

- 1 A baseball pitcher acquires an unbalanced electrical charge by scuffing his feet in the dirt and transfers -0.0001C to a baseball as he throws it toward home plate. A thunderstorm is brewing and there is a vertical electric field of $10,000\text{N/C}$ *pointing straight up*. The electrical force on the baseball is
 - a. 1N upward.
 - b. 1N downward.
 - c. 0.1N upward.
 - d. 0.1N downward.

- 2 If a bar magnet is cut in half, the result will be
 - a. one half with a strong north-seeking pole and a weak south-seeking pole and one half the reverse.
 - b. one half that is a north-seeking pole and one half that is a south-seeking pole.
 - c. two bar magnets, each with a north-seeking pole on one end and an equally strong south-seeking pole on the other.
 - d. cancellation of the magnetic field.

- 3 Light that strikes a mirror at a 30 degree angle of incidence will reflect at an angle to the perpendicular of
 - a. 90 degrees.
 - b. 45 degrees.
 - c. 30 degrees.
 - d. 60 degrees.

- 4 Subway cars sometimes get their power from a “third rail” that is at a potential of about 600V above the potential of the other two rails (which are connected to the ground). If you are unfortunate enough to find yourself on the tracks of such a subway, which of the following situations is the most dangerous.
 - a. both feet on the third rail.
 - b. one foot on the third rail and one foot on another rail.
 - c. both feet on a grounded rail.
 - d. neither foot on a rail.

- 5 The set of wavelengths present in the light from a given source is that source’s
 - a. electronic structure.
 - b. intensity.
 - c. spectrum.
 - d. radiation curve.

- 6 The number of waves that pass a given point in one second is called the
 - a. wave velocity.
 - b. wavelength.
 - c. amplitude.
 - d. frequency.

- 7 (Astronomical note: In this part of the world, the sun rises in the east, moves across the southern sky, and sets in the west.)
It has just stopped raining and you see a rainbow that is a full half-circle in the eastern sky. What time is it?
- 6:00 am.
 - 9:00 am.
 - 3:00 pm.
 - 6:00 pm.
- 8 If the electric field everywhere near a particular point in space points away from that point, it follows that
- there is a negative charge at that point.
 - there is a dipole at that point.
 - there is a positive charge at that point.
 - there is no charge at that point.
- 9 A pair of electrically charged objects repel each other with a force of 144 Newton when they are a distance of 2m apart. If their charges stay the same, what will be the repulsive force between them when they are 6m apart?
- 16N.
 - 144N.
 - 48N.
 - 9N.
- 10 A compound microscope can be thought of as
- one magnifier looking at the image from another.
 - a magnifier looking at a camera image.
 - a magnifier looking at a projector image.
 - a camera looking at the image formed by a magnifier.
- 11 Consider a mirror shaped like a shallow bowl. When light strikes this mirror from the top (into the bowl), the mirror acts like
- a converging lens.
 - a pane of glass.
 - a pinhole camera.
 - a diverging lens.
- 12 The average speed with which a change in electric potential moves through a wire is
- close to the speed of light.
 - close to the speed of sound.
 - zero.
 - a few millimeters per second.

- 13 In order for a converging lens to produce an enlarged virtual image, the object should be placed
- between the lens and its focal point.
 - just beyond the focal point of the lens.
 - far beyond the focal point of the lens.
 - at the focal point of the lens.
- 14 Which way does the earth's magnetic field point at a position directly over the magnetic equator (somewhere in Brazil, perhaps).
- up.
 - south.
 - down.
 - north.
- 15 Which of the following colors corresponds to the longest wavelength?
- violet.
 - red.
 - green.
 - blue.
- 16 A near-sighted person, someone who has trouble focusing on distant objects, needs to wear glasses with
- flat lenses.
 - diverging lenses.
 - barrel-shaped lenses.
 - converging lenses.
- 17 Two twins in twin spaceships separate at 99% of the speed of light. When they separate, they are each 20 years old. They have agreed that one of them will turn around after one year of travel and fly back to rejoin the other. If the one who turns around is 22 years old when they get back together, the other twin will be
- also 22 years old.
 - either older or younger than 22, there is no way to tell.
 - more than 22 years old.
 - less than 22 years old.
- 18 Which of the following rays from a point on an object will pass through the farther focus of a converging lens?
- a ray that passes through the nearer focal point of the lens.
 - a ray parallel to the axis.
 - a ray that passes through the center of the lens.

- 19 Suppose that the focal point of a converging lens is 4cm from the lens. If an object is placed 4.1cm from the lens, then its image will be
- reduced and virtual.
 - enlarged and real.
 - reduced and real.
 - enlarged and virtual.
- 20 The speed of light is 3×10^8 m/s. How much energy is released when the mass of a system decreases by one gram (10^{-3} kg)?
- 3×10^5 J.
 - 9×10^{16} J.
 - 9×10^{10} J.
 - 9×10^{13} J.
- 21 A converging lens
- brings parallel light rays together.
 - spreads parallel light rays apart.
 - spreads all light rays apart.
 - brings all light rays together.
- 22 If light is incident on a diffuse reflector from a single direction, it will be
- reflected into a single direction.
 - reflected without loss.
 - completely absorbed.
 - scattered in all directions.
- 23 The potential energy of a charge of 3 coulombs in a potential of 50 volts is
- 4J.
 - 50J.
 - 150J.
 - 200J.
 - 6J.
- 24 The critical angle for a water-air surface is 48 degrees. In which of the following situations will light be 100% reflected?
- Light coming from
- the air side at a 50 degree angle of incidence.
 - the air side at a 45 degree angle of incidence.
 - the water side at a 45 degree angle of incidence.
 - the water side at a 50 degree angle of incidence.

- 25 A total eclipse of the moon happens when
- the moon passes into the umbra of the earth's shadow.
 - the earth passes into the penumbra of the moon's shadow.
 - the moon passes into the penumbra of the earth's shadow.
 - the earth passes into the umbra of the moon's shadow.
- 26 Which of the following colors would you expect to be deflected the most by a glass prism?
- yellow.
 - green.
 - red.
 - blue.
- 27 Calculate (based on the assumptions made in class) the smallest potential difference that could possibly cause death to someone touching bare terminals with clean hands.
- 120V.
 - 50V.
 - 5V.
 - 24V.
 - 5000V.
- 28 The MKS unit of electrical current is the
- ohm.
 - watt.
 - ampere.
 - volt.
 - coulomb.
- 29 Two particles, each with a rest mass-energy of 1 Mev, collide head-on. Before the collision, each particle is moving at $\frac{12}{13}$ the speed of light. If the energy of the collision materializes as 1 Mev particles, how many of them could there be after the collision (including the two that we started with)?
- 4.
 - 3.
 - 6.
 - 2.
 - 5.

- 30 If the frequency of a wave increases by a factor of ten and its velocity stays the same, its wavelength will be multiplied by a factor of
- 0.1.
 - 0.01.
 - 1.
 - 10.
- 31 All of the following statements are true. Which one states the ray approximation?
- Rays spread outward from a source.
 - Rays are perpendicular to wavefronts.
 - For long wavelengths, rays bend around corners.
 - For short wavelengths, rays are straight lines.
- 32 You are standing in a stream (up to your knees) and see a fish swimming by. If you wish to hit the fish with a spear, you should
- aim directly at where you see it.
 - aim beside where you see it.
 - aim below where you see it.
 - aim above where you see it.
- 33 If one of two charges is increased by a factor of 5 and the distance between the charges is not changed, then the electrical force between the charges is
- unchanged.
 - multiplied by 5.
 - divided by 25.
 - divided by 5.
- 34 Two identical clocks, one on the ground and the other in an earth satellite are set to the same time as the satellite passes overhead. A year later, the clocks are read again. According to the earth clock, the satellite clock
(*Hint: Don't calculate anything. Only one answer is consistent with physical laws.*)
- reads exactly the correct time.
 - has lost one millisecond.
 - has gained one millisecond.
 - has gained ten days.

- 35 When one coulomb of charge passes through a battery, the electrical potential energy of the charge increases by 1.5J. If 4 coulombs of charge pass through the same battery, its electrical potential energy will increase by
- a. 0.375J.
 - b. 6.0J.
 - c. 1.5J.
 - d. 3.0J.
- 36 A negative charge of one micro-coulomb is one meter away from a much larger positive charge and has two joules of potential energy. If the charge moves to two meters away from the positive charge, its potential energy could be
- a. 1J.
 - b. 2J.
 - c. 3J.
- 37 In relativistic mechanics, the one inertial reference frame that is uniquely defined for describing a moving object is
- a. the frame in which the microwave background is at rest.
 - b. the instantaneous rest frame of the object.
 - c. the universal rest frame.
 - d. the inertial frame of the observer.
- 38 The image that is produced by a movie projector is
- a. always a virtual image.
 - b. virtual only when it appears on a screen.
 - c. real only when it appears on a screen.
 - d. always a real image.

Answer Key: Fall 2007 PHX4A

- 1 Choice b. (1N downward.)
- 2 Choice c. (two bar magnets, each with a north-seeking pole on one end and an equally strong south-seeking pole on the other.)
- 3 Choice c. (30 degrees.)
- 4 Choice b. (one foot on the third rail and one foot on another rail.)
- 5 Choice c. (spectrum.)
- 6 Choice d. (frequency.)
- 7 Choice d. (6:00 pm.)
- 8 Choice c. (there is a positive charge at that point.)
- 9 Choice a. (16N.)
- 10 Choice c. (a magnifier looking at a projector image.)
- 11 Choice a. (a converging lens.)
- 12 Choice a. (close to the speed of light.)
- 13 Choice a. (between the lens and its focal point.)
- 14 Choice d. (north.)
- 15 Choice b. (red.)
- 16 Choice b. (diverging lenses.)
- 17 Choice c. (more than 22 years old.)
- 18 Choice b. (a ray parallel to the axis.)
- 19 Choice b. (enlarged and real.)
- 20 Choice d. ($9 \times 10^{13}\text{J}$.)
- 21 Choice a. (brings parallel light rays together.)
- 22 Choice d. (scattered in all directions.)
- 23 Choice c. (150J.)
- 24 Choice d. (the water side at a 50 degree angle of incidence.)
- 25 Choice a. (the moon passes into the umbra of the earth's shadow.)
- 26 Choice d. (blue.)
- 27 Choice b. (50V.)
- 28 Choice c. (ampere.)
- 29 Choice e. (5.)
- 30 Choice a. (0.1.)
- 31 Choice d. (For short wavelengths, rays are straight lines.)
- 32 Choice c. (aim below where you see it.)
- 33 Choice b. (multiplied by 5.)
- 34 Choice b. (has lost one millisecond.)
- 35 Choice b. (6.0J.)

36 Choice c. (3J.)

37 Choice b. (the instantaneous rest frame of the object.)

38 Choice d. (always a real image.)

Solutions

1. Module 080 Definition of an Electric Field: Question 3.1
2. Module 092 Magnetic Poles: Question 3.2
3. Module 102 Interactions at boundaries: Question 1.1
4. Module 083 Definition of Electric Potential: Question 4.1
5. Module 100 Wave Properties: Question 4.2
6. Module 099 Wave Properties: Question 3.1
7. Module 103 Dispersion effects: Question 3.2
8. Module 080 Definition of an Electric Field: Question 1.2
9. Module 077 Coulomb's Force Law: Question 1.3
10. Module 107 Optical Instruments: Question 4.2
11. Module 106 Lenses: Question 3.1
12. Module 084 Electric Current: Question 4.1
13. Module 107 Optical Instruments: Question 2.2
14. Module 092 Magnetic Poles: Question 4.3
15. Module 100 Wave Properties: Question 1.1
16. Module 107 Optical Instruments: Question 3.3
17. Module r41 The Twin Paradox: Question 3.2
18. Module 105 Images: Question 1.4
19. Module 107 Optical Instruments: Question 1.3
20. Module r42 Relativistic Mechanics: Question 4.1
21. Module 106 Lenses: Question 1.3
22. Module 102 Interactions at boundaries: Question 2.2
23. Module 083 Definition of Electric Potential: Question 2.4
24. Module 102 Interactions at boundaries: Question 4.3
25. Module 104 The Ray Approximation: Question 3.2
26. Module 103 Dispersion effects: Question 1.2
27. Module 086 Electrical Resistance: Question 4.2
28. Module 084 Electric Current: Question 1.3
29. Module r42 Relativistic Mechanics: Question 3.3
30. Module 099 Wave Properties: Question 4.2
31. Module 104 The Ray Approximation: Question 2.1
32. Module 102 Interactions at boundaries: Question 3.1
33. Module 077 Coulomb's Force Law: Question 2.1
34. Module r41 The Twin Paradox: Question 1.1
35. Module 082 Electric Potential Energy: Question 4.1
36. Module 082 Electric Potential Energy: Question 2.2

37. Module r42 Relativistic Mechanics: Question 2.2

38. Module 105 Images: Question 2.2