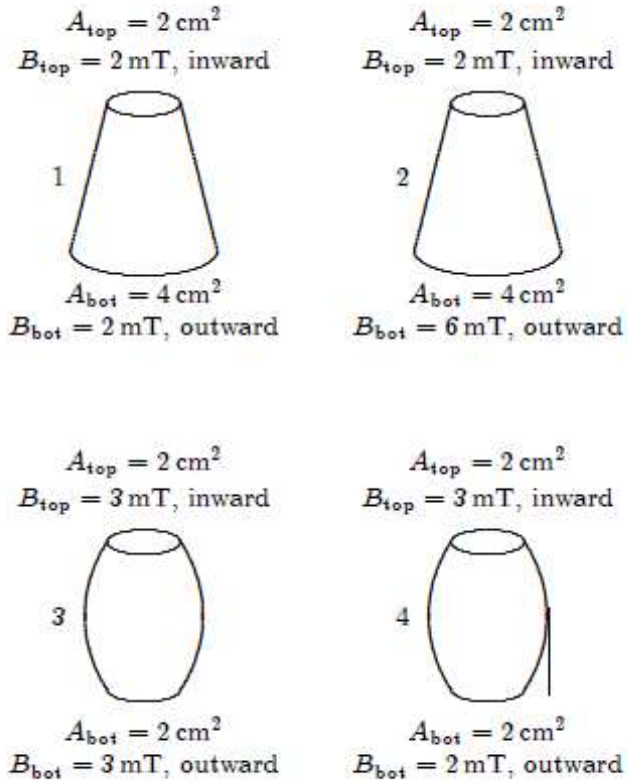
Physics 2

Set no. 5

1. Please obtain the components of the vector $\vec{E} = [E_x, E_y, E_z]$ from the scalar potential V(x,y,z) = xy

2. Four closed surfaces are shown. The areas A_{top} and A_{bot} of the top and bottom faces and the magnitudes B_{top} and B_{bot} of the uniform magnetic fields through the top and bottom faces are given. The fields are perpendicular to the faces and are either inward or outward. Please rank the surfaces according to the magnitude of the magnetic flux through the curved sides, least to greatest.



A) 1, 2, 3, 4 B) 3, 4, 1, 2 C) 1, 2, 4, 3 D) 4, 3, 2, 1 E) 2, 1, 4, 3

3. Two of Maxwell's equations contain a path integral on the left side and an area integral on the right. For them:
   A) the path must pierce the area
   B) the path must be well-separated from the area
   C) the path must be along a field line and the area must be perpendicular to the field line
   D) the path must be the boundary of the area
   E) the path must lie in the area, away from its boundary

4. Two of Maxwell's equations contain an integral over a closed surface. For them the infinitesimal vector area $\overrightarrow{dS}$ is always:
   A) tangent to the surface
   B) perpendicular to the surface and pointing outward
   C) perpendicular to the surface and pointing inward
   D) tangent to a field line
   E) perpendicular to a field line

5. Please show that the field $\vec{E} = [0,0,c\cos(y-ct)]$ $\vec{B} = [\cos(y-ct,0,0]$ fulfils Maxwell's equations: using Maxwell's equations for a vacuum, derive the Electromagnetic Wave Equation

6. The dimensions of $\vec{S} = (1/\mu_0)\,\vec{E} \times \vec{B}$ are:
   A. J/m^2
   B. J/s
   C. W/s
   D. W/m^2
   E. J/m^3

7. In a plane electromagnetic wave in vacuum, the ratio E/B of the amplitudes in SI units of the two fields is:
   A. the speed of light
   B. an increasing function of frequency
   C. a decreasing function of frequency
   D. $\sqrt{2}$
   E. $1/\sqrt{2}$

8. If the magnetic field in a plane electromagnetic wave is along the y axis and its component is given by $B_m \sin(kx - \omega t)$, in SI units, then the electric field is along the z axis and its component is given by:

   A. $(cB_m)\cos(kx - \omega t)$
   B. $-(cB_m/c)\cos(kx - \omega t)$
   C. $-(cB_m/c)\sin(kx - \omega t)$
   D. $B_m \cos(kx - \omega t)$
   E. $(cB_m/c)\sin(kx - \omega t)$

9. A diffraction grating has 2000 lines per centimeter. At what angle will the first-order maximum be for 520-nm-wavelength green light?

10. Please find the angle for the third-order maximum for 580-nm-wavelength yellow light falling on a difraction grating having 1500 lines per centimeter.

11. How many lines per centimeter are there on a diffraction grating that gives a first-order maximum for 470-nm blue light at an angle of 25.0°?

12. The tungsten elements of incandescent light bulbs operate at 3200 K. At what wavelength does the filament radiate maximum energy?

13. The radiant energy from the Sun reaches its maximum at a wavelength of about 500.0 nm. Please find the approximate temperature of the Sun's surface?

14. The maximum of blackbody intensity has been shifted from 350 nm to 700 nm. Please determine how the total rate of energy density emitted under these conditions changed in this process.

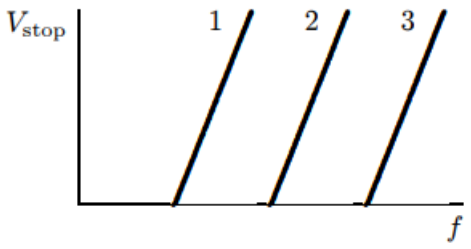
15. The units of the Planck constant h are those of:
A. energy
B. power
C. momentum
D. angular momentum
E. frequency

16. Please calculate the momentum and photon energy when the radiated wavelength is 400 nm , 500 nm and 600nm.

17. Which of the following electromagnetic radiations has photons with the greatest momentum?
A. blue light
B. yellow light
C. x rays
D. radio waves
E. microwaves

18. What is the speed of photoelectrons with mass $m_e = 1.11 \cdot 10^{-31}$ kg leaving the silver surface illuminated with monochromatic light of wavelength 150 nm, if for silver the wavelength at which the photoelectric phenomenon starts is 260nm?

19. The diagram shows the graphs of the stopping potential as a function of the frequency of the incident light for photoelectric experiments performed on three different materials. Please rank the materials according to the values of their work functions, from least to greatest.
A. 1, 2, 3
B. 3, 2, 1
C. 2, 3, 1
D. 2, 1, 3
E. 1, 3, 2



20. The work function for a certain sample is 2.3 eV. Please find the stopping potential for electrons ejected from the sample by $7.0 \cdot 10^{14}$ Hz electromagnetic radiation.