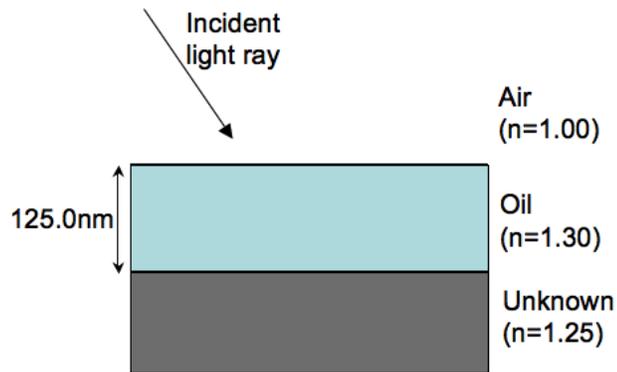


Closed book. No work needs to be shown for multiple-choice questions. Choose the closest answer.

- 1) While conducting an experiment in 1CL you note that a simple pendulum has a period of 2.0 seconds. The bob at the end of the pendulum has a mass of 0.33 kg. What is the length of the pendulum?
- 0.36 meters.
 - 0.78 meters.
 - 0.99 meters.
 - 2.4 meters.
 - 3.3 meters.
- 2) A contact lense is in the shape of a convex meniscus. The inner surface is shaped to fit the eye. It has a curvature of 7.8mm. The lens is made out of plastic with index of refraction $n=1.56$. The lens has focal length of 44.4cm. What is the curvature radius of the outer surface of the lense?
- a) 7.16mm b) 7.32mm c) 7.56mm d) 7.75mm e) 8.02mm
- 3) An atom is in a state with orbital quantum number $\ell = 2$. Possible values of the magnetic quantum number m_ℓ are:
- only 1 and 2.
 - only 0, 1, and 2.
 - only 0 and 1.
 - only -1, 0, and 1.
 - only -2, -1, 0, 1, and 2.
- 4) A drug tagged with $^{99}_{43}\text{Tc}$ is prepared for a patient. Technetium ($^{99}_{43}\text{Tc}$) has a half-life of 6.05 hr. If the original activity of the sample was 1.1×10^4 Bq, what is the activity after it has sat on the shelf for 2.0 hr.?
- 3.7×10^3 Bq.
 - 8.1×10^3 Bq.
 - 5.5×10^3 Bq.
 - 1.3×10^3 Bq.
 - 8.7×10^3 Bq.

5) An oil film ($n_{oil} = 1.30$) floating on an experimental unknown fluid ($n_{unknown} = 1.25$) is illuminated by white light at normal incidence. The film is 125 nm thick. Find the **longest** wavelength of light **in the visible spectrum** that is most strongly reflected. Assume the light enters normal to the plane of oil (i.e. straight down in the picture).

- 217 nm.
- 433 nm.
- 325 nm.
- 650 nm.
- 541 nm.



6) A piano tuner using a 264 Hz tuning fork hears 2 beats per second while playing the tuning fork and a piano key at the same time. What are the two possible frequencies of vibration of the piano wire?

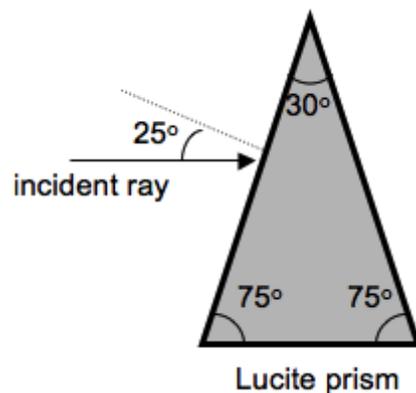
- 260 Hz and 268 Hz.
- 264 Hz and 268 Hz.
- 262 Hz and 268 Hz.
- 262 Hz and 266 Hz.
- 260 Hz and 262 Hz.

7) The Stern-Gerlach experiment makes use of:

- a strong uniform magnetic field.
- a strong non-uniform magnetic field.
- a strong uniform electric field.
- a strong non-uniform electric field.
- a much stronger than normal gravitational field.

8) A ray of light in air is incident on the mid-point of a Lucite prism surface at an angle of 25.0° with the normal. For the Lucite, $n = 1.55$, and the prism apex angle is 30.0° . What angle does the ray make with respect to the normal as it enters the air on the far side of the Lucite prism?

- 15.8° .
- 75.8° .
- 28.4° .
- 22.3° .
- 14.2° .



9) An object is placed 400 mm to the left of a certain converging lens. The resulting image is three times the size of the object and projected onto a screen. To make the image now five times the size of the object on the same screen, the object-lens distance, p , must be changed to (note that the image-lens distance q also changes in this process):

- a. $p = 360$ mm.
- b. $p = 540$ mm.
- c. $p = 600$ mm.
- d. $p = 720$ mm.
- e. $p = 960$ mm.

10) An ocean wave is created with a frequency of 1.25 Hz with waves that have a wavelength of 1.00 meters traveling with a speed of 1.25 m/s. The frequency is suddenly doubled to 2.50 Hz, how does this affect the wavelength and wave speed for the ocean waves?

- a. The new wavelength will be 2.00 meters and the wave speed will remain 1.25 m/s.
- b. The new wavelength will be 0.500 meters and the wave speed will remain 1.25 m/s.
- c. The wavelength will remain 1.00 meters and the new wave speed will be 2.50 m/s.
- d. The wavelength will remain 1.00 meters and the new wave speed will be 0.625 m/s.
- e. The new wavelength will be 0.500 meters and the new wave speed will be 2.50 m/s.

11)

"Vibrato" in a violin is produced by sliding the finger back and forth along a vibrating string. The G-string on a particular violin measures 30cm between bridge and its far end and is clamped rigidly at both points. It's fundamental frequency is 197Hz. If the violinist executes vibrato by moving a finger 0.50cm to either side of the position appropriate for playing an A (440Hz), what range of frequencies results?

- A) 400–500Hz B) 424–457Hz C) 431–449Hz D) 435–445Hz

12)

Under the best conditions, atmospheric turbulence limits the resolution of ground-based telescopes to about 1 arc second (1/3600 of a degree). For what aperture sizes is this limitation more severe than that of diffraction at 550nm ?

- A) 10cm B) 1m C) 5m D) 10m E) 50m

- 13) If an electron has a measured deBroglie wavelength of $0.850 \times 10^{-10} \text{m}$, what is its kinetic energy?
- 55.0 eV.
 - 104 eV.
 - 147 eV.
 - 207 eV.
 - 18.8 eV.
- 14) What particle is emitted when ${}^{240}_{94}\text{Pu}$ decays to ${}^{236}_{92}\text{U}$?
- alpha.
 - beta (electron).
 - beta (positron).
 - gamma.
 - quark.
- 15) An X-ray of energy 75.0 keV strikes an electron initially at rest. The X-ray is scattered through an angle of 75.0° compared to the incident direction. What is the new wavelength of the X-ray after scattering?
- $1.83 \times 10^{-11} \text{m}$.
 - $1.48 \times 10^{-11} \text{m}$.
 - $1.66 \times 10^{-11} \text{m}$.
 - $1.80 \times 10^{-12} \text{m}$.
 - $1.96 \times 10^{-11} \text{m}$.
- 16) What is the binding energy per nucleon of ${}^{197}_{79}\text{Au}$? The atomic mass of ${}^{197}_{79}\text{Au}$ is 196.966543 u.
- 1.9 MeV.
 - 7.3 MeV.
 - 7.6 MeV.
 - 7.9 MeV.
 - 8.3 MeV.
- 17) If the length of a simple pendulum is doubled, its period will:
- halve.
 - increase by a factor of $\sqrt{2}$.
 - decrease by a factor of $\sqrt{2}$.
 - double.
 - remain the same.

18)

A 0.20-kg block rests on a frictionless level surface and is attached to a horizontally aligned spring with a spring constant of 40 N/m. The block is initially displaced 4.0 cm from the equilibrium point and then released to set up a simple harmonic motion. What is the speed of the block when it passes through the equilibrium point?

- a. 2.1 m/s.
- b. 1.6 m/s.
- c. 1.1 m/s.
- d. 0.57 m/s.
- e. 0.32 m/s.

19) A railroad train is travelling at 30m/s in still air. The frequency of the note emitted by the train whistle is 262Hz. What frequency is heard by a passenger on a train moving in the opposite direction towards the train at 18m/s with respect to the ground?

- a) 275Hz b) 300Hz c) 325Hz d) 350 Hz e) 375Hz

20) Oxygen-15 is a radioactive isotope with a 2 minute half-life. Approximately how long will it take for 99.9% of a sample of Oxygen-15 to decay?

- a) 20minutes b) 2 hours c) 8 hours d) 2 days e) 10 minutes

Answer Key:

- 1) C
- 2) C
- 3) E
- 4) E
- 5) D
- 6) D
- 7) B
- 8) D
- 9) A
- 10) B
- 11) B
- 12) A
- 13) D
- 14) A
- 15) A
- 16) D
- 17) B
- 18) D
- 19) B
- 20) A