PHY1322
I MIDTERM
Feb14 2008

STUDENT NUMBER: _____

STUDENT NAME: _____

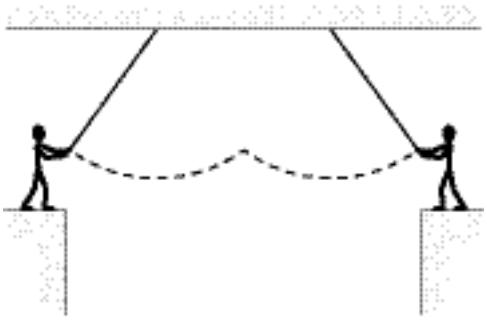
VERSION B

CLOSED BOOK TEST
Duration: 75minutes

PART I MC questions. To be answered using SCANTRON sheets
Best 8 answers count toward 70% of the test grade

1. A uniform rod (mass $m = 1$ kg and length $L = 2$ m) pivoted at one end oscillates in a vertical plane. The period (in *s)* of oscillation is approximately
a. 4.0. b. 1.6. c. 3.2. **d. 2.3.** e. 2.0.

2. 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. 10s **b.** 50s **c.** 15s
d. 20s **e.** 25s

3 A truck moving at 36 m/s is moving toward a police car moving at 45 m/s in the opposite direction. If the frequency of the siren relative to the police car is 500 Hz, what is the frequency heard by an observer in the truck as the police car approaches the truck? (The speed of sound in air is 343 m/s.)
a. 396 b. 636 **c.** 361 **d.** 393 **e.** 617

4 If $y = 0.02 \sin(30x - 400t)$ (SI units), the angular frequency of the wave is

a. 30 rad/s **b.** 30/2π rad/s **c.** 400/2π rad/s d. 400 rad/s **e.** 40/3 rad/s

5. A string is stretched and fixed at both ends, 200 cm apart. If the density of the string is 0.015 g/cm, and its tension is 600 N, what is the wavelength (in cm) of the first harmonic?

a. 600 b. 400 **c.** 800 **d.** 1000 **e.** 200

6. A charge *q* is located inside a spherical surface of radius *r*. What happens to the net electric flux through the side walls when the sphere is replaced by a cube of side r?

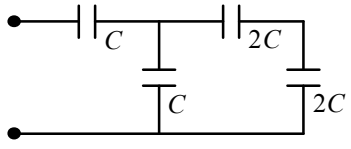
a. It changes by a factor of $\frac{4}{3}\pi$. b. It changes by a factor of π.

c. It changes by a factor of 4π. d. It changes by a factor of $\frac{3}{2}\pi$.

e. It remains the same.

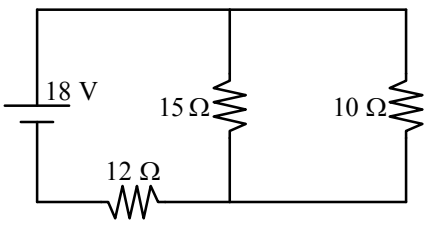
7. Three capacitors are placed in parallel. Their capacitances are $3\ \mu$F , $6\ \mu$F , and $9\ \mu$F . What is their total capacitance in μF ?
a. 4 **b. 18** c. 12 d. 21 e. 2

8. Determine the equivalent capacitance in pF for the network shown when $C = 45$ pF.



a. 36 b. 32 c. 34 **d. 30** e. 38

9. How much internal energy in J is produced in the 10 Ω resistor in 5.0 s?
a. 72 b. 32
c. 50 **d. 18**
e. 90



LONG PROBLEMS

In your exam booklet solve 3 out of following 4 questions (total 30% of the test grade)

1. A sinusoidal sound wave is described by the displacement wave function

$$s(x, t) = (2.00\ \mu\text{m})\cos[(15.7\ \text{m}^{-1})x - (858\ \text{s}^{-1})t]$$

(a) Find the amplitude, wavelength, and speed of this wave.
(b) Determine the instantaneous displacement from equilibrium of the elements of air at the position $x = 0.150\ 0$ m at $t = 6.00$ ms.
(c) Determine the maximum speed of the element's oscillatory motion.

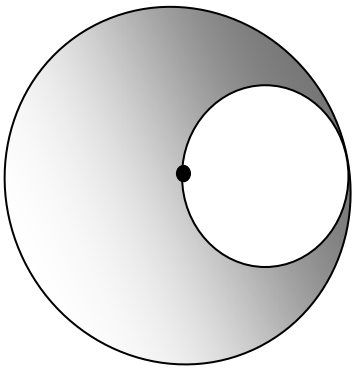
2 A uniform rod of length L and r radius of its circular cross-section and mass M has a small lead ball of mass m attached to its one end, so that it floats upright in water. The rod is pushed down from its equilibrium position and released.

a) Draw a clear diagram of this situation when lower end of the rod is at depth y below the equilibrium (1points)
b) Identify the restoring force (2 points)
c) Demonstrate that the rod's motion is a simple harmonic motion. (5 points)
d) Find the general expression for the rod's period (2 points).

3 Using Gauss Law obtain following expressions

a) Electric Field at the distance r from infinite plane charged with charge density σ (4 points)
b) electric field at distance r from the centre of a full charged sphere of charge density ρ and radius R.
inside the sphere (r<R) (3 points)
outside the sphere (r>R) (3 points)

4 Uniformly charged Sphere of charge Q=1mC and radius R =2m has a small sphere of radius R/2 volume removed from it as shown (the removed part is a sphere as well).
Find the Electric field (magnitude and direction) at the centre of large sphere. Only complete reasoning will result in full mark awarded.



PHY1322
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STUDENT NUMBER:_____

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VERSION A

CLOSED BOOK TEST
Duration: 75minutes

PART I MC questions. To be answered using SCANTRON sheets
Best 8 answers count toward 70% of the test grade

1. 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

2. If $y = 0.02 \sin(30x - 400t)$ (SI units), the wave number is

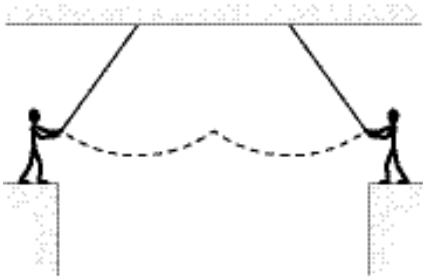
a. 30 m^{-1} **b.** $30/2\pi$ m^{-1} **c.** $400/2\pi$ m^{-1} **d.** 400 m^{-1} **e.** 60 m^{-1}

3. A truck moving at 36 m/s passes a police car moving at 45 m/s 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

4. Two circus clowns (each having a mass of 50 kg) swing on two flying trapezes (negligible mass, length 6.25 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. 5 s
c. 15 s **d.** 20 s
e. 25 s



5. A string is stretched and fixed at both ends, 200 cm apart. If the density of the string is 0.015 g/cm, and its tension is 600 N, what is the fundamental frequency?

a. 316 Hz **b.** 632 Hz c. 158 Hz **d.** 215 Hz **e.** 79 Hz

6. A charge q is located inside a spherical surface of radius r. What happens to the electric flux when the sphere radius is increased by factor 2?

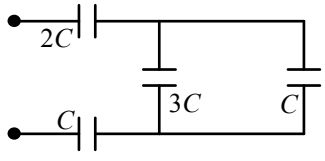
a. It changes by a factor of $\frac{4}{3}\pi$. b. It changes by a factor of π. c. It changes by a factor of 4π
d. It changes by a factor of 4. **e. It remains the same.**

7. Three capacitors are placed in series. Their capacitances are $3\ \mu\text{F}$, $6\ \mu\text{F}$, and $9\ \mu\text{F}$. What is their total capacitance in μF?

a. 4 b. 18 **c. 1.6** d. 1.8 e. 1.5

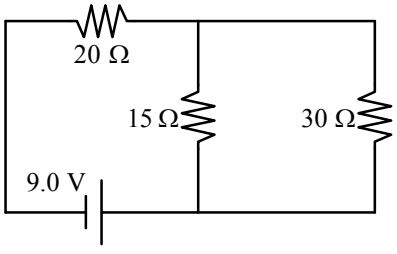
8. Determine the equivalent capacitance in pF for the network shown when $C = 50\ \text{pF}$.

a. 29 b. 0.19 c. 34 d. 0.23
e. 75



9. What is the current in A in the 15 Ω resistor?

a. 0.20
b. 0.30
c. 0.10
d. 0.26
e. 0.60



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(a) Find the amplitude, wavelength, and speed of this wave.
(b) Determine the instantaneous displacement from equilibrium of the elements of air at the position $x = 0.050\ 0$ m at $t = 3.00$ ms.
(c) Determine the maximum speed of the element's oscillatory motion.

2 Using Gauss Law obtain following expressions

a) Electric Field at the distance r from infinite rod charged with charge density λ (4 points)

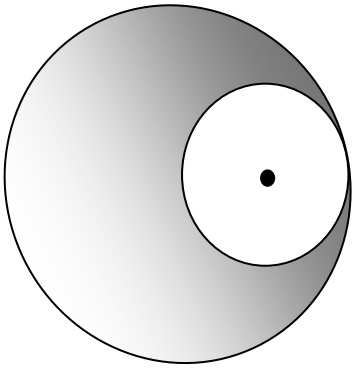
b) Electric field at distance r from the centre of a empty sphere of charge Q and radius R.

inside the sphere (r<R) (3 points)
outside the sphere (r>R) (3 points)

3 A uniform rod of length D and radius R of its circular cross-section and mass m1 has a small lead ball of mass m2 attached to its one end, so that it floats upright in water. The rod is pushed down from its equilibrium position and released.

a) Draw a clear diagram of this situation when lower end of the rod is at depth y below the equilibrium (1points)
b) Identify the restoring force (2 points)
c) Demonstrate that the rod's motion is a simple harmonic motion. (5 points)
d) Find the general expression for the rod's period (2 points).

4 Uniformly charged sphere of charge Q=1mC and radius R =2m has a small sphere of radius R/2 volume removed from it as shown (the removed part is a sphere as well ,.
Find the Electric field (magnitude and direction) at the centre of smaller (hollow) sphere.
Only complete reasoning will result in full mark awarded.



NOTE: the sphere was first charged and than hollowed!