February 15, 2011
(7:00 pm – 9:00 pm)

MIDTERM TEST

PAPER NO.: **A**

PAGE NO.: 1 of 4 (+ formula sheet)

DEPARTMENT & COURSE NO.: PHYS 1070

TIME: 2.0 hours

EXAMINATION: Physics 2: Waves and Modern Physics

EXAMINERS: P.G. Blunden, G. Gwinner

All questions are of equal value. Answer all questions. No marks are subtracted for wrong answers.

Record all answers on the computer score sheet provided. **USE PENCIL ONLY!** Black pen will look good but may not be read reliably by the scoring machine. **Mark only <u>one</u> answer for each question!** Select the answer that is closest to yours.

"n.o.t." denotes "none of these" choices.

A formula sheet is provided for your use; you may **not** use your own formula sheet or any other materials or notes. Calculators of any type are allowed, but not devices that store text or that can communicate with other such devices.

Be sure your name and student number are printed on the score sheet and the student number correctly coded in the box at the top right-hand side of the sheet.

This is paper A. Questions are numbered 1 to 20. Mark the correct answers in rows 1-20 of the ***first*** column of the accompanying IBM sheet in pencil. Also write "Paper A" next to your name on the IBM sheet.

---

1. A block attached to a spring oscillates in simple harmonic motion along the x axis. The limits of its motion are x = 10 cm and x = 50 cm and it goes from one of these extremes to the other in 0.25 s. Its amplitude and frequency are:

   (a) 40 cm, 2 Hz
   (b) 20 cm, 4 Hz
   (c) 25 cm, 4 Hz
   (d) 20 cm, 2 Hz
   (e) 40 cm, 4 Hz

2. Two identical undamped oscillators have the same amplitude of oscillation only if:

   (a) they are started with the same displacement x_0
   (b) they are started with the same velocity v_0
   (c) they are started with the same phase
   (d) they are started so the combination $\omega^2 x_0^2 + v_0^2$ is the same
   (e) they are started so the combination $x_0^2 + \omega^2 v_0^2$ is the same

3. The displacement of an object oscillating on a spring is given by $x(t) = x_m \cos(\omega t + \phi)$. If the object is initially displaced in the negative x direction and given a negative initial velocity, then the phase constant ϕ is between:

   (a) 0 and π/2 radians
   (b) π/2 and π radians
   (c) π and 3π/2 radians
   (d) 3π/2 and 2π radians
   (e) none of the above (ϕ is exactly 0, π/2, π, or 3π/2 radians)

4. A certain spring elongates 9 mm when it is suspended vertically and a block of mass M is hung on it. The natural angular frequency of this mass-spring system is:

(a) is 0.088 rad/s
(b) is 33 rad/s
(c) is 200 rad/s
(d) is 1140 rad/s
(e) cannot be computed unless the value of M is given

5. An object of mass 0.20-kg attached to a spring whose spring constant is 500 N/m executes simple harmonic motion. If its maximum speed is 5.0 m/s, the amplitude of its oscillation is:

(a) 0.20 m (b) 250 m (c) 0.0020 m (d) 25 m (e) 0.10 m

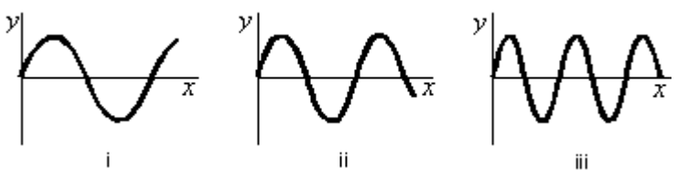
6. A particle is in simple harmonic motion along the x axis. The amplitude of the motion is x_m. When it is at $x = x_1$, its kinetic energy is $K = 4$J and its potential energy (measured with $U = 0$ at $x = 0$) is $U = 4$J. When it is at $x = -x_1/2$, the kinetic and potential energies are:

(a) $K = 7$J and $U = 1$J
(b) $K = 6$J and $U = 2$J
(c) $K = 4$J and $U = 4$J
(d) $K = 2$J and $U = 6$J
(e) $K = 1$J and $U = 7$J

7. A block of mass 0.25-kg oscillates on the end of the spring with a spring constant of 200 N/m. If the oscillation is started by elongating the spring 0.15 m and giving the block a speed of 3.0 m/s, then the amplitude of the oscillation is:

(a) 0.13 m (b) 13 m (c) 3.7 m (d) 5.2 m (e) 0.18 m

8. Three travelling sinusoidal waves are on identical strings, with the same tension. The mathematical forms of the waves are $y_1(x,t) = y_m\sin(3x - 6t)$, $y_2(x,t) = y_m\sin(4x - 8t)$, and $y_3(x,t) = y_m\sin(6x - 12t)$, where x is in meters and t is in seconds. Match each mathematical form to the appropriate graph below.



(a) y_1: i, y_2: ii, y_3: iii (b) y_1: iii, y_2: ii, y_3: I (c) y_1:i, y_2: iii, y_3: ii
(d) y_1: ii, y_2: i, y_3: iii (e) y_1: iii, y_2: i, y_3: ii

9. Sinusoidal water waves are generated in a large ripple tank. The waves travel at 20 cm/s and their adjacent crests are 5.0 cm apart. The time required for each new whole cycle to be generated is:

(a) 100 s (b) 4.0 s (c) 2.0 s (d) 0.5 s (e) 0.25 s

10. The tension in a string with a linear density of 0.0010 kg/m is 0.40 N. A 100 Hz sinusoidal wave on this string has a wavelength of:

(a) 0.05 cm (b) 2.0 cm (c) 5.0 cm (d) 20 cm (e) 100 cm

11. Three separate strings are made of the same material. String 1 has length L and tension τ, string 2 has length $2L$ and tension 2τ and string 3 has length $3L$ and tension 3τ. A pulse is started at one end of each string. If the pulses start at the same time, the order in which they reach the other end is:

(a) 1, 2, 3
(b) 3, 2, 1
(c) 2, 3, 1
(d) 3, 1, 2
(e) they all take the same time

12. A transverse travelling sinusoidal wave on a string has a frequency of 100 Hz, a wavelength of 0.040 m and an amplitude of 2.0 mm. The maximum velocity in m/s of any point on the string is:

(a) 0.2 (b) 1.3 (c) 4 (d) 15 (e) 25

13. A stretched string, clamped at its ends, vibrates in its fundamental frequency. To double the fundamental frequency, one can change the string tension by a factor of:

(a) 2 (b) 4 (c) $\sqrt{2}$ (d) ½ (e) $1/\sqrt{2}$

14. The intensity of a certain sound wave is 6 μW/cm^2. If its intensity is raised by 10 decibels, the new intensity (in μW/cm^2) is:

(a) 60 (b) 6.6 (c) 6.06 (d) 600 (e) 12

15. The sound level at a point P is 14 db below the sound level at a point 1.0 m from a point source. The distance from the source to point P is:

(a) 4.0 cm (b) 20.2 m (c) 2.0 m (d) 5.0 m (e) 25 m

16. A piano wire has a length of 81 cm and a mass of 2.0 g. If its fundamental frequency is to be 394 Hz, it tension must be:

(a) 0.32 N (b) 63 N (c) 130 N (d) 1000 N (e) none of these

17. A column of argon is open at one end and closed at the other. The shortest length of such a column that will resonate with a 200 Hz tuning fork is 42.5 cm. The speed of sound in argon must be:

(a) 85.0 m/s (b) 170 m/s (c) 340 m/s (d) 470 m/s (e) 940 m/s

18. Five organ pipes are described below. Which one has the highest frequency fundamental?

(a) a 2.3-m pipe with one end open and the other closed
(b) a 3.3-m pipe with one end open and the other closed
(c) a 1.6-m pipe with both ends open
(d) a 3.0-m pipe with both ends open
(e) a pipe in which the displacement nodes are 5-m apart

19. A source emits sound with a frequency of 1000 Hz. It is moving at 20 m/s toward a stationary reflecting wall. If the speed of sound is 340 m/s an observer at rest directly behind the source hears a beat frequency of:

(a) 11 Hz (b) 86 Hz (c) 97 Hz (d) 118 Hz (e) 183 Hz

20. The speed of sound is 340 m/s. A plane flies horizontally at an altitude of 10,000 m and a speed of 400 m/s. When an observer on the ground hears the sonic boom the horizontal distance from the point on its path directly above the observer to the plane is:

(a) 5,800 m (b) 6,200 m (c) 8,500 m (d) 12,000 m (e) 16,000 m

THE END