SAINT JOSEPH'S PREPARATORY SCHOOL
HONORS PHYSICS TEST
May 2016

1. What are the units of the constant k, which appears in Coulomb's law?
   a) N·m/C
   b) N/C
   c) $N^2 \cdot m/C^2$
   d) $N \cdot m^2/C^2$

2. Two charged objects are separated by a distance d. The first charge is larger in magnitude than the second charge.
   a) The first charge exerts a larger force on the second charge.
   b) The second charge exerts a larger force on the first charge.
   c) The charges exert forces on each other equal in magnitude and opposite in direction.
   d) The charges exert forces on each other equal in magnitude and pointing in the same direction.

3. Sphere A carries a net charge and sphere B is neutral. They are placed near each other on an insulated table. Which statement best describes the electrostatic force between them?
   a) There is no force between them since one is neutral.
   b) There is a force of repulsion between them.
   c) There is a force of attraction between them.
   d) The force is attractive if A is charged positively and repulsive if A is charged negatively.

4. Two charged objects attract each other with a certain force. If the charges on both objects are doubled with no change in separation, the force between them
   a) quadruples.
   b) doubles.
   c) halves.
   d) increases, but we can't say how much without knowing the distance between them.

5. An electron and a proton are separated by a distance of 1.0 m. What happens to the magnitude of the force on the proton if a second electron is placed next to the first electron?
   a) It quadruples.
   b) It doubles.
   c) It will not change.
   d) It goes to zero.

6. Which of the following is not a vector?
   a) electric force
   b) electric field
   c) electric charge
   d) gravitational force

7. At twice the distance from a point charge, the strength of the electric field
   a) is four times its original value.
   b) is twice its original value.
   c) is one-half its original value.
   d) is one-fourth its original value.

8. Is it possible to have a zero electric field value anywhere along the line segment between a negative and positive charge?
   a) Yes, if the two charges are equal in magnitude.
   b) Yes, regardless of the magnitude of the two charges.
   c) No, a zero electric field cannot exist between the two charges.
   d) cannot be determined without knowing the separation between the two charges

9. Electric field lines near positive point charges
   a) circle clockwise.
   b) circle counter-clockwise.
   c) radiate inward.
   d) radiate outward.

10. Who made electrons negative?
    a) Thomas Edison
    b) Nicola Tesla
    c) Benjamin Franklin
    d) Albert Einstein

11. What is polarity of the charge that collects on a piece of glass when it is rubbed with fur?
    a) Positive
    b) Negative
    c) Neutral
    d) Electric charge does not have polarity.

12. In the figure, Q1 is 750 nC and Q2 is -650 nC. In which area of the line is there a point at which the electric field is zero?
    a) A
    b) B
    c) C
    d) The electric field cannot be zero anywhere in the figure.

13. Which of these is a correct formula for determining the magnitude of the electrostatic force between two charges?
   a) $k\dfrac{Q_1Q_2}{R^2}$
   b) $k\dfrac{Q}{R^2}$
   c) $k\dfrac{Q_1Q_2}{R}$
   d) $k\dfrac{Q}{R}$

14. Which of these is a correct formula for determining the magnitude of an electric field?
   a) $k\dfrac{Q_1Q_2}{R^2}$
   b) $k\dfrac{Q}{R^2}$
   c) $k\dfrac{Q_1Q_2}{R}$
   d) $k\dfrac{Q}{R}$

15. Is it possible for two negative charges to attract each other?
   a) Yes, they always attract.
   b) Yes, they will attract if they are close enough.
   c) Yes, they will attract if one carries a larger charge than the other.
   d) No, they will never attract.

16. A glass rod is rubbed with a piece of silk. If, during the process the glass rod acquires a positive charge, the silk
   a) will acquire a positive charge also.
   b) will acquire a negative charge.
   c) will remain neutral.
   d) could either be positively charged or negatively charged. It depends on how hard the rod was rubbed.

17. When the ball of a van de Graaff generator becomes negatively charged, what is the source of the electrons?
   a) the wool.
   b) the rubber band.
   c) the earth.
   d) the air.

18. What is the name of the device that converts electrical energy to heat?
   a) Resistor
   b) Inductor
   c) Transistor
   d) Capacitor

19. Which of the following prepositions is usually used when describing voltage?
   a) Through
   b) from
   c) by
   d) across

20. Which of the following prepositions is usually used when describing current?
   a) through
   b) from
   c) across
   d) on

21. What quantity is measured in ohms?
   a) capacitance
   b) resistance
   c) conductance
   d) power

22. What is the name of the device that stores energy in an electric Field?
   a) resistor.
   b) electrochemical cell or battery.
   c) multimeter.
   d) capacitor.

23. What is the name of the device that converts electrical energy to heat?
   a) capacitor
   b) LED
   c) resistor
   d) battery

24. What is the name of the device that is made of two conductors separated by a non-conductor?
   a) resistor
   b) capacitor
   c) battery
   d) transistor

25. What is the name of the device that converts chemical energy to electrical energy?
   a) transistor
   b) electrochemical cell
   c) resistor
   d) capacitor

26. How is the voltage related to current in regards to capacitors.
   a) directly proportional
   b) inversely proportional
   c) directly proportional to the square root
   d) They are not directly related to one another.

27. How is the voltage related to current in regards to resistors?
   a) directly proportional
   b) inversely proportional
   c) directly proportional to the square
   d) They are not directly related to one another.

28. Which quantity is the same for all devices connected in parallel?
    a) current
    b) voltage
    c) power
    d) charge

29. Which quantity is the same for all devices connected in series?
    a) current
    b) voltage
    c) power
    d) charge

30. What effect does doubling the voltage have on the charge on a capacitor?
    a) Reduces it to one half.
    b) Reduces it to one quarter.
    c) Increases it by a factor of 4.
    d) Increases it by a factor of 2.

31. What effect does doubling the voltage have on the current associated with a resistor?
    a) Reduces it to one half.
    b) Reduces it to one quarter.
    c) Increases it by a factor of 4.
    d) Increases it by a factor of 2.

32. What effect does doubling the voltage have on the resistance of an ordinary resistor?
    a) Reduces it to one half.
    b) Reduces it to one quarter.
    c) Increases it by a factor of 4.
    d) It has no effect.

33. What effect does doubling the voltage have on the rate at which an ordinary resistor generates heat?
    a) Reduces it to one half.
    b) Reduces it to one quarter.
    c) Increases it by a factor of 4.
    d) It has no effect.

34. What effect does adding another resistor to a series circuit have on the equivalent resistance of the circuit?
    a) It has no effect.
    b) Increases it
    c) Decreases it
    d) It depends on what position the new resistor occupies in the circuit.

35. The $\mathcal{E}$ (EMF) of a battery may be expressed as volts or:
    a) Newtons.
    b) Joules.
    c) Joules per coulomb.
    d) Watts.

36. In a complete circuit, the $\mathcal{E}$ (EMF) of a battery is higher than the terminal voltage because:
    a) The battery has chemical defects.
    b) The battery has "internal resistance."
    c) Some of the electrons are absorbed by the chemicals in the battery.
    d) The resistance of the external circuit opposes the flow of electrons through it.

37. When current goes through a device from a less positive end to a more positive end, what is the device doing to the circuit?
    a) Building up a static charge.
    b) extracting energy from the circuit.
    c) supplying energy to the circuit.
    d) Current never flows that way.

38. When is the current through two resistors connected in series the same?
    a) Always.
    b) Sometimes.
    c) Never.
    d) Not enough information given.

39. When is the voltage across two resistors connected in series the same?
    a) Always.
    b) Sometimes.
    c) Never.
    d) Not enough information given.

40. When is the current through two resistors connected in parallel the same?
    a) Always.
    b) Sometimes.
    c) Never.
    d) Not enough information given.

41. When is the voltage across two resistors connected in parallel the same?
    a) Always.
    b) Sometimes.
    c) Never.
    d) Not enough information given.

42. When an RC (resistance – capacitance) circuit is switched on, how does the voltage across the capacitor compare to the supply voltage after one time constant?
    a) 100%
    b) about 63.2%
    c) about 86.5%
    d) about 95.0%

43. atoms whose magnetic fields are aligned in a common direction is called a(n) ____. In most materials, when these groups are randomly distributed, the substance will show ____ magnetism.
    a) domain; no
    b) pole; some
    c) cell; unusual
    d) ion; strong

44. Which of the following statements about Earth's magnetic field is true?
    a) The geographic North Pole of Earth and Earth's magnetic north pole are at the same location.
    b) The geographic South Pole of Earth and Earth's magnetic north pole are relatively close to each other.
    c) The north needle of a compass always points to the geographic North Pole of Earth.
    d) The north needle of a compass points to Earth's magnetic north pole.

45. Which of the following situations is NOT true for magnets?
    a) Like poles repel each other.
    b) Unlike poles repel each other.
    c) North poles repel each other.
    d) A north pole and a south pole will attract each other.

46. The south pole of a magnet points toward the Earth's
    a) South Pole.
    b) North Pole.
    c) center.
   d) middle latitudes.

47. The lines of the magnetic field around a current-carrying wire
    a) point away from the wire.
    b) point toward the wire.
    c) form concentric circles around the wire.
    d) are parallel with the wire.

48. All of the following statements about magnetic field lines around a permanent magnet are true except which one?
    a) Magnetic field lines appear to end at the north pole of a magnet.
    b) Magnetic field lines always form a closed loop.
    c) Magnetic field lines have no beginning or end.
    d) In a permanent magnet, the field lines actually continue within the magnet itself.

49. Which compass needle orientation in the figure might correctly describe the magnet's field at that point?
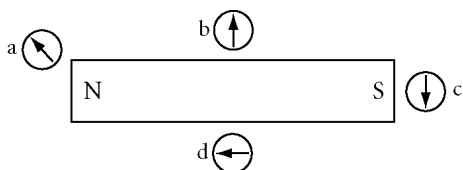
50. The source of all magnetic fields is
    a) moving electric charges.
    b) ferromagnetic materials.
    c) tiny domains of aligned atoms.
    d) tiny pieces of iron.
    e) none of the above.

51. An electric current produces a circular
    a) gravitational field.
    b) electric field.
    c) magnetic field.
    d) electromagnetic field.

52. The magnitude of the magnetic field around a long wire carrying a current is B at a distance R from the center of the wire. What is the magnitude of the field at a distance 2R from the center of the wire?
    b) $4B$
    b) $2B$
    c) $\frac{1}{2}B$
    d) $\frac{1}{4}B$

53. The time for one cycle of a periodic process is called the
    a) amplitude.
    b) wavelength.
    c) frequency.
    d) period.

54. For a periodic process, the number of cycles per unit time is called the
    a) amplitude.
    b) wavelength.
    c) frequency.
    d) period.

55. For vibrational motion, the maximum displacement from the equilibrium point is called the
    a) amplitude.
    b) wavelength.
    c) frequency.
    d) period.

56. A mass on a spring undergoes SHM. When the mass is at its maximum displacement from equilibrium, its instantaneous velocity
    a) is maximum.
    b) is less than maximum, but not zero.
    c) is zero.
   d) cannot be determined from the information given.

57. A mass on a spring undergoes SHM. When the mass passes through the equilibrium position, its instantaneous velocity
    a) is maximum.
    b) is less than maximum, but not zero.
    c) is zero.
    d) cannot be determined from the information given.

58. A mass on a spring undergoes SHM. When the mass is at maximum displacement from equilibrium, its instantaneous acceleration
    a) is a maximum..
    b) is less than maximum, but not zero.
    c) is zero.
    d) cannot be determined from the information given.

59. In order for simple harmonic motion (SHM) to occur, what must be directly proportional to displacement from equilibrium?
    a) motivating force.
    b) restoring force.
    c) amplitude.
    d) period.

60. The maximum velocity of an object undergoing simple harmonic motion (SHM) can be calculated by multiplying the amplitude by
    a) the angular velocity.
    b) the restoring force.
    c) the mass of the object.
    d) the period.

61. Under what circumstances is it appropriate to consider a pendulum to be undergoing simple harmonic motion (SHM)?
    a) never.
    b) only when the string is pendulum long.
    c) only when the amplitude is small.
    d) only when the amplitude is large (15° or more.)

62. If the equation describing the location of an object undergoing SHM as a function of time is
    $$y = 4\sin(3t)$$
    ,
    what is the amplitude of the oscillation?
    a) 3 m
    b) 4 m
    c) 9 m
    d) 12 m

63. If the equation describing the location of an object undergoing SHM as a function of time is
    $$y = 4\sin(3t)$$
    ,
    what is the maximum speed of the object?
    a) 3 m/s
    b) 4 m/s
    c) 9 m/s
    d) 12 m/s

64. A mass attached to a spring vibrates back and forth. At the equilibrium position, the
    a) the acceleration reaches a maximum.
    b) velocity reaches a maximum.
    c) net force reaches a maximum.
    d) velocity reaches zero.

65. A mass attached to a spring vibrates back and forth. At maximum displacement, the spring force and the
    a) velocity reach a maximum.
    b) velocity reach zero.
    c) acceleration reach a maximum.
    d) acceleration reach zero.

66. Which of the following is the time it takes to complete a cycle of motion?
    a) amplitude
    b) period
    c) frequency
    d) revolution

67. At a fixed boundary, waves are
    a) neither reflected nor inverted.
    b) reflected but not inverted.
    c) reflected and inverted.
    d) inverted but not reflected.
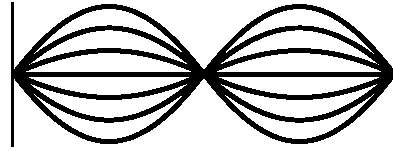
68. How many nodes and antinodes are shown in the standing wave above?
    a) two nodes and three antinodes
    b) one node and two antinodes
    c) one-third node and one antinode
    d) three nodes and two antinodes

69. What is simple harmonic motion a projection of?
    a) sinusoidal motion.
    b) spring motion.
    c) circular motion.
    d) periodic motion.

70. What must be directly proportional to displacement from equilibrium in order for simple harmonic motion to occur?
    a) the restoring force.
    b) the amplitude.
    c) the frequency.
    d) the mass.

71. Two pure tones are sounded together and a particular beat frequency is heard. What happens to the beat frequency if the frequency of one of the tones is increased?
    a) It increases.
    b) It could either increase or decrease.
    c) It decreases.
    d) It does not change.

72. Which of the following increases as a sound becomes louder?
    a) velocity
    b) wavelength
    c) period
    d) amplitude
    e) frequency

73. Sound waves
    a) are a part of the electromagnetic spectrum.
    b) do not require a medium for transmission.
    c) are longitudinal waves.
    d) are transverse waves.

74. The trough of the sinusoidal curve used to represent the pressure of a sound wave corresponds to
   a) a compression.
   b) the amplitude.
   c) the wavelength.
   d) a rarefaction.

75. The highness or lowness of a sound's frequency is perceived as
   a) compression.
   b) wavelength.
   c) ultrasound.
   d) pitch.

76. A train moves down the track toward an observer. The sound from the train, as heard by the observer, is _____ the sound heard by a passenger on the train.
   a) the same as
   b) a different timbre than
   c) higher in pitch than
   d) lower in pitch than

77. The Doppler effect occurs with
   a) only sound waves.
   b) only transverse waves.
   c) only water waves.
   d) all waves.

78. The intensity of a sound at any distance from the source is directly proportional to the sound's _____ at the source.
   a) wavelength.
   b) pitch.
   c) power.
   d) frequency.

79. The perceived loudness of a sound is measured in
   a) hertz.
   b) decibels.
   c) watts.
   d) watts per square meter.

80. When the frequency of a force applied to a system matches the natural frequency of vibration of the system, _____ occurs.
   a) damped vibration
   b) random vibration
   c) timbre
   d) resonance

81. The wavelength of the fundamental frequency of a vibrating string of length L is
   a) 1/2 L.
   b) L.
   c) 2L.
   d) 4L.

82. Audible beats are formed by the interference of two waves
   a) of slightly different frequencies.
   b) of greatly different frequencies.
   c) with equal frequencies, but traveling in opposite directions.
   d) from the same vibrating source.

83. The dB method of measuring loudness was developed by
   a) Thomas Edison.
   b) Alexander Graham Bell.
   c) Anthony Deci
   d) Albert Einstein.

84. A doubling of the intensity of a soundwave would result in approximately what change in dB level?
   a) +3 dB
   b) −3 dB
   c) +10 dB
   d) −10 dB

85. Which of the following is a false statement
   a) All points on a given wave front have the same phase
   b) Rays are always perpendicular to wave fronts.
   c) All wave fronts have the same amplitude.
   d) The spacing between adjacent wave fronts is one-half wavelength.

86. When a light wave enters into a medium of different "optical density",
   a) its speed and frequency change.
   b) its speed and wavelength change.
   c) its frequency and wavelength change.
   d) its speed, frequency, and wavelength change.

87. When a beam of light (wavelength = 590 nm), originally traveling in air, enters a piece of glass (index of refraction 1.50), its frequency
   a) increases by a factor of 1.50.
   b) is reduced to 2/3 its original value.
   c) is unaffected.
   d) none of the given answers

88. What principle is responsible for light spreading as it passes through a narrow slit?
   a) refraction
   b) polarization
   c) diffraction
   d) interference

89. Radio waves are diffracted by large objects such as buildings, whereas light is not noticeably diffracted. Why is this?
   a) Radio waves are unpolarized, whereas light is plane polarized
   b) The wavelength of light is much smaller than the wavelength of radio waves.
   c) The wavelength of light is much greater than the wavelength of radio waves.
   d) Radio waves are coherent and light is usually not coherent.

90. What principle is responsible for alternating light and dark bands when light passes through two or more narrow slits?
   a) refraction
   b) polarization
   c) dispersion
   d) interference

91. At the first maxima on either side of the central bright spot in a double-slit experiment, light from each opening arrives
    a)   in phase.
    b)   90° out of phase.
    c)   180° out of phase.
    d)   none of the given answers

92. At the first minima on either side of the central bright spot in a double-slit experiment, light from each opening arrives
    a)   in phase.
    b)   90° out of phase.
    c)   180° out of phase.
    d)   none of the given answers

93. In a Young's double slit experiment, if the separation between the slits decreases, what happens to the distance between the interference fringes?
    a)   It decreases.
    b)   It increases.
    c)   It remains the same.
    d)   There is not enough information to determine.

94. If a wave from one slit of a Young's double slit experiment arrives at a point on the screen one-half wavelength behind the wave from the other slit, which is observed at that point?
    a)   bright fringe
    b)   dark fringe
    c)   gray fringe
    d)   multi-colored fringe

95. The separation between adjacent maxima in a double-slit interference pattern using monochromatic light is
    a)   greatest for red light.
    b)   greatest for green light.
    c)   greatest for blue light.
    d)   the same for all colors of light.

96. The principle which explains why a prism separates white light into different colors is
    a)   refraction.
    b)   polarization.
    c)   dispersion.
    d)   total internal reflection.

97. The principle which allows a rainbow to form is
    a)   refraction.
    b)   polarization.
    c)   dispersion.
    d)   total internal reflection.

98. Which color of light undergoes the greatest refraction when passing from air to glass?
    a)   red
    b)   yellow
    c)   green
    d)   violet

99. Which color of light undergoes the smallest refraction when passing from air to glass?
    a)   red
    b)   yellow
    c)   green
    d)   violet

100. Consider two diffraction gratings; one has 4000 lines per cm and the other one has 6000 lines per cm. Make a statement comparing the dispersion of the two gratings.
    a)   The 4000-line grating produces the greater dispersion.
    b)   The 6000-line grating produces the greater dispersion.
    c)   Both gratings produce the same dispersion, but the orders are sharper for the 4000-line grating.
    d)   Both gratings produce the same dispersion, but the orders are sharper for the 6000-line grating.

101. Consider two diffraction gratings with the same slit separation, the only difference being that one grating has 3 slits and the other 4 slits. If both gratings are illuminated with a beam of the same monochromatic light, make a statement concerning the separation between the orders.
    a)   The grating with 3 slits produces the greater separation between orders.
    b)   The grating with 4 slits produces the greater separation between orders.
    c)   Both gratings produce the same separation between orders.
    d)   Both gratings produce the same separation between orders, but the orders are better defined with the 4-slit grating.

102. The colors on an oil slick are caused by reflection and
    a)   diffraction.
    b)   interference.
    c)   refraction.
    d)   polarization.

103. What principle is responsible for the fact that certain sunglasses can reduce glare from reflected surfaces?
    a)   refraction
    b)   polarization
    c)   diffraction
    d)   total internal reflection

104. For a beam of light, the direction of polarization is defined as
    a)   the beam's direction of travel.
    b)   the direction of the electric field's vibration
    c)   the direction of the magnetic field's vibration.
    d)   the direction that is mutually perpendicular to the electric and magnetic field vectors.

105. When the transmission axes of two Polaroid films are perpendicular to each other, what is the percentage of the incident light which will pass the two films?
    a)   0 %
    b)   25 %
    c)   50 %
    d)   75 %

106. In which of the following is diffraction NOT exhibited?
    a)   viewing a light source through a small pinhole
    b)   examining a crystal by X-rays
    c)   using a microscope under maximum magnification
    d)   resolving two nearby stars with a telescope
    e)   determining the direction of polarization with a
          polarizing crystal