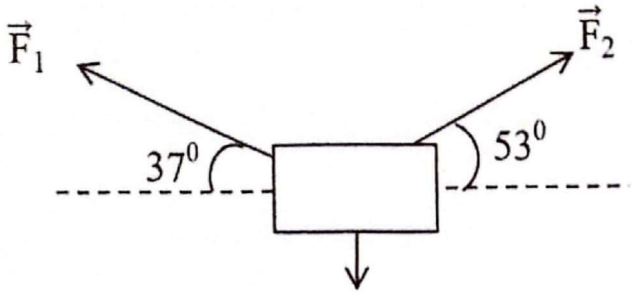
SUBJECT CODE: 04 BOOKLET CODE: 012

1. Two students A and B exert forces $\vec{F}_1$ and $\vec{F}_2$, respectively on an object of weight 300 N as shown in the figure below.



W=300 N

If the object remains in equilibrium, what are the magnitude of $\vec{F}_1$ and $\vec{F}_2$ respectively?

A. 600 N and 500 N
B. 180 N and 240 N
C. 170 N and 280 N
D. 300 N and 250 N

2. Uniformly accelerated motion is a motion of an object in which

A. displacement changes linearly with time.
B. velocity changes equally with equal interval of time.
C. acceleration increases equally with equal time interval.
D. acceleration varies linearly with displacement.

3. A force F acts on an object of mass 4 kg along a frictionless straight track and speeds up the object from rest to 28 $\frac{m}{s}$ in 4seconds. The magnitude of the force F is

A. 28 N.
B. 32 N.
C. 7 N.
D. 112 N

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4. Which one of the following statements is correct about collisions in an isolated system?

A. In inelastic collision, both the momentum and kinetic energy of the system are conserved.
B. In elastic collision, the momentum of the system is conserved but not its kinetic energy.
C. In inelastic collision, the kinetic energy of the system is conserved but not its momentum.
D. In elastic collision, both the momentum and kinetic energy of the system are conserved.

5. A bullet of mass 100 g moving horizontally with a constant speed of 600 $\frac{m}{s}$ strikes a freely suspended wooden block of mass 4.9 kg and embedded in the block. How high above the initial position does the bullet-block system rises after impact?

A. 2.88 m
B. 5.0 m
C. 7.2 m
D. 1.44 m

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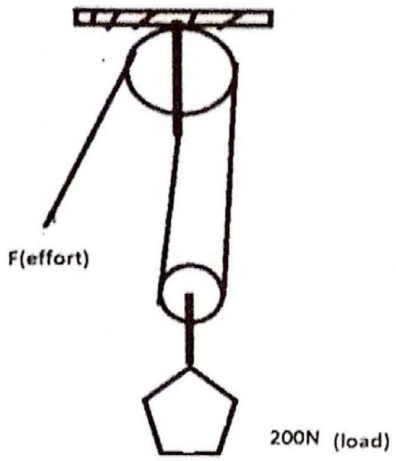
6. Consider the pulley system in the figure below. Assume the pulley system is frictionless and massless.



If the load shown attached to the lower movable pulley is raised upward by 10cm, then the mechanical advantage and velocity ratio of the pulley system are, respectively,

A. 2 and 2
C. 2 and 1.5
B. 3 and 5
D. 1.5 and 2

7. A circular cylinder of height 20 cm is filled totally with liquid mercury of density $13.6x10^3$ kg/m^3 and is opened on the top to the atmosphere. What is the total pressure in the cylinder at 10 cm above the bottom of the cylinder? (Use atmospheric pressure of the location, $P_{atm} = 1.01X10^5$ N/m^2)

A. $2.46x10^5$ N/m^2
C. $1.36x10^4$ N/m^2
B. $8.64x10^4$ N/m^2
D. $1.146x10^5$ N/m^2

8. Which one of the following factors does **NOT** affect the amount of heat absorbed or liberated by a body while remaining in the same phase?

A. The mass of the body
B. The specific heat capacity of the body
C. The latent heat of the body
D. The change in temperature the body undergoes

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9. A 1000 cm^3 liquid with coefficient of volume expansion, $\gamma = 1.8x10^{-4}\ K^{-1}$ placed in aluminum cylinder having coefficient of linear expansion, $\alpha = 2.3x10^{-5}\ K^{-1}$, is heated to a change of temperature 50 °C. The apparent expansion of the liquid is

A. $9.00 \times 10^{-6}\ m^3$.
B. $1.11x10^{-6}\ m^3$.
C. $5.55 \times 10^{-6} m^3$.
D. $3.45x10^{-6}\ m^3$.

10. Which one of the following statements does **NOT** describe property of waves?

A. When waves propagate from point to point in a medium they are carried by actually displaced particles of the medium.
B. Waves propagating from one medium to another medium of different density can show reflection and refraction at the boundary of the media.
C. The change in direction of wave propagation at a boundary of intersecting media is due to the variation of their speeds in the media.
D. When two or more waves meet at a point in a medium, they ether interfere constructively or destructively, depending on the path difference they travel.

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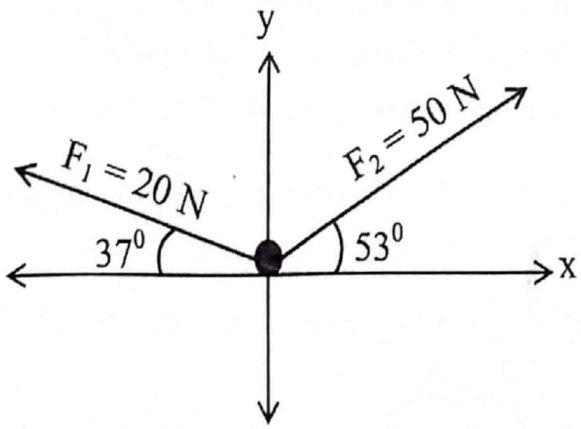
11. An object is pulled by two forces, as shown below. What will be the magnitude of the third force that is required to keep the object in equilibrium?



A. 60.0 N
B. 63.34
C. 71.0
D. 54.0

12. A simple wheel and axle is used to lift a load of 300 N from the ground to top of a building. The radii of the wheel and axle are 30 cm and 6 cm, respectively. Assuming that there is no energy loss, then values of the velocity ratio and the effort required to lift the load, respectively, are

A. 0.5 and 120N.
B. 5 and 60N.
C. 2 and 30N.
D. 0.2 and 12N.

13. Consider a square metallic sheet of side length 2.0 cm at a temperature of 1 °C. If its coefficient of linear expansion is 1.1×10^{-5}/K, which of the following would be its increase in area when heated to 90 °C?

A. 4.00704 cm^2
B. 0.00352 cm^2
C. 0.00704 cm^2
D. 0.0704 cm^2

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14. Which one of the following is an application of sound waves?

A. Measuring depth of oceans.
B. Measuring speed of airplanes
C. Measuring distances of planets
D. Measuring distances of cities

15. Which one of the following relations between variables of rotational and translational kinematics is correct?

A. Radial velocity equals the product of radius of the circular path and tangential velocity.
B. Tangential speed equals the square root of the product of radius of the circular path and centripetal acceleration.
C. Angular displacement equals tangential displacement times the radius of the circular path.
D. Tangential speed equals the square root of radius of the circular path times radial velocity.

16. For an object moving with uniform circular motion, which one of the following physical quantities is **NOT** constant?

A. Acceleration.
B. Speed.
C. Kinetic energy
D. angular velocity

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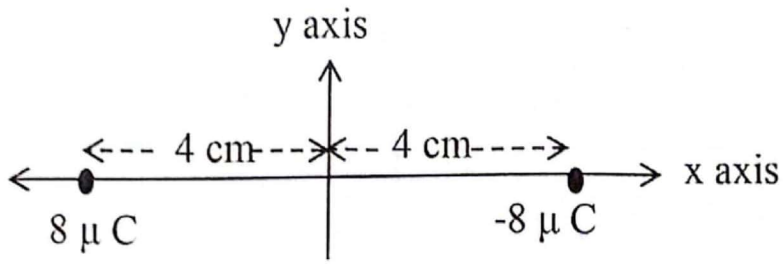
17. Two point particles carrying the same amount of charge 8 μ C but opposite in sign are placed on the x axis as shown in the figure below.



The electric field due to these charges at the origin is

A. 2.25×10^7 N/C along the positive x axis.
B. 1.80×10^6 N/C along the negative x axis.
C. 9.00×10^7 N/C along the positive x axis.
D. Zero

18. The average voltage from the main power supply line is 230.0 V. An electric heater rated as 2 kW power drains 16.0 A from the power supply. What is the resistance of the heater?

A. 64.5 Ω
B. 7.8 Ω
C. 14.4 Ω
D. 125 Ω

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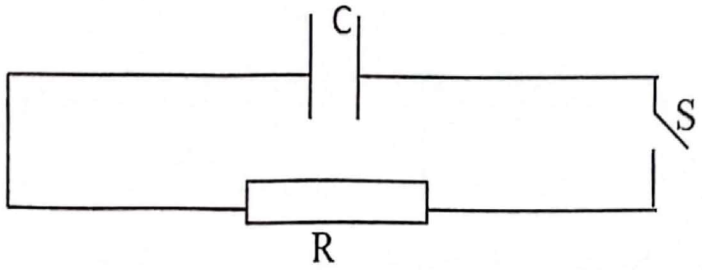
19. A capacitor of capacitance C is charged with a potential difference of V_0 to a charge of Q_0. The capacitor is then disconnected from the power supply and connected to a resistor of resistance R as shown in the figure below.



When the switch S is closed the capacitor starts to discharge. Which one of the following statements correctly explains the effect of discharging the capacitor?

A. For time t equals to RC, the voltage V_0 drops to $0.632V_0$.
B. When the capacitor is fully discharged the voltage drops across R equals V_0.
C. The discharging process is fast for large value of time constant RC.
D. Large value of R implies the capacitor discharges slowly.

20. A beam of electrons directed to pass a target point produces a current of 32.0 A in a time interval of 4 seconds. The number of electrons that pass through the point is

A. 8×10^{20}.
B. 1.28×10^{22}.
C. 8×10^{22}.
D. 128.

21. Two parallel conductors of length 2.0 m each carry 0.5 A in the same direction. If the conductors are separated by a distance of 25 cm, the force between the two wires is

A. 2×10^{-7} N, attractive.
B. 4×10^{-7} N, repulsive.
C. 2×10^{-7} N, repulsive.
D. 4×10^{-7} N, attractive.

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22. Faraday's law of induction states that

A. the induced current is inversely proportional to the rate of change of magnetic flux.

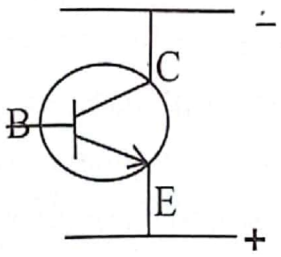
B. the induced electromotive force is in such a way acts to oppose the cause producing it.

C. the direction of the induced current is in such a way acts to oppose the change causing it.

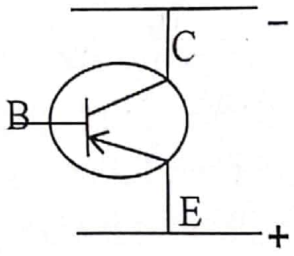
D. the magnitude of the induced electromotive force is directly proportional to the rate of change of magnetic flux.

23. Which one of the following diagrams describes the correct biasing of transistor?

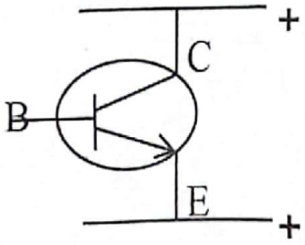
A



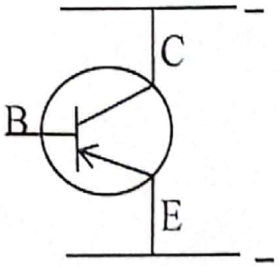
C.



B.



D.



24. Which one of the following statements defines refraction of light? It is

A. the spreading of a light at small gap on its way.

B. the bending of light rays at boundary of two media.

C. bouncing of the light rays from boundary of two media.

D. the polarization of a light rays through a media.

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25. Which one of the following statements correctly explains projectile motion of an object?

A. Two objects projected with the same initial speed will cover equal horizontal range if their angles of projection sum up to 90^0.
B. During an inclined projectile, the same time is required to cover maximum height and horizontal range.
C. During inclined projectile, the velocity remains constant along the trajectory of the motion.
D. A football player should kick the ball from the ground at an angle of 60^0 for the ball to attain a maximum horizontal range.

26. Consider a parallel plate capacitor separated by distance, d and not filled with dielectric material. Let V, C and ε_0 represent electric potential, capacitance of the capacitor and dielectric constant of vacuum, respectively. Which of the following relations explain electric potential energy stored, U, in the capacitor if the surface area of each plate is A and charged to Q?

A. $U = \frac{Q^2 A}{2\varepsilon_0 C^2}$
B. $U = \frac{1}{2}\frac{CQ^2d^2}{\varepsilon_0^2 A^2}$
C. $U = \frac{1}{2}Q^2CV$
D. $U = \frac{1}{2}\frac{QdC^2}{\varepsilon_0 A}$

27. Which of the following is correct about combination of cells in a circuit?

A. When in series their total e.m.f will be less than sum of each.
B. When in parallel their total e.m.f. will be the sum of each.
C. When in series their total e.m.f. will be the same as that of each cell.
D. When in parallel their total e.m.f. will be the same as that of each cell.

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28. Which of the following is correct about the use of the law of reflection in explaining image formation by plane mirrors?

A. The angle of incident is equal to the angle of reflection.
B. The angle of incident and the angle of reflection are measured from the mirror surface.
C. Reflected rays would be traced to the front of the mirror to locate the position of the image.
D. The image located behind the mirror at a point where two backward extended reflected rays meet.

29. The line passing through the center of a lens and perpendicular to it surface is

A. focal length.
B. principal axis.
C. principal point.
D. center of curvature.

30. Which one of the following is correct about errors in a measurement?

A. Errors that cause readings to be below or above accepted value are random errors.
B. Errors that show trend or bias are random errors.
C. Errors that can be reduced by taking repeated measurements are systematic errors.
D. Errors with no bias are known as systematic errors.

31. Which one of the following activities does **NOT** need the knowledge of vectors?

A. Constructing a bridge on a river
B. Analyzing electric fields
C. Studying the motion of planets
D. Measurement of time

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32. Consider four given vectors $\vec{A}$ = 5 unit North, $\vec{B}$ = 9 unit East, $\vec{C}$ = 2 unit south and $\vec{D}$ = 5 unit west. What are the magnitude and direction of the resultant vector?

A. $7\sqrt{5}$ unit and $\tan^{-1}(\frac{1}{2})$ North of East

B. 21unit and $\tan^{-1}(\frac{1}{2})$ North of East

C. 5 unit and $\tan^{-1}(\frac{3}{4})$ North of East

D. 7 unit and $tan^{-1}(\frac{1}{2})$ North of East

33. Consider an object that is released from a high altitude and falling under the action of gravity and air resistance. At some point on its path the object will attain its terminal velocity when the force on it due to air resistance is

A. less than its weight.
B. equal to its weight.
C. greater than its weight.
D. equal to half of the force due to gravity.

34. Which one of the following equations represents a projectile motion launched with initial velocity u from the ground, at an angle θ with the horizontal in a gravitational acceleration g?

A. Range, $R=2\frac{u^2}{g}\sin\theta$

B. Maximum height, $h_{max} = \frac{u^2}{2g}$

C. Maximum height, $h_{max} = (u\sin\theta)^2/g$

D. time of flight, $t = \frac{2\,u\sin\theta}{g}$

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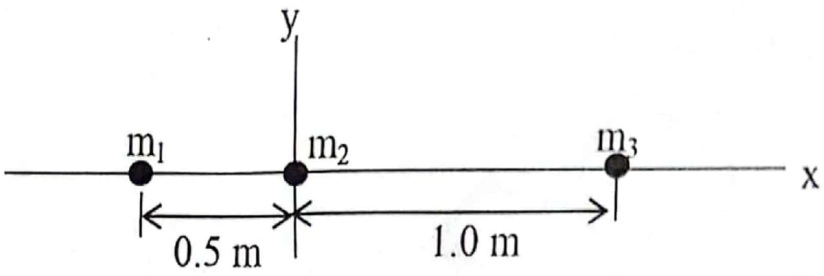
35. A horizontal force of 150.0 N is applied to a block of mass 60.0 kg on a rough horizontal level surface. If the block accelerates at 2.0 m/s^2, what is the magnitude of the force of kinetic friction acting on the block?

A. 75.0 N
B. 30.0 N
C. 90.0 N
D. 120.0 N

36. Three particles of masses $m_1 = 4$ kg, $m_2 = 3$ kg, and $m_3 = 5$ kg are placed on the x–axis, as shown in the figure below.



The location of the center of mas of the system of particles is at

A. x = 0.25 m.
B. x = 0.33 m.
C. x = 0.58 m.
D. x = 0.13 m.

37. A new amusement park roller coaster is to be tested with an empty car of mass 120 kg. One part of the track is a vertical loop with radius 12 m. At the bottom of the loop (point A) the car has speed 25 m/s and at the top of the loop (point B) it has speed 8 m/s. Which one of the following is correct about the motion of the car on the roller coaster?

A. The mechanical energy at point B is equal to the mechanical energy at point A.
B. At any point on the loop of the roller coaster, the mechanical energy of the system is conserved.
C. The kinetic energy at point A is equal to the sum of the kinetic and potential energies at point B.
D. The energy dissipated is equal to the kinetic energy at point A minus mechanical energy at point B.

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38. A professional swimmer of mass 90 kg in basic training climbs a 10.0 m vertical rope at a constant speed in 9.0 seconds. What is the power developed by the swimmer?

A. 81.0 kW.
C. 1.0 kW
B. 8.1 kW
D. 0.1 kW

39. A horizontal merry-go-round of mass m = 80 kg is a solid disk of radius R = 1.50 m and is started from rest by a constant horizontal force of 50.0 N applied tangentially to the edge of the disk. The rotational kinetic energy of the disk just after 3.00 s is_____. (Use moment of inertia of the disk $I = \frac{1}{2} m R^2$)

A. 112.5 J
C. 562.6 J
B. 281.3 J
D. 75 J

40. The angular momentum ($\vec{L}$) of an object of mass m, rotating a circle of radius r with a constant tangential velocity $\vec{v}$ is

A. $\vec{L} = m(\vec{r} \times \vec{v})$.
C. $\vec{L} = m(\vec{v} \times \vec{r})$.
B. $\vec{L} = (\vec{r} \times \vec{v}) / m$.
D. $\vec{L} = m^2(\vec{r} \times \vec{v})$.

41. An object that is acted up on by three coplanar forces will be in equilibrium, if

A. the object rotates with constant angular velocity about its center of mass.
B. the net force acting on the object is zero while the net torque is nonzero.
C. the net torque acting on the object is zero while the net force is nonzero.
D. both the net force and the net torque acting on the object are zero.

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42. A 200 kg load is hung on a wire of length 4.0 m, cross-sectional area 2.0 x 10^{-5} m^2, and Young's modulus 8.0 x 10^{10} Pa. What is its increase in length?

A. 5.0 x 10^{-3} m
B. 5.0 x 10^{-2} m
C. 1.0 x 10^{-2} m
D. 2.5 x 10^{-3} m

43. Consider a capillary tube of radius r that is immersed in a liquid of density, ρ. If f is the liquid-air surface tension, θ is the contact angle, and g is the acceleration due to gravity, then which one of the following equation gives the height (h) the liquid will rise up in the capillary?

A. $h=\frac{2\rho g\cos\theta}{fr}$
B. $h=\frac{2fg\cos\theta}{\rho r}$
C. $h=\frac{2f\cos\theta}{\rho gr}$
D. $h=\frac{2g\cos\theta}{\rho fr}$

44. Water is moving with a speed of 5.0 m/s through a vertical pipe with a cross-sectional area of 4.0 cm^2. The water gradually descends 10 m as the pipe cross-sectional area increases to 8.0 cm^2. If the pressure at the upper level is 1.50 × 10^5 Pa, then the pressure at the lower level of the pipe is

A. 2.50 x 10^5 Pa.
B. 2.75 x 10^5 Pa.
C. 2.78 x 10^5 Pa.
D. 2.59 x 10^5 Pa.

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45. A student is interested to know the acceleration due to gravity around his school and does an experiment. After completing his measurement and data collection, which of the following is the correct procedure to write the report?

A. Title (and date), theory, aim, method, Diagram of experimental arrangement, result, error analysis, analysis, conclusion, evaluation

B. Title (and date), aim, theory, method, result, analysis, conclusion, error analysis, evaluation, Diagram of experimental arrangement

C. Title (and date), Diagram of experimental arrangement, aim, theory, method, result, analysis, conclusion, evaluation, error analysis

D. Title (and date), aim, theory, Diagram of experimental arrangement, method, result, analysis, error analysis, conclusion, evaluation

46. The difference between average velocity and instantaneous velocity is that

A. Average velocity is the total displacement travelled divided by total time taken whereas the instantaneous velocity is the velocity at a time.

B. Average velocity is the time rate of change of acceleration whereas instantaneous velocity is the total displacement traveled divided by the total time taken.

C. The instantaneous velocity is the total distance travelled divided by total time taken whereas average velocity is the time rate of change of displacement.

D. As the difference in displacement extremely increases the average velocity tends towards instantaneous velocity.

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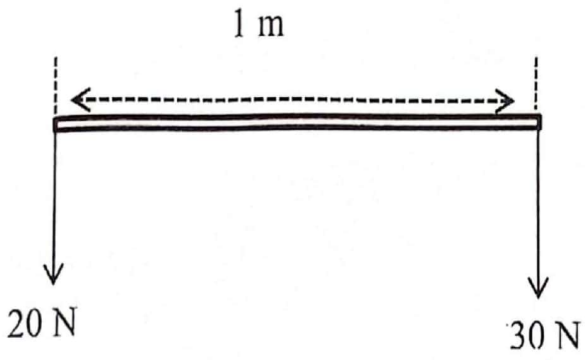
47. Which one of the following statements is correct about Newton's law of universal gravitation?

A. the gravitational force between two objects is repulsive.
B. the gravitational force between two objects is either attractive or repulsive
C. the gravitational force between two objects is inversely proportional to the square of their separation.
D. the gravitational force between two objects is independent of the object's masses.

48. Two forces are applied to a rigid bar of negligible mass and length 1 m as shown in the figure.



If the bar is pivoted at its center, then what force is required and where should be placed with respect to the left end so that the system to be in a rotational equilibrium?

A. 50 N upward at 0.4 m to the right
B. 50 N downward at 0.4 m to the right
C. 10 N upward at 0.6 m to the right
D. 50 N upward at 0.6 m to the right

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54. You intended to do an experiment on a pressure using a plastic bottle that is continuously kept filled to the top with water. Which one of the following will help you to determine that fluid pressure in a fluid at rest depends on the depth of the fluid?

A. Punch the bottle at the same height and measure each distance moved by the water that leaves each hole.
B. Punch the bottle at different height and measure each distance moved by the water that leaves each hole.
C. Punch the bottle at a point and measure distance moved by water that leaves the hole at different places on the ground.
D. Punch the bottle at a point, squeeze the bottle and measure distance moved by water for different magnitude of forces that you exert on the bottle.

55. Which one of the following is correct about fluid flow?

A. Steady flow occurs in a fluid when the speed of the fluid is too high.
B. Steady flow of water occurs where rocks and other obstructions are encountered.
C. Turbulent flow of water occurs where rocks and other obstructions are encountered.
D. Turbulent flow occurs in a fluid when the speed of fluid is too small.

56. Which one of the following statement is correct, about magnets and magnetic fields?

A. One can isolate north and South Pole of a magnet by breaking it into pieces.
B. The source of magnetic field of a magnet is due to its mass.
C. The magnetic field of a bar magnet is strong at the geometrical center of the bar magnet.
D. If one breaks a magnet into two pieces, the two pieces will have their own north and south poles.

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57. A uniform magnetic field of magnitude, B = 2 T, passes through a square loop of side length, L = 20 cm. If the direction of the field is parallel to the normal to the surface of the square, what is the magnetic flux passing through the area?

A. zero
B. 0.08 Wb
C. 0.40 Wb
D. 0.80 Wb

58. A circular coil made of 200 turns of copper wire and enclosing an area of 100 cm^2 is placed on a horizontal table in a magnetic field which decreases at a rate of 0.5 T/s and points perpendicularly upward through the plane of the coil. The ends of the wire are connected across 5 Ω resistor to form a closed circuit. What is the magnitude and direction of flow of the induced current?

A. 1 A, clockwise
B. 1 A, anticlockwise
C. 0.2 A, clockwise
D. 0.2 A, anticlockwise.

59. Which one of the following statements is **NOT** correct about a transistor?

A. It is a semiconductor device used to amplify or switch electronic signals.
B. It has three terminals called emitter, collector, and base.
C. The majority of current carriers in a NPN transistor are holes.
D. In a PNP transistor, the base terminal is at the middle region on the N type material.

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60. Which one of the following is a correct property of magnetic field lines?

A. The strength of the field is high when the field lines are sparsely distributed.

B. The field lines around a permanent magnet emerge from South pole and terminate at North pole.

C. Inside a magnet, the direction of field lines is from South pole to North pole.

D. The direction of field lines around an electromagnet is not dependent on the direction of the current it carries.

The End

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