University of Warmia and Mazury in Olsztyn
School of Medicine

Medical School Admission Test sample:

PHYSICS

1. Ray of light travelling through air is incident on a piece of glass whose refractive index is 1.5. If the sine of the angle of incidence is 0.6, what's the sine of the angle of refraction?

A. 0.2
B. 0.3
C. 0.4
D. 0.5
E. 0.6

2. An object is placed 40 cm in front of a concave mirror with a radius of curvature of 60 cm. Locate the image.

A. 30 cm
B. 40 cm
C. 60 cm
D. 120 m
E. 240 m

3. Which of the following particles is less massive?

A. A proton
B. A neutron
C. An atom
D. A beta particle
E. An alpha particle

4. Ethyl alcohol has a specific gravity of 0.8. If cork of specific gravity 0.25 floats in a beaker of ethyl alcohol, what fraction of the cork's volume is submerged?

A. 4/25
B. 1/5
C. ¼
D. 5/16
E. 8/16

5. A 2 cm3 sample of osmium has a mass of 45 g. What is density of this metal?

A. 22.5 kg/m3
B. 22,500 kg/m3
C. 45 kg/m3
D. 45,000 kg/m3
E. 20,000 kg/m3

6. A particle with positive charge q and mass m moving with speed v undergoes uniform circular motion in a constant magnetic field B. If the radius of the particle's path is r, which one of the following expressions gives the magnitude of the momentum of the particle?

A. qB/r,
B. r/qB,
C. rB/q,
D. qBr
E. q/rB

7. There are three resistors R1 = 12Ω, R2 = 6Ω, and R3 = 12Ω in parallel. The equivalent resistance, Req, is:

A. 30 Ω
B. 3 Ω
C. 12 Ω
D. 120 Ω
E. 36 Ω

8. In following nuclear reaction, what particle is represented by X?
(_95^241)Am → (_93^237)Np+X

A. A proton
B. An electron
C. An alpha particle
D. A gamma ray
E. A beta particle

9. The steel bed of a suspension bridge is 200 m long at 20 oC. Coefficient of linear expansion for steel is α=12x10-6 (Co)-1. The increase in length when it is at 40 oC is

A. 4.8 m
B. 48 m
C. 4.8x10-2 m
D. 2.4 m
E. 2.4x10-2 m

10. The 70-L steel gas tank of a car is filled to top with gasoline at 20 oC. Coefficient of volume expansion for gasoline is β=950x10-6 (Co)-1 The car sits in the sun and the tank reaches a temperature of 40 oC. How much gasoline overflow from the tank?

A. 1.3 L
B. 13 L
C. 2.6 L
D. 3.6 L
E. 4.6 L

11. What is the average translational kinetic energy of molecules in an ideal gas at 37 oC ? Boltzmann's constant k=1.38x10-23 J/K.

A. 10-21 J
B. 4.42x10-21 J
C. 6.42x10-21 J
D. 4.42x10-22 J
E. 6.42x10-22 J

12. How much heat input is needed to raise the temperature of an empty 20-kg container made of iron from 10 oC to 90 oC ? Iron specific heat c = 450 J/(kg oC).

A. 20 kJ
B. 200 kJ
C. 90 kJ
D. 72 kJ
E. 720 kJ

13. How much energy does a freezer have to remove from 1.5 kg of water at 20 oC to make ice at -12 oC ? Water specific heat cW = 4186 J/(kg oC), ice (-5 oC) specific heat 2100 J/(kg oC), water latent heat LW = 3.33x105 J/kg.

A. 150 kJ
B. 200 kJ
C. 330 kJ
D. 660 kJ
E. 990 kJ

14. 2800 J of heat (Q) is added to a system, and 1500 J of work (W) is done on the system. The change in internal energy (ΔU) of the system is

A. 1500 J
B. 2800 J
C. 4300 J
D. 1300 J
E. 2000 J

15. The average distance between electron and proton in a hydrogen atom is r = 0.53x10-10 m. The electron and proton have the same magnitude of charge Q1 = Q2 = 1.6x10-19 C. Assume that constant k = 9.0x109 (Nm2/C2). The electric force of electron and proton interaction in a hydrogen atom is

A. 1.6 x 10-8 N
B. 5.5 x 10-8 N
C. 8.2 x 10-8 N
D. 9.0 x 10-8 N
E. 11.2 x 10-8 N

16. Assume that constant k = 9.0x109 (Nm2/C2). The magnitude of the electric field (E) at a point which is at the distance of 30 cm from point charge Q = 3.0 x 10-6 C is

A. 3.0 N/C
B. 3.0 x 102 N/C
C. 3.0 x 103 N/C
D. 3.0 x 104 N/C
E. 3.0 x 105 N/C

17. If σ is the surface charge density and ε0 is the permittivity of free space, the electric field outside the surface of any good conductor of arbitrary shape is given by

A. $E = \sigma \varepsilon 0$
B. $E = \varepsilon 0 / \sigma$
C. $E = \sigma / \varepsilon 0$
D. $E = 2\sigma \varepsilon 0$
E. $E = (2\sigma) / \varepsilon 0$

18. Two parallel plates are charged to produce a potential difference of 50 V. If the separation between the plates is 0.050 m, the magnitude of the electric field in the space between the plates is

A. 5.0 V/m
B. 50 V/m
C. 10 V/m
D. 100 V/m
E. 1000 V/m

19. Determine the electric potential at a point 0.50 m from a + 20 μC point charge. k = 9.0x109 (Nm2/C2).

A. 1.0 x 105 V
B. 2.0 x 105 V
C. 2.6 x 105 V
D. 3.6 x 105 V
E. 4.6 x 105 V

20. What minimum work must be done by an external force to bring a charge q = 3.0 μC from a great distance away (take r = ∞) to a point 0.5 0 m from a charge Q = 20.0 μC ?

A. 0.44 J
B. 0.84 J
C. 1.08 J
D. 2.34 J
E. 3.22 J

21. How much electric energy can be stored in a 150-µF capacitor at 200 V ?

A. 2.0 J
B. 3.0 J
C. 6.0 J
D. 9.0 J
E. 15.0 J

22. What is the charge on each plate of a parallel-plate capacitor (C=53 pF) if a 12-V battery is connected across the two plates ?

A. 4.6 x 10-10 C
B. 6.4 x 10-10 C
C. 6.4 x 10-11 C
D. 3.6 x 10-9 C
E. 3.6 x 10-11 C

23. A steady current of 2.5 A exists in a wire for 4.0 min. How much total charge passed by a given point in the circuit during those 4. min ?

A. 100 C
B. 300 C
C. 400 C
D. 500 C
E. 600 C

24. A mechanical stopwatch uses a balance wheel that rotates back and forth 10 times in 2 seconds. What is the period of the balance wheel?

A. 0.1 s
B. 0.2 s
C. 0.4 s
D. 0.8 s
E. 1.0 s

25. A car accelerates from 20 to 25 m/s in 4 seconds. What is its acceleration?

A. 0.25 m/s2
B. 0.50 m/s2
C. 0.75 m/s2
D. 1.0 m/s2
E. 1.25 m/s2

26. Compute the acceleration of car as it goes around a curve. The radius of a segment is 20 meters, and a car might take the curve with a constant speed of 10 m/s.

A. 1 m/s2
B. 3 m/s2
C. 5 m/s2
D. 7 m/s2
E. 9 m/s2

27. An automobile manufacturer decides to build a car that can accelerate uniformly from 0 to 60 mph in 10 s. In metric units, this is from 0 to 27 m/s. The car's mass is to be about 1000 kilograms. What is the force required ?

A. 700 N
B. 1000 N
C. 1700 N
D. 2000 N
E. 2700 N

28. During 50 seconds of use, 250 C of charge flow through a microwave oven. Compute the size of the electric current.

A. 0.5 A
B. 1 A
C. 5 A
D. 25 A
E. 50 A

29. A light bulb used in a 3-volt flashlight has a resistance equal to 6 ohms. What is the power output ?

A. 0.5 W
B. 0.75 W
C. 1.0 W
D. 1.25 W
E. 1.5 W

30. A copper wire of length 4 m and cross-sectional area 4 mm2 is connected to a battery with a potential difference of 9 V. What is the resistance of the wire? Approximate the resistivity for copper to be 10–8 Ω • m.

A. 1 x 10-2 Ω
B. 1.5 x 10-2 Ω
C. 2.0 x 10-2 Ω
D. 1 x 10-3 Ω
E. 1.5 x 10-3 Ω

31. A circuit with a potential difference of 10 V is hooked up to a light bulb whose resistance is 20 Ω. The filament in the light bulb heats up, producing light. If the light bulb is left on for one minute, how much heat is produced ?

A. 10 J
B. 20 J
C. 120 J
D. 200 J
E. 300 J

32. What is the de Broglie wavelength of an electron with speed 2.19 x 106 m/s?
me = 9.11 x 10-31 kg. h = 6.63 x 10-34 Js.

A. 0.223 nm
B. 0.332 nm
C. 0.423 nm
D. 0.545 nm
E. 0.624 nm

33. Find the frequency of the photon emitted when a hydrogen atom goes from the n=3 to the n=2 state. The energy of E3 = -1.51 eV, E2 = -3.4 eV. h = 6.63 x 10-34 Js.

A. 4.57 x 1014 Hz
B. 5.57 x 1014 Hz
C. 4.57 x 1015 Hz
D. 6. 28 x 1014 Hz
E. 7. 18 x 1014 Hz

34. A deuteron, a particle consisting of a proton and a neutron, has a binding energy of 1.12 MeV per nucleon. What is the mass of the deuteron?

A. 3.99 x 10-30 kg
B. 3.99 x 10-31 kg
C. 3.99 x 10-29 kg
D. 4.99 x 10-30 kg
E. 4.99 x 10-31 kg

35. In a sidle projector, a slide is positioned 0.102 meter from a converging lens that has a focal length of 0.1 m meter. At what distance from the lens must the screen be placed so that the image of the slide will be focused?

A. 1.5 m
B. 5.1 m
C. 6.2 m
D. 6.8 m
E. 8.4 m

36. Which of the following phenomena does NOT affect the direction of a wave of light?

A. Dispersion
B. Polarization
C. Diffraction
D. Reflection
E.Refraction

37. Sound waves do not exhibit polarization because, unlike light waves, they are not

A. Longitudinal
B. Coherent
C. Dispersive
D. Transverse
E. Refractive

38. A 5-kilogram concrete block falls to the ground from a height of 10 meters. If all of its original potential energy goes to heat the block when it hits the ground, what is its change in temperature? The specific heat capacity of concrete is 670 J/kgoC.

A. $\Delta T = 0.15$ oC
B. $\Delta T = 0.40$ oC
C. $\Delta T = 1.25$ oC
D. $\Delta T = 2.35$ oC
E. $\Delta T = 3.45$ oC

39. A gas is compressed inside a cylinder. An average force of 50 N acts to move the piston 0.1 m. During the compression, 2 J of heat are conducted away from the gas. What is the change in internal energy of the gas?

A. 3 J
B. 9 J
C. 15 J
D. 50 J
E. 100 J

40. A 4-Hz continuous wave travel on a rubber rope. If the wavelength is 0.5 m, what is the speed of waves on the rubber rope ?

A. 2.0 m/s
B. 4.0 m/s
C. 8.0 m/s
D. 12.0 m/s
E. 20.0 m/s

41. Before a concert, musicians in an orchestra tune their instruments to the note A, which has a frequency of 440 hertz. What is the wavelength of this sound in air at room temperature? The speed of sound at this temperature is 344 m/s.

A. 1.0 m
B. 2.8 m
C. 0.78 m
D. 4.44 m
E. 8.88 m

42. A wave travelling 80 m/s has a wavelength of 8 m. What is the frequency of the wave?

A. 8.0 Hz
B. 80.0 Hz
C. 160 Hz
D. 100 Hz
E. 10 Hz

43. Modern orchestras generally tune their instruments so that the note "A" sounds at 440 Hz. If one violinist is slightly out of tune, so that his "A" sounds at 438 Hz, what will be the time between the beats perceived by someone sitting in the audience?

A. 0.50 s
B. 1.50 s
C. 4.40 s
D. 4.38 s
E. 12.64 s

44. A cop car drives at 30 m/s toward the scene of a crime, with its siren blaring at a frequency of 2000 Hz. At what frequency do people hear the siren as it approaches? The speed of sound in the air is 343 m/s.

A. 2000 Hz
B. 1897 Hz
C. 2356 Hz
D. 1744 Hz
E. 2192 Hz

45. If the work function of a metal is 2,130 J and a ray of light with frequency of 1037 Hz is incident on the metal, what will be the speed of the electrons ejected? (h = 6.63x10-34 Js, melectron = 9.1x10-31kg).

A. 4,500 m/s
B. 3x10-29 m/s
C. 1017 m/s
D. 1034 m/s
E. 1030 m/s

46. A ball of mass 2 kg is dropped from a height of 100 m. As it falls, the ball feels an average force of air resistance of magnitude 4 N. What is the ball's speed as it strikes the ground?

A. 2 m/s2
B. 4 m/s2
C. 40 m/s2
D. 10 m/s2
E. 100 m/s2

47. The relation between half life T1/2 of a radioactive sample and its decay constant λ is

A. λ = 2.718 T1/2
B. λ = T1/2
C. λ = 0.693 T1/2
D. λ = (0.693)/(T1/2)
E. λ = 1/(T1/2)

48. An object of mass m is moving with velocity v. What will happen to its momentum if v doubles?

A. No change
B. increases by factors 2
C. increases by factor 4
D. decreases by factors 2
E. decrease by factor 4

49. In the figure below, assume that a ray of sunlight strikes the water, making an angle of 60o with the surface. What is the angle of reflection?

A. 15o
B. 30 o
C. 45 o
D. 60 o
E. 75 o

50. Estimate the temperature of the surface of our Sun, given that the Sun emits light whose peak intensity occurs in the visible spectrum at around 500 nm.

A. about 4500 K
B. about 5000 K
C. about 5500 K
D. about 6000 K
E. about 7000 K