

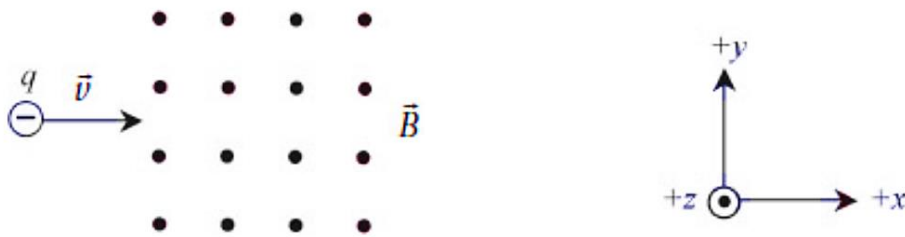
PHYSICS

Instruction: You are offered the test items with one correct answer from four proposed ones.

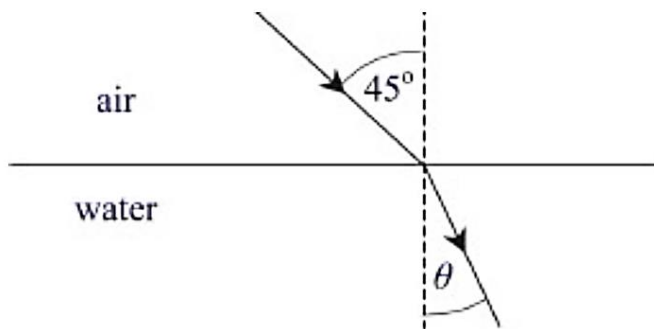
1. A car uniformly accelerates from rest at 3 m/s^2 down a 150 m track. Final velocity of the car
 - A) 30 m/s
 - B) 25 m/s
 - C) 20 m/s
 - D) 50 m/s
2. Bernoulli's equation
 - A) $P = \rho gh$
 - B) $\rho S = \text{const}$
 - C) $P = \frac{1}{3} \rho \vartheta^2$
 - D) $P + \frac{1}{2} \rho v^2 + \rho gh = \text{const}$
3. During an isothermic process 1 kJ of heat is removed from a trapped gas in a container. Determine the change in internal energy of the gas
 - A) 1000 J
 - B) 100 J
 - C) -1000 J
 - D) 0 J
4. What is the partial pressure of water vapour in air at 20°C , if the relative humidity is 60%? The vapour pressure of water at 20°C is $p_v=2333 \text{ Pa}$.
 - A) $\approx 3890 \text{ Pa}$
 - B) $\approx 1333 \text{ Pa}$
 - C) $\approx 1666 \text{ Pa}$
 - D) $\approx 1400 \text{ Pa}$
5. A capacitor is fully charged and the power supply is disconnected, isolating the capacitor completely. Then the plates of the capacitor are pulled apart. This results in the
 - A) capacitance decreasing and the potential difference decreasing
 - B) capacitance decreasing and the potential difference increasing
 - C) capacitance increasing and the potential difference decreasing
 - D) capacitance increasing and the potential difference increasing
6. A plucked guitar string vibrates at a frequency of 100 Hz. The period of vibration of the string
 - A) 0,01 s
 - B) 1 s
 - C) 0,1 s
 - D) 0,001 s

7. Find the rms current in the circuit when a capacitor of $6 \mu\text{F}$ is connected to an AC source of $u_{\text{rms}}=60 \text{ V}$ and $f = 50 \text{ Hz}$ (take $\pi=3$)
- A) 0.16 A
 - B) 0.08 A
 - C) 0.21 A
 - D) 0.108 A
8. When a light wave moving in air enters a block of glass, which of the following properties does NOT change?
- 1) Wave speed
 - 2) Wavelength
 - 3) Frequency
- A) only 1
 - B) 1 and 2
 - C) only 2
 - D) only 3
9. During a thunderstorm a flash of lightning is seen. Then, 5 seconds later, a thunderous crack is heard. How far away was the lightning? (the speed of sound in air is about 340 m/s).
- A) 68 m
 - B) 2700 m
 - C) 680 m
 - D) 1700 m
10. A diffraction grating has 100 slits in 1 mm . Find the distance between two successive slits.
- A) 10^{-5} m
 - B) 1 m
 - C) 10^{-3} m
 - D) 10^{-2} m
11. Which of these is NOT a consequence of the second law of thermodynamics?
- A) The entropy of isolated systems always increases
 - B) All naturally occurring events are reversible
 - C) The natural direction of heat flow is from hot to cold
 - D) No heat engine can ever be 100 percent efficient

12. Negative charge q moving with speed v in the $+x$ -direction enters a uniform $+z$ -directed magnetic field \vec{B} as shown in the figure below. Determine the direction of the magnetic force acting on the charge at the instant it first enters the magnetic field.

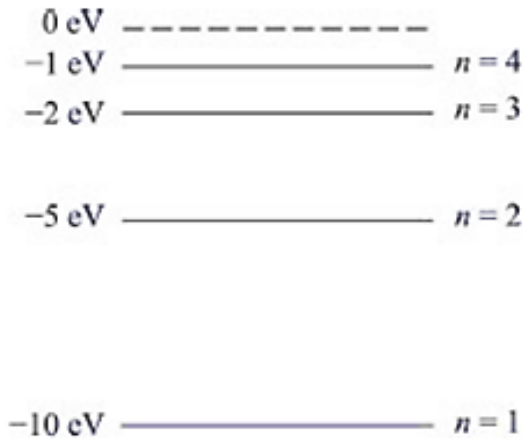


- A) $+z$
 B) $-y$
 C) $+y$
 D) $+x$
13. A spacecraft with a speed of $0,99c$ passes by a stationary observer. The stationary observer makes observations regarding the time on the spacecraft, the length and the mass of the spacecraft. Which set of observations correctly indicates how the motion of the spacecraft has altered these values?
- A) Time speeds up, length shortens and mass increases
 B) Time slows down, length shortens and mass decreases
 C) Time is the same, length shortens and mass decreases
 D) Time slows down, length shortens and mass increases
14. A beam of light moving in air strikes the surface of a lake at an angle of 45° as shown in the diagram below. Which statement below is true?

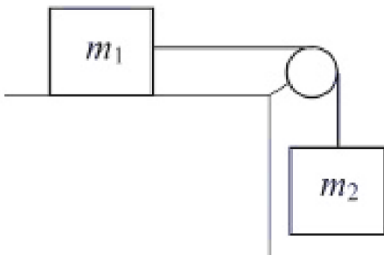


- A) $n_{\text{water}} > n_{\text{air}}$ and $\theta < 45^\circ$
 B) $n_{\text{water}} < n_{\text{air}}$ and $\theta < 45^\circ$
 C) $n_{\text{water}} = n_{\text{air}}$ and $\theta = 45^\circ$
 D) $n_{\text{water}} > n_{\text{air}}$ and $\theta > 45^\circ$
15. As an object approaches the speed of light its time, length and mass are affected. Which of the following is NOT true?
- A) Length shortens
 B) Momentum increases
 C) Mass increases
 D) Time speeds up

16. According to the energy-level diagram below find the wavelength of a photon, which can excite an atom to its first excited state ($c=3 \cdot 10^8$ m/s, $h=6.63 \cdot 10^{-34}$ J·s)

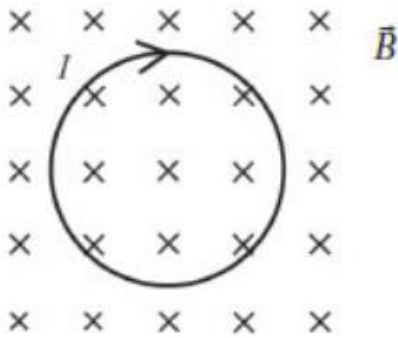


- A) ≈ 130 nm
 - B) ≈ 225 nm
 - C) ≈ 250 nm
 - D) ≈ 183 nm
17. Two masses of $m_1 = 2$ kg and $m_2 = 3$ kg are connected by a massless and stretchless string with the aid of a frictionless pulley as shown in the figure. The masses are released from rest. Determine the tension in the string. ($g=10$ m/s², the surface is frictionless)



- A) 10 N
- B) 12 N
- C) 16 N
- D) 14 N

18. As shown in the diagram below a metal loop is placed into a uniform external magnetic field. A current runs clockwise through the loop, and the magnetic field is in the $-z$ -direction. The magnetic force acting on the loop is

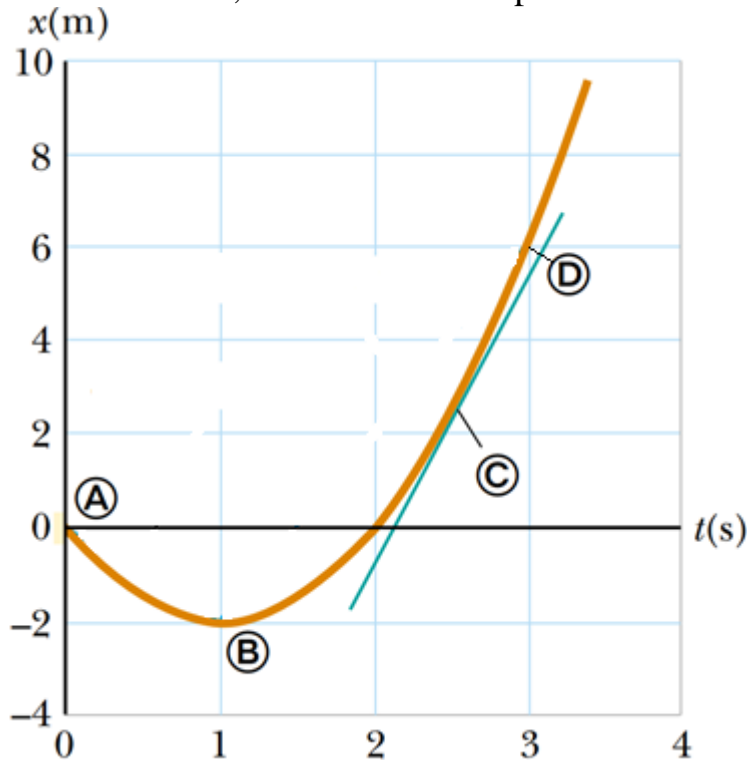


- A) in the $+z$ -direction
B) in the $-z$ -direction
C) away from the center of the loop and acts to expand the loop
D) toward the center of the loop and acts to shrink the loop
19. The maximum values of charge and current in an LC circuit are given as $2\mu\text{C}$ and 3 mA respectively. Find the wavelength of the EM waves generated by the charge oscillating in the circuit. ($c=3\cdot 10^8\text{ m/s}$)
- A) 628 km
B) 914 km
C) 1256 km
D) 1163 km
20. 120 g sample of iodine-131 has a half-life of 8 days. How much of the original sample remains after 24 days?
- A) 15 g
B) 4 g
C) 10 g
D) 5 g

Instruction: You are offered the test items on the base of context with one correct answer from four proposed ones. Read the context attentively and do the items.

Average and Instantaneous Velocity

A particle moves along the x axis. Its position varies with time according to the expression $x = -4t + 2t^2$ where x is in meters and t is in seconds. The position–time graph for this motion is shown in the figure. Note that the particle moves in the negative x direction for the first second of motion, is momentarily at rest at the moment $t = 1$ s, and moves in the positive x direction at time period $t > 1$ s.



21. By analyzing the graph, find the point where the speed of the particle is maximum.
- A) Point C
 - B) Point D
 - C) Point A
 - D) Point B
22. Between which points of the graph displacement of the particle is negative?
- A) Between B and C
 - B) Between A and B
 - C) Between C and D
 - D) Displacement is positive between all points of the graph

23. Calculate the average velocities in the time intervals $t = 0$ to $t = 1$ s and $t = 1$ s to $t = 3$ s
- A) 2 m/s and -4 m/s
 - B) -4 m/s and $+2$ m/s
 - C) -2 m/s and $+4$ m/s
 - D) 4 m/s and -2 m/s
24. Determine the displacement of the particle in the time intervals $t = 0$ to $t = 1$ s and $t = 1$ s to $t = 3$ s
- A) -5 m and $+5$ m
 - B) -2 m and $+8$ m
 - C) -3 m and $+7$ m
 - D) -4 m and $+6$ m
25. Find the instantaneous velocity of the particle at $t = 2.5$ s
- A) -6 m/s
 - B) -4 m/s
 - C) $+4$ m/s
 - D) $+6$ m/s

Instruction: You are offered the test items with one or more correct answers.

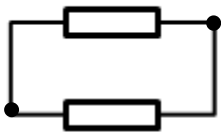
26. How much work is done if a force of 100 N moves an object to a distance of 10 m?

- A) 100 J
- B) 1000 J
- C) 0.01 J
- D) 100 kJ
- E) 0.1 kJ
- F) 1 kJ

27. Ideal gas law is an empirical physics law. Experiment shows that the ratio of the products $\frac{PV}{nT}$ equals the same constant for any gas sample. The constant in the equation is expressed as

- A) ϵ_0
- B) μ_0
- C) c
- D) k
- E) R
- F) N_A

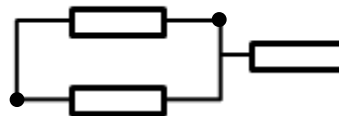
28. Classify connections of resistors



1



2



3

- A) 3 - series and parallel
- B) 3 - parallel
- C) 1 - series
- D) 2 - series
- E) 2 - parallel
- F) 1 - parallel

29. A particle in the SHM represented by $x = 0.04 \sin\left(\frac{\pi t}{3} + \frac{\pi}{6}\right)$. Find the amplitude;

A) $\frac{1}{6}$ m

B) 4 cm

C) 400 m

D) 0.04 m

E) $\frac{4}{100}$ m

F) $\frac{\pi}{6}$

30. A common characteristic of Electromagnetic (EM) waves

A) EM waves consist of E and B fields oscillating in phase

B) EM waves do not require a material medium

C) All EM waves propagate with a same speed in a vacuum

D) EM waves consist of E and B vectors and its speed is equal to the speed of sound

E) EM waves require a material medium

F) EM waves consist of E and M vectors

31. Car lift compressed air exerts a force on a small circular piston of a radius of 5 cm. This pressure is transmitted by a liquid to another circular piston that has a radius of 15 cm. What force must be exerted on smaller piston to lift a car weighing 13300 N

A) $\approx 0.148 \cdot 10^5$ N

B) ≈ 1480 N

C) ≈ 740 N

D) ≈ 1.48 kN

E) $\approx 1.48 \cdot 10^3$ N

F) $\approx 7.4 \cdot 10^3$ N

32. A cowboy fires a silver bullet with a muzzle speed of 200 m/s into the pine wall of a saloon. Assume that all the internal energy generated by the impact remains with the bullet. What is the temperature change of the bullet? (

$c_{\text{silver}} = 237 \text{ J/kg}^\circ\text{C}$)

A) ≈ 21 °C

B) ≈ 357 K

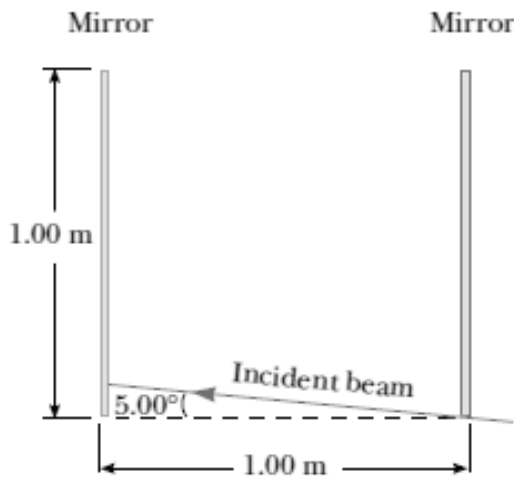
C) ≈ 63 °C

D) ≈ 84 °C

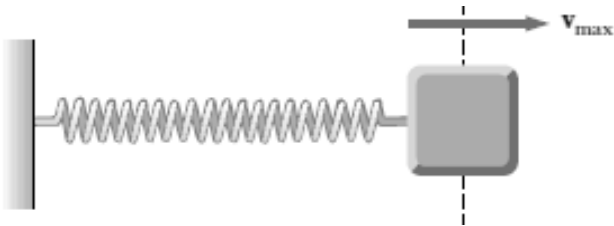
E) ≈ 84 K

F) ≈ 42 °C

33. How many times incident light beam in the picture be reflected by each mirrors?
($\tan 5^\circ = 0.0875$)



- A) five times from the left-hand mirror
 B) three times from the right-hand mirror
 C) five times from the right-hand mirror
 D) seven times from the left-hand mirror
 E) six times from the left-hand mirror
 F) six times from the right-hand mirror
34. A 0.5-kg object connected to spring ($k = 20 \text{ N/m}$) and oscillates on horizontal frictionless plane. Find total energy of the system and the ϑ_{max} if $A = 3 \text{ cm}$



- A) $\approx 0.19 \text{ m/s}$
 B) 9 mJ
 C) $\approx 19 \text{ m/s}$
 D) 0.09 J
 E) $\approx 1.9 \text{ m/s}$
 F) $9 \cdot 10^{-3} \text{ J}$
35. What is the distance between a crest and the adjacent trough of a sinusoidal wave, if the wavelength is 8 cm and the amplitude is 1.5 cm ?
- A) 0.05 m
 B) 12.5 cm
 C) 5 cm
 D) 7.5 cm
 E) 0.1 m
 F) 10 cm