

Physics 104 Final Exam

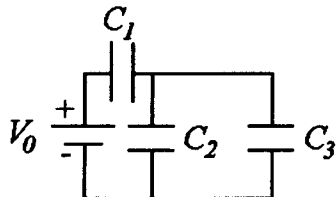
Name _____ ID # _____

Section # _____ TA Name _____

Fill in your name, student ID # (not your social security #), and section # on the scantron sheet. Fill in the letters given for the first 5 questions on the scantron sheet. These letters determine which version of the test you took and are IMPORTANT to get right.

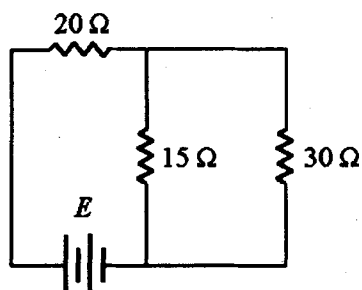
1. A
2. D
3. C
4. B
5. E
6. At what point is the charge-per-unit area smallest on the surface of an irregularly shaped conducting solid?
 - a. at the average curvature
 - b. where surface curves inward
 - c. where surface is flat
 - d. where outward curvature is greatest
 - e. where outward curvature is ~~least~~ small.
7. In a thundercloud there may be an electric charge of +4 C near the top of the cloud and -4 C near the bottom of the cloud. These charges are separated by about 2 km. What is the electric force between these two sets of charges?
 - a. 3.6×10^4 N
 - b. 3.6×10^5 N
 - c. 3.6×10^6 N
 - d. 3.6×10^7 N
 - e. 3.6×10^6 N
8. Decreasing the separation of the two charged parallel plates of a capacitor which are disconnected from a battery will produce what effect on the capacitor?
 - a. decrease stored energy
 - b. increase charge
 - c. decrease charge
 - d. decrease capacitance
 - e. increase stored energy

9. If $C_1 = 15 \mu\text{F}$, $C_2 = 10 \mu\text{F}$, $C_3 = 20 \mu\text{F}$, and $V_0 = 18 \text{ V}$, determine the energy stored by C_3
- 0.72 mJ
 - 0.36 mJ
 - 0.50 mJ
 - 0.18 mJ



10. A wire carries a steady current of 0.1 A over a period of 200 s. What total charge passes through the wire in this time interval?
- 20 C
 - 200 C
 - 2.0 C
 - 300 C
 - 0.005 C
11. A high-voltage transmission line carries 1000 A at 990,000 V. What is the maximum power transmitted by the line?
- 370 MW
 - 700 MW
 - 100 MW
 - 990 MW
 - 70 MW
12. Three resistors connected in series have the individual voltages labeled V_1 , V_2 and V_3 , respectively. Which of the following expresses the total voltage across the three resistors when connected in this manner?
- $V_t = V_1 + V_2 + V_3$
 - $V_t = (1/V_1 + 1/V_2 + 1/V_3)$
 - $V_t = V_1 = V_2 = V_3$
 - $V_t = (1/V_1 + 1/V_2 + 1/V_3)^{-1}$
 - $V_t = 0$

13. If $E = 24 \text{ V}$, at what rate is thermal energy generated in the 30Ω resistor?
- 13 W
 - 3.2 W
 - 23 W
 - 39 W
 - 2.1 W



14. A current in a solenoid with N turns creates a magnetic field at the center of that loop. The field strength is directly proportional to:
- number turns in loop
 - the square of the current
 - Choices A and B are valid
 - current strength
 - Choices A and D are valid
15. Two long parallel wires 20 cm apart carry currents of 5A and 10A in the same direction. Is there any point between the two wires where the magnetic field is zero?
- Yes, 12 cm from the 5A wire.
 - Yes, midway between the wires.
 - Yes, 7.7 cm from the 5A wire.
 - Yes, 6.7 cm from the 5A wire.
 - No.
16. How is the energy stored in a current carrying inductor related to the current value, I ?
- directly proportional to I^2
 - directly proportional to $I^{1/2}$
 - directly proportional to I
 - inversely proportional to I
 - inversely proportional to I^2

17. A circular loop (area = 0.20 m^2) turns in a uniform magnetic field with $B = 0.13 \text{ T}$. At an instant when the angle between the magnetic field and the normal to the plane of the loop is 90° and is increasing at the rate of 0.50 rad/s , what is the magnitude of the emf induced in the loop?
- 13 mV
 - zero
 - 26 mV
 - 33 mV
 - 20 mV
18. An ac series circuit contains a resistor of 20 Ohms, a capacitor of 0.75 microFarads and an inductor of 60 mH. What frequency should be used to create a resonance condition in the circuit?
- 318 Hz
 - 159 Hz
 - 750 Hz
 - 4320 Hz
 - 531 Hz
19. Which of the following effects is the result of the fact that the index of refraction of glass will vary with wavelength?
- mirages
 - spherical aberration
 - chromatic aberration
 - birefringence
 - light scattering
20. Monochromatic light hits a piece of glass. What happens to the wavelength in the glass as the index of refraction decreases?
- increases
 - decreases
 - remains constant
 - is zero
 - approaches $3 \times 10^8 \text{ m}$
21. An underwater scuba diver sees the sun at an apparent angle of 40° from the vertical. How far is the sun above the horizon? ($n_{\text{water}} = 1.333$)
- 13.8°
 - 9.90°
 - 19.5°
 - 31.0°
 - 27.0°

22. Sally places an object 6 cm from a thin convex lens along its axis. The lens has a focal length of 9 cm. What are the respective values of the image distance and magnification?
- 18 cm and 3
 - 18 cm and 3
 - 3 cm and -0.5
 - 3 cm and 0.5
 - 18 cm and -3
23. A candle is 49 cm in front of a convex spherical mirror of radius of curvature 70 cm. Where is the image and what is its magnification?
- $q = -20.4$ cm, $M = +0.417$
 - $q = +20.4$ cm, $M = -0.417$
 - $q = 122.5$ cm, $M = +2.50$
 - $q = -20.4$ cm, $M = -0.417$
 - $q = 122.5$ cm, $M = -2.50$
24. A Young's double slit apparatus is set up where a screen is positioned 0.8 m from the double slits. If the distance between alternating bright fringes is 0.83 cm and the light source has a wave length of 580 nm, what is the separation of the double slits?
- 2.8×10^{-5} m
 - 4.9×10^{-5} m
 - 5.6×10^{-5} m
 - 6.0×10^{-5} m
 - 9.3×10^{-5} m
25. A possible means for making an airplane radar-invisible is to coat the plane with an antireflective polymer. If radar waves have a wavelength of 3 cm and the index of refraction of the polymer is $n = 1.5$, how thick would the coating be?
- 2 mm
 - 1 mm
 - 5 mm
 - 10 mm
 - 2 cm
26. The ciliary muscle of the eye is contracted under which condition?
- eye is focused on a nearby object
 - eye is focused on a distant object
 - subject being viewed is well illuminated
 - eye is shut
 - subject being viewed is dimly illuminated

27. A binary star in the constellation Orion has an angular separation between the stars of 10^{-5} radians. If $\lambda = 500$ nm, what is the smallest aperture (diameter) telescope that will just resolve the two stars?
- 4.2 cm
 - 3.0 cm
 - 6.1 cm
 - 140 cm
 - 12.6 cm
28. A tuning fork has a frequency of 400 Hz and hence the period of one cycle is 2.5×10^{-3} s. If the tuning fork is in an inertial frame of reference moving by the observer at speed of $0.75c$, what is the frequency of the fork as measured by the observer when the tuning fork is moving at right angles to the observer's line of sight (point of closest approach)? (Assume that measurements are strictly by optical means and that the speed of sound waves in air is not pertinent here.)
- 302 Hz
 - 265 Hz
 - 454 Hz
 - 175 Hz
 - 605 Hz
29. At what speed would a clock have to be moving in order to run at a rate that is one-half the rate of a clock at rest?
- $0.67c$
 - $0.75c$
 - $0.87c$
 - $0.95c$
 - $0.93c$
30. Light of wavelength 450 nm is incident on a target metal which has a work function of 2.2 eV. What stopping potential is required for this combination in a phototube? ($h = 6.63 \times 10^{-34}$ J-s, $c = 3 \times 10^8$ m/s. 1 eV = 1.6×10^{-19} J and 1 nm = 10^{-9} m)
- 0.96 V
 - 0.56 V
 - 2.76 V
 - 0.32 V
 - 4.56 V

31. How much energy (in eV) does a photon of red light ($\lambda = 640 \text{ nm}$) have? ($h = 6.626 \times 10^{-34} \text{ J-s}$ and $1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$)
- 2.5 eV
 - 0.9 eV
 - 1.3 eV
 - 3.2 eV
 - 1.9 eV
32. Of the various wavelengths emitted from a hydrogen gas discharge tube, those associated with transitions from higher levels down to the $n = 2$ level produce which of the following?
- microwaves
 - X-rays
 - ultraviolet
 - infrared
 - mixture of visible and near ultraviolet
33. The wavelength of coherent ruby laser light is 688.3 nm. What energy difference (in eV) exists between the upper state and the lower state of the transition producing this light?
- 1.80 eV
 - 1.99 eV
 - 1.93 eV
 - 1.74 eV
 - 1.86 eV
34. The alpha radiation first detected by Becquerel was in fact which of the following?
- high energy quanta
 - neutrinos
 - positrons
 - helium nuclei
 - electrons
35. A 1-gram sample of petrified wood is taken from a petrified forest. If the Carbon-14 activity of the sample is 20% that of present-day organic material, what is the age of the petrified wood? ($T_{1/2}$ for C-14 is 5,730 years)
- 8,600 years
 - 2,230 years
 - 17,200 years
 - 4,460 years
 - 13,300 years

36. Which of the following will not influence the rate at which nuclear reactions will occur in a nuclear power plant where the fuel elements are a mixture of U-235 and U-238?
- The presence of control rods
 - The percentage of the energy that is used to produce electricity
 - The presence of moderating material
 - The percentage of U-235 relative to U-238
 - All will affect the rate
37. The pion ($m = 135 \text{ MeV}/c^2$) is thought to be the particle exchanged in the nuclear force. What is the maximum range of this particle if its "time of existence" is as long as can be allowed by the uncertainty principle? ($h = 1.054 \times 10^{-34} \text{ J}\cdot\text{s}$)

- | | |
|--|-------------------------|
| a. $1.2 \times 10^{-15} \text{ m}$ | a. 10^{-20} m |
| b. $1.5 \times 10^{-15} \text{ m}$ | b. 10^{-16} m |
| c. $2.0 \times 10^{-15} \text{ m}$ | c. 10^5 m |
| d. $7.5 \times 10^{-15} \text{ m}$ | d. 10^{10} m |
| e. $9.0 \times 10^{-15} \text{ m}$ | e. 10^{-10} m |