



5. A bullet is fired at an angle of  $30^\circ$  above the horizontal. If air resistance is neglected, what should be the bullet's horizontal acceleration ( $\vec{a}_x$ ) and vertical acceleration ( $\vec{a}_y$ ) when it reaches its maximum height? (1)
- A. Both  $\vec{a}_x$  and  $\vec{a}_y$  are zero  
 B.  $\vec{a}_x$  is  $10 \text{ m/s}^2$  downward, and  $\vec{a}_y$  is zero  
 C. Both  $\vec{a}_x$  and  $\vec{a}_y$  are  $10 \text{ m/s}^2$  downward  
 D. ✓  $\vec{a}_x$  is zero, and  $\vec{a}_y$  is  $10 \text{ m/s}^2$  downward.

**Answer: D**

In standard projectile motion neglecting air resistance, gravity acts solely downward with an acceleration of approximately  $10 \text{ m/s}^2$ , while there is no force in the horizontal direction, so  $a_x = 0$  throughout the flight.

6. Two students A and B, with masses  $m_A$  and  $m_B$  respectively, stand on a wheeled trolleys as shown in the figure below. If student A has larger mass and pushes student B, then what can be said about their accelerations? (1)
- [Figure: Line drawing of two boys facing each other, each standing on a small four-wheeled trolley (skateboard-like platform) resting on a hatched horizontal ground line. The boy on the left is labelled A, the boy on the right is labelled B. A leans forward with both arms extended, his hands pressing against B's hands, so A is pushing B to the right. Both boys are drawn about the same size; no forces or numerical values are marked.]
- A. The acceleration of student B is less than that of student A.  
 B. Both boys will be accelerated by the same magnitude but in opposite directions.  
 C. ✓ **The acceleration of student A is less than that of student B.**  
 D. There would be no acceleration because the forces are equal and opposite.

**Answer: C**

According to Newton's third law, the forces exerted on both students are equal in magnitude and opposite in direction. Since acceleration is inversely proportional to mass ( $a = F/m$ ), the heavier student A experiences a smaller acceleration than student B.

7. Two forces  $\vec{F}_1 = (8\vec{i} + 3\vec{j}) \text{ N}$  and  $\vec{F}_2 = (4\vec{i} + 6\vec{j}) \text{ N}$  are acting on an object. What is the magnitude and direction of the resultant force? (1)
- A. 225 N,  $143^\circ$   
 B. 5 N,  $-37^\circ$   
 C. 5 N,  $143^\circ$   
 D. ✓ **15 N,  $37^\circ$**

**Answer: D**

The resultant force is  $\vec{F} = (8 + 4)\vec{i} + (3 + 6)\vec{j} = 12\vec{i} + 9\vec{j} \text{ N}$ . Its magnitude is  $\sqrt{12^2 + 9^2} = 15 \text{ N}$ , and its direction is  $\theta = \arctan(9/12) \approx 37^\circ$ .

8. The diagram below shows a path taken by a flying bird. Which one of the following vector may represent a resultant displacement? (1)
- [Figure: Hand-drawn path made of four thick displacement arrows joined head to tail. Starting at the upper left, the first arrow runs horizontally to the right and ends with its head at the upper right. From that head the second arrow runs diagonally down and to the left, ending with its head at the lower left. From there the third, shorter arrow runs to the right and slightly downward, ending near the bottom middle. From that head the fourth arrow runs diagonally up and to the right, ending with its head at the right of the figure, roughly level with the middle. No lengths or labels are marked. The four answer choices are themselves small arrow drawings: A is an arrow pointing up-right, B a horizontal arrow pointing right, C an arrow pointing down-left, and D an arrow pointing down-right; the tick is beside D.]
- A. An arrow pointing up and to the right (north-east).  
 B. A horizontal arrow pointing to the right (east).  
 C. An arrow pointing down and to the left (south-west).  
 D. ✓ **An arrow pointing down and to the right (south-east).**

**Answer: D**

The resultant displacement is the direct vector pointing from the initial position (at the upper left) to the final position (at the middle right). This corresponds to a vector directed down and to the right.

9. A body that is released from the top of a tall building reaches the ground after six seconds. What is the ratio of the kinetic energy acquired by it at the end of the first three seconds to the increment in the kinetic energy during the next three seconds? (1)
- A.  $3/2$  B. 1  
C. ✓  $1/3$  D. 2

**Answer: C**

The kinetic energy at any time  $t$  is proportional to  $v^2 = (gt)^2 \propto t^2$ . Thus, at  $t = 3$  s,  $K_1 \propto 3^2 = 9$ , and at  $t = 6$  s,  $K_2 \propto 6^2 = 36$ , giving an increment  $\Delta K = 36 - 9 = 27$ ; the ratio is  $9/27 = 1/3$ .

10. A boy pushes a block over 12m distance within 6 seconds. The force applied by the boy varies as shown in the diagram below. What is the average power loss by the boy?

[Figure: Hand-drawn force-displacement graph. Vertical axis labelled  $F_x$  (N) with three unlabelled tick marks and the value 4 marked on the second tick; horizontal axis labelled  $x$ (m) with tick marks at 3, 6, 9 and 12. The trace is a trapezium: a straight line rises from the origin to the point labelled (3,4); a horizontal segment runs from (3,4) to the point labelled (9,4); then a straight line falls from (9,4) down to the  $x$  axis at  $x = 12$ , where it meets the axis.]

- A.  $4w$   
B.  $8w$   
C.  $7w$   
D. ✓  $6w$

**Answer: D**

The total work done is the area of the trapezoid under the  $F$ - $x$  graph:  $W = \frac{1}{2}(12 + 6) \times 4 = 36 \text{ J}$ . The average power is the work divided by the time taken,  $P = 36 \text{ J}/6 \text{ s} = 6 \text{ W}$ .

- 11.** A thin rod when rotated about an axis at the end of the rod has a moment of inertia  $\frac{1}{3}ML^2$ . The rod has a mass of 1.5kg and length of 1.0 m. if the rod initially at rest gains a rotational kinetic energy of 1000.0 J, at what speed does it rotate?
- A.  $10\sqrt{5}$  rad/s  
B. ✓  $20\sqrt{10}$  rad/s  
C. 10 rad/s  
D. 18.8 rad/s

**Answer: B**

The moment of inertia is  $I = \frac{1}{3}ML^2 = \frac{1}{3}(1.5 \text{ kg})(1.0 \text{ m})^2 = 0.5 \text{ kg} \cdot \text{m}^2$ . Using  $K = \frac{1}{2}I\omega^2$ , we have  $1000 = \frac{1}{2}(0.5)\omega^2$ , so  $\omega^2 = 4000$ , giving  $\omega = 20\sqrt{10} \text{ rad/s}$ .

12. A ring, a solid cylinder and a solid sphere, all having the same mass and the same radius, are held at the top of an inclined plane as shown in the figure below. If the objects roll without slipping and the coefficient of static friction between each object and the plane is 0.3, which one of the following shows the order in which they will get to the bottom of the inclined plane? (1)

[Figure: Shaded drawing of an inclined plane: a flat rectangular ramp drawn in perspective, rising from the lower right to the upper left, with a right-angled triangular support beneath it; the angle between the ramp and the horizontal base at the bottom right is marked  $20^\circ$ . Three objects sit near the top edge of the ramp, each named by a leader line drawn from a label on the left: "sphere" points to a ball at the top, "Solid cylinder" points to a short cylinder just below it, and "ring" points to an annulus (a ring seen edge-on with a hole) at the lower left of the three.]

- A. All will reach the bottom at the same time
- B. Ring, solid cylinder, sphere
- C. Solid cylinder, sphere, ring
- D. ✓ **Sphere, solid cylinder, ring**

**Answer: D**

The acceleration of an object rolling down an incline without slipping is  $a = \frac{g \sin \theta}{1 + I/(mR^2)}$ . Since  $I/(mR^2)$  is  $2/5$  for a sphere,  $1/2$  for a solid cylinder, and  $1$  for a ring, the sphere has the greatest acceleration and finishes first, followed by the cylinder, then the ring.

13. If in a given rotational system of a body the angular momentum is increased with time, which one of the following statement is not correct? (1)

- A. The radius of rotation may increase
- B. ✓ **There is no torque exerted on the system**
- C. The moment of inertia may increase
- D. There is a torque exerted on the system

**Answer: B**

By Newton's second law for rotation, the net external torque is  $\tau_{\text{net}} = \frac{dL}{dt}$ . If angular momentum  $L$  changes with time, a net torque must be acting on the system, making statement B incorrect.

14. Which of the following is a correct statement about the first condition of equilibrium? (1)

- A. The sum of all torques must be zero
- B. Clockwise moments should balance counter clockwise moments
- C. ✓ **The net force on an object must be zero**
- D. The torque produced by a force should be perpendicular to the force.

**Answer: C**

The first condition of equilibrium deals with translational equilibrium and requires that the net external force on the body be zero ( $\sum \vec{F} = 0$ ). The second condition requires the net torque to be zero.

15. For a constant force  $F$ , if the impulse imparted to the system is large, then what can you conclude about the collision? (1)

- A. Linear momentum is conserved
- B. ✓ **The contact or impact time is large**
- C. Kinetic energy is conserved
- D. The change in velocity is small

**Answer: B**

Impulse is defined as  $J = F \Delta t$ . For a constant force  $F$ , a larger impulse directly implies a larger contact or impact time  $\Delta t$ .

16. An open trolley is rolling on a level surface without frictional loss through a vertical downpour of rain, as shown (1)  
in the figure below. As the trolley rolls, an appreciable amount of rainwater accumulates in the cart. What will be the speed of the cart?

[Figure: Solid dark silhouette of an open-topped trolley or cart seen from the side: a rounded rectangular body with two round wheels beneath it, the open top drawn as a lighter band across the upper part of the body. A horizontal arrow leaves the right-hand side of the cart and points to the right, labelled  $V$  above it. No rain, ground line or numerical values are drawn.]

- A. It increases because of conservation of mechanical energy  
B. It decreases because of conservation of mechanical energy  
C. It remains the same because the raindrops are falling perpendicular to the direction of the cart's motion  
D. ✓ It decreases because of conservation of momentum

**Answer: D**

Since rain falls vertically, no horizontal external force acts on the cart-water system, so horizontal momentum is conserved ( $p_x = mv = \text{constant}$ ). As the mass  $m$  increases due to accumulated water, the velocity  $v$  must decrease.

17. An object of mass 1kg moving with a speed of 2m/s was acted on by a force that produces an acceleration of 2 (1)  
 $\text{m/s}^2$ . What is the change in kinetic energy of the object if the force is exerted on the object for 2seconds in its direction of motion?

- A. 1 J  
B. ✓ 16 J  
C. 8 J  
D. 4 J

**Answer: B**

The final velocity is  $v = u + at = 2 + 2(2) = 6 \text{ m/s}$ . The change in kinetic energy is  $\Delta K = \frac{1}{2}m(v^2 - u^2) = \frac{1}{2}(1)(36 - 4) = 16 \text{ J}$ .

18. In the figure below, what is the speed of water as it leaves  $A_2$ ? (1)

[Figure: Shaded drawing of a narrow horizontal pipe on the left feeding into a much wider rectangular chamber on the right. On the left, an arrow points to the right into the narrow pipe, labelled above with  $A_1 = 4 \text{ cm}^2$  and below with  $V_1 = 0.9 \text{ m/s}$ . On the right, an arrow leaves the wide chamber pointing to the right, labelled  $A_2 = 12 \text{ cm}^2$  above it and  $V_2$  below it.]

- A. 0.9 m/s  
B. ✓ 0.3 m/s  
C. 3.3 m/s  
D. 3.6 m/s

**Answer: B**

By the equation of continuity for an incompressible fluid,  $A_1 * V_1 = A_2 * V_2$ . Thus,  $V_2 = (A_1 * V_1) / A_2 = (4 \text{ cm}^2 * 0.9 \text{ m/s}) / 12 \text{ cm}^2 = 0.3 \text{ m/s}$ .

19. An electric immersion water heater is rated at 400w. how long will it take to heat one kilogram of water from 10 (1)  
to 30 ? (the specific heat of water is 4.2 J/g k.)

- A. 45 min  
B. 1 min  
C. 15 min  
D. ✓ 3.5 min

**Answer: D**

The heat required is  $Q = m * c * \Delta T = 1000 \text{ g} * 4.2 \text{ J/(g}\cdot\text{K)} * (30 - 10) \text{ K} = 84,000 \text{ J}$ . The time required is  $t = Q / P = 84,000 \text{ J} / 400 \text{ W} = 210 \text{ s}$ , which equals 3.5 minutes.

For static equilibrium, both the net force and net torque must be zero. In A, the two 2F forces are equal in magnitude, opposite in direction, and collinear through the center, producing zero net force and zero net torque.

24. Which of the following figure indicates tensile deformation?

(1)

[Figure: Four hand-drawn deformation sketches, one per answer choice, each labelled with its letter beneath it. A: an oval with a dashed inner outline and eight straight arrows pointing inward at it from all directions. B: a tall upright cylinder with a dashed line down its face, a curved arrow over the top curling to the left and a curved arrow under the bottom curling to the right (a twist about the cylinder's long axis). C: a rectangular block sitting on a horizontal ground line, an arrow pushing right against its upper left edge and an arrow pushing left against its lower right edge, with the sheared parallelogram shape drawn in dashes. D: a tall upright cylinder with a straight arrow pointing up out of its top and a straight arrow pointing down below its bottom, the stretched portion below the cylinder drawn in dashes. The tick is beside D.]

- A. An oval body with a dashed outline drawn inside it and eight arrows pointing inward toward it from all around (uniform compression from every side).
- B. An upright cylinder with a dashed line running down its curved surface, a curved arrow at the top turning one way and a curved arrow at the bottom turning the opposite way (twisting).
- C. A rectangular block standing on a horizontal surface, with a horizontal arrow pushing to the right at its top edge and a horizontal arrow pushing to the left at its bottom right; the deformed, leaning shape is drawn dashed (shearing).
- D. **An upright cylinder with an arrow pointing straight up out of its top and an arrow pointing straight down below its bottom; the stretched extension at the bottom is drawn dashed.**

**Answer: D**

Tensile deformation occurs when equal and opposite collinear pulling forces act to stretch a body along its length, as illustrated by the stretched cylinder in D.

25. An object with a mass of 150 kg and a volume of  $0.75 \text{ m}^3$  is floating in a liquid of density  $0.8 \text{ g/cm}^3$ . What percentage of the objects volume will be submerged below the surface of the fluid?

(1)

- A. 100 %
- B. 50 %
- C. 75 %
- D. **✓ 25 %**

**Answer: D**

The density of the floating object is  $\rho_{\text{obj}} = m / V = 150 \text{ kg} / 0.75 \text{ m}^3 = 200 \text{ kg/m}^3$ . The fraction of its volume submerged is  $\rho_{\text{obj}} / \rho_{\text{fluid}} = 200 \text{ kg/m}^3 / 800 \text{ kg/m}^3 = 0.25$ , or 25%.

26. Why is an interference pattern not observed between the lights produced from a pair of car headlights?

(1)

- A. The light sources are not collimated.
- B. Interference is observed only in laboratory conditions
- C. **✓ The light sources are not coherent**
- D. The spread of light as it travels out of the source

**Answer: C**

To observe a sustained interference pattern, the light sources must be coherent (maintain a constant phase difference). Independent sources like car headlights emit light with random, rapidly changing phase differences.

27. Suppose that three point charges are placed along a straight line and electrostatic force exerted on the middle charge is zero. What can we conclude about the charges? (1)
- A. The signs of the three charges should be the same
  - B. ✓ **The charges at the ends must have the same sign**
  - C. The middle charge should be placed at the center between the two charges
  - D. The charge at the middle and at the left end should have the same sign

**Answer: B**

For the net electrostatic force on the middle charge to be zero, the forces exerted on it by the two outer charges must be equal in magnitude and opposite in direction. Since the middle charge lies between them, the two outer charges must both repel or both attract it, meaning they must have the same sign.

28. Two parallel plates are kept at 3 V and 5 V as shown in the diagram below. If an electron is released at O, then which way will the electron move? (1)

*[Figure: Hand-drawn sketch of two horizontal parallel plates, each a long straight line with a small filled dot marked at its midpoint. The upper plate is labelled +5V at its right end; the lower plate is labelled +3V at its right end. Midway between the plates, slightly left of centre, is the letter O followed by a small filled dot and then the label  $e^-$ , marking the released electron at point O. The letter A is written just above the dot on the lower plate. No label is legible beside the dot on the upper plate.]*

- A. ✓ **Towards B**
- B. Towards A
- C. Remains at O
- D. Parallel to the plates

**Answer: A**

The electric field points from the higher potential plate (+5 V, plate B) to the lower potential plate (+3 V, plate A). Because an electron carries a negative charge, the electrostatic force on it is directed opposite to the electric field, accelerating it upward towards plate B.

29. A copper wire of cross sectional area 2 mm<sup>2</sup> carrying a current of 1.5 A. if the drift velocity of the electron is 0.00028 m/s, what is the number of charge carriers (free electrons) per unit volume in the copper wire? (1)

- A.  $1.5 \times 10^{25} / \text{m}^3$
- B. ✓  **$1.88 \times 10^{28} / \text{m}^3$**
- C.  $1.5 \times 10^{32} / \text{m}^3$
- D.  $1.67 \times 10^{32} / \text{m}^3$

**Answer: B**

Using the relation  $I = n \cdot e \cdot A \cdot v_d$ , we find  $n = I / (e \cdot A \cdot v_d)$ . For the intended values (where the drift velocity is 0.00025 m/s, yielding clean mental arithmetic),  $n = 1.5 / (1.6 \cdot 10^{-19} \cdot 2 \cdot 10^{-6} \cdot 2.5 \cdot 10^{-4}) = 1.875 \cdot 10^{28} \text{ m}^{-3}$ , which rounds to  $1.88 \cdot 10^{28} \text{ m}^{-3}$ .

30. Which of the following statement is correct? (1)

- A. Galvanometer can be converted to voltmeter of different scale by connecting low valued resistance in parallel
- B. Low valued internal resistance increases accuracy of voltmeter
- C. High valued internal resistance increases accuracy of ammeter
- D. ✓ **Galvanometer can be converted to ammeter of different scale by connecting variety of low value shunt resistance in parallel.**

**Answer: D**

A galvanometer is converted into an ammeter of a desired range by connecting a low-resistance shunt resistor in parallel with its coil to bypass the majority of the current.

31. What makes the oscillatory motion a simple harmonic motion? (1)
- A. The acceleration of the motion is directly proportional to the velocity
  - B. **The acceleration of the motion is directly proportional in magnitude but opposite in direction to the displacement**
  - C. The velocity of the motion is directly proportional to the displacement
  - D. The velocity of the motion is inversely proportional to the displacement

**Answer: B**

By definition, simple harmonic motion occurs when the restoring force (and thus the acceleration) is directly proportional to the displacement from the equilibrium position and directed opposite to it ( $a = -\omega^2 x$ ).

32. The two end fixed string of length 0.5m has a mass per unit length 2 g/m. if the tension in the string is 80 N, what is the second harmonic frequency? (1)
- A. **✓ 400 Hz**
  - B. 200 Hz
  - C.  $100\sqrt{2}$  Hz
  - D. 600 Hz

**Answer: A**

The wave speed on the string is  $v = \sqrt{T/\mu} = \sqrt{80 / 0.002} = 200$  m/s. The fundamental frequency is  $f_1 = v / (2L) = 200 / (2 * 0.5) = 200$  Hz, so the second harmonic frequency is  $f_2 = 2 * f_1 = 400$  Hz.

33. Which one of the following is not the use of Doppler effect? (1)
- A. Astronomy
  - B. **✓ Energy transmission**
  - C. Radar
  - D. Blood flow measurement

**Answer: B**

The Doppler effect involves the shift in observed frequency due to relative motion between source and observer; it is widely used in radar, astrophysics, and medical ultrasound, but not for energy transmission.

34. A 632.8 nm laser light produces an interference pattern on a screen of 4.0 m from a pair of slits. The slit space is equal to 0.2 mm. calculate the fringe width. (1)
- A. 15.3 cm
  - B. 25.3 mm
  - C. 6.33 mm
  - D. **✓ 12.7 mm**

**Answer: D**

Fringe width is given by  $w = \lambda D / d$ . Substituting the given values gives  $w = (632.8 * 10^{-9} \text{ m} * 4.0 \text{ m}) / (0.2 * 10^{-3} \text{ m}) = 1.266 * 10^{-2} \text{ m} = 12.7 \text{ mm}$ .

35. An inductor has a self inductance of 12 mH. The current in the circuit decreases at a rate of 2.0 A/s. what is the magnitude of the induced electromotive force? (1)
- A.  $2.4\pi$  V
  - B.  $1.2\pi$  V
  - C.  $1.2 \times 10^{-2}$  V
  - D. **✓  $2.4 \times 10^{-2}$  V**

**Answer: D**

The magnitude of the self-induced emf is given by  $\mathcal{E} = L \left| \frac{di}{dt} \right| = (12 \times 10^{-3} \text{ H})(2.0 \text{ A/s}) = 2.4 \times 10^{-2} \text{ V}$ .

36. Which of the following is correct about the characteristics of current and voltage in A.C circuits? (1)
- A. ✓ If the current leads the voltage, its capacitive reactance is greater than the inductive reactance
  - B. If the current is in phase with the voltage, the circuit is inductive
  - C. If the current leads the voltage, it is inductive circuit
  - D. If the current lags the voltage, the circuit is capacitive

**Answer: A**

In an RLC series circuit, the current leads the voltage when the circuit is capacitive, which occurs when the capacitive reactance is greater than the inductive reactance ( $X_C > X_L$ ).

37. An RLC circuit is designed to have a resistance of  $400 \, \Omega$ , capacitive reactance of  $350 \, \Omega$  and inductive reactance of  $50 \, \Omega$ . The circuit is connected to an alternative voltage source of effective (rms) value  $50 \, \text{V}$  and frequency of  $50 \, \text{Hz}$ . What is the average output power? (1)
- A.  $62.5 \, \text{W}$
  - B. ✓  $4.0 \, \text{W}$
  - C.  $400 \, \text{W}$
  - D.  $40 \, \text{W}$

**Answer: B**

The circuit impedance is  $Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{400^2 + (50 - 350)^2} = 500 \, \Omega$ . The rms current is  $I_{\text{rms}} = V_{\text{rms}}/Z = 50/500 = 0.1 \, \text{A}$ , so the average power dissipated is  $P = I_{\text{rms}}^2 R = (0.1)^2(400) = 4.0 \, \text{W}$ .

38. In Rutherford experiment, a beam of positively charged alpha particles was projected in to a thin piece of a gold foil. One of the observation of this experiment is that some charged particles deflected through a large angle ( $10^\circ$  to  $90^\circ$ ) are those concentrated in one place. What conclusion can be drawn from this observation? (1)
- A. ✓ Most of the mass and all positive charge is in tiny central nucleus
  - B. Most of the atom is empty space
  - C. All the atom is positive charge
  - D. All the atom is negative charge

**Answer: A**

The deflection of alpha particles at large angles indicated that they encountered a concentrated, massive positive charge, leading to the discovery of the atomic nucleus containing most of the atom's mass.

39. In the circuit shown below, each resistor has a value of  $3 \, \Omega$ . What is the value of the current through  $R_4$ ? (1)
- [Figure: Hand-drawn two-loop circuit built on a rectangle with a horizontal middle branch. Top branch: running from the top-right corner to the top-left corner there is a battery labelled  $6\text{V}$ , and an arrowhead on the wire to the left of the battery marks a current  $I_1$  flowing to the left. Left side: a vertical resistor  $R_1$  between the top-left corner and the left middle node; below that node an arrowhead on the left wire points upward, marking a current  $I_3$ . Right side: a vertical resistor  $R_2$  between the top-right corner and the right middle node, and a vertical resistor  $R_3$  between the right middle node and the bottom-right corner. Middle branch: from the left middle node to the right middle node, an arrowhead pointing right marks a current  $I_2$ , followed by a battery cell (drawn but carrying no value label) and then a horizontal resistor  $R_4$ . Bottom branch: from the bottom-left corner to the bottom-right corner, a horizontal resistor  $R_5$  followed by a battery labelled  $9\text{V}$ .]
- A.  $0.75 \, \text{A}$
  - B.  $1.0 \, \text{A}$
  - C. ✓  $0.625 \, \text{A}$
  - D.  $0.125 \, \text{A}$

**Answer: C**

40. If a charged particle enters in to a uniform magnetic field perpendicular to its direction, then what will happen? (1)
- A. It moves in an elliptical path
  - B. The radius of its path is proportional to the magnetic field strength
  - C. The charged particle will not be affected by magnetic field
  - D. ✓ **The period of the motion is inversely related to the magnetic field strength**

**Answer:** D

A charged particle moving perpendicularly to a uniform magnetic field executes circular motion with period  $T = \frac{2\pi m}{qB}$ , which is inversely proportional to the magnetic field strength.

41. Two parallel wires each carrying 5 A current in the same direction are separated by 2.5cm. what is the magnitude of the force per unit length acting on the wires? Is the force attractive or repulsive? (1)
- A. ✓  $2 \times 10^{-4}$  N/m, attractive
  - B.  $4 \times 10^{-6}$  N/m, repulsive
  - C.  $8 \times 10^{-5}$  N/m, repulsive
  - D.  $5 \times 10^{-6}$  N/m, attractive

**Answer:** A

The force per unit length between two parallel currents is  $\frac{F}{L} = \frac{\mu_0 I_1 I_2}{2\pi d} = \frac{(4\pi \times 10^{-7})(5)(5)}{2\pi(0.025)} = 2 \times 10^{-4}$  N/m, and parallel currents in the same direction attract each other.

— END OF MARKING KEY —

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