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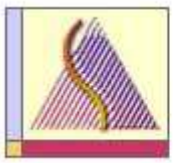
Principles of Physics
PHY1322



Department of Physics

Instructor: Dr. Andrzej Czajkowski
Final Exam
April 28, 2010

Closed book exam
Duration: 3 hrs
Return only the scantron sheets

1 Electron volt (eV) is a unit of:
a) charge. b) energy. c) potential. d) atomic power. e) atomic size.

2. Two equal charges are separated by a distance $r$. At what point, between the two charges, would a third test charge experience no net electrical force?

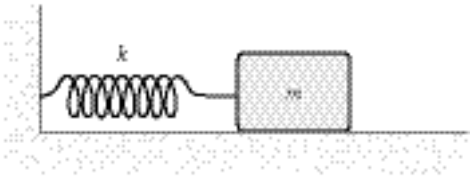
a) $\frac{3}{2}r$ b) $\frac{r}{4}$ c) $\frac{r}{2}$ d) $\frac{3}{4}r$ e) impossible to answer

3. The total electric flux through a closed cylindrical (length $= 1.2$ m, diameter $= 0.20$ m) surface is equal to $-5.0\ \mathrm{N m^2/C}$. Determine the net charge within the cylinder in pC. ($\varepsilon_o = 8.85 \times 10^{-12}\ \mathrm{C^2/N m^2}$)
a) – 71 b) – 62 c) – 53 d) – 44 e) –16

4. Three resistors are connected in parallel. Their resistances are 16Ω, 24Ω, and 48Ω. What is their total resistance in Ω?
a) 8 b) 36 c) 54 d) 62 e) 88

5. A mass $m$ = 2.0 kg is attached to a spring having a force constant $k$ = 290 N/m as in the figure. The mass is displaced from its equilibrium position and released. Its frequency of oscillation (in Hz) is approximately

a) 12
b) 0.50
c) 0.01
d) 1.9
e) 0.08




6.A 100-m long transmission cable is suspended between two towers. If the mass density is 2.01 kg/m and the tension in the cable is $3.00 \times 10^4$ N, what is the speed of transverse waves on the cable?
a) 60 m/s b) 122 m/s c) 244 m/s d) 310 m/s e) 1500 m/s

7. A convex mirror has a focal length of –20 cm. What is the object distance in cm when the image distance is –10 cm?
a) 10 b) 40 c) 60 d) 20 e) 30

8. 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) $\theta > 45.2°$

9. In a double slit experiment, the third bright fringe occurs at a distance of 2 cm from the central bright spot. The slits are 1 mm apart and the screen is 3 m from the slits. What is the wavelength of the light ( in meters)?
a) $2 \times 10^{-4}$ b) $2 \times 10^{-8}$ c) $2 \times 10^{-6}$ d) $0.2 \times 10^4$ e) $0.02 \times 10^{-6}$

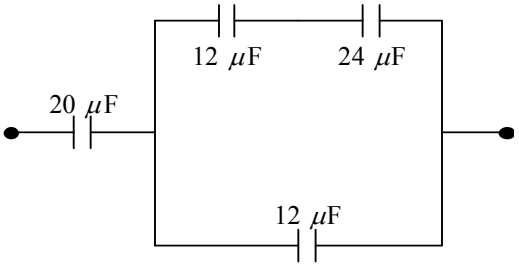
10. X-rays of wavelength $\lambda_0 = 0.21$ nm are incident on a block of material. Scattered X-rays are observed at an angle of 40° to the incident X-ray beam. What is the wavelength of the scattered X-rays?
($m_e = 9.11 \times 10^{-31}$ kg ; $h = 6.626 \times 10^{-34}$ J·s ; $c = 3.00 \times 10^8$ m / s)
a)0.0210463nm b) 0.210543nm c) 0.210567 nm d) 0.210661nm
e) 0.210581nm

11. An electron is moving at a speed of $2.1 \times 10^6$ m/s in the first Bohr orbit. Its deBroglie wavelength in m is ($h = 6.626 \times 10^{-34}$ Js; $m_e = 9.11 \times 10^{-31}$ kg )

a). $0.3 \times 10^{-10}$ b) $1.7 \times 10^{-10}$ c) $0.5 \times 10^{-10}$ d) $3.5 \times 10^{-10}$

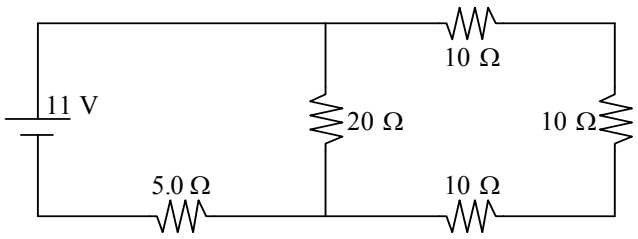
e) $1.5 \times 10^{-10}$

12. What is the equivalent capacitance in $\mu$F of the combination shown?




a) 20
b) 10
c) 40
d) 25
e) 6.0

13. What is the magnitude (in V) of the potential difference across the 20 Ω resistor?




a) 3.2
b) 7.8
c) 11
d) 5.0
e) 8.6

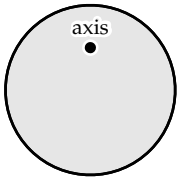
14. A series *RC* circuit contains a resistor, a capacitor and a source of *emf* with $R = 220\ \Omega$, $C = 5 \times 10^{-6}$ F and $emf = 300$ V. Initially a switch is open. At a time 0.011 s after the switch is closed the current in the resistor in A is

a) $6.2 \times 10^{-5}$ b) $1.3 \times 10^{-5}$ c) $6.7 \times 10^{-5}$ d) $6.4 \times 10^{-5}$ e) $6.9 \times 10^{-5}$

15. In the figure below, a disk (radius $R$ = 1.0 m, mass = 2.0 kg) is suspended from a pivot a distance $d$ = 0.25 m above its center of mass. The angular frequency (in rad/s) for small oscillations is approximately

a) 4.2

b) 2.1
c) 1.5
d) 1.0
e) 3.8



16. A truck moving at 36 m/s passes a police car moving at 45 m/s in the opposite direction. If the frequency of the siren is 500 Hz relative to the police car, what is the frequency heard by an observer in the truck after the police car passes the truck? (The speed of sound in air is 343 m/s.)

a) 361 b) 636 c) 393 d) 396 e) 383

17. A string is stretched and fixed at both ends, 200 cm apart. If the density of the string is 0.015 g/cm, and its tension is 600 N, what is the wavelength (in cm) of the first harmonic?

a) 600 b) 400 c) 800 d) 1000 e) 200

18. A jet plane has a sound level of 150 dB. What is the intensity in $W/m^2$?

a) 1 b) 100 c) 10 d) 1000 e) 10000

19. A student stands 2 m from a plane mirror and sees one fourth of her body in the mirror. At what distance in m from the mirror, if any, must she stand in order to see half her body?
a) 1 b) 4 c) 6 d) 8
e. She will see one-fourth of her body at all distances.

20. A convex lens is made of thin plastic filled with air. Its surfaces both have a radius of curvature of 50.0 cm. When it is placed in water where $n = 1.33$, the magnitude of its focal length, in cm, is
a) 0 b) 19 c) 76 d) 152 e) infinite.

21.A body of mass 5.0 kg is suspended by a spring which stretches 10 cm when the mass is attached. It is then displaced downward an additional 5.0 cm and released. Its position as a function of time is approximately

**a.** $y = 0.10 \sin 9.9t$
**b.** $y = 0.10 \cos 9.9t$
**c.** $y = 0.10 \cos (9.9t + .1)$
**d.** $y = 0.10 \sin (9.9t + 5)$
**e.** $y = 0.05 \cos 9.9t$

22. 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

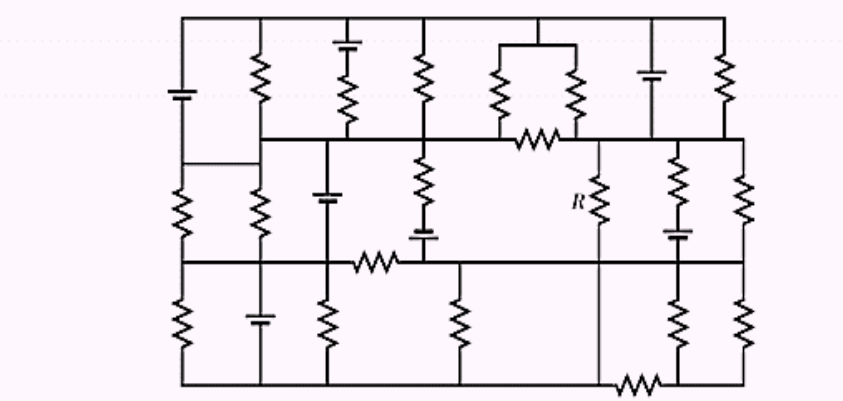
23. Ideally, how close together in km could 2 objects on the moon's surface be if they can just be resolved by the human eye? $D$ (Earth-moon) = 385,000 km, $\lambda$ (visible) $= 5.00 \times 10^{-7}$ m, and $d$(pupil) $= 0.00700$ m. Assume eye fluid has an average $n = 1.33$.
a) 170 b). 335 c) 33.5 d) 25.2 e) 42.0

24. The cutoff wavelength for photoelectric emission of a particular substance is 500 nm. What is the work function in eV? ($h = 6.626 \times 10^{-34}$ J·s; $c = 3.00 \times 10^{8}$ m / s)
a) 4.2 b) $4.0 \times 10^{-19}$ c) $4.0 \times 10^{-10}$ d) $2.5 \times 10^{-19}$ e) 2.5

25. Any two points in space connected by a perfect conductor ( 0resisitence):
a) will have a constant current flowing between them
b) will have no current flowing between them
c) will have the same value of electric potential
d) a and b only are true
e) none of the above

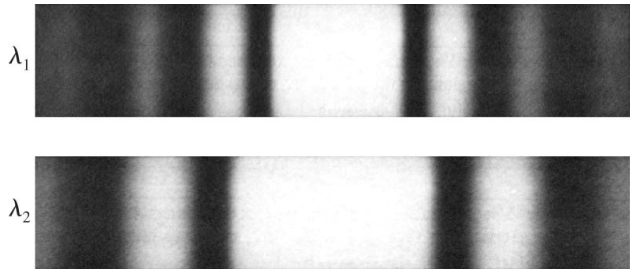
26. All resistors have resistance 4 and al batteries have emf 4V. What is the current through the resistor R? (Hint: I you find proper loop in this maze you can solve this in less than one minute of mental calculations)

a) 0.5 A
b) 1.0 A
c) <u>2.0 A</u>
d) 4.0 A
e) None of the above




27 The figure shows two single-slit diffraction patterns. The distance between the slit and the viewing screen is the same in both cases. Which of the following could be true?

Aperture size $a$
Intensity magnitude $I$

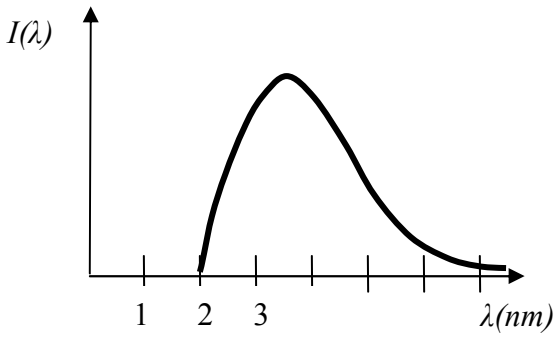



a) <u>The wavelengths are the same for both; $a1 > a2$.</u>
b) The wavelengths are the same for both; $a2 > a1$.
c) The slits and the wavelengths are the same for both; I1 > I2.
d) The slits and the wavelengths are the same for both; I2 > I1.
e) None of these answers is true

28. A block of density 2000kg/m$^3$ has a horizontal cross-sectional area 4m$^2$ and vertical height 1m. It floats in a fluid of density 900kg/m$^3$. The block is pushed down and released. The period of its harmonic oscillations is:
a) T=1s b) T= 2s c) T=3s d) T=4s e) <u>none of the above</u>

29. A metal of work function 5eV is illuminated with the light emitted by a black body. The cut off frequency of the metal corresponds to the frequency at which blackbody emission has maximum. Find the temperature of the black body.
a) 10.4K b) 104K c) 1166K <u>d) 11 660K</u> e) none of the above

30.The X ray intensity distribution function for X ray lamp is given on the figure. It is evident that electrons have been accelerated to maximum velocity of




a) 29.6x10$^3$km/s b) c/2 c) 7.4x10$^3$km/s
<u>d)14.8x10$^3$km/s</u> e) there is not enough information to answer question

31 Light of a wavelength 548nm illuminates two slits separated by 0.25 mm. At what angle would one find the phase difference between the waves from two slits to be 2 radians

a) $0.04^o$ b) 0.04 rad c) 0.02 rad d)$0.02^o$ e) none of these results

32 To measure the speed of light a following setup is contrived:
A pulsed laser beam ( repetition rate 10kHz) is send over a distance of 20m to a rotating mirror mounted on each face of the octagonal prism. The frequency of the mirror driver motor is increased until the maximum reflected signal is received by the time integrating detector.

Given the known value of light speed what is the frequency of the rotating mirror?

a) 7.50MHz b)1.18MHz c) 0.94 MHz d) 0.150 MHz e) none of the above

33. An isolated infinite conducting plane of thickness of 1cm ( work function =2.5eV) is illuminated with intense light at 400nm.. What is the maximum value of the surface charge density ($\sigma$) that will build on the plane?

a) $3.44nC/m^2$ b) $2.15nC/m^2$ c) $1.72nC/m^2$ d ) $1.08nC/m^2$) e) none of the above