1 If light is incident on a diffuse reflector from a single direction, it will be

a. reflected without loss.

b. scattered in all directions.

c. completely absorbed.

d. reflected into a single direction.

2 In relativistic mechanics, the one inertial reference frame that is uniquely defined for describing a moving object is

a. the universal rest frame.

b. the instantaneous rest frame of the object.

c. the inertial frame of the observer.

d. the frame in which the microwave background is at rest.

3 A total eclipse of the sun happens when and where

a. the umbra of the earth's shadow touches the moon.

b. the umbra of the moon's shadow touches the earth.

c. the penumbra of the moon's shadow touches the earth.

d. the penumbra of the earth's shadow touches the moon.

4 The potential energy of a charge of 3 micro-coulombs in a potential of 1 million volts is

a. 6J.

b. 1J.

c. 2J.

d. 3J.

5 Which of these mirrors will bring parallel rays to an approximate focal point?

a. a flat mirror.

b. a mirror shaped like part of the inside surface of a sphere.

c. a mirror shaped like part of the outside surface of a sphere.

d. a mirror shaped like part of the inside surface of a cylinder.

e. a mirror shaped like part of the outside surface of a cylinder.

6 If 100 coulombs of charge flows through a wire in 10 seconds, the current in the wire is

a. 0.1A.

b. 100A.

c. 0.01A.

d. 10A.

7 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.

8 A few millimeters per second is

a. the typical speed with which a change in electric potential moves through a wire.

b. the typical average speed of electrons in a current-carrying wire.

c. a speed that has nothing to do with electricity.

d. the instantaneous speed of individual electrons in a wire.

9 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 10,000N/C *pointing straight down*. The electrical force on the baseball is

a. 1N upward.

b. 1N downward.

c. 0.1N upward.

d. 0.1N downward.

10 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 8m apart?

a. 16N.

b. 144N.

c. 48N.

d. 9N.

11 If two charges are each increased by a factor of 2 and the distance between the charges is not changed, then the electrical force between the charges is

a. divided by 2.

b. unchanged.

c. divided by 4.

d. multiplied by 2.

e. multiplied by 4.

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

a. 9×10^{13}J.

b. 9×10^{10}J.

c. 9×10^{16}J.

d. 3×10^5J.

13 (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 eastern sky. What time is it?

a. 6:00 am.

b. 3:00 pm.

c. 6:00 pm.

d. 9:00 am.

14 Near a positive charge, the electric field points

a. upward.

b. directly toward the charge.

c. directly away from the charge.

d. in circles around the charge.

15 A lens that brings parallel rays together at a focal point 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.

16 The ray approximation applies to light in the limit of

a. high intensity.

b. low intensity.

c. long wavelength.

d. short wavelength.

17 Which way does the earth's magnetic field point at a position directly over the magnetic equator (somewhere in Brazil, perhaps).

a. south.

b. down.

c. north.

d. up.

18 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. 5000V.

b. 120V.

c. 24V.

d. 5V.

e. 50V.

19 Which of the following types of radiation has the longest wavelength?

a. gamma rays.

b. X-rays.

c. ultraviolet light.

d. violet light.

20 Which of the following rays from a point on an object will travel through a converging lens in a straight line without bending?

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

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

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

d. a ray parallel to the axis.

21 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. 60 degrees.

c. 45 degrees.

d. 30 degrees.

22 When one coulomb of charge passes through a battery, the electrical potential energy of the charge increases by 1.5J. If 2 coulombs of charge pass through the same battery, its electrical potential energy will increase by

a. 1.5J.

b. 3.0J.

c. 6.0J.

d. 0.375J.

23 A near-sighted person, someone who has trouble focusing on distant objects, needs to wear glasses with

a. converging lenses.

b. barrel-shaped lenses.

c. flat lenses.

d. diverging lenses.

24 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. 0.0625m.

c. 0.25m.

d. 16m.

e. 4m.

25 A compound microscope can be thought of as

a. a magnifier looking at a projector image.

b. one magnifier looking at the image from another.

c. a camera looking at the image formed by a magnifier.

d. a magnifier looking at a camera image.

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

a. between the lens and its focal point.

b. at the focal point of the lens.

c. just beyond the focal point of the lens.

d. far beyond the focal point of the lens.

27 Suppose that a projectile launcher obtains its energy by converting mass into energy. Assuming that the launcher is 100% efficient, how much mass must it convert in order to launch a one kilogram projectile at 12/13 the speed of light?

a. $(1/4)$kg.

b. $(1/12)$kg.

c. $(13/5)$kg.

d. $(8/5)$kg.

e. $(2/3)$kg.

28 If a bar magnet is cut in half, the result will be

a. cancellation of the magnetic field.

b. two bar magnets, each with a north-seeking pole on one end and an equally strong south-seeking pole on the other.

c. one half that is a north-seeking pole and one half that is a south-seeking pole.

d. one half with a strong north-seeking pole and a weak south-seeking pole and one half the reverse.

29 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

a. enlarged and real.

b. enlarged and virtual.

c. reduced and real.

d. reduced and virtual.

30 For the image of an object to be real, the light from each point of the object must

a. actually reach the image point.

b. appear to come from the image point.

c. stop at the image point.

d. travel only in straight lines.

31 Which of the following colors would you expect to be deflected the most by a glass prism?

a. green.

b. blue.

c. yellow.

d. red.

32 Joyce takes a trip to a nearby star and back again on a very fast starship. She spends one year of ship-time travelling at 99% of the speed of light. When she returns, her sister Josephine tells her that while she was gone

a. one year has passed.

b. seven years have passed.

c. 52 days have passed.

33 A positive charge of one micro-coulomb is one meter away from a much larger negative charge and has -2J of potential energy. If the charge moves to two meters away from the negative charge, its potential energy could be

a. -3J.

b. -2J.

c. -1J.

34 The process of total internal reflection typically loses

a. 96% of the incident energy.

b. about 1% of the incident energy.

c. about 50% of the incident energy.

d. none of the incident energy.

35 The spectrum of Hydrogen gas describes

a. the amount of light that it emits.

b. the particles it is made out of.

c. the wavelengths that it emits.

d. the wavefunctions of its molecules.

36 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. 1000V and 10,000V.

b. 10,000V and 10,500V.

c. 0V and 1000V.

d. 1000V and 10,500V.

e. 0V and 10,000V.

37 In the twin paradox, the important difference between the reference frame of the stay-at-home twin and the reference frame of the traveling twin is that the traveling twin

a. must decelerate upon return to earth.

b. must accelerate to leave the earth.

c. must turn around at the destination.

d. is moving while the other twin is not.

38 The wavelength of a wave is

a. the velocity of a wavefront.

b. the reciprocal of its rate of spread.

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

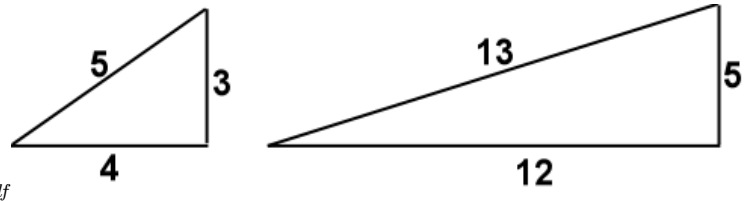
d. the distance from one wavefront to the next.

e. the distance from its beginning to its end.

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 2

1 Choice b. (scattered in all directions.)

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

3 Choice b. (the umbra of the moon's shadow touches the earth.)

4 Choice d. (3J.)

5 Choice b. (a mirror shaped like part of the inside surface of a sphere.)

6 Choice d. (10A.)

7 Choice b. (32° from the vertical.)

8 Choice b. (the typical average speed of electrons in a current-carrying wire.)

9 Choice a. (1N upward.)

10 Choice d. (9N.)

11 Choice e. (multiplied by 4.)

12 Choice a. (9×10^{13}J.)

13 Choice c. (6:00 pm.)

14 Choice c. (directly away from the charge.)

15 Choice b. (thick in the middle and thin around the edges.)

16 Choice d. (short wavelength.)

17 Choice c. (north.)

18 Choice e. (50V.)

19 Choice d. (violet light.)

20 Choice c. (a ray that passes through the center of the lens.)

21 Choice d. (30 degrees.)

22 Choice b. (3.0J.)

23 Choice d. (diverging lenses.)

24 Choice e. (4m.)

25 Choice a. (a magnifier looking at a projector image.)

26 Choice a. (between the lens and its focal point.)

27 Choice d. ($(8/5)$kg.)

28 Choice b. (two bar magnets, each with a north-seeking pole on one end and an equally strong south-seeking pole on the other.)

29 Choice a. (enlarged and real.)

30 Choice a. (actually reach the image point.)

31 Choice b. (blue.)

32 Choice b. (seven years have passed.)

33 Choice c. (-1J.)

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

35 Choice c. (the wavelengths that it emits.)

36 Choice b. (10,000V and 10,500V.)

37 Choice c. (must turn around at the destination.)

38 Choice d. (the distance from one wavefront to the next.)

Where to Look in the Notes

1 Module 102 Interactions at boundaries: Question 2.2

2 Module r42 Relativistic Mechanics: Question 2.2

3 Module 104 The Ray Approximation: Question 3.3

4 Module 083 Definition of Electric Potential: Question 2.2

5 Module 106 Lenses: Question 3.3

6 Module 084 Electric Current: Question 1.2

7 Module 102 Interactions at boundaries: Question 3.2

8 Module 084 Electric Current: Question 3.2

9 Module 080 Definition of an Electric Field: Question3.3

10 Module 077 Coulomb's Force Law: Question 1.4

11 Module 077 Coulomb's Force Law: Question 2.4

12 Module r42 Relativistic Mechanics: Question 4.1

13 Module 103 Dispersion effects: Question 3.2

14 Module 080 Definition of an Electric Field: Question 1.1

15 Module 106 Lenses: Question 1.2

16 Module 104 The Ray Approximation: Question 2.2

17 Module 092 Magnetic Poles: Question 4.3

18 Module 086 Electrical Resistance: Question 4.2

19 Module 100 Wave Properties: Question 3.2

20 Module 105 Images: Question 1.2

21 Module 102 Interactions at boundaries: Question 1.1

22 Module 082 Electric Potential Energy: Question 4.2

23 Module 107 Optical Instruments: Question 3.3

24 Module 099 Wave Properties: Question 4.3

25 Module 107 Optical Instruments: Question 4.2

26 Module 107 Optical Instruments: Question 2.2

27 Module r42 Relativistic Mechanics: Question 3.4

28 Module 092 Magnetic Poles: Question 3.2

29 Module 107 Optical Instruments: Question 1.3

30 Module 105 Images: Question 2.1

31 Module 103 Dispersion effects: Question 1.2

32 Module r41 The Twin Paradox: Question 1.3

33 Module 082 Electric Potential Energy: Question 2.3

34 Module 102 Interactions at boundaries: Question 4.2

35 Module 100 Wave Properties: Question 4.1

36 Module 083 Definition of Electric Potential: Question 4.4

37 Module r41 The Twin Paradox: Question 3.1

38 Module 099 Wave Properties: Question 2.2