1 Suppose that the focal point of a converging lens is 4cm from the lens. If an object is placed 3.9cm from the lens, then its image will be

a. enlarged and real.

b. reduced and virtual.

c. enlarged and virtual.

d. reduced and real.

2 A lens that spreads parallel light rays apart is

a. wedge-shaped.

b. thick in the middle and thin around the edges.

c. thin in the middle and thick around the edges.

d. flat like a window pane.

3 A positive charge of one micro-coulomb is one meter away from a much larger positive charge and has one joule of potential energy. If the charge moves closer, to one half meter away from the positive charge, its potential energy could be

a. 1J.

b. 0.5J.

c. 2J.

4 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?

a. 16N.

b. 144N.

c. 48N.

d. 9N.

5 All of the following statements are true. Which one states the ray approximation?

a. Rays spread outward from a source.

b. For short wavelengths, rays are straight lines.

c. For long wavelengths, rays bend around corners.

d. Rays are perpendicular to wavefronts.

6 The wavelength of a wave is

a. the rate at which waves pass a fixed position.

b. the distance from one wavefront to the next.

c. the velocity of a wavefront.

d. the reciprocal of its rate of spread.

e. the distance from its beginning to its end.

7 A magnifier that is looking at the image formed by a projector is called

a. a camera.

b. a compound microscope.

c. an astronomical telescope.

d. a Galilean telescope.

8 The points of a virtual optical image are always places where

a. light stops.

b. light starts.

c. light really goes.

d. no light really goes.

9 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. 3.0J.

c. 6.0J.

d. 1.5J.

10 The potential energy of a charge of 3 micro-coulombs in a potential of 2 million volts is

a. 2J.

b. 6J.

c. 3J.

d. 1J.

11 Which of the following rays from a point on an object will become parallel to the axis after traveling through a converging lens?

a. a ray that passes through the nearer focal point of the lens.

b. a ray that passes through the center of the lens.

c. a ray that passes through the farther focal point of the lens.

d. a ray parallel to the axis.

12 (Atronomical 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 western sky. What time is it?

a. 6:00 pm.

b. 6:00 am.

c. 3:00 pm.

d. 9:00 am.

13 Suppose that a sound wave with a frequency of 1000Hz has a wavelength of one meter. Assuming that the speed of sound does not depend on frequency, the wavelength of a sound wave with a frequency of 250Hz should be

a. 1m.

b. 16m.

c. 0.25m.

d. 0.0625m.

e. 4m.

14 Which of the following colors corresponds to the shortest wavelength?

a. yellow.

b. blue.

c. red.

d. green.

15 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.

a. 24V.

b. 120V.

c. 5000V.

d. 50V.

e. 5V.

16 For an accelerated particle, proper time and rest-mass are defined

a. in the inertial frame of the observer.

b. using gravity because of the acceleration.

c. only in the universal inertial frame.

d. in the instantaneous rest-frame of the particle.

17 The speed of light is 3×10^8m/s. How much energy is released when the mass of a system decreases by one microgram (10^{-9}kg)?.

a. 0.3J

b. 9×10^{16}J.

c. 9×10^{10}J.

d. 9×10^{7}J.

e. 9×10^{13}J.

18 The process of total internal reflection typically loses

a. about 50% of the incident energy.

b. 96% of the incident energy.

c. about 1% of the incident energy.

d. none of the incident energy.

19 The part of a shadow where no light rays go is called the

a. inner shadow.

b. penumbra.

c. zone of totality.

d. umbra.

20 The MKS unit of electrical current is the

a. ohm.

b. watt.

c. ampere.

d. volt.

e. coulomb.

21 The spectrum of Hydrogen gas describes

a. the amount of light that it emits.

b. the wavelengths that it emits.

c. the particles it is made out of.

d. the wavefunctions of its molecules.

22 Light that strikes a mirror at a 60 degree angle of incidence will reflect at an angle to the perpendicular of

a. 60 degrees.

b. 45 degrees.

c. 30 degrees.

d. 90 degrees.

23 Which of the following surfaces would most likely be a diffuse reflector?

a. A water surface.

b. A polished metal surface.

c. A window pane.

d. Cotton cloth.

24 You notice that a friend's glasses make her eyes seem smaller than normal.

Without her glasses, your friend would most likely have trouble seeing

a. objects at a distance.

b. objects nearby.

c. objects that are moving.

d. anything.

25 A baseball pitcher acquires an unbalanced electrical charge by scuffing his feet in the dirt and transfers -0.00001C to a baseball as he throws it toward home plate. A thunderstorm is brewing and there is a vertical electric field of 10,000N/C *pointing straight up*. The electrical force on the baseball is

a. 0.1N downward.

b. 0.1N upward.

c. 1N upward.

d. 1N downward.

26 In order for a converging lens to produce an enlarged real image, the object should be placed

a. just beyond the focal point of the lens.

b. at the focal point of the lens.

c. between the lens and its focal point.

d. far beyond the focal point of the lens.

27 Which way does the earth's magnetic field point at a position directly over the magnetic south pole (somewhere in Antarctica).

a. south.

b. north.

c. down.

d. up.

28 If light hits the surface of a pond, coming from air, at an angle of incidence of 45° it will travel into the pond (through the water) at an angle of

a. 54° from the vertical.

b. 32° from the vertical.

c. 45° from the vertical.

d. 90° from the vertical.

29 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

a. less than 22 years old.

b. more than 22 years old.

c. either older or younger than 22, there is no way to tell.

d. also 22 years old.

30 A compass needle is used to test the magnetization of an object by putting the needle near every different part of the object and watching which way it points. Which of the following results is possible?

a. The needle points at some parts and away from others.

b. The needle always points toward the object.

c. The needle always points away from the object.

31 A flock of extremely large birds has landed on some power lines. The power lines are at various electric potentials — 0V, 1000V, 10,000V, 10,500V. Each large bird is standing with one foot on each of two power lines. The bird which is in the *least* danger is the one with its feet on

a. 10,000V and 10,500V.

b. 0V and 1000V.

c. 1000V and 10,500V.

d. 0V and 10,000V.

e. 1000V and 10,000V.

32 Consider a mirror shaped like a shallow bowl. When light strikes this mirror from the top (into the bowl), the mirror acts like

a. a diverging lens.

b. a converging lens.

c. a pane of glass.

d. a pinhole camera.

33 The average speed with which a change in electric potential moves through a wire is

a. close to the speed of light.

b. zero.

c. close to the speed of sound.

d. a few millimeters per second.

34 When white light enters a glass pane with air on one side and water on the other, its different wavelengths are sent in different directions. When light goes out the water side of the pane, this separation of wavelengths

a. is increased.

b. is decreased but not canceled.

c. stays the same.

d. is completely canceled.

35 If a particle whose rest-mass-energy is 1 Mev travels at 5/13 the speed of light, its kinetic energy is

a. $(2/3)$Mev.

b. $(1/12)$Mev.

c. $(1/13)$Mev.

d. $(8/5)$Mev.

36 If one of two charges is increased by a factor of 6 and the distance between the charges is not changed, then the electrical force between the charges is

a. divided by 36.

b. unchanged.

c. multiplied by 6.

d. divided by 6.

37 Two identical clocks are set to the exact same time. One clock stays in the laboratory while the other clock is flown around the earth in a jet plane. When the clocks are brought back together, the flying clock reads

a. one tenth of a microsecond less time than the lab clock.

b. exactly the same time as the lab clock.

c. one tenth of a microsecond more time than the lab clock.

38 If the electric field everywhere near a particular point in space points away from that point, it follows that

a. there is a dipole at that point.

b. there is a positive charge at that point.

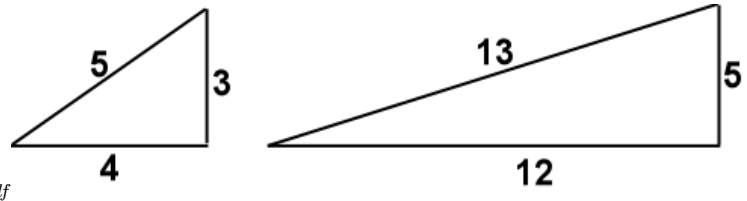
c. there is a negative charge at that point.

d. there is no charge at that point.

Useful Formulas

$p = mv$	$W = F_d d = F d_F$	$F = ma$
$\text{K.E.}_{\text{Newton}} = \frac{1}{2}mv^2$	$\text{P.E.} = mgh$	$W = mg$
$v = at$	$v^2 = 2ad$	$d = \frac{1}{2}at^2$
$v_{\text{average}} = \frac{d}{t}$	$\text{Eff} = \frac{\text{Work out}}{\text{Work in}}$	
$F = G\frac{mM}{D^2}$	$t_{\text{earth}} = \frac{T_{\text{ship}}}{\sqrt{1-(v/c)^2}}$	$E = \frac{mc^2}{\sqrt{1-(v/c)^2}}$
$F = k\frac{qQ}{D^2}$	$\text{K.E.}_{\text{Einstein}} = E - mc^2$	${T_{\text{ship}}}^2 = {t_{\text{earth}}}^2 - {x_{\text{earth}}}^2$
$E = \frac{\text{Force}}{\text{Electric charge}}$	$V = \frac{\text{P.E.}_{\text{electrical}}}{\text{Electric charge}}$	$I = \frac{\text{Charge flow}}{\text{Time taken}}$
	$R = \frac{V}{I}$	$v = f\lambda$

Integer right triangles:
triangles



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Answer Key: Exam 4 Preview 1

1 Choice c. (enlarged and virtual.)

2 Choice c. (thin in the middle and thick around the edges.)

3 Choice c. (2J.)

4 Choice a. (16N.)

5 Choice b. (For short wavelengths, rays are straight lines.)

6 Choice b. (the distance from one wavefront to the next.)

7 Choice b. (a compound microscope.)

8 Choice d. (no light really goes.)

9 Choice c. (6.0J.)

10 Choice b. (6J.)

11 Choice a. (a ray that passes through the nearer focal point of the lens.)

12 Choice b. (6:00 am.)

13 Choice e. (4m.)

14 Choice b. (blue.)

15 Choice d. (50V.)

16 Choice d. (in the instantaneous rest-frame of the particle.)

17 Choice d. (9×10^7J.)

18 Choice d. (none of the incident energy.)

19 Choice d. (umbra.)

20 Choice c. (ampere.)

21 Choice b. (the wavelengths that it emits.)

22 Choice a. (60 degrees.)

23 Choice d. (Cotton cloth.)

24 Choice a. (objects at a distance.)

25 Choice a. (0.1N downward.)

26 Choice a. (just beyond the focal point of the lens.)

27 Choice d. (up.)

28 Choice b. (32° from the vertical.)

29 Choice b. (more than 22 years old.)

30 Choice a. (The needle points at some parts and away from others.)

31 Choice a. (10,000V and 10,500V.)

32 Choice b. (a converging lens.)

33 Choice a. (close to the speed of light.)

34 Choice b. (is decreased but not canceled.)

35 Choice b. ($(1/12)$Mev.)

36 Choice c. (multiplied by 6.)

37 Choice a. (one tenth of a microsecond less time than the lab clock.)

38 Choice b. (there is a positive charge at that point.)

Where to Look in the Notes

1 Module 107 Optical Instruments: Question 2.3

2 Module 106 Lenses: Question 2.2

3 Module 082 Electric Potential Energy: Question 1.1

4 Module 077 Coulomb's Force Law: Question 1.3

5 Module 104 The Ray Approximation: Question 2.1

6 Module 099 Wave Properties: Question 2.2

7 Module 107 Optical Instruments: Question 4.3

8 Module 105 Images: Question 3.3

9 Module 082 Electric Potential Energy: Question 4.1

10 Module 083 Definition of Electric Potential: Question 2.1

11 Module 105 Images: Question 1.3

12 Module 103 Dispersion effects: Question 3.1

13 Module 099 Wave Properties: Question 4.3

14 Module 100 Wave Properties: Question 1.2

15 Module 086 Electrical Resistance: Question 4.2

16 Module r42 Relativistic Mechanics: Question 2.1

17 Module r42 Relativistic Mechanics: Question 4.2

18 Module 102 Interactions at boundaries: Question 4.2

19 Module 104 The Ray Approximation: Question 3.1

20 Module 084 Electric Current: Question 1.3

21 Module 100 Wave Properties: Question 4.1

22 Module 102 Interactions at boundaries: Question 1.2

23 Module 102 Interactions at boundaries: Question 2.1

24 Module 107 Optical Instruments: Question 3.2

25 Module 080 Definition of an Electric Field: Question3.2

26 Module 107 Optical Instruments: Question 1.2

27 Module 092 Magnetic Poles: Question 4.2

28 Module 102 Interactions at boundaries: Question 3.2

29 Module r41 The Twin Paradox: Question 3.2

30 Module 092 Magnetic Poles: Question 3.1

31 Module 083 Definition of Electric Potential: Question 4.4

32 Module 106 Lenses: Question 3.1

33 Module 084 Electric Current: Question 4.1

34 Module 103 Dispersion effects: Question 2.3

35 Module r42 Relativistic Mechanics: Question 3.1

36 Module 077 Coulomb's Force Law: Question 2.2

37 Module r41 The Twin Paradox: Question 1.2

38 Module 080 Definition of an Electric Field: Question 1.2