Chapter 4: Reflection and Mirrors

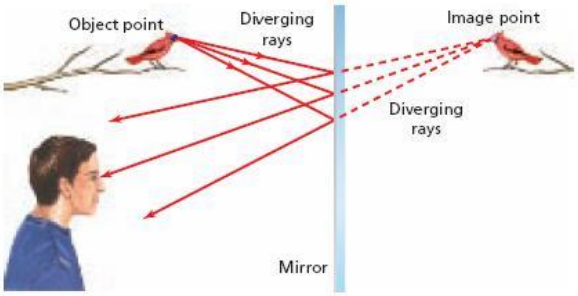
1 - The line perpendicular to the reflective surface is the _____.

A) line of reflection B) line of incidence C) normal D) line of refraction

2 - How does light normally travel?

A) in a straight line B) in concentric circles C) always toward a dark area D) in a curved line

3 - Which statement about the light rays in the figure below is true?



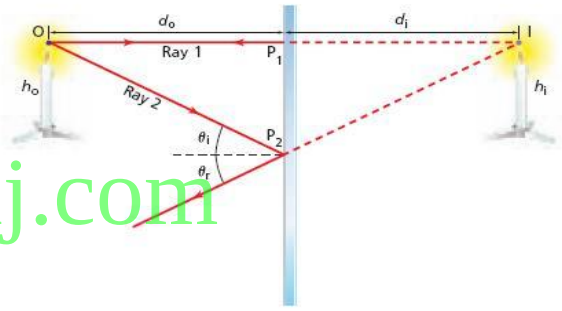
A) The light originates from the boy's eyes.

B) The light originates from the bird's image.

C) The image of the bird creates light rays.

D) The light originates from the bird.

4 - In the figure below, if the flame on the candle is 2 cm tall, how tall is the flame of the image?



A) 1 cm B) 4 cm

C) 8 cm D) 2 cm

5 - Your image in a bathroom mirror results from _____.

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A) diffuse reflection B) specular reflection

C) diffuse refraction D) specular refraction

6 - You are standing in front of a bathroom mirror. Where is your image located?

A) behind you B) in front of the mirror

C) behind the mirror D) between you and the mirror

7 - Which type of mirror produces an image that is always erect, always the same height as the object, and always virtual?

A) diffuse B) concave C) plane D) convex

8 - When an object is placed between the focal point and a concave mirror, the rays _____.

A) diverge and sight lines diverge and form a real image

B) converge and sight lines diverge and form a virtual image

C) diverge and sight lines converge and form a virtual image

D) converge and sight lines converge and form a real image

9 - A _____ image is formed when light rays converge and pass through the image.

A) real B) virtual C) convex D) critical

10 - In a concave mirror, an object placed _____ will result in a virtual image.

A) past the focal point B) twice the distance of the focal point

C) between the focal point and mirror D) between the focal point and twice the distance of the focal point

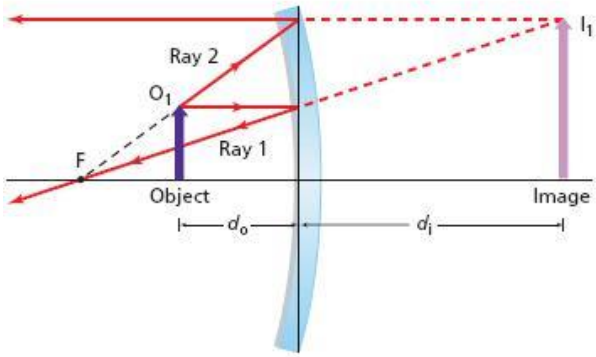
11 - Spherical aberration can be avoided by using a _____.

A) spherical mirror B) plane mirror C) parabolic mirror D) convex mirror

12 - What is f if you have an object 2.0 m from the concave mirror, and the image is 4.0 m from the mirror?

A) 2.0 m B) 1.3 m C) 4.0 m D) 0.67 m

13 - If you wanted to adjust the situation in the figure below to produce a real image, which one of the following options by itself would work?



A) replace the mirror with a convex mirror of the same focal length

B) replace the object with a larger object.

C) move the object out past the focal point

D) replace the mirror with another concave mirror of longer focal leng

14 - A 10-cm object has a 20-cm image. What is the magnification?

A) 10 B) 2 C) 20 D) 0.5

15 - _____ is located behind a convex mirror.

A) A ray B) A real image C) The object D) The focal point

16 - Real images produced by mirrors have _____ magnification.

A) massive B) negative C) opposite D) positive

17 - The distance from the focal point to the mirror is the _____.

A) focal length B) foci C) focus point D) focal distance

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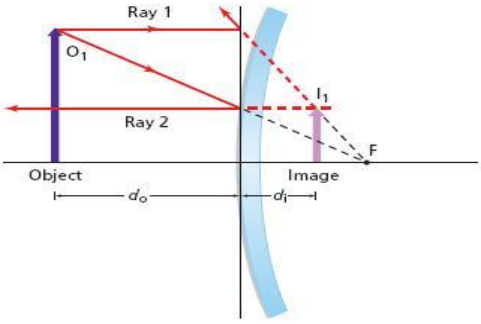
18 - What does the F on a ray diagram represent?

A) the focal point B) the location of the virtual image

C) the location of the object D) the center of the mirror

19 - In the figure below, if the object is 4 times farther from the mirror than the image, what is the focal length of the mirror?



A) 0.75 m

B) 0.80 m

C) 1.25 m

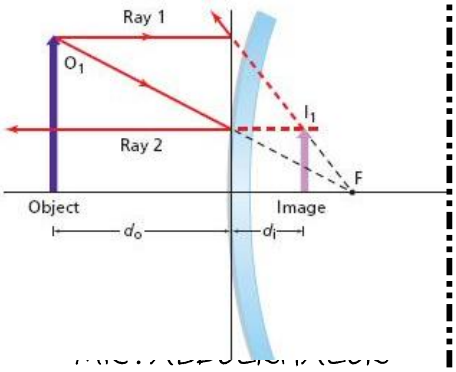
D) 1.33 m

20 - The image from a convex mirror will _____.

A) always be projected C) always be virtual

B) never be virtual D) always be real

21 - In the figure below, if the image is one-third the size of the object and the object is 3.0 m away from the mirror, what is the focal length of the mirror?



A) -1.5 m B) 3 m

C) 0.75 m D) 0.66 m

22 - In a ray tracing diagram, two rays must pass through the _____ to determine the location of the image.

A) image B) focal point C) lens edge D) object

Chapter 5: Refraction and Lenses

1 - How is information carried in an optical fiber?

A) by sound B) by different colors C) by electrical impulses D) by light

2 - For the situation shown in the figure below, which of the substances listed below should be chosen to put in front of the pencil to make its "break" the most pronounced?

A) flint glass

B) vacuum

C) ethanol

D) water

3 - A light ray is traveling through an unknown material when it intersects ethanol (n = 1.36) at an incident angle of 62.0°. If the angle of refraction is 46.4°, what is the index of refraction of the unknown material?

A) 1.12 B) 1.66 C) 0.985 D) 2

4 - If a refracted ray moves away from the normal, the speed of light of the ray in this material is _____ that of the incident ray.

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A) unrelated to B) less than C) greater than D) the same as

5 - If a substance has a critical angle of 50°, what happens to the light from an incident angle hitting the boundary at 30°?

A) It is stopped. B) It is reflected. C) It is diffused. D) It is refracted.

6 - What is dispersion?

A) the separation of light into its spectrum B) the refraction of light

C) the combining of colored light into white light D) the reflection of colored light

7 - The incident angle that causes a refracted ray to lie along the boundary of a substance is the _____.

A) refracted angle B) reflected angle C) critical angle D) normal angle

8 - What is the speed of light in a diamond (n = 2.42)?

A) 2.42×10^8 m/s B) 1.24×10^8 m/s C) 7.26×10^8 m/s D) 3.00×10^8 m/s

9 - Why would it be impossible to have optical fibers filled with a vacuum?

A) there is nothing for light to travel through B) there is nothing less optically dense than a vacuum

C) because a vacuum is too optically dense D) because optical fibers must use glass

10 - A light ray traveling through crown glass (n = 1.52) intersects a sheet of flint glass (n = 1.61) at an angle of 27.3°. What is the angle of refraction?

A) 0.839° B) 33.0° C) 25.7° D) 0.433°

11 - In relation to a rainbow that you are looking at, where is the Sun?

A) in the center of the rainbow B) behind you C) directly overhead D) in front of you

12 - Water is more optically dense than air. Therefore, the speed of light in water is _____.

A) the same as the speed of light in a vacuum B) slower than the speed of light in air

C) faster than the speed of light in air D) the same as the speed of light in air

13 - According to Snell's law, light traveling from a vacuum to glass will _____.

A) speed up B) travel at the same speed C) stop completely D) slow down

14 - Because of refraction, the Sun actually sets _____ we see it disappear.

A) after B) before C) at the same time as D) hours before

15 - A beam of light travels through air (n = 1.0003) and strikes an unknown material at an angle of 50.0°. The new angle of refraction is 25.0°. What is the index of refraction of this material?

A) 0.643 B) 1.2 C) 1.81 D) 0.709

16 - What happens to light during total internal reflection?

A) The angle of refraction is less than the critical angle.

B) The angle of incidence is greater than the critical angle.

C) The angle of incidence is 0.

D) The angle of reflection is the same as the critical angle.

17 - Optical fibers are a technical application of _____.

A) diffraction B) dispersion C) total internal reflection D) refraction

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18 - A ray of light striking perpendicular to an optically dense surface will _____.

A) refract away from the normal B) reflect C) refract toward the normal D) remain straight

19 - A ray of sunlight travels through air and intersects the surface of water at a small incident angle. The ray is _____.

A) pure B) reflected C) refracted D) incident

20 - What causes a mirage?

A) heatstroke

B) a continuous change in the index of refraction of air because n increases as air gets warmer

C) water on the ground

D) a continuous change in the index of refraction of air because n decreases as air gets warmer

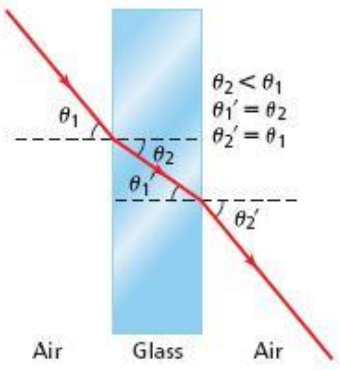
21 - In the figure below, if the incident angle is 35°, what is the angle of refraction in the glass? Use 1.55 for the index of refraction of glass.

A) 35°

B) 68°

C) 57°

D) 22°



22 - Through which medium is the speed of light the fastest?

A) air B) water C) vacuum

D) glass

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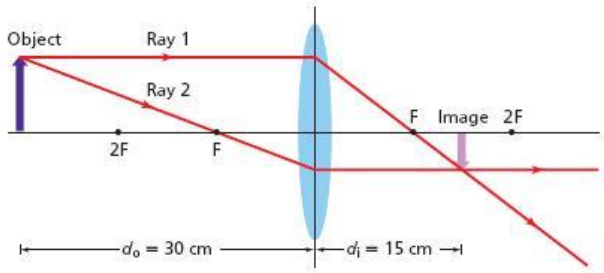
23 - What does Snell's law compare?

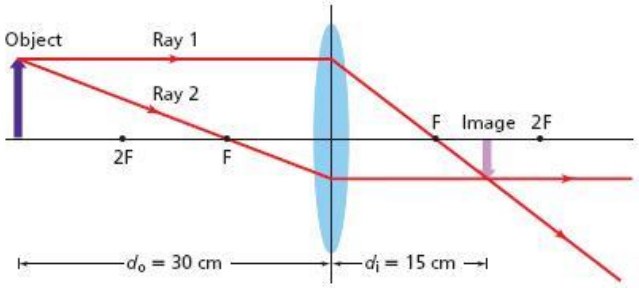
A) the reflective nature of materials
B) the cosines of the refracted angles
C) the density of the materials
D) the sines of the refracted angles

24 - In the figure below, if the bottom half of the lens is covered, what will happen to the image?



A) Nothing.
B) The bottom half of the image will disappear
C) The top half of the image will disappear.
D) The image will become dimmer.

25 - In the figure below, if the top half of the lens is covered, what will happen to the image?



A) The top half of the image will disappear.
B) The bottom half of the image will disappear
C) Nothing.
D) The image will become dimmer.

26 - An image of a flower is seen through a lens. What is the object?

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A) a flower B) an image C) a lens D) a mirror

27 - The refractive indices of lenses are _____.

A) the same as air
B) less than air
C) independent of the refractive index of air
D) greater than air

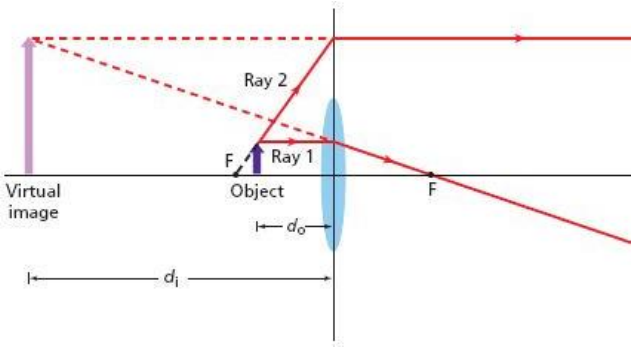
28 - The focal length of a concave lens is _____.

A) negative B) reduced C) magnified D) positive

29 - A concave lens is also known as a _____ lens

A) concave B) converging C) diverging D) plane

30 - In the figure below, if you wanted to make the virtual image larger, what could you do?



A) Move the object further out, but not past the focal point.
B) Replace the object with a shorter object.
C) Replace the lens with one of larger focal length.
D) Replace the lens with a taller one.

31 - Why are bigger lenses better for observing dim objects?

A) they have better curvatures
B) they refract light less
C) they collect more light
D) they reduce spherical aberration

32 - Unlike mirrors, lenses have _____.

A) one focal point B) no focal points C) many focal points D) two focal points

33 - An achromatic lens corrects chromatic aberration using _____.

A) two convex lenses with the same index of refraction

B) a combination of concave and convex lenses with different indices of refraction

C) two concave lenses with the same index of refraction

D) no lenses

34 - _____ single lenses have chromatic aberration.

A) Only parabolic B) Only concave C) Only convex D) All

35 - In nearsightedness, the image is focused _____.

A) in front of the retina B) beyond the retina C) directly on the retina D) in front of the eye

36 - Farsightedness can be corrected with a _____.

A) parabolic lens B) convex lens C) concave lens D) plane lens

Chapter 6 : Vibrations and Waves

1 - The formula represents the period of a pendulum, T. What is the period of a 3.5 m-long pendulum on Earth? $T = 2\pi\sqrt{\frac{l}{g}}$

A) 3.2 s B) 4.6 s C) 3.8 s D) 1.4 s

2 - In the figure below, if the spring's constant is 20.0 N/m and x has a value of 0.25 m, what is m equal to?

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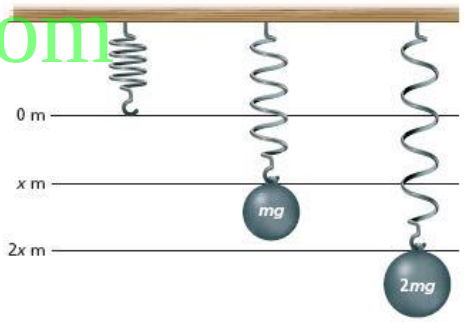


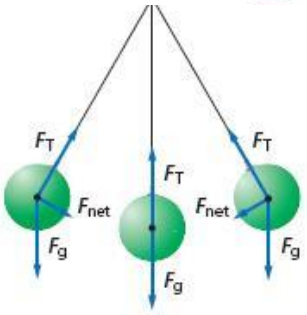
A) 0.06 kg

B) 0.63 kg

C) 0.51 kg

D) 5.0 kg

3 - In the figure below, if you doubled the mass of the pendulum, what effect, if any, would it have on its period?



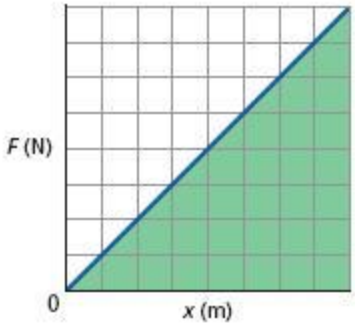
A) The new period would be half the old period.

B) The new period would be the old period, divided by the square root of two.

C) The new period would be the old period, times the square root of two.

D) It would have no effect.

4 - In the figure below, if the scale of the graph is 1 block = 10 N on the vertical axis and one block = 2 cm on the horizontal axis, what is the spring constant?



A) 500 N/m

B) 250 N/m

C) 5 N/m

D) 20 N/m

5 - In the figure below, if you quadrupled the length of the string, what effect, if any, would it

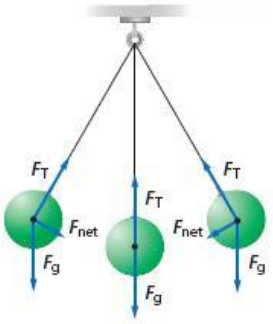
have on its period?

A) The period would be halved.

B) The period would be doubled.

C) It would have no effect.

D) The period would be quadrupled.



6 - If a wave's frequency increases, its period _____.

A) fluctuates B) remains the same

C) decreases D) increases

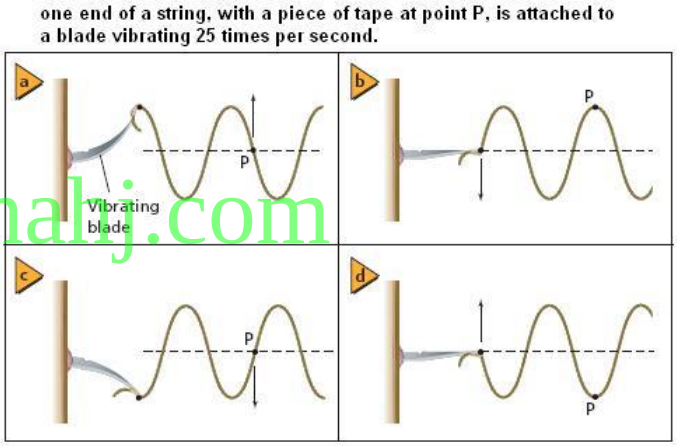
7 - Mechanical waves require _____.

A) a gas B) a solid C) a medium D) a vacuum

8 - What mathematical expression relates frequency to period?

A) f = 1/T B) 1/f = 1/T C) f = 2T D) f = T

9 - In the figure below, how much time elapses between pictures a and c?



A) 25 s

B) 0.02 s

C) 0.04 s

D) Not enough information is given to answer this question.

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10 - A wave with a frequency of 10 Hz and a wavelength of 2 m has a speed of _____.

A) 20 m/s B) 0.2 m/s

C) 5 m/s D) 2 m/s

11 - The _____ of a wave can be used to determine how much energy is being transferred by the wave.

A) speed B) frequency C) period D) amplitude

12 - What does a wave carry?

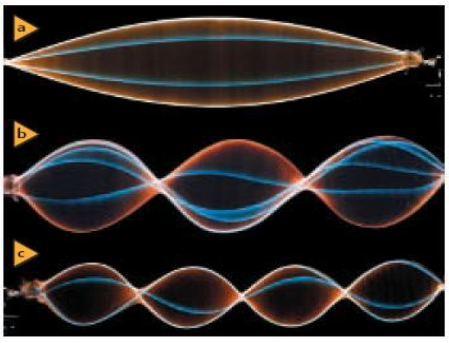
A) matter B) particles C) energy D) heat

13 - Surface waves move in a position _____ to the direction of the wave motion.

A) both parallel and perpendicular B) in a circular motion relative

C) parallel D) perpendicular

14 - A single bump or disturbance that travels through a medium is a _____.



A) wave pulse B) surface wave

C) compressional wave D) continuous wave

15 - In Figure 14-14, how do the frequencies of the waves in pictures a and c compare?

A) a's frequency is twice c's. B) a's frequency is four times c's

C) a's frequency is half of c's. D) a's frequency is one-quarter of c's.

16 - A trough is _____ of a wave.

A) the starting point B) the midpoint C) the low point D) the high point

17 - A pulse traveling along a bullwhip is an example of a _____ wave.

A) surface B) longitudinal C) compressional wave D) transverse

18 - The speed of a wave depends on the _____.

A) frequency B) medium C) energy D) amplitude

19 - A(n) _____ is a line perpendicular to a reflective surface.

A) incidence B) reflection C) normal D) angle

20 - Waves become inverted if they reflect off a medium that is _____ than the initial medium.

A) less dense B) softer C) more gaseous D) more dense

21 - The principle of superposition states that _____.

A) waves from different mediums can combine to form a new wave

B) the energy of a wave depends on its position

C) waves can never combine

D) two or more waves can combine to form a new wave

22 - The superposition of waves with equal but opposite amplitueds causes _____.

A) constructive interference B) consonance C) dissidence D) destructive interference

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23 - When a continuous wave meets a boundary that transmits the wave at a lower speed, the wavelength _____.

A) increases B) decreases C) interferes with itself D) becomes negative

24 - A standing wave appears to be _____.

A) moving very fast B) fluctuating C) standing still D) moving very slowly

25 - When a wave pulse strikes a wall, it reflects back and is _____.

A) changed from compressional to transverse B) inverted

C) amplified D) reduced to zero

26 - _____ is the point of the largest displacement where two waves meet.

A) A node B) A period C) A crest D) An antinode

27 - A wave that reflects off a flat surface will reflect at _____.

A) a different angle from which it struck the surface B) an angle of zero

C) the same angle at which it struck the surface D) a right angle to the surface

28 - _____ is the change in direction of a wave when it intersects a boundary between two different media.

A) Refraction B) Diffusion C) Diffraction D) Reflection

29 - A _____ wave bounces off a boundary.

A) incident B) surface C) transverse D) reflected

Chapter 7 : Thermal Energy

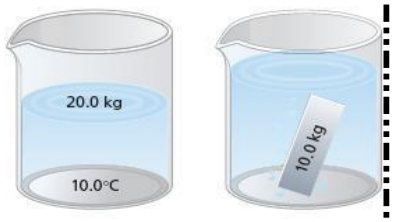
1-If the final temperature of a system is greater than the initial temperature, δt is _____.

A) positive B) eliminated C) negative D) reduced

2- _____ is the amount of energy that must be added to a material to raise one unit of mass by one temperature unit.

A) Temperature B) Specific Heat C) Radiation D) Hotness

3- In the figure below, if you doubled the amount of zinc put into the beaker, which of the following effects would it have on the final equilibrium temperature?



A) This question can not be answered without knowing the size of the container.

B) The final equilibrium temperature of the water and zinc would be greater.

C) It would have no effect; the final equilibrium temperature would be the same as before.

D) The final equilibrium temperature of the water and zinc would be lower.

4 - Thermodynamics is the study of _____.

A) heat B) light C) stars D) sound

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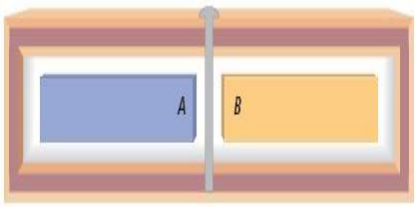
5 - What does a calorimeter measure?

A) change in radiation B) change in thermal energy

C) change in kinetic energy D) change in temperature

6 - Looking at the situation in the figure below, and using the same color scheme as in the figure, how would the block in part b be shaded after a really long time? Assume the two blocks have the same mass.



A) The left half would be yellow and the right half would be blue.

B) The whole block would be red.

C) The left half would be blue and the right half would be yellow.

D) The whole block would be green.

7 - In which direction does heat flow?

A) from hot to cold B) from left to right C) from light to dark D) from cold to hot

8 - Absolute zero is _____.

A) 273 K B) -273°F C) -273 K D) -273°C

9 - You have equal masses of four of the substances listed in Table 12-1. All are at the same initial temperature, and then you place them in a hotter room. Which of the objects' temperatures will increase the most rapidly?

A) Iron B) Aluminum C) Lead D) Zinc

10 - The Sun warms us by _____.

A) conduction B) convection C) induction D) radiation

11 - You have equal masses of four of the substances listed in Table 12-1. All are at the same initial temperature, and then you place them in a hotter room. Which of the objects' temperatures will increase the most slowly?

Heats of Fusion and Vaporization of Common Substances

Material	Heat of Fusion H_f (J/kg)	Heat of Vaporization H_v (J/kg)
Copper	2.05×10^5	5.07×10^6
Mercury	1.15×10^4	2.72×10^5
Gold	6.30×10^4	1.64×10^6
Methanol	1.09×10^5	8.78×10^5
Iron	2.66×10^5	6.29×10^6
Silver	1.04×10^5	2.36×10^6
Lead	2.04×10^4	8.64×10^5
Water (ice)	3.34×10^5	2.26×10^6

A) Brass B) Glass

C) Zinc D) Aluminum

12 - Heat is transferred by _____ when objects touch.

A) convection B) radiation C) thermoduction D) conduction

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13 - Water boils at 100° on the _____ temperature scale.

A) Celsius B) Molecular C) Kelvin D) Fahrenheit

14 - Which of the following is ordered from the least thermal energy to the most?

A) ice to steam to water B) water to ice to steam C) ice to water to steam D) steam to water to ice

15 - The thermal energy needed to boil a liquid is the heat of _____.

A) condensation B) specific C) fusion D) vaporization

16 - When disorder increases, entropy _____.

A) decreases B) fluctuates C) reaches zero D) increases

17 - The average kinetic energy of ice particles_____ as ice melts.

A) decreases B) increases C) reduces to zero D) remains constant

18 - An increase in heat in a system _____.

A) less kinetic energy B) decreases entropy

C) increases entropy D) reduces temperatur

19 - Which of the following processes is NOT like the dye spreading through the beaker in the figure below?

A) Shortly after your mother puts cookies in the oven to bake you can smell them in your bedroom.

B) Dandilion seeds spread from one yard into several others.

C) At a restaurant, you notice smoke in the air from the cigarette of a person several tables away.

D) You use the vacuum cleaner to suck the dirt out of the carpet.

20 - Which has the highest entropy?

A) a diamond B) a fire C) an ice cube D) a stack of books

21 - Using information from the table below, determine which of the following processes will require the most energy be added.

A)1 kg of iron is changed from liquid to gas.

B)2 kg of water is evaporated.

C)1 kg of liquid mercury is frozen.

D)1 kg of copper is converted from solid to liquid.

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Iron	2.66×10^5	6.29×10^6
Silver	1.04×10^5	2.36×10^6
Lead	2.04×10^4	8.64×10^5
Water (ice)	3.34×10^5	2.26×10^6

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22 - Heat spontaneously flowing from a cold body to a hot body violates the _____.

A) law of conservation of energy B) kinetic-molecular law

C) first law of thermodynamics D) second law of thermodynamics

23 - The first law of thermodynamics is a restatement of which law?

A) gravity B) second law of thermodynamics C) conservation of energy D) kinetic-molecular law

24 - Friction that you feel when you rub your hands together was changed from _____ to heat.

A) sound energy B) thermal energy C) nuclear energy D) kinetic energy

25 - A perpetual motion machine violates which law?

A) third law of conservation B) first law of thermodynamics

C) third law of thermodynamics D) first law of gravity

26 - Which is an example of a heat engine?

A) windmill B) automobile engine C) solar panels D) volca

Chapter 8 : States of Matter

1 - Which state of matter is the most common in the universe?

A) solid B) gas C) liquid D) plasma

2 - As water cools below 4°C, what happens?

A) it changes to an amorphous solid B) it contracts C) it melts D) it expands

3 - What causes air pressure?

A) air particles vaporize B) air particles flow through an object

C) air particles hit an object D) air particles suck away from an object

4 - What are the four stages of matter in order from least kinetic energy to most kinetic energy?

A) plasma, gas, liquid, solid B) plasma, solid, gas, liquid C) solid, liquid, gas, plasma D) solid, liquid, plasma, gas

5 - What are the particles in plasma?

A) free nuclear particles of protons, neutrons, and electrons B) positively charged ions and negatively charged electrons

C) negatively charged ions and positively charged protons D) free neutrons

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6 - _____ have no definite shape and flow.

A) Crystals B) Solids C) Metals D) Fluids

7 - Pressure is measured as _____.

A) FA B) F/A C) A/F D) F + A

8 - A particle is moving so fast in a liquid that it escapes the liquid's cohesive force. This is an example of _____.

A) condensation B) sublimation C) evaporation D) melting

9 - Surface tension is a result of _____ in a fluid.

A) nuclear forces B) adhesive forces C) cohesive forces D) kinetic force

10 - _____ is the force that acts between particles of different substances.

A) Rehesion B) Cohesion C) Elasticity D) Adhesion

11 - Which of the following does pressure in water not depend on?

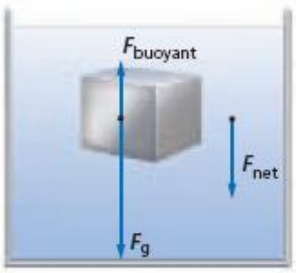
A) depth B) density C) shape D) gravity

12 - The buoyant force is in which direction?

A) toward higher pressures B) upward C) circular D) downward

13 - In the figure below, if the chunk of steel were cut in half and one of the pieces were placed in the same liquid, how would it behave?

A) It would float mostly submerged. B) It would sink to the bottom of the container



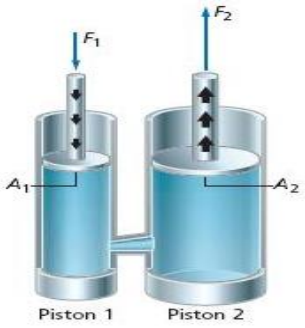
MR :

C) There is insufficient information to answer the question. D) It would float almost entirely above the surfac

14 - If you wanted to use a setup like the one in the figure below to create an upward force triple that of the downward force you exert, which of the following combination of piston radii could accomplish this?

A) r_1, 3 m; r_2, 1 m B) r_1, 0.577 m; r_2, 1 m

C) r_1, 0.333 m; r_2, 1 m D) r_1, 1.73 m; r_2, 1 m



15 - To rise in water, a fish uses its air bladder to _____.

A) displace more water B) increase water pressure

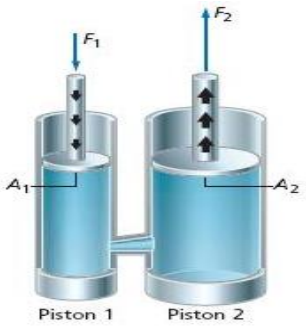
C) increase air pressure D) displace less water

16 - _____ states that any change in pressure applied to any point on a confined fluid is transmitted undiminished throughout the fluid.

A) Boyle's law B) Pascal's principle

C) Galileo's law D) Dalton's law

17 - If you wanted to use a setup like the one in the figure bellow to create an upward force triple that of the downward force you exert, which of the following combination of piston areas could accomplish this?



A) A_1, 6 m^2; A_2,10 m^2 B) A_1, 6 m^2; A_2, 18 m^2

C) A_1, 6 m^2; A_2, 2 m^2 D) A_1, 6 m^2; A_2, 8 m^2

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18 - What type of buoyancy results in a feeling of weightlessness?

A) positive B) neutral C) changing D) negative

19 - Why does ice float?

A) It is an amorphous solid. B) It has strong cohesive properties.

C) It has a lower density than water. D) It has a higher density than water.

20 - Which is an example of Pascal's principle?

A) a straw B) hydroplaning wheels C) hydraulic brakes D) a sipho

21 - According to Archimedes' principle, an object immersed in fluid has an upward force on it equal to _____.

A) the weight of the fluid displaced B) the weight of all the fluid in the container

C) the weight of the fluid displaced minus the weight of the object D) the weight of the object

22 - What happens to a bimetallic strip when it is heated?

A) it becomes elastic B) its cohesive properties decrease

C) it bends D) it contracts

23 - Why is it important to take thermal expansion into account when building bridges?

A) so the bridge will not move at all

B) so the bridge materials expand and contract with the changes in weather

C) so the bridge materials can change state as the weather changes

D) so the bridge materials don't deteriorate

24 - Amorphous solids have no _____.

A) volume B) liquid phase C) crystalline pattern D) shape

25 - In terms of the kinetic-molecular theory, why do substances expand when heated?

A) The particles vibrate less and push other particles away.

B) The particles on the surface vibrate faster.

C) The particles vibrate more, causing air pressure to compress the substance.

D) The particles vibrate more and push other particles away.

26 - Which example demonstrates elasticity?

A) a snapping rubber band B) a bent iron bar C) a broken stick D) a melted stick of butter

17 - If an iron bar expands 0.1 cm when heated 20°C, how much would it expand if it were heated 40°C?

A) 1 cm B) 0.1 cm C) 0.05 cm D) 0.2 cm

قوانين عاشر عام ف2 + ف3			
Reflection and Mirrors الإنعكاس والمرايا			
$f = \frac{r}{2}$	$\frac{1}{f} = \frac{1}{di} + \frac{1}{do}$	$m = \frac{hi}{ho} = \frac{-di}{do}$	
Refraction and Lenses الإنكسار والعدسات			
$n = \frac{c}{v}$	$n_1 \sin\theta_1 = n_2 \sin\theta_2$	$\theta_c = \sin^{-1}\frac{n_2}{n_1}$	$\frac{1}{f} = \frac{1}{di} + \frac{1}{do}$
$m = \frac{hi}{ho} = \frac{-di}{do}$			
Vibrations and waves الإهتزازات والموجات			
$f = \frac{1}{T}$		$\lambda = \frac{v}{f}$	
Thermal Energy الطاقة الحرارية			
$T_K = T_C + 273$ $Q = m C \Delta T$	$T_f = \frac{m_A C_A T_A + m_B C_B T_B}{m_A C_A + m_B C_B}$		$Q = mH_f$ $Q = mH_v$
$\Delta U = Q - W$	$e = \frac{W}{Q_H}$	$\Delta S = \frac{Q}{T}$	
States Of Matter حالات المادة			
$P = \frac{F}{A}$	$P_1V_1 = P_2V_2$	$\frac{V_1}{T_1} = \frac{V_2}{T_2}$	$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
$PV = nRT$	$\frac{F_1}{A_1} = \frac{F_2}{A_2}$	$P = \rho g h$	$F_{Buoyant} = \rho_{flouid} V g$
$F_{net} = F_g - F_{buoyant}$	$F_g = mg = \rho_{solid} V g$	$\alpha = \frac{\Delta L}{L_1 \Delta T} = \frac{L_2 - L_1}{L_1(T_2 - T_1)}$	$\beta = \frac{\Delta V}{V_1 \Delta T} = \frac{V_2 - V_1}{V_1(T_2 - T_1)}$
الثوابت			
$C = 3\times10^8$ m/s	$g = 9.81$ m/s^2	1 atm = 1.01×10^5 Pa	R = 8.31 Pa·m^3/(mol·K)
Avogadro no = 6.022×10^{23}			

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