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DEPARTMENT OF PHYSICS

2005/2006 RAIN SEMESTER EXAMINATION

J2: GENERAL PHYSICS II

Time-50mins

Some useful constants:

$$k = 9.0 \times 10^9 \text{ N.m}^2/\text{C}^2$$

$$m_e = 9.109 \times 10^{-31} \text{ kg}$$

$$m_p = 1.673 \times 10^{-27} \text{ kg}$$

$$e = 1.602 \times 10^{-19} \text{ C}$$

$$\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2/\text{N.m}^2$$

1. Three charges $+7 \times 10^{-9} \text{ C}$, $-14 \times 10^{-9} \text{ C}$, $+7 \times 10^{-9} \text{ C}$, are placed, respectively, at the corners A, B, and C of an equilateral triangle of side 20cm. The potential at C and the potential energy of the charge at B are, respectively:
a) 360 V, $9.36 \times 10^{-8} \text{ J}$ b) 315 V, $8.82 \times 10^{-6} \text{ J}$ c) 765 V, $3.49 \times 10^{-5} \text{ J}$ d) 910 V, $3.49 \times 10^{-4} \text{ J}$
e) None of the above.
2. The electric field in some position in space is given by $E = 3x^2 + 14x + 18$. The potential drop in going from $x = 5$ to $x = 23$ is
a) 7890 V b) 13,201 V c) 795 V d) 15,894 V e) None of the above.
3. A $1 \mu\text{f}$ capacitor is charged to 100 V and a $3 \mu\text{f}$ capacitor is charged to 300V. They are then connected in series by a very thin wire. The initial and final energies, and source of energy difference are respectively:
a) 0.135J, 0.12J, generation of heat. b) 3.651J, 0.53J, radio wave generation.
c) 3.98J, 3.90J, generation of heat. d) None of the above.
4. (i) The electric field at a location does not necessarily exert a force on any charge placed there.
(ii) Two charges in motion exert both electric and magnetic forces on each other.
(iii) The units of electric potential and electric potential energy are the same.
(iv) The relationship between the charge Q, the potential difference V, and capacitance C of a capacitor is $V = CQ$.
(v) The capacitance C of a capacitor filled with a dielectric substance of dielectric constant K is related to the capacitance C_v of the same capacitor in vacuum by $C = K C_v$.
a) (i), (ii) and (v) are correct. b) (ii), (iv) and (v) are correct. c) (i), (iii) and (iv) are correct.
d) Only (ii), and (v) are correct. e) None of the above.
5. The electric potential at the surface of a gold nucleus of radius $6.6 \times 10^{-13} \text{ cm}$ and atomic number 79 is:
a) $5.63 \times 10^5 \text{ Volts}$. b) $1.7 \times 10^7 \text{ Volts}$. c) $8.18 \times 10^{-3} \text{ Volts}$. d) $9.53 \times 10^4 \text{ Volts}$.
e) None of the above.
6. (i) The rate at which charge flows through a surface is called the electric current through the surface.
(ii) The resistivity of a material is the reciprocal of its resistance.
(iii) The power P going through a resistor of resistance R carrying a current I is $P = I^2 R$.
(iv) The terminal voltage V across a battery with emf ϵ and internal resistance r carrying a current I is $V = \epsilon + Ir$.
(v) To convert a galvanometer into an ammeter we must connect a high resistance in series with it.
a) (ii), (iii) and (v) are correct. b) Only (i), and (iv) are correct. c) (i), (iii) and (v) are correct.
d) (i), (ii), and (iv) are correct. e) None of the above.
7. A current 10^{-9} amperes flowing through a uniform wire corresponds to flow of electrons per second through any section of the wire given by:
a) 6.242×10^9 b) 1.675×10^{20} c) 5.390×10^5 d) 7.49×10^{18} e) None of the above.
8. If the critical angle of water is c and the refractive index is μ then
(a) $\mu = 1/\sin c$ (b) $\sin c = \mu$ (c) $\sin c = 1/\mu$ (d) $\sin \mu = 1/\sin c$
9. A wave traveling along a string is described by
 $Y(x,t) = 0.00327 \sin(72.1x - 2.72t)$ where numerical constants are in SI units.
What is the wavelength of this wave?
(a) 0.087m (b) 2.31m (c) 0.43m (d) 11.49m
10. What is the velocity of the wave described in question 9 above?
(a) 0.0277m/s (b) 26.5m/s (c) 72.1m/s (d) 2.72m/s

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11. A rocket moves at a speed of 242 m/s directly toward a stationary pole which sound waves at frequency 1250 Hz. What frequency f' is measured by a detector attached to the pole if the velocity of sound in air is 343 m/s? $F' = f$
 (a) 3175 Hz (b) 2005 Hz (c) 4245 Hz (d) 3142 Hz
12. The following is one of the characteristics of musical notes
 (a) Tension (b) Length (c) Timbre (d) Noise
13. Echoes are produced by the reflection of:
 (a) beats (b) noise (c) Doppler's effect (d) sound waves
14. The pitch of musical notes depends on:
 (a) intensity (b) instrument (c) frequency (d) loudness
15. The half-life of a radioactive substance is 20 days. How long will it take for an initial sample to decay into half?
 (a) 10 days (b) 4 days (c) 20 days (d) 5 days
16. Calculate the disintegration constant for a radioactive isotope of Ra if its half-life is 60 yrs.
 (a) 85.58/hr (b) $11.55 \times 10^{-3}/\text{hr}$ (c) $115.5 \times 10^{-2}/\text{hr}$ (d) $8.56 \times 10^{-2}/\text{hr}$
- Use the following statement to answer questions 17 to 19.
 Potassium has a photoelectric work function of 1.9 eV. Ultraviolet light of 5000 Å falls on it.
17. The stopping potential
 (a) 2.90 V (b) 0.58 V (c) 2.00 V (d) 0.72 V (e) 4.00 V $E_{12} = hf - W$
18. The maximum velocity of the emitted electrons is
 (a) $0.20 \times 10^6 \text{ m s}^{-1}$ (b) $2.0 \times 10^3 \text{ m s}^{-1}$ (c) $4.52 \times 10^6 \text{ m s}^{-1}$ (d) 10^3 m s^{-1} (e) none of the above.
19. The Threshold frequency is
 (a) $4.58 \times 10^{14} \text{ Hz}$ (b) $4.00 \times 10^{10} \text{ Hz}$ (c) $4.58 \times 10^{12} \text{ Hz}$ (d) $4.58 \times 10^{13} \text{ Hz}$ (e) $4.00 \times 10^{14} \text{ Hz}$ $W = hf_0$
20. A man stands 2m in front of a plane mirror. If the mirror is moved 3m further away from the man, the distance between him and his image is now:
 (a) 5m (b) 6m (c) 8m (d) 10m
21. In which of the following is total internal reflection not an important factor?
 (a) submarine's periscope (b) rainbow (c) prismatic binoculars (d) terrestrial telescope
22. Which of the following always forms virtual image?
 (a) The eye (b) A camera (c) A plane mirror (d) A convex lens
23. Faraday's law of electromagnetic induction states that
 (a) an induced e.m.f. is produced in any closed circuit if there exists a varying magnetic flux.
 (b) like charges repel while unlike charges attract
 (c) the magnitude of induced e.m.f. is greater than the time rate of change of the magnetic flux through the circuit
 (d) induced e.m.f. is inversely proportional to the rate at which the flux links the circuit.
The greater the flux, the greater the emf.
24. How many fundamental Maxwell's equations are basic to the study of electromagnetic phenomena?
 (a) 3 (b) 4 (c) 5 (d) 6 (e) 2
25. The significance of Maxwell equations is/are
 I. The equations predict that an accelerated charge generates an electromagnetic wave.
 II. The equations predict that light may consist electromagnetic wave.
 III. The equations indicate that electric and magnetic fields are interrelated.
 (a) I and II only (b) I only (c) III only (d) I, II and III.

THE END

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