Physics 1C **Final**
Summer Session II, 2011 **Original**
Quiz ID _____

1. An automobile ($m = 1.0 \times 10^3\ kg$) is driven into a brick wall in a safety test. The bumper behaves like a spring ($k = 5.00 \times 10^6\ Nm$), and is observed to compress a distance of 3.16 cm as the car is brought to rest. What was the initial speed of the automobile in m/s?

   (a) 2.23
   (b) 8.13
   (c) 2.75
   (d) 9.84
   (e) 8.98

2. By what factor is the maximum magnitude of the acceleration increased if the maximum displacement from equilibrium is increased by a factor of 4?

   (a) 1/2
   (b) 1
   (c) 2
   (d) 4
   (e) 8

3. When a pendulum clock is moved to the top of a mountain,

   (a) its period of oscillation decreases.
   (b) its period of oscillation increases.
   (c) its frequency increases.
   (d) its moment of inertia decreases.
   (e) its moment of inertia increases.

4. Ocean waves with a wavelength of 120 m are coming in at a rate of 8 per minute. What is their speed in m/s?

   (a) 8
   (b) 16
   (c) 24
   (d) 32

(e) 4

5. A guitar string 80.0 cm long has a mass density of 3.0 g/m. What is the velocity of waves on the string in m/s if the string tension is 87 N?

   (a) 88

   (b) 170

   (c) 256

   (d) 440

   (e) 200

6. The wave number of a wave is doubled. By what factor does the wavelength change?

   (a) It doesnt change.

   (b) 1/4

   (c) 1/2

   (d) 2

   (e) 4

7. The origin of an x coordinate axis is located at one end of a string of length L. When a standing wave of wavelength $L/4$ causes the string to vibrate, the location closest to the origin of a point of minimum amplitude other than an end is $x =$

   (a) L

   (b) $L/2$

   (c) $L/4$

   (d) $L/6$

   (e) $L/8$

8. A small speaker is placed close to the open end of a cylindrical pipe that is closed at the other end. The pipe is 2 m long. The speed of sound in air in that room is 336 m/s. Some frequencies of the speaker, in Hz, at which resonance might occur in the air in the pipe are

   (a) 42, 126, 210.

   (b) 84, 252, 420.

   (c) 42, 84, 126.

   (d) 84, 168, 252.

(e) 42, 168, 336.

9. A fire engine approaches a wall at 5 m/s while the siren emits a tone of 500 Hz frequency. At the time, the speed of sound in air is 340 m/s. How many beats per second do the people on the fire engine hear?

   (a) 0
   (b) 7
   (c) 15
   (d) 29
   (e) 250

10. When unpolarized light is passed through two polarizing filters in succession, its intensity is decreased by 87.5%. Determine the angle between the transmission axis of the two filters.

   (a) 15°
   (b) 30°
   (c) 60°
   (d) 75°
   (e) 20°

11. A layer of kerosene ($n = 1.45$) is floating on water ($n = 1.33$). For what angles of incidence at the kerosene-water interface will light be totally internally reflected within the kerosene?

   (a) $\theta < 32.1°$
   (b) $\theta > 66.5°$
   (c) $\theta < 42.1°$
   (d) $\theta > 55.1°$
   (e) $\theta > 45.2°$

12. A diver shines light up to the surface of a glass-bottomed boat at an angle of 30° relative to the normal. If the index of refraction of water and glass are 1.33 and 1.5, at what angle in degrees does the light leave the glass, relative to its normal?

   (a) 26
   (b) 35
   (c) 42

(d) 22

(e) 48

13. A fish is located in water. The fish is 6.65 m beneath the surface and appears to be 5 m beneath the surface. What is the index of refraction of the water?

    (a) 2.11

    (b) 1.67

    (c) 1.55

    (d) 1.33

    (e) 1.25

14. A concave mirror has a focal length of 20 cm. What is the position of the object if the image is upright and is two times larger than the object?

    (a) 30

    (b) 205

    (c) 10

    (d) 40

    (e) 60

15. If the distance of an object to the lens (focal length 2 cm) is 1 cm, what is the magnification of the object?

    (a) 6

    (b) 1

    (c) 4

    (d) 2

    (e) 1.5

16. Two slits separated by 0.05 mm are illuminated with green light ($\lambda = 540$ nm). How many fringes of bright lines are there between the central maximum and the 12 cm position. (The distance between the double slits and the screen is 1 m.)

    (a) 1111

    (b) 111

    (c) 11

    (d) 1

(e) 11111

17. Monochromatic light ($\lambda = 500\ nm$) is incident on a soap bubble ($n = 1.4$). What is the minimum thickness (in nm) of the soap film if destructive interference occurs in light reflected from the bubble?

    (a) 102
    (b) 179
    (c) 54
    (d) 1
    (e) 89

18. At what distance in km could one theoretically distinguish two automobile headlights separated by 1.5 meters? Assume a pupil diameter of 0.5 cm and yellow headlights seen at wavelength $5 \times 10^{-7}\ m$. Assume eye fluid has an average n=1.33.

    (a) 6
    (b) 12
    (c) 9
    (d) 18
    (e) 16

19. What is the maximum kinetic energy in eV of a photoelectron emitted from a surface whose work function is 5.0 eV when the surface is illuminated by radiation of 200 nm wavelength? ($h = 6.626 \times 10^{-34}\ J \cdot s$; $c = 3.00 \times 10^{8}\ m/s$; $e = 1.60 \times 10^{-19}$ C; $1eV = 1.602 \times 10^{-19} J$)

    (a) 1.89
    (b) 1.2
    (c) 3.1
    (d) zero
    (e) 6.2

20. X-rays of wavelength $\lambda_0 = 0.21nm$ are incident on a block of material. Scattered X-rays are observed at an angle of 40° to the incident X-ray beam. What is $\Delta\lambda$ in m? ($m_e = 9.11 \times 10^{-31}\ kg$; $h = 6.626 \times 10^{-34}\ J \cdot s$; $c = 3.00 \times 10^{8}\ m/s$)

    (a) 5.67×10^{-13}
    (b) 3.31×10^{-13}

(c) 5.86×10^{-13}

(d) 5.21×10^{-13}

(e) 6.11×10^{-13}

21. A persons skin temperature is $37°C$. What is the maximum wavelength of the emitted radiation in m?

(a) 9.35×10^{-6}

(b) 7.83×10^{-6}

(c) 1.42×10^{-4}

(d) 0.233×10^{-7}

(e) 9.38×10^{4}

22. The Rydberg constant is $1.10 \times 10^{7}\ m^{-1}$. What is the frequency in s^{-1} of a photon caused by a hydrogen transition from energy state 4 to energy state 3?

(a) 8.00×10^{13}

(b) 3.21×10^{14}

(c) 1.60×10^{14}

(d) 2.23×10^{14}

(e) 1.79×10^{14}

23. When the principle quantum number is 2, the magnetic orbital quantum number can be

(a) 0 or 1

(b) 0, 1 or 2

(c) -2, -1, 0, 1, or 2

(d) 1, -1 or -2

(e) -1, 0 or 1

24. If the exclusion principle were not valid,

(a) every electron in an atom would have a different mass.

(b) every atom would be in its state of greatest ionization.

(c) the quantum numbers l and ml would not exist.

(d) every pair of electrons in a state would have to have opposite spins.

(e) every electron in an atom would end up in the atoms lowest energy state.

25. Which of the following electron configurations corresponds to an excited state of an atom?

    (a) $1s^2 2s^2 2p^1$
    (b) $1s^2 2s^1 2p^2$
    (c) $1s^2 2s^2 2p^3$
    (d) $1s^2 2s^2 2p^4$
    (e) $1s^2 2s^2 2p^6$

26. The ratio of the size of a classical electron $\left(r_e = \frac{k_e e^2}{m_e c^2} = 2.8 \times 10^{-15} m\right)$ to the size of a ${}^4_2$He nucleus is

    (a) 2.0.
    (b) 0.68.
    (c) 1.5.
    (d) 0.92.
    (e) 2.4.

27. Calculate the binding energy per nucleon (MeV/nucleon) for tritium, ${}^3_1$H, a radioactive isotope of hydrogen. Assume:
    $(m_p = 1.007825u; m_n = 1.008665u; m_t = 3.01605u; u = 1.66 \times 10^{-27} kg)$

    (a) 3.1
    (b) 2.8
    (c) 1.0
    (d) 8.5
    (e) 2.1

28. What value of Z (atomic number) and A (mass number) result in the following alpha decay? ${}^{238}_{92}\mathrm{U} \rightarrow {}^A_Z \mathrm{X} + \alpha$

    (a) $Z = 92; A = 238$
    (b) $Z = 91; A = 238$
    (c) $Z = 90; A = 234$
    (d) $Z = 93; A = 238$
    (e) $Z = 88; A = 236$

29. Compared to an electron, the positron has

    (a) the same charge, but different mass.

(b) the opposite charge, but the same mass.

(c) no relationship.

(d) the same properties with slightly less mass.

(e) properties identical to those of the electron in every respect.

30. After n half-lives, the fraction of radioactive nuclei remaining in a sample is

(a) $\frac{1}{n^2}$

(b) $\frac{1}{n}$

(c) $\ln(n)$

(d) $\frac{1}{2n}$

(e) $\frac{1}{2^n}$