support the weight of an 70.0 kg student?

How much weigh could be supported with such a device on the moon, where the air pressure is 0?

**27.**  A balloon of radius 1.06 m floats at a constant height. If the density of air is 1.29 kg/m3, what is the mass of the balloon?

**Chapter 15 (Please note that the sine function is mainly used here to describe the position, whereas in class we mostly used the cosine function)**

**Also ignore problems involving physical pendulum (e.g. problems 12, 13).**

 **2.** A body oscillates with simple harmonic motion along the *x*-axis. Its displacement varies with time according to the equation *x* = 5.0 sin (*t* + **/3). The acceleration (in m/s2) of the body at *t* = 1.0 s is approximately

 **a.** 3.5

 **b.** 49

 **c.** 14

 **d.** 43

1. 4.3

 **4.** A body oscillates with simple harmonic motion along the *x* axis. Its displacement varies with time according to the equation *x* = 5.0 sin (*t* + **/3). The velocity (in m/s) of the body at *t* = 1.0 s is

 **a.** +8

 **b.** –8

 **c.** –14

 **d.** +14

1. –5

**5.** The motion of a particle connected to a spring is described by *x* = 10 sin (*t* + **/3). At what time (in s) is the potential energy equal to the kinetic energy?

 **a.** 0.7

 **b.** 0.8

 **c.** 0.9

 **d.** 0.6

 **e.** 0.2

 **9.** Two circus clowns (each having a mass of 50 kg) swing on two flying trapezes (negligible mass, length 25 m) shown in the figure. At the peak of the swing, one grabs the other, and the two swing back to one platform. The time for the forward and return motion is

 

 **a.** 10 s

 **b.** 50 s

 **c.** 15 s

 **d.** 20 s

 **e.** 25 s

**10.** A 0.400 kg mass attached to a spring with a force constant of 8.00 N/m vibrates in simple harmonic motion with an amplitude of 12.5 cm.

 (a) Calculate the maximum value of its speed and acceleration.

 (b) Calculate the speed and acceleration when the mass is 10.50 cm from the equilibrium

 position.

 (c) Calculate the time it takes the mass to move from x = 0 to x = 4.50 cm.

**11**. A 2.00 kg mass is attached to a spring and placed on a horizontal, smooth surface. A horizontal force of 20.0 N is required to hold the mass at rest when it is pulled 0.200 m from its equilibrium position. The mass is now released from rest with an initial displacement of xi = 0.200 m, and it subsequently undergoes simple harmonic oscillations.

1. Find the force constant of the spring
2. Find the frequency of the oscillation
3. Find the maximum speed of the mass. Where does it occur?
4. Find the maximum acceleration of the mass. Where does it occur?
5. Find the total energy of the oscillating system
6. Find the speed and the acceleration when the displacement equals one third of the maximum value.

**12.** A uniform rod (mass *m* = 1.0 kg and length *L* = 2.0 m) pivoted at one end oscillates in a vertical plane as shown below. The period of oscillation (in s) is approximately



**a.** 4.0

**b.** 1.6

**c.** 3.2

**d.** 2.3

**e.** 2.0

**13.** In the figure below, a disk (radius *R* = 1.0 m, mass = 2.0 kg) is suspended from a pivot a distance *d* = 0.25 m above its center of mass. The angular frequency (in rad/s) for small oscillations is approximately



**a.** 4.2

**b.** 2.1

**c.** 1.5

**d.** 1.0

**e.** 3.8

**Chapter 16. Wave Motion**

 **1.** The speed of lightwaves in air is 3.0 x 108 m/sec. The speed of sound waves in air is
333 m/s. How long between the time a lightning flash is seen and the thunderclap is heard if the lightning flash is 1.0 km away?

 **a.** 3.0 s

 **b.** 5.0 s

 **c.** 7.0 s

 **d.** 10 s

 **e.** 1.0 s

 **2.** The wavelength of light visible to the human eye is on the order of 5 x 10–7 m. If the speed of light in air is 3 x 108 m/s, find the frequency of the lightwave.

 **a.** 3 x 107 Hz

 **b.** 4 x 109 Hz

 **c.** 5 x 1011 Hz

 **d.** 6 x 1014 Hz

 **e.** 4 x 1015 Hz

 **10.** The lowest A on a piano has a frequency of 27.5 Hz. If the tension in the 2-m string is
308 N, and one-half wavelength occupies the string, what is the mass of the wire?

 **a.** .025 kg

 **b.** .050 kg

 **c.** .072 kg

 **d.** .081 kg

 **e.** .037 kg

 **11.** If *y* = .02 sin (30*x* – 400*t*) (SI units), the frequency of the wave is

 **a.** 30 Hz

 **b.** 15/** Hz

 **c.** 200** Hz

 **d.** 400 Hz

 **e.** 800** Hz

 **12.** If *y* = .02 sin (30*x* – 400*t*) (SI units), the wavelength of the wave is

 **a.** **15 m

 **b.** 15** m

 **c.** 60** m

 **d.** 4.2 m

 **e.** 30 m

 **13.** If *y* = .02 sin(30*x* – 400*t*) (SI units), the velocity of the wave is

 **a.** 3/40 m/s

 **b.** 40/3 m/s

 **c.** 60**400 m/s

 **d.** 400/60** m/s

 **e.** 400 m/s

 **14.** If *y* = .02 sin (30*x* – 400*t*) (SI units), the angular frequency of the wave is

 **a.** 30 rad/s

 **b.** 30/2** rad/s

 **c.** 400/2** rad/s

 **d.** 400 rad/s

 **e.** 40/3 rad/s

 **15.** If *y* = .02 sin (30*x* – 400*t*) (SI units), the wave number is

 **a.** 30 m–1

 **b.** 30/2** m–1

 **c.** 400/2** m–1

 **d.** 400 m–1

 **e.** 60** m–1

 **17.** Write the equation of a wave, traveling along the +*x* axis with an amplitude of .02 m, a frequency of 440 Hz, and a speed of 330 m/sec.

 **a.** *y* = .02 sin [880*x*/330 – *t*)]

 **b.** *y* = .02 cos [880*x*/330 – 440*t*]

 **c.** *y* = .02 sin [880***x*/330 + *t*)]

 **d.** *y* = .02 sin [2***x*/330 + 440*t*)]

 **e.** *y* = .02 cos [2***x*/330 + 440*t*)]

1. A stone is dropped from rest into a well. The sound of the splash is heard exactly 2 s later. Find the depth of the well (speed of sound = 344 m/s).

**37.** A circus performer stretches a tightrope between two towers. He strikes one end of the rope and sends a wave along it toward the other tower. He notes that it takes 0.8 s for the wave to travel the 20 m to the opposite tower. If one meter of the rope has a mass of 0.35 kg, find the tension in the tightrope.

**Chapter 17. Sound Waves**

 **4.** It is possible to hear an approaching train before you can see it by listening to the sound wave through the track. If the elastic modulus is 2.0 x 1011 N/m2 and the density of steel is 7.8 x 103 kg/m3, approximately how many times faster is the speed of sound in the track than in air?

 **a.** 20

 **b.** 5

 **c.** 10

 **d.** 15

 **e.** 25

**10.** The variation in the pressure of helium gas, measured from its equilibrium value, is given by *P* = 2.9 × 10–5 cos (6.2*x* – 3000*t*) where *x* and *t* have units m and s. Determine the speed (in m/s) of the wave.

**a.** 1515

**b.** 153

**c.** 484

**d.** 828

**e.** 101

**20.** A car approaches a stationary police car at 36 m/s. The frequency of the siren (relative to the police car) is 500 Hz. What is the frequency (in Hz) heard by an observer in the moving car as he approaches the police car? (Assume the velocity of sound in air is
343 m/s.)

 **a.** 220

 **b.** 448

 **c.** 5264

 **d.** 552

 **e.** 383

 **21.** A car moving at 36 m/s passes a stationary police car whose siren has a frequency of
500 hz. What is the change in the frequency (in Hz) heard by an observer in the moving car as he passes the police car?

 **a.** 416

 **b.** 208

 **c.** 105

 **d.** 52

 **e.** 552

 **23.** A truck moving at 36 m/spasses a police car moving 45 m/s headed in the opposite direction. If the frequency of the siren is 500 Hz relative to the police car, what is the frequency heard by an observer in the truck after the police car passes the truck? (The speed of sound in air is 343 m/s.)

 **a.** 361

 **b.** 636

 **c.** 393

 **d.** 396

 **e.** 383

 **25.** How fast (in m/s) is the Concorde moving if it reaches Mach 1.5? (The speed of sound in air is 343 m/s.)

 **a.** 229

 **b.** 515

 **c.** 416

 **d.** 728

 **e.** 858

Answers:

13. Gravitation

3b

9d

**14. Fluid mechanics**

9b

15d

17a

20d

25 [6.45] cm [2.23] kg

26 [0.00677] m2; 0

27. 6.4 kg

**15. Harmonic motion**

2d

4b

5c

9a

10: [55.9] cm/s; [250] cm/s2; [30.3] cm/s; [-210] cm/s2; [0.0823] s

11: (a) *k* = (b) ** = rad/s; *f* = = ; (c) *v*max= at *x* = 0; (d) *a*max = at *x* = ± *A*; (e) *E* = (f) *v* =

1. *a* =

12 d

13b

**16. Wave motion**

1a

2d

10b

11c

12a

13b

14d

15a

17a

25: 18.6

37: 219 N

**17. Sound waves**

4d

10c

20d

21c

23d

25b

**Also: Go through HW problems.**