SPRING 2016

PHYSICS 220 FINAL **FORM A**

PRINT NAME:_____ **PID:**_____

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QUESTIONS 1 - 35 EACH WORTH 7 POINTS

MULTIPLE CHOICE. Choose the best answers

1) Which of the following statements concerning speed is/are correct?
A) Speed must change in order to have an acceleration.
B) Constant speed implies a constant acceleration. C) Speed is a vector.
D) All of the above are correct. E) None of the above are correct.

2) "At any two points along the same streamline in a non-viscous, incompressible fluid in steady flow, the sum of the pressure, the kinetic energy per unit volume, and the potential energy per unit volume has the same value." This is a statement of:
A) Law of Continuity B) Bernoulli's Law C) Eddy Flow
D) Archimedes' Principle E) Buoyant Law

3) A pipe with a diameter of 2-in tapers down to a 1-in diameter pipe and has an incompressible fluid flowing in it. Which of the following statements is correct?
A) Pressure in the 2-in pipe is greater than in the 1-in pipe.
B) Velocity of fluid in 1-in the pipe is higher than in the 2-in pipe.
C) The volume of fluid flowing per unit time is the same in both pipes.
D) All of the above are correct. E) None of the above is correct.

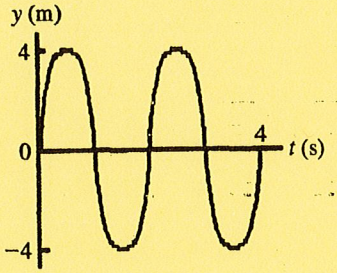
4) A simple harmonic oscillator oscillates with frequency f when its amplitude is A. If the amplitude is now doubled to $2A$, what is the new frequency?
A) $4f$ B) $2f$ C) $f/2$ D) $f/4$ E) f

5) The total energy of a simple harmonic oscillating system is
A) A non-zero constant. B) Zero as it passes the equilibrium point.
C) A minimum when it passes through the equilibrium point.
D) A maximum when it passes through the equilibrium point.
E) Zero when it reaches the maximum displacement.

6) A mass on a spring undergoes simple harmonic motion. When the mass is at its maximum distance from the equilibrium position, which of the following statements about it is true?
A) Its acceleration is zero. B) Its speed is zero. C) Its total energy is zero.
D) Its elastic potential energy is zero. E) Its kinetic energy is a maximum.

7) The intensity of a spherical wave from a point source at a distance d from the source is I. What is the intensity at a distance $2d$ from the source?
A) $4I$ B) $I/2$ C) $I/4$ D) $I/\sqrt{2}$ E) $2I$

8) What is the wavelength of the wave shown in the figure?



A) 4 m. B) 1 m. C) 8 m. D) 2 m.
E) It cannot be determined from the given information.

9) A train passes you standing by the track blowing its whistle. You note that:
A) The wavelength went from shorter to longer
B) The wavelength went from longer to shorter C) The frequency remains constant
D) The frequency and wavelength remain constant E) Nothing changed

10) Object 1 has three times the specific heat capacity and four times the mass of Object 2. The two objects are given the same amount of heat. If the temperature of Object 1 changes by an amount ΔT, the change in temperature of Object 2 will be
A) 4/3 ΔT. B) 12ΔT. C) 3/4ΔT. D) ΔT. E) 6ΔT

11) Complete the following statement: The transfer of heat by convection will occur:
A) Only in metals B) Only in a vacuum C) Only in non-metallic solids
D) With or without the presence of matter E) Only in the presence of a liquid or a gas

12) The specific heat capacity of iron is approximately half that of aluminum. Two balls of equal mass, one made of iron and the other of aluminum, both at 80 °C, are dropped into a thermally insulated jar that contains an equal mass of water at 20 °C. Thermal equilibrium is eventually reached. Which one of the following statements concerning the final temperatures is true?
A) Both balls will reach the same final temperature.
B) The iron ball will reach a higher final temperature than the aluminum ball.
C) The aluminum ball will reach a higher final temperature than the iron ball.
D) The difference in the final temperatures of the balls depends on the initial mass of the water.
E) The difference in the final temperatures of the balls depends on the initial temperature of the water.

13) A spinning ice skater on extremely smooth ice is able to control the rate at which she rotates by pulling in her arms. Which of the following statements are true about the skater during this process?
A) She is subject to a constant non-zero torque. B) Her kinetic energy remains constant.
C) Her angular momentum remains constant.
D) Her moment of inertia remains constant. E) All of the above

14) The second law of thermodynamics leads us to conclude that:
A) The entropy of the universe remains constant.
B) The total energy of the universe is constant.
C) Disorder in the universe is increasing with the passage of time.
D) The average temperature of the universe is increasing with the passage of time.
E) It is theoretically possible to convert heat into work with 100% efficiency.

15) Suppose you have a grandfather (pendulum) clock that runs fast. Which adjustments of the bob would make it more accurate?
A) Raise the bob. B) Lower the bob. C) Add more mass to the bob.
D) Remove mass from the bob. E) Decrease the amplitude of swing by a small amount.

16) When is the average velocity of an object equal to the instantaneous velocity?
A) Only when the velocity is increasing at a constant rate
B) Only when the velocity is decreasing at a constant rate
C) When the velocity is constant D) Always E) Never

17) A spider sits on a turntable rotating at a constant 33 rpm. The acceleration of the spider is:
A) Greater the closer the spider is to the central axis.
B) Greater the farther the spider is from the central axis.
C) Nonzero and independent of the location of the spider on the turntable.
D) Zero. E) None of the above.

18) A bicycle has wheels that are 60 cm in diameter. What is the angular speed of these wheels when it is moving at 4.0 m/s?
A) 13 rad/s B) 1.2 rad/s C) 4.8 rad/s D) 0.36 rad/s E) 7.6 rad/s

19) A 75-N box rests on a perfectly smooth (frictionless) horizontal surface. The minimum force needed to start the box moving is:
A) 75 N. B) 7.5 N. C) 750 N. D) Any horizontal force greater than zero.
E) Need to know mass of the box

20) An object moves in a circular path at a constant speed. Compare the direction of the object's velocity and acceleration vectors.
A) The vectors point in opposite directions.
B) The acceleration is zero but the velocity is constant.
C) Both vectors point in the same direction.
D) The vectors are perpendicular to each other.
E) The velocity vector is zero since the speed is constant.

21) A hypothetical planet has a mass of one-half that of the Earth and a radius of twice that of the Earth. What is the acceleration due to gravity on the surface of the planet in terms of g, the acceleration due to gravity at the surface of the Earth?
A) $g/16$ B) $g/8$ C) $g/2$ D) g E) $g/4$

22) A tiger is running in a straight line. If we double both the mass and speed of the tiger, the magnitude of its momentum will increase by what factor?
A) 8 B) 4 C) 16 D) $\sqrt{2}$ E) 2

23) You slam on the brakes of your car in a panic, and skid a certain distance on a straight level road. If you had been traveling twice as fast, what distance would the car have skidded, under the same conditions?
A) It would have skidded one half as far. B) It would have skidded twice as far.
C) It would have skidded 1.4 times farther. D) It would have skidded 4 times farther.
E) It is impossible to tell from the information given.

24) Two men, Joel and Jerry, push against a car that has stalled, trying unsuccessfully to get it moving. Jerry stops after 10 min, while Joel is able to push for 5.0 min longer. Compare the work they do on the car.
A) Joel does 75% more work than Jerry. B) Joel does 50% more work than Jerry.
C) Jerry does 50% more work than Joel. D) Joel does 25% more work than Jerry.
E) Neither of them does any work.

25) On a cold day, a piece of metal feels much colder to the touch than a piece of wood. This is due to the difference in which one of the following physical properties of these materials?
A) Density B) Latent heat C) Emissivity D) Thermal conductivity E) Mass

26) A steel ball sinks in water but floats in a pool of mercury, which is much denser than water. Where is the buoyant force on the ball greater?
A) Submerged in the water B) It is the same in both cases.
C) Floating on the mercury D) Need to know the density of the steel ball
E) It cannot be determined from the information given.

27) The two dams are identical with the exception that the water reservoir behind dam **A** extends twice the horizontal distance behind it as that of dam **B**. The depth of water is the same in both reservoirs. Which of the following regarding these dams is correct?
A) The force exerted by the water on dam **B** is greater than that on dam **A**.
B) The horizontal distance of the water behind the two dams does not determine the force on them.
C) Dam **B** is more likely to collapse than dam **A** if the water level rises.
D) Dam **A** is more likely to collapse than dam **B** if the water level rises.
E) The force exerted by the water on dam **A** is greater than that on dam **B**.

28) A violin string of length L is fixed at both ends. Which one of the following is **NOT** a wavelength of a standing wave on the string?
A) L B) 2L C) L/2 D) 2L/3 E) 3L/2

29) In the Ideal Gas Law, what scale is used for the temperature?
A) Kelvin B) Fahrenheit C) Celsius D) All temperature scales will work
E) Both Celsius and Kelvin may be used since the degree size is the same for both.

30) Jane pushes a box 4.00 m along a horizontal surface by applying a 25.0-N horizontal force. How much work does she do?
A) 100 J B) 10.0 J C) 125 J D) 550 J E) 6.25 J

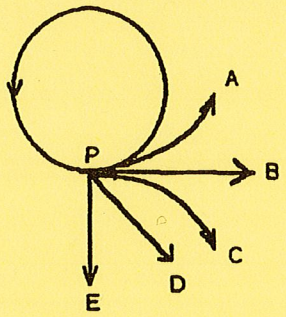
31) An apple falls from a tree. It hits the ground at a speed of 5 m/s. What is the fall time?
A) 1s B) 2s C) 0.5s D) 9.8s E) Need more information.

32) When an object is in translational equilibrium, which of the following is **NOT** true?
A) The vector sum of the forces acting on the object is zero.
B) The object must be stationary. C) The object has a constant velocity.
D) The speed of the object is constant. E) All of the above are true.

33) Two balls, identical except for color, are projected horizontally from the roof of a tall building at the same instant. The initial speed of the red ball is twice the initial speed of the blue ball. Ignoring air resistance:
A) The red ball reaches the ground first. B) The blue ball reaches the ground first.
C) Both balls land at the same instant with different speeds.
D) Both balls land at the same instant with same speeds.
E) The red ball reaches the ground first but has less speed than the blue ball.

34) A 3 kg object is initially at rest. It receives an impulse of magnitude 15 Ns. After the impulse, the object has:
A) A speed of 45 m/s B) A momentum of magnitude 5 kg m/s C) A speed of 7.5 m/s
D) A momentum of magnitude 15 kg m/s E) An inertia of 45 kg/m

35) A rock attached to a string, swings counter-clockwise in a horizontal circle. The string breaks at point P in the figure (as seen from above). Which path (A-E) will the rock follow?



A) Path A B) Path B C) Path C D) Path D E) Path E

QUESTIONS 36 - 40 EACH WORTH 9 POINTS

36) Water flowing through a cylindrical pipe suddenly comes to a section of pipe where the diameter decreases to 86% of its previous value. If the speed of the water in the larger section of the pipe was 32 m/s what is its speed in this smaller section if the water behaves like an ideal incompressible fluid?

A) 43 m/s B) 24 m/s C) 28 m/s D) 37 m/s E) None of the above

37) What is the frequency of the fundamental mode of vibration of a steel piano wire stretched to a tension of 440 N? The wire is 0.600 m long and has a mass of 5.60 g.

A) 234 Hz B) 517 Hz C) 366 Hz D) 312 Hz E) 181 Hz

38) A 1200-kg car is pulling a 500-kg trailer along level ground. Friction of the road on the trailer is negligible. The car accelerates with an acceleration of 1.3 m/s^2. What is the force exerted by the car on the trailer?

A) 600 N B) 650 N C) 550 N D) 700 N E) 750 N

39) How much work must be done by frictional forces in slowing a 1000-kg car from 26.1 m/s to rest?

A) 4.77×10^5 J B) 3.41×10^5 J C) 4.09×10^5 J D) 2.73×10^5 J

E) Need the coefficient of friction

40) A force of 17 N is applied to the end of a 0.63-m long torque wrench at an angle 45° from a line joining the pivot point to the handle. What is the magnitude of the torque about the pivot point produced by this force?

A) 12.0 N · m B) 10.7 N · m C) 7.6 N · m D) 9.7 N · m E) 9.7 N

QUESTION 41 IS WORTH 10 POINTS

41) The melting point of aluminum is 660°C, its latent heat of fusion is 4.00×10^5 J/kg, its latent heat of vaporization is 10.9×10^6 J/kg and its specific heat is 900J/kg K. How much heat must be added to 500 g of aluminum originally at 27°C to completely melt it?

A) 395 kJ B) 485 kJ C) 273 kJ D) 14 kJ E) 147 kJ

$\pi = 3.14159$ $\quad G = 6.673\times10^{-11}\ \mathrm{m^3/(kg\cdot s^2)}$ $\quad 1\,\mathrm{N} = 1\,\mathrm{kg(m/s^2)}$

$g = 9.81\,\mathrm{m/s^2}$ $\quad 1\,\mathrm{lb} = 4.448\,\mathrm{N}$ $\quad N_A = 6.022\times10^{23}\,/\,\mathrm{mole}$

$k = 1.38\times10^{-23}\,\mathrm{J/K}$; $R = N_A k$ $\quad 1\,\mathrm{J} = 1\,\mathrm{N\,m}$

$1\mathrm{Pa} = 1\dfrac{\mathrm{N}}{\mathrm{m^2}}$; $1\mathrm{atm} = 1.013\times10^5\,\mathrm{Pa} = 14.7\dfrac{\mathrm{lb}}{\mathrm{in^2}}$ $\quad F_{Grav} = G\dfrac{m_1 m_2}{r^2}$

$F_{spring} = -kx$ $\quad F_{friction} = \mu N$ $\quad V_{sphere} = \dfrac{4}{3}\pi R^3$ $\quad A_{circle} = \pi R^2$

$x = x_o + \dfrac{1}{2}(v_o + v_f)t$ $\quad v_f = v_o + at$ $\quad a_c = \dfrac{v^2}{r} = \omega^2 r$

$x = x_o + v_o t + \dfrac{1}{2}at^2$ $\quad v_f^2 = v_o^2 + 2a(x - x_o)$ $\quad T_{max} = \dfrac{v_o}{g}\sin\theta$

$\vec{p} = m\vec{v}$ $\quad (PE)_{grav} = U_g = mgy = mgh$ $\quad (PE)_{elastic} = U_s = \dfrac{1}{2}kx^2$

$KE = \dfrac{1}{2}mv^2 = \dfrac{1}{2}I\omega^2$ $\quad W = Fd\cos\theta$ $\quad \alpha = \dfrac{\Delta\omega}{\Delta t}$ $\quad \tau = FL\sin\theta$

$KE_{ave} = \dfrac{3}{2}kT = \dfrac{1}{2}m\overline{v^2}$ $\quad P = \rho g y_{depth}$ $\quad F_B = V\rho_{fluid}\,g$

$\omega = \omega_o + \alpha t$ $\quad \theta = \theta_o + \omega_o t + \dfrac{1}{2}\alpha t^2$ $\quad \omega_f^2 = \omega_o^2 + 2\alpha(\theta - \theta_o)$

$T_F = \dfrac{9}{5}T_C + 32^\circ$; $T_C = T_K - 273^\circ$ $\quad PV = NkT = nN_A kT = nRT$

$Q_f = mL_f$, $\quad Q_v = mL_v$, $\quad Q = mc\,\Delta T$, $\quad P = F/A$

$t = \sqrt{\dfrac{2h}{g}}$ $\quad v_f = \sqrt{2gh}$ $\quad \theta = \dfrac{s}{r}$, $\quad \omega = \dfrac{\theta}{t} = \dfrac{v}{r}$ $\quad \theta = \omega_0 t + \dfrac{1}{2}\alpha t^2$,

$\theta = \left(\dfrac{\omega_0 + \omega_f}{2}\right)t$, $\quad \omega_f^2 = \omega_0^2 + 2\alpha\theta$, $\quad \theta = \dfrac{s}{r} = \dfrac{vt}{r}$ $\quad \omega = \dfrac{\theta}{t}$

$W = Fs = \tau\theta$, $P = \dfrac{W}{t} = Fv = \tau\omega$, $\quad I = F\Delta t = \Delta(mv)$ $\quad L = I\omega = mvr$,

$\lambda_n = \dfrac{2L}{n}$; $\quad f_n = \dfrac{v}{\lambda_n} = nf_1$; $k = \dfrac{\omega}{v} = \dfrac{2\pi f}{v} = \dfrac{2\pi}{\lambda}$; $\quad \mu = \dfrac{m}{L}$; $\quad v = \sqrt{T/\mu}$

$T(period) = 2\pi\sqrt{\dfrac{m}{k}} = 2\pi\sqrt{\dfrac{L}{g}} = \dfrac{1}{f}$, $\quad v_{max} = \sqrt{\dfrac{k}{m}}A$

$P + \rho gh + \frac{1}{2}\rho v^2 = \text{constant}$, $\quad v_1A_1 = v_2A_2$ $\quad Q = \dfrac{Vol}{\Delta t} = vA$