YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

(1) Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number). Code your name on your answer sheet. DARKEN CIRCLES COMPLETELY. Code your UFID number on your answer sheet.

(2) Print your name on this sheet and sign it also.

(3) Do all scratch work anywhere on this exam that you like. Circle your answers on the test form. At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout.

(4) Blacken the circle of your intended answer completely, using a #2 pencil or blue or black ink. Do not make any stray marks or some answers may be counted as incorrect.

(5) The answers are rounded off. Choose the closest to exact. There is no penalty for guessing. If you believe that no listed answer is correct, leave the form blank.

(6) Hand in the answer sheet separately.

Take \( g = 10 \text{ m/s}^2 \) as the acceleration due to gravity.
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1. Over a short interval, starting at time \( t = 0 \), the coordinate of an automobile in meters is given by \( x(t) = 27t - 4t^3 \), where \( t \) is in seconds. The magnitudes of the initial (at \( t = 0 \)) velocity and acceleration of the auto respectively are:

(1) 27 m/s; 0  
(2) 0; 12 m/s\(^2\)  
(3) 0; 24 m/s\(^2\)  
(4) 27 m/s; 12 m/s\(^2\)  
(5) 27 m/s; 24 m/s\(^2\)

2. Neglecting the effect of air resistance, a stone dropped off a 175-m high building lands on the ground in:

(1) 6 s  
(2) 3 s  
(3) 4 s  
(4) 18 s  
(5) 36 s

3. An elevator is moving upward with constant acceleration. The dashed curve shows the position \( y \) of the ceiling of the elevator as a function of time \( t \). At the instant indicated by the dot, a bolt breaks loose and drops from the ceiling. Which curve best represents the position of the bolt as a function of time?

(1) B  
(2) A  
(3) C  
(4) D  
(5) E

4. A particle goes from \( x = -2 \text{ m}, y = 3 \text{ m}, z = 1 \text{ m} \) to \( x = 3 \text{ m}, y = -1 \text{ m}, z = 4 \text{ m} \). Its displacement is:

(1) \( (5m)\hat{i} - (4m)\hat{j} + (3m)\hat{k} \)
(2) \( (1m)\hat{i} + (2m)\hat{j} + (5m)\hat{k} \)
(3) \( -(5m)\hat{i} + (4m)\hat{j} - (3m)\hat{k} \)
(4) \( -(1m)\hat{i} - (2m)\hat{j} - (5m)\hat{k} \)
(5) \( -(5m)\hat{i} - (2m)\hat{j} + (3m)\hat{k} \)

5. A stone is thrown horizontally from the top of a 20-m high hill. It strikes the ground at an angle of 45°. With what speed was it thrown?

(1) 20 m/s  
(2) 14 m/s  
(3) 28 m/s  
(4) 32 m/s  
(5) 40 m/s

6. A dart is thrown horizontally toward X at 20 m/s as shown. It hits Y 0.1 s later. The distance XY is:

(1) 0.05 m  
(2) 1 m  
(3) 0.5 m  
(4) 0.1 m  
(5) 2 m

7. A stone is tied to a 0.50-m string and whirled at a constant speed of 4.0 m/s in a vertical circle. The magnitude of its acceleration in m/s\(^2\) at the bottom of the circle is:

(1) 32, up  
(2) 9.8, up  
(3) 9.8, down  
(4) 8.0, up  
(5) 32, down
8. Two projectiles are in flight at the same time. The acceleration of one relative to other:

(1) is zero.
(2) is always 9.8 m/s².
(3) can be as large as 19.8 m/s².
(4) can be horizontal.
(5) none of these

9. Acceleration is always in the direction:

(1) of the net force.
(2) of the displacement.
(3) of the initial velocity.
(4) of the final velocity.
(5) opposite to the frictional force.

10. Two forces, one with a magnitude of 3 N and the other with a magnitude of 5 N, are applied to an object. For which orientation of the forces is the magnitude of the acceleration of the object the least?

(1) 3 N
(2) 5 N
(3) 3 N
(4) 5 N
(5) 3 N

11. A 25-kg chair is pushed across a frictionless horizontal floor with a force of 20 N, directed 20° below the horizontal. The acceleration of the chair is:

(1) 0.75 m/s²
(2) 0.27 m/s²
(3) 0.80 m/s²
(4) 170 m/s²
(5) 470 m/s²

12. A 90-kg man stands in an elevator that has downward acceleration of 1.5 m/s². The force exerted by him on the floor is about:

(1) 765 N
(2) zero
(3) 90 N
(4) 880 N
(5) 1035 N

13. Two blocks are connected by a string and pulley as shown. Assuming that the string and pulley are massless, the magnitude of the acceleration of each block is:

(1) 1.0 m/s²
(2) 0.05 m/s²
(3) 0.02 m/s²
(4) 0.1 m/s²
(5) 10 m/s²

14. Two blocks (X and Y) are in contact on a horizontal frictionless surface. A 36-N constant force is applied to X as shown. The force exerted by X on Y is:

(1) 30 N
(2) 1.5 N
(3) 6.0 N
(4) 29 N
(5) 36 N
15. A box with a weight of 50 N rests on a horizontal surface. A person pulls horizontally on it with a force of 10 N and it does not move. To start it moving, a second person pulls vertically upward on the box. If the coefficient of static friction is 0.4, what is the smallest vertical force for which the box moves?

(1) 25 N (2) 10 N (3) 14 N (4) 4 N (5) 35 N

16. A block of mass $m$ is pulled along a rough horizontal floor by an applied force $\vec{T}$ as shown. The vertical component of the force exerted on the block by the floor is:

(1) $mg - T \sin \theta$ (2) $mg$ (3) $mg - T \cos \theta$ (4) $mg + T \cos \theta$ (5) $mg + T \sin \theta$

17. A 5.0-kg crate is on a frictionless incline that makes an angle of 30° with the horizontal. The maximum force that can be applied parallel to the plane without moving the crate is:

(1) 25 N (2) 0 (3) 3.3 N (4) 42 N (5) 55 N

18. Block A, with a mass of 10 kg, rests on a $\theta = 35^\circ$ incline. The coefficient of static friction is 0.40. An attached string is parallel to the incline and passes over a massless, frictionless pulley at the top. The largest mass $m_B$, attached to the dangling end, for which A remains at rest is:

(1) 9.0 kg (2) 3.5 kg (3) 5.9 kg (4) 10.5 kg (5) 2.5 kg

19. An object moves in a circle. If the radius is doubled keeping the speed the same, then the centripetal force must be:

(1) half as great (2) twice as great (3) four times as great (4) one-fourth as great (5) the same

20. One end of a 1.0-m string is fixed, the other end is attached to a 2.0-kg stone. The stone swings in a vertical circle, passing the bottom point at 4.0 m/s. The string tension (in newtons) at this point is about:

(1) 52 (2) 0 (3) 20 (4) 32 (5) 12