St John Baptist De La Salle Catholic School, Addis Ababa

Grade 11 Physics Midterm Examination

4^{th} Quarter

November, 2024

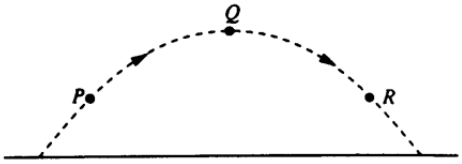
Name:_____ Roll Number:_____ Section: ____ Time Allowed: **2:00**

This exam contains 45 questions, 6 pages (including the cover) for the total of 45 marks.

Multiple Choice Questions

1. (1 point) A car travels 30 miles at an average speed of 60 miles per hour and then 30 miles at an average speed of 30 miles per hour. The average speed the car over the 60 miles is
   A. 35 mph B. 40 mph C. 45 mph D. 10 mph E. 53 mph

2. (1 point) A ball is thrown and follows the parabolic path shown below. Air friction is negligible. Point Q is the highest point on the path. Points P and R are the same height above the ground.



   A. $V_P < V_Q < V_R$ B. $V_R < V_Q < V_P$ C. $V_Q < V_R < V_P$ D. $V_Q < V_P = V_R$ E. $V_P = V_R < V_Q$

3. (1 point) A flare is dropped from a plane flying over level ground at a velocity of 70 m/s in the horizontal direction. At the instant the flare is released, the plane begins to accelerate horizontally at 0.75 m/s^2. The flare takes 4.0 s to reach the ground. Assume air resistance is negligible. Relative to a spot directly under the flare at release, the flare lands
   A. directly on the spot. B. 6.0 m in front of the spot. C. 274 m in front of the spot.
   D. 280 m in front of the spot. E. 286 m in front of the spot.

4. (1 point) Two planets have the same size, but different masses, and no atmospheres. Which of the following would be the same for objects with equal mass on the surfaces of the two planets?

   I The rate at which each would fall freely

   II The amount of mass each would balance on an equal-arm balance

   III The amount of momentum each would acquire when given a certain impulse

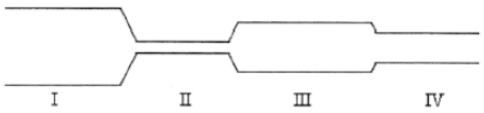
   A. I only B. III only C. I and II only D. II and III only E. I, II, and III

5. (1 point) Two spheres have equal densities but different radii and are subject only to their mutual gravitational attraction. Which of the following quantities must have the same magnitude for both spheres?
   A. Acceleration B. Velocity C. Kinetic energy D. Displacement from the center of mass
   E. Gravitational force

6. (1 point) A hypothetical planet orbits a star with mass one-half the mass of our sun. The planet's orbital radius is the same as the Earth's. Approximately how many Earth years does it take for the planet to complete one orbit?
   A. $\frac{1}{2}$ B. $\frac{1}{\sqrt{2}}$ C. $\sqrt{2}$ D. 2 E. $\frac{2}{\sqrt{2}}$

7. (1 point) A cork has weight W and density 25% of water density. A string is tied around the cork and attached to the bottom of a water-filled container. The cork is totally immersed. Express in terms of the cork weight W, the tension in the string A. 0 B. W C. $2W$ D. $3W$ E. $4W$

8. (1 point) A fluid is forced through a pipe of changing cross section as shown. In which section would the pressure of the fluid be a minimum



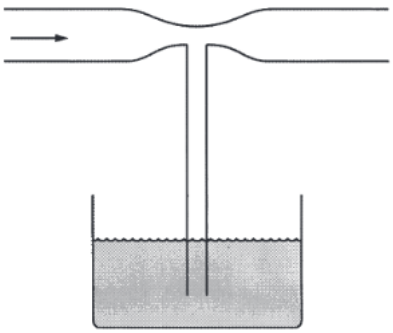
   A. I B. II C. III D. IV E. All sections have the same pressure.

9. (1 point) A 500 N weight sits on the small piston of a hydraulic machine. The small piston has an area of $2cm^2$. If the large piston has an area of $40cm^2$, how much weight can the large piston support?
   A. 25 N B. 500 N C. 10000 N D. 40000 N E. 1000 N

10. (1 point) As a rock sinks deeper and deeper into water of constant density, what happens to the buoyant force on it? A. It increases B. It decreases C. It may increase or decrease depending on the shape of the rock. D. It remains constant E. Not enough information available to answer.

11. (1 point) Salt water is more dense than fresh water. A ship floats in both fresh water and salt water. Compared to the fresh water, the amount of water displaced in the salt water is
   A. more. B. less. C. the same. D. Cannot be determined from the information given.

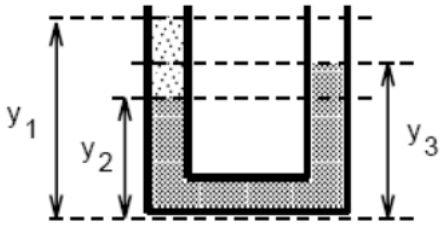
12. (1 point) A T-shaped tube with a constriction is inserted in a vessel containing a liquid, as shown. What happens if air is blown through the tube from the left, as shown by the arrow in the diagram?



   A. The liquid level in the tube rises to a level above the surface of the liquid in the surrounding tube
   B. The liquid level in the tube falls below the level of the surrounding liquid
   C. The liquid level in the tube remains where it is
   D. The air bubbles out at the bottom of the tube.
   E. Any of the above depending on how hard the air flows.

13. (1 point) The apparent weight of a 600 kg object of volume 0.375 m^3 submerged in a liquid of density $1.25 \times 10^3 kg/m^3$ is
   A. 180 N B. 250 N C. 480 N D. 1300 N E. 4700 N

14. (1 point) In the open manometer shown, water occupies a part of the left arm, from a height of y_1 to a height of y_2. The remainder of the left arm, the bottom of the tube, and the right arm to a height of y_3 are filled with mercury. Which of the following is true?



A. the pressure at a height y_3 is the same in both arms.
B. the pressure at a height y_2 is the same in both arms.
C. the pressure at the bottom of the right arm is greater than at the bottom of the left arm.
D. the pressure at a height y_3 is less in the left arm than in the right arm
E. the pressure at a height y_1 is greater in the left arm than in the right arm. 1 is greater in the left arm than in the right arm

15. (1 point) A 12-g CD with a radius of 6.0 cm rotates with an angular speed of 34 rad/s. What angular speed must the CD have if its kinetic energy is to be doubled? ($I_{CD} = \frac{1}{2}MR^2$)
A. 20 rad/s B. 40 rad/s C. 48 rad/s D. 68 rad/s E. None

16. (1 point) As an ice skater begins a spin, his angular speed is 3.17 rad/s. After pulling in his arms, his angular speed increases to 5.46 rad/s. What is the ratio of the skater's final moment of inertia to his initial moment of inertia?
A. 0.34 B. 6.34 C. 0.58 D. 3.22 E. None

17. (1 point) When the earth is closer to the sun is it moving faster, at the same speed, or slower then when it is at the farthest distance from the sun?
A. Faster B. Slower C. The same speed. D. Cannot be determined. E. None.

18. (1 point) Turning a doorknob through 1/4 of a revolution requires 0.14 J of work. What is the torque required to turn the doorknob?
A. 10 Nm B. 1 Nm C. 0.089 Nm D. 0.13 Nm E. None

19. (1 point) Intravenous infusions are often made under gravity. The fluid has a density of 1.00 g/cm^3. If the blood pressure is 18 mm-Hg above atmospheric pressure, how high should the bottle be placed so that the fluid just barely enters the vein?
A. 0.884 m B. 0.552 m C. 0.245 m D. 0.502 m E. None

20. (1 point) A boy stands 4 m from a vertical wall and throws a ball. The ball leaves the boys hand at 2 m above the ground with an initial velocity of $\vec{V_0} = (10\hat{i} + 10\hat{j})m/s$ When the ball hits the wall, the horizontal component of the velocity is reversed and the vertical component remains unchanged. Where does the ball hit the ground(horizontally)?
A. 17.8m from the wall B. 12.8m from the wall C. 10.8m from the wall
D. 8.2m from the wall E. None.

21. (1 point) A railroad crew is repairing a rail during in a desert on a hot day in the summer (42°C). You hear the hammer 0.5 seconds after it is swung. How far away is the crew? (Assume v)
A. 170.2 m B. 178.1 m C. 331 m D. 720 m E. None.

22. (1 point) The newton·second is a unit of
A. work B. angular momentum C. power D. linear momentum E. none of these

23. (1 point) A 2.0-kg block starts from rest on the positive x axis 3.0 m from the origin and thereafter has an acceleration given by $\vec{a} = (4\hat{i} - 3\hat{j})m/s^2$. At the end of 2.0 s its angular momentum about the origin is:
A. 0 B. $(-36kgm^2/s)\hat{k}$ C. $(48kgm^2/s)\hat{k}$ D. $(-96kgm^2/s)\hat{k}$ E. $(96kgm^2/s)\hat{k}$

24. (1 point) A pirate treasure chest rests at the bottom of an ocean. If the water is still, the net force it exerts on the chest:
A. is upward B. is downward C. is zero
D. depends on the mass of the chest E. depends on the contents of the chest

25. (1 point) A fir wood board floats in fresh water with 60% of its volume under water. What is its specific gravity?
A. 0.4 B. 0.5 C. 0.6 D. less than 0.4 E. more than 0.6 F. None

26. (1 point) The apparent weight of a steel sphere immersed in various liquids is measured using a spring scale. The greatest reading is obtained for that liquid:
A. having the smallest density B. having the largest density C. having the greatest volume
D. subject to the greatest atmospheric pressure E. in which the sphere was submerged deepest

27. (1 point) A cork floats in water in a bucket resting on the floor of an elevator. The elevator then accelerates upward. During the acceleration:
A. the cork is immersed more B. the cork is immersed less C. the cork is immersed the same amount
D. at first the cork is immersed less but as the elevator speeds up it is immersed more E. at first the cork is immersed more but as the elevator speeds up it is immersed less

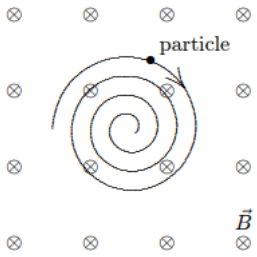
28. (1 point) The two arms of a U-tube are not identical, one having twice the diameter of the other. A cork in the narrow arm requires a force of 16 N to remove it. The tube is filled with water and the wide arm is fitted with a piston. The minimum force that must be applied to the piston to push the cork out is:
A. 4 N B. 8 N C. 16 N D. 32 N E. 64 N F. None

29. (1 point) Electrons are going around a circle in a counterclockwise direction. At the center of the circle they produce a magnetic field that is:
A. into the page B. out of the page C. to the left D. to the right E. zero

30. (1 point) A wire carrying a large current i from east to west is placed over an ordinary magnetic compass. The end of the compass needle marked "N" will point:
A. North B. South C. East D. West E. the compass will act as an electric motor, hence the needle will keep rotating

31. (1 point) The magnetic force on a charged particle is in the direction of its velocity if:
A. it is moving in the direction of the field
B. it is moving opposite to the direction of the field
C. it is moving perpendicular to the field
D. it is moving in some other direction
E. Never

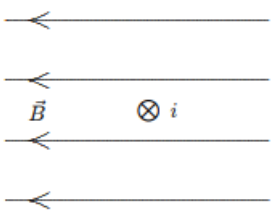
32. (1 point) A uniform magnetic field is directed into the page. A charged particle, moving in the plane of the page, follows a clockwise spiral of decreasing radius as shown. A reasonable explanation is:



A. the charge is positive and slowing down B. the charge is negative and slowing down
C. the charge is positive and speeding up D. the charge is negative and speeding up E. none

33. (1 point) An electron is launched with velocity nv in a uniform magnetic field $\vec{B}$. The angle θ between $\vec{v}$ and $\vec{B}$ is between 0 and 90°. As a result, the electron follows a helix, its velocity vector $\vec{v}$ returning to its initial value in a time interval of:
A. $\frac{2\pi m}{eB}$ B. $\frac{2\pi mv}{eB}$ C. $\frac{2\pi mvsin\theta}{eB}$ D. $\frac{2\pi mvcos\theta}{eB}$ E. None

34. (1 point) The figure shows a uniform magnetic field $\vec{B}$ directed to the left and a wire carrying a current into the page. The magnetic force acting on the wire is:



A. toward the top of the page B. toward the bottom of the page C. toward the left
D. toward the right E. zero

35. (1 point) If you wish to detect details of the size of atoms (about 1 a°) with electromagnetic radiation, it must have a wavelength of about this size. What is its frequency?
A. 2.1×10^{16} Hz B. 2.1×10^{17} Hz C. 2.99×10^{18} Hz D. 2.99×10^{17} Hz E. None

36. (1 point) Which types of seismic waves do the most damage as they linger around the surface of the crust?
A. L-waves B. P-waves C. S-waves D. M-waves E. None

37. (1 point) The Earth has an average temperature of 288K. What is the Earth's wavelength of maximum emission?
A. $1.87 \times 10^{-2}m$ B. $1.00 \times 10^{-6}m$ C. $1.00 \times 10^{-2}m$ D. $2.06 \times 10^{-6}m$ E. None

38. (1 point) What does the following equation imply $\vec{\nabla} \cdot \vec{B} = 0$ (divergence of the magnetic field is 0)?
    A. That electric field vector creates and will always create a magnetic field around it.
    B. The electric field vector always has a positive divergence, meaning the flux is outwards.
    C. Magnetic mono-poles do not exist.
    D. Electric mono poles exist and always give rise to magnetic fields.
    E. None.

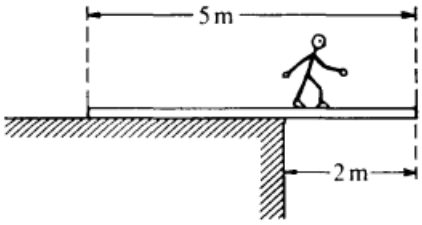
39. (1 point) Why are radio waves used to broadcast radio and television signals?
    A. They have high frequency and high energy
    B. They have short wavelengths and high energy
    C. They can cover a greater distance through the atmosphere due to their short wavelength
    D. They can cover a greater distance through the atmosphere due to their long wavelength
    E. None

40. (1 point) What will happen when signals from two radio systems are operating at the same frequency?
    A. These two signals harmonize and increase sound volume for the receiver
    B. These two signals will interfere and the signal reception will be disrupted
    C. A radio which was broadcasting at 87.6Hz will shift to 107.1MHz
    D. The signal will become weak and the radio will shut down
    E. None.

Free Response Questions

41. (1 point) A child tosses a ball directly upward. Its total time in the air is T. Its maximum height is 10 m. What is its height after it has been in the air a time $\frac{T}{4}$? Neglect air resistance.

42. (1 point) A 5-meter uniform plank of mass 100 kilograms rests on the top of a building with 2 meters extended over the edge as shown. How far can a 50-kilogram person venture past the edge of the building on the plank before the plank just begins to tip?



43. (1 point) A tapered horizontal pipe carries water from one building to another on the same level. The wider end has a cross-sectional area of $4m^2$. The narrower end has a cross-sectional area of $2m^2$. Water enters the wider end at a velocity of 10 m/s. The gauge pressure of the water at the wide end of the pipe is 2×10^5 pascals. What is the gauge pressure at the narrow end of the pipe?

44. (1 point) A wave has frequency of 5 Hz and a speed of 25 m/s. What is the wavelength of the wave?

45. (1 point) A wire loop is bent into the shape of a square with each side of length 4.5 cm. The loop is placed horizontally on a tabletop with two of the sides oriented north/south and two of the sides oriented east/west. A battery is connected so that a current of 24 mA is produced around the loop; the current flows in the clockwise direction looking from the top. What is the overall torque (*in* Nm) on the loop?