

5. A certain capacitor, in series with a $720\text{-}\Omega$ resistor, is being charged. At the end of 10 ms its charge is half the final value. The capacitance is about:

- (1) $20\ \mu\text{F}$ (2) $14\ \mu\text{F}$ (3) $9.6\ \mu\text{F}$ (4) $7.2\ \text{F}$ (5) $10\ \mu\text{F}$

6. A certain capacitor, in series with a $360\text{-}\Omega$ resistor, is being charged. At the end of 2.5 ms its charge is half the final value. The capacitance is about:

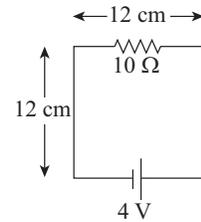
- (1) $10\ \mu\text{F}$ (2) $14\ \mu\text{F}$ (3) $9.6\ \mu\text{F}$ (4) $7.2\ \text{F}$ (5) $20\ \mu\text{F}$

7. Electrons (mass m , charge $-e$) are accelerated from rest through a potential difference V and are then deflected by a magnetic field \vec{B} that is perpendicular to their velocity. The radius of the resulting electron trajectory is:

- (1) $(\sqrt{2mV/e})/B$ (2) $B\sqrt{2eV}/m$ (3) $(\sqrt{2eV/m})/B$ (4) $B\sqrt{2mV}/e$ (5) none of these

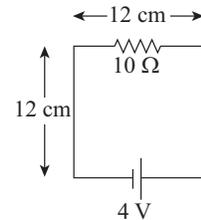
8. The circuit shown is in a uniform magnetic field that is into the page. The current in the circuit is 0.20 A clockwise. At what rate is the magnitude of the magnetic field changing? Is it increasing or decreasing?

- (1) 420 T/s, decreasing
 (2) zero
 (3) 140 T/s, increasing
 (4) 140 T/s, decreasing
 (5) 420 T/s, increasing



9. The circuit shown is in a uniform magnetic field that is into the page. The current in the circuit is 0.20 A counter-clockwise. At what rate is the magnitude of the magnetic field changing? Is it increasing or decreasing?

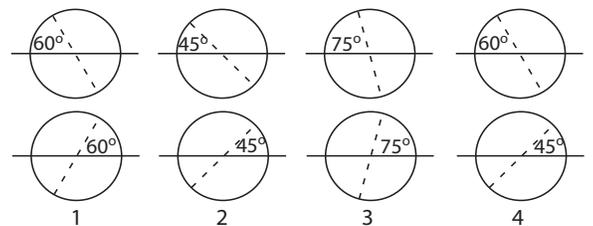
- (1) 140 T/s, decreasing
 (2) zero
 (3) 140 T/s, increasing
 (4) 420 T/s, decreasing
 (5) 420 T/s, increasing



10. A sinusoidal electromagnetic wave with electric field amplitude of 100 V/m is incident normally on a surface with an area of $1\ \text{cm}^2$ and is completely absorbed. The energy absorbed in 10 s is:

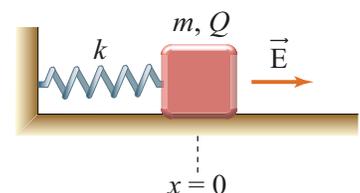
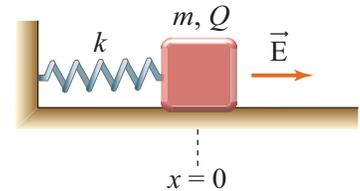
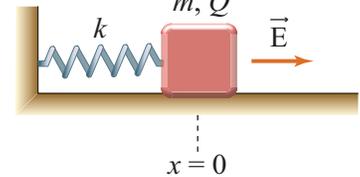
- (1) 13 mJ (2) 1.3 mJ (3) 27 mJ (4) 130 mJ (5) 270 mJ

11. The diagrams show four pairs of polarizing sheets, with the polarizing directions indicated by dashed lines. The two sheets of each pair are placed one behind the other and the front sheet is illuminated by unpolarized light. The incident intensity is the same for all pairs of sheets. Rank the pairs according to the intensity of transmitted light, greatest to least.

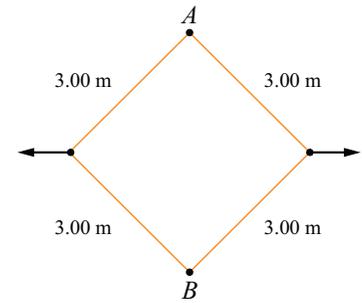


- (1) 3, 1, 4, 2 (2) 4, 2, 1, 3 (3) 2, 4, 3, 1 (4) 1, 2, 3, 4 (5) 2, 4, 1, 3

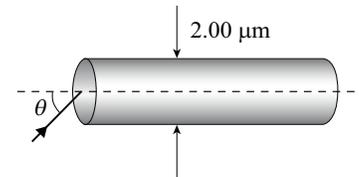
12. The object-lens distance for a certain converging lens is 400 mm. The real image is three times the size of the object. To make the image five times the size of the object, the object-lens distance must be changed to:
- (1) 360 mm (2) 540 mm (3) 600 mm (4) 720 mm (5) 960 mm
13. The object-lens distance for a certain converging lens is 600 mm. The real image is three times the size of the object. To make the image five times the size of the object, the object-lens distance must be changed to:
- (1) 540 mm (2) 360 mm (3) 600 mm (4) 720 mm (5) 960 mm
14. An object is 20 cm to the left of a lens of focal length +10 cm. A second lens, of focal length +12.5 cm, is 30 cm to the right of the first lens. The distance between the original object and the final image is:
- (1) 0 (2) 50 cm (3) 100 cm (4) 28 cm (5) infinity
15. A soap film is illuminated by white light normal to its surface. The index of refraction of the film is 1.50. Wavelengths of 480 nm and 800 nm and no wavelengths between are being intensified in the reflected beam. The thickness of the film is:
- (1) 4.0×10^{-5} cm (2) 2.4×10^{-5} cm (3) 3.6×10^{-5} cm (4) 1.5×10^{-5} cm (5) 6.0×10^{-5} cm
16. Three electrons are placed at the corners of an equilateral triangle of side 1 nm. Find the electrical potential energy in J of this configuration.
- (1) $+6.9 \times 10^{-19}$ (2) -6.9×10^{-19} (3) $+2.3 \times 10^{-19}$ (4) -2.3×10^{-19} (5) $+4.6 \times 10^{-19}$
17. A cube with mass $m = 4.00$ kg carrying a charge $Q = 50.0 \mu\text{C}$ is attached to a spring with a constant of $k = 100$ N/m. The cube lies on a frictionless horizontal surface, and the system is placed in a uniform electric field with $E = 5.00 \times 10^5$ V/m directed (as in Figure) to the right. If the cube is released at rest when the spring is unstretched (at $x = 0$), by what maximum amount does the spring expand (in meters)?
- (1) 0.50 (2) 0.25 (3) 0.10 (4) 1.25 (5) zero
18. A cube with mass $m = 4.00$ kg carrying a charge $Q = 25.0 \mu\text{C}$ is attached to a spring with a constant of $k = 200$ N/m. The cube lies on a frictionless horizontal surface, and the system is placed in a uniform electric field with $E = 8.00 \times 10^5$ V/m directed (as in Figure) to the right. If the cube is released at rest when the spring is unstretched (at $x = 0$), by what maximum amount does the spring expand (in meters)?
- (1) 0.20 (2) 0.40 (3) 0.10 (4) 1.00 (5) zero
19. A cube with mass $m = 4.00$ kg carrying a charge $Q = 80.0 \mu\text{C}$ is attached to a spring with a constant of $k = 200$ N/m. The cube lies on a frictionless horizontal surface, and the system is placed in a uniform electric field with $E = 5.00 \times 10^5$ V/m directed (as in Figure) to the right. If the cube is released at rest when the spring is unstretched (at $x = 0$), by what maximum amount does the spring expand (in meters)?
- (1) 0.40 (2) 0.20 (3) 0.80 (4) 2.00 (5) zero



25. The square loop in the figure is made of wires with a total series resistance of $5.0\ \Omega$. It is placed in a uniform 0.200-T magnetic field directed perpendicular into the plane of the paper. The loop, which is hinged at each corner, is pulled as shown until the separation between points A and B is 3.00 m . If this process takes 0.200 s , what is the average current (in Amperes) generated in the loop?



- (1) 0.24 (2) 0.12 (3) 0.36 (4) 0.48 (5) zero
26. A driver tries to explain to the police that the yellow warning lights on the side of the road looked green to him because of the Doppler shift. How fast would the speeder have been traveling (in m/s), if yellow light of wavelength 580 nm had been shifted to green with a wavelength of 560 nm ?
- (1) 1.1×10^7 (2) 2.2×10^6 (3) 3.4×10^4 (4) 5.2×10^2 (5) 9.2
27. Determine the maximum angle (in degrees) for which the light rays incident on the end of the light pipe in Figure are subject to total internal reflection along the walls of the pipe. Assume that the light pipe has an index of refraction of 1.36 and that the outside medium is air.
- (1) 67.2 (2) 84.7 (3) 46.7 (4) 32.5 (5) 23.2
28. White light falls normally on a diffraction grating having 1000 lines/cm . At what angle (in degrees) will red light [$\lambda = 650\text{ nm}$] be observed in the third-order spectrum?
- (1) 11.2 (2) 3.7 (3) 7.5 (4) 1.1 (5) none of these
29. White light falls normally on a diffraction grating having 2000 lines/cm . At what angle (in degrees) will blue light [$\lambda = 450\text{ nm}$] be observed in the third-order spectrum?
- (1) 15.7 (2) 1.56 (3) 0.15 (4) none of these (5) 2.7
30. White light falls normally on a diffraction grating having 2000 lines/cm . At what angle (in degrees) will red light [$\lambda = 650\text{ nm}$] be observed in the second-order spectrum?
- (1) 15 (2) 1.5 (3) 7.5 (4) none of these (5) 3.2
31. An old person sees objects clearly only when they are at distances between 18 cm and 32 cm from his eyes. If he wears contact lenses to correct his nearsightedness, what is the minimum distance in cm that he will be able to see an object clearly?
- (1) 41 (2) 11.5 (3) 18.0 (4) 32 (5) 70
32. An old person sees objects clearly only when they are at distances between 15 cm and 28 cm from his eyes. If he wears contact lenses to correct his nearsightedness, what is the minimum distance in cm that he will be able to see an object clearly?
- (1) 32 (2) 9.7 (3) 13.2 (4) 15 (5) 28



33. An old person sees objects clearly only when they are at distances between 20 cm and 35 cm from his eyes. If he wears contact lenses to correct his nearsightedness, what is the minimum distance in cm that he will be able to see an object clearly?
- (1) 47 (2) 20 (3) 35 (4) 12.8 (5) 15

FOLLOWING GROUPS OF QUESTIONS WILL BE SELECTED AS ONE GROUP FROM EACH TYPE

TYPE 1

Q# S 1

Q# S 2

TYPE 2

Q# S 5

Q# S 6

TYPE 3

Q# S 8

Q# S 9

TYPE 4

Q# S 12

Q# S 13

TYPE 5

Q# S 17

Q# S 18

Q# S 19

TYPE 6

Q# S 21

Q# S 22

Q# S 23

TYPE 7

Q# S 24

Q# S 25

TYPE 8

Q# S 28

Q# S 29

Q# S 30

TYPE 9

Q# S 31

Q# S 32

Q# S 33