

Encode your **name** (last name, first name) and the **test number** shown above, on the scan sheets provided, leaving a space between your last and first name. Select the **best answer** for each of the questions below and encode your choice on the scan sheet. There is an equation sheet attached to this exam which you may tear off and keep (if you wish).

- Suppose you have been asked to move a 200 kg piano. Suppose further that there is an electric field in your area of 10 N/C downward. Your plan is to put an electric charge on the piano so that the electric field will “float” the piano making it easy to move. What type of electric charge will you put on the piano.
a.) Large and negative c.) Large and positive e.) Large and neutral.
b.) Small and negative d.) Small and positive
- A metallic sphere is initially uncharged. If 6.25×10^{10} protons are added to the sphere, the final charge on the sphere will be.
a.) -5 nC b.) +5 nC c.) +10 nC d.) +15 nC e.) +20 nC
- You wish to calculate the electric potential from a proton. The equation you would use is
a.) Force/mass = $kQ/(mr^2)$ c.) $V = k Q/r$ e.) $V = k Q/ r^2$
b.) energy = $Fd = \frac{1}{2} mv^2$ d.) $E = kQ/ r^2$
- If you compare the resistances in a 40 watt and a 100 watt light bulb
a.) the 40 watt is larger c.) the 100 watt is larger
b.) they are both the same d.) can't tell without knowing the voltage.
- A wire located near the equator carries a current of 1.2 amps toward the east. The magnetic field will produce a force on the wire in the _____ direction.
a.) west d.) up
b.) north e.) down
c.) south
- At what distance from a long, straight wire carrying a current of 8.0 A is the magnetic field due to the wire equal to the strength of the earth's field (approximately 5.0×10^{-5} T)?
a.) 0.032 m d.) 3.2 m
b.) 2.65 m e.) 18.34 m
c.) 0.265 m

14. A circular coil of wire containing 10 turns of wire and a radius of 50 cm has its area perpendicular to a magnetic field of 2×10^{-4} T. The magnetic field drops to zero in 4 ms. The induced emf in the coil will be
- a.) 1.6 mV c.) 39 mV e.) 0.39 volts
b.) 160 mV d.) 0.039 volts
15. A dentist holds a small mirror 2.5 cm from a surface of a patient's tooth. The image formed is upright and 5.0 times as large as the object. What is the focal length of the mirror?
- a.) 3.13 cm c.) 3.75 cm e.) 5.23 cm
b.) 3.50 cm d.) -3.75 cm
16. A beam of laser light ($\lambda_0 = 632.8$ nm) is incident from air ($n_{\text{air}} = 1$) on a smooth surface of water ($n_{\text{water}} = 1.33$) at an angle of $\theta_1 = 40.0^\circ$. Determine the angle of refraction.
- a.) 48.3° c.) 28.9° e.) 64.6°
b.) 42.9° d.) 25.4°
17. Why are anti-reflective coatings put onto camera lenses?
- a.) to reduce internal reflections
b.) to make the pictures brighter
c.) to make the focus sharper
d.) all of the above are correct
e.) choices a.) and b.) above are correct.
18. Laser light ($\lambda = 632.8$ nm) falls on a single rectangular slit, 0.015 cm wide. A diffraction pattern is formed on a screen 2.00 meters from the slit. How wide is the central bright spot?
- a.) 4.22×10^{-3} m c.) 1.69 cm e.) 3.4 cm
b.) 0.844 cm d.) 2.53 cm
19. The Rayleigh Criteria states that the resolving power of a circular aperture follows the relation: $a \sin\theta = 1.22 \lambda$. Suppose you wish to count clearly the number of "points" on a deer's antler at 500 meters in a late evening setting (light of wavelength 600 nm). That is, be able to resolve a distance 5 cm at that distance. Approximately, what should the diameter of the objective lens in your telescope be?
- a.) 0.5 cm c.) 1.5 cm e.) 3.5 cm
b.) 0.75 cm d.) 1.8 cm

20. Suppose you are unable to focus your eyes on anything closer than 40 cm. What power contact lenses would allow you to see clearly at the normal near point?
- a.) +1 D c.) +2 D e.) - 3.5 D
b.) +1.5 D d.) - 1 D
21. Two waves can be at the same place at the same time and cancel each other out. This is called
- a.) destructive interference c.) disenfranchised waves e.) bad news
b.) constructive interference d.) destructive refraction
22. What is the wavelength of South Dakota Public Radio's waves that are broadcast at a frequency of 88.3 MHz?
- a.) 0.29 m c.) 2.96 m e.) 4.6 m
b.) 2.55 m d.) 3.40 m
23. Light in air, with a frequency of 5.66×10^{14} Hz enters water of index of refraction 1.33. What is the frequency of the light in the water
- a.) 4.25×10^{14} Hz c.) 1.89×10^6 Hz e.) 1.89×10^{12} Hz
b.) 5.66×10^{14} Hz d.) 3.78×10^{14} Hz
24. Light in air, with a frequency of 5.66×10^{14} Hz enters water of index of refraction 1.33. What is the wavelength of the light in the water
- a.) 399 nm c.) 425 nm e.) 630 nm
b.) 530 nm d.) 550 nm
25. A spacecraft is moving away from the earth with a speed of 1.5×10^8 m/s (0.5c) when a radio signal is sent from the earth to the spacecraft. With what speed will the spacecraft "see" this signal approaching the spacecraft?
- a.) 0.25 c c.) 0.75 c e.) 1.5 c
b.) 0.5 c d.) 1.0 c