EQ. C

SOLUTIONS

Name _____

Physics 101
Instr: J. Oliva

Equivalent Exam

Midterm Exam #2

There are 30 questions.

Use: $g = 10\ m/s^2$

1. Thermal radiation .....

a) refers to the radiation emitted by an object only when it is illuminated by the room lights
b) is always not visible
(c) is mainly both in the visible and infrared portions of the spectrum for an electric stove burner.
d) refers only to ultraviolet rays (i.e., heat waves)

2. A light bulb is in a spherical enclosure with inside surface area of $24\ m^2$. If the intensity of the radiation on the inside surface of the enclosure is $5\ Watts/m^2$, what is the power (i.e., wattage) of the bulb ?

a) 60 Watts
b) 40
(c) 120
d) 25

$I = \frac{P}{A}$

$\Rightarrow P = IA = 5\frac{W}{m^2} \cdot 24\ m^2 = 120\ W$

3. In selective absorption.....

(a) CO_2 gas absorbs certain wavelengths of infrared light.
b) air molecules condense and form a thin film of liquid on a cold piece of glass.
c) an electron is attracted to a proton.
d) red light and blue light combine to give yellow light.

4. Which statement concerning global warming is TRUE ?

(a) The amount of carbon dioxide gas in the atmosphere has increased significantly since the start of the industrial revolution.
b) The average surface temperature of the Earth has increased by roughly 5 °C over the last 100 years.
c) Over the last 100 yrs., the carbon dioxide content of the atmosphere has decreased while the average surface temperature of the Earth has increased.
d) There is <u>no</u> general scientific consensus that the observed average temperature increase of the Earth over the last 100 yrs. is due to increased deposition of carbon dioxide into the atmosphere by increased human fossil-fuel burning activity.

5. Our sun appears to be yellow in color. If you look into the heavens and see a star that has a bluish tint to it, what can you conclude about the temperature of the star ? (Note: blue light has a shorter wavelength than yellow light.) $\lambda_{max} = const./T \Rightarrow T = \frac{const}{\lambda_{max}}$

(a) the star is hotter than the sun $\lambda_{max,B} < \lambda_{max,Y} \Rightarrow T_B > T_Y$
b) the sun is hotter than the star
c) color has nothing to do with temperature, so the two are at the same temperature
d) Need more information to tell

6. Star A is 81 times as bright (as intense) as star B. How does the temperature of A compare to that of B? Hint: $3^4 = 81$.

(a) Star A is 3 times higher in temperature.
b) " " " 9 " " " " "
c) " " " 27 " " " " "
d) " " " 81 " " " " "

$\frac{I_A}{I_B} = \left(\frac{T_A}{T_B}\right)^4 \qquad I_A = 81\, I_B$

$\frac{81 I_B}{I_B} = \left(\frac{T_A}{T_B}\right)^4 \Rightarrow \frac{T_A}{T_B} = \sqrt[4]{81} = 3$

$\Rightarrow T_A = 3\, T_B$

7. Which statement concerning the wavelength λ_{max} at the peak of the intensity vs. wavelength curve is TRUE?

a) It does not depend on the temperature.
b) It is given by: λ_{max} = constant T^2, where T is the temperature on the absolute scale.
c) It increases as the temperature increases.
(d) If it occurs in the middle of the visible wavelength range the object appears whitish. (Note: white is the combination of all colors.)

8. What color results if a green spotlight is overlapped with a blue spotlight?

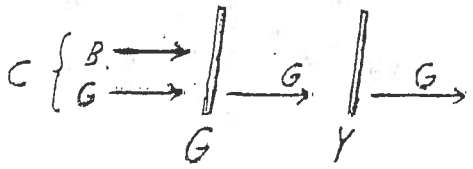
a) magenta
b green
(c) cyan
d) yellow

9. Which statement concerning the greenhouse effect is FALSE?

a) shortwavelength visible radiation from the sun is converted to longwavelength infrared radiation at the earth's surface
(b) all of the infrared radiation emitted by the earth's surface escapes into space thereby cooling the surface of the earth
c) infrared radiation emitted by the earth is selectively absorbed by the atmosphere
d) after selective absorption the warmed atmosphere releases infrared radiation back down to the surface of the earth

10. Cyan light is shined on a combination of a green and a yellow filter. What is the color of light emerging from the combination of the filters?

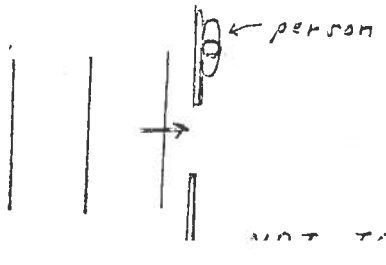
a) cyan
(b) green
c) blue
d) red



11. A sound wave of wavelength λ = 1.5 m approaches an open door of width a = 1 m. Can a person standing against the wall as shown hear the sound? (Assume that the walls don't transmit sound.)

Sound has to diffract for person to hear

(a) Yes, since $\lambda \gtrsim a \Rightarrow \lambda \gtrsim a$ (1.5m > 1m ⇒ sound diffracts.)
b) Yes, since any sound, regardless of wavelength, can be heard in this arrangement.
c) No, since $\lambda > a$
d) No, since any sound, regardless of wavelength, can't be heard in this arrangement.



12. Which statement concerning diffraction is TRUE ?

a) Diffraction is pronounced when the wavelength is much less than the size of the opening.
b) Diffraction refers to the bending of light when it passes from air to glass.
(c) Diffraction is the flaring out (or widening out) of a wave when it passes through an opening.
d) When diffraction is pronounced, wave energy is transmitted through an opening only in the same direction as the incoming wave.

13. Which of the following is FALSE ?

a) Reflection is the bouncing of light from a mirror.
b) Refraction is the bending of light when it passes from, for example, air to glass.
c) If white light is shined onto a prism, different colors will be bent different amounts.
(d) If a light beam is shined onto a mirror at an angle, the reflected light goes in exactly the reverse direction as the incoming beam.

14. The radiation produced by the Sun .....

a) contains negligible amounts of infrared and ultraviolet components.
(b) is mostly in the visible range of wavelengths.
c) contains no x-rays whatsoever.
d) is mostly in the infrared (i.e., "heat wave") part of the spectrum.

15. Imagine that you are 10 m away from a light source. You now change your position so that you now see the light to be 1/36 as intense as before. Where are you located now ?

a) 80 m away
(b) 60
c) 40
d) 20

$$\frac{I_f}{I_i} = \left(\frac{d_i}{d_f}\right)^2 \qquad I_f = \frac{1}{36} I_i$$

(took square root)

$$\frac{1/36\, I_i}{I_i} = \left(\frac{10}{d_f}\right)^2 \Rightarrow \frac{1}{36} = \left(\frac{10}{d_f}\right)^2 \Rightarrow \frac{1}{6} = \frac{10}{d_f}$$

$$\Rightarrow d_f = 6 \cdot 10 = 60\ m.$$

16. A light bulb filament (thin wire) is glowing while electricity flows through it: Which is TRUE ?

a) There is never any green component in the light released.
b) At very "low" temperature, light of all colors of the spectrum (ROYGBIV) is released and all of these color components are weighted about equally.
c) At "high" temperature there is only a red component of the light released (i.e., no green, blue, etc.)
(d) At "low" temperature there is much more red light released than violet light.

17. Three filters: first yellow, then cyan, and then magenta are spaced in a series. White light is then shined onto this combination. What happens ?

a) Red and blue light emerge from the yellow filter.
b) Blue light emerges from the cyan filter.
(c) No light emerges from the whole combination.
d) White light is " re-constructed" and emerges from the combination.

18. A red book (a typical solid object) at room temperature releases .....

a) no radiation when the room lights are on.
b) red radiation when the room lights are off.
c) infrared radiation when the room lights are off.
d) no radiation at all when the room lights are off.

19. An object moves in a straight line from location x = - 6 m to location x = 5 m What is the displacement for this movement ?

a) 13 m
b) 11
c) 9
d) 7

$\Delta x = x_f - x_i$

$\Delta x = 5 - (-6)$

$\Delta x = 11\ m$

20. An object starts from rest and begins to accelerate. It reaches a velocity of 20 m/s after a time of 4 s . What is the acceleration ?

a) 5 m/s^2
b) 8
c) 10
d) 2

$v = at$

$a = \frac{v}{t}$

$a = \frac{20\ m/s}{4s} = 5\ m/s^2$

21. An object moves in a straight line from location x = 3 m to location x = 12 m and then back to location x = 3 m in a total time of 8 s. Find the average velocity and average speed for this round trip .

avg. vel. (m/s)	avg. spd. (m/s)
a) 0	2.25
b) 0	4.65
c) 2.25	2.25
d) 2.25	4.65

$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{\Delta t} = \frac{3 - 3}{8} = 0$

$\bar{s} = \frac{d}{\Delta t}$

$d = \underset{(3 \to 12)}{9} + \underset{(12 \to 3)}{9} = 18$

$\bar{s} = \frac{18}{8} = 2.25$

22. If the acceleration is 6 m/s^2 .....

a) the velocity is constant.
b) the speed is constant.
c) the velocity increases by 6 m/s per every second that goes by.
d) the velocity of the object (starting from rest) is 12 m/s after 4 s.

23. An object starts from rest at the origin and has constant acceleration 6 m/s^2. What is the distance from the origin after 4 s ? HINT: You will need a formula that involves distance, acceleration, and time.

a) 64 m
b) 48
c) 32
d) 20

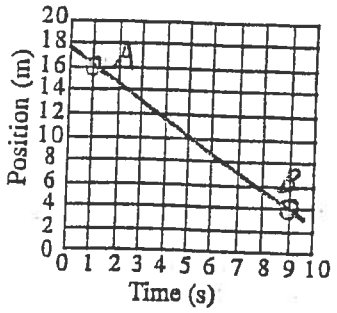
$d = \frac{1}{2} a t^2$

$d = \frac{1}{2} \cdot 6 \cdot 4^2$

$d = 48\ m$

24. Find the average velocity based on the linear graph of position vs. time shown.

(a) - 1.5 m/s
b) - 2.5
c) - 3.5
d) - 4.5



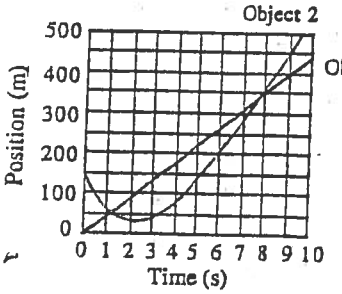
$\bar{v}$ = slope in x vs t graph

$\bar{v} = \frac{x_B - x_A}{t_B - t_A} = \frac{4 - 16}{9 - 1}$

$\bar{v} = -1.5$ m/s

25. Consider two objects with position vs. time graphs as shown. Which best describes the motion at t = 9 s ?

a) Object #1 is clearly moving faster.
(b) Object #2 " " " ".
c) Both objects have about the same velocity.



Draw tangent lines at t = 9s for both #1 & #2. Tangent for #2 is steeper ⇒ inst. velocity of #2 greater (inst. velocity = slope of tangent line)

26. Which statement concerning a round trip is FALSE ?

a) During the course of the trip, the position is in the process of changing.
(b) The total distance swept through is zero.
c) The displacement is zero.
d) The average velocity is zero.

27. At time t = 0 the brakes are applied in a car initially moving at 20 m/s. The car decelerates at a rate of - 4 m/s^2. How long does it take for the velocity to be reduced to 12 m/s ?

a) 3.5 s
b) 3.0
c) 2.5
(d) 2.0

t (s)	v (m/s)
0	20
1	16
(2)	12
3	8

← $a = -4$ m/s^2 means v decreases by 4 m/s for each second that goes by.

28. If an object moves at a constant speed in a circle, its acceleration .....

a) is zero since the speed is constant.
(b) is nonzero since the velocity direction is continually changing.
c) is negative because the path is curved.
d) is zero since its velocity is not changing

29. How fast is an object falling 5 s after being released from rest (Ignore air resistance)?

a) 5 m/s
b) 25
(c) 50
d) 100

$v = gt$

$v = 10.5$

$v = 50$ m/s

30. Which of the following statements concerning distance swept (d) and displacement (Δ x) is TRUE?

a) The distance swept is never numerically equal to the displacement.
(b) The displacement is positive if the object moves to the right.
c) If the displacement is zero, then the distance swept is also zero (Hint: Think round trip.)