Instructor(s): *Field/Matcheva*

PHYSICS DEPARTMENT

PHY 2048 Exam 1 February 10, 2015

Name (print, last first): ______________________ Signature: ______________________

On my honor, I have neither given nor received unauthorized aid on this examination.

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.

Use $g = 9.80$ m/s^2

PHY2048 Exam 1 Formula Sheet

Vectors

$\vec{a} = a_x\hat{i} + a_y\hat{j} + a_z\hat{k}$ $\quad \vec{b} = b_x\hat{i} + b_y\hat{j} + b_z\hat{k}$ $\quad$ Magnitudes: $|\vec{a}| = \sqrt{a_x^2 + a_y^2 + a_z^2}$ $\quad |\vec{b}| = \sqrt{b_x^2 + b_y^2 + b_z^2}$

Scalar Product: $\vec{a}\cdot\vec{b} = a_x b_x + a_y b_y + a_z b_z$ Magnitude: $\vec{a}\cdot\vec{b} = |\vec{a}||\vec{b}|\cos\theta$ (θ = angle between $\vec{a}$ and $\vec{b}$)

Vector Product: $\vec{a}\times\vec{b} = (a_y b_z - a_z b_y)\hat{i} + (a_z b_x - a_x b_z)\hat{j} + (a_x b_y - a_y b_x)\hat{k}$

Magnitude: $|\vec{a}\times\vec{b}| = |\vec{a}||\vec{b}|\sin\theta$ (θ = smallest angle between $\vec{a}$ and $\vec{b}$)

Motion

Displacement: $\Delta x = x(t_2) - x(t_1)$ (1 dimension) $\quad \Delta\vec{r} = \vec{r}(t_2) - \vec{r}(t_1)$ (3 dimensions)

Average Velocity: $v_{ave} = \dfrac{\Delta x}{\Delta t} = \dfrac{x(t_2) - x(t_1)}{t_2 - t_1}$ (1 dim) $\quad \vec{v}_{ave} = \dfrac{\Delta\vec{r}}{\Delta t} = \dfrac{\vec{r}(t_2) - \vec{r}(t_1)}{t_2 - t_1}$ (3 dim)

Average Speed: s_{ave} = (total distance)/Δt

Instantaneous Velocity: $v(t) = \dfrac{dx(t)}{dt}$ (1 dim) $\quad \vec{v}(t) = \dfrac{d\vec{r}(t)}{dt}$ (3 dim)

Relative Velocity: $\vec{v}_{AC} = \vec{v}_{AB} + \vec{v}_{BC}$ (3 dim)

Average Acceleration: $a_{ave} = \dfrac{\Delta v}{\Delta t} = \dfrac{v(t_2) - v(t_1)}{t_2 - t_1}$ (1 dim) $\quad \vec{a}_{ave} = \dfrac{\Delta\vec{v}}{\Delta t} = \dfrac{\vec{v}(t_2) - \vec{v}(t_1)}{t_2 - t_1}$ (3 dim)

Instantaneous Acceleration: $a(t) = \dfrac{dv(t)}{dt} = \dfrac{d^2x(t)}{dt^2}$ (1 dim) $\quad \vec{a}(t) = \dfrac{d\vec{v}(t)}{dt} = \dfrac{d^2\vec{r}(t)}{dt^2}$ (3 dim)

Equations of Motion (Constant Acceleration)

$$v_x(t) = v_{x0} + a_x t \qquad v_y(t) = v_{y0} + a_y t \qquad v_z(t) = v_{z0} + a_z t$$

$$x(t) = x_0 + v_{x0}t + \tfrac{1}{2}a_x t^2 \qquad y(t) = y_0 + v_{y0}t + \tfrac{1}{2}a_y t^2 \qquad z(t) = z_0 + v_{z0}t + \tfrac{1}{2}a_z t^2$$

$$v_x^2(t) = v_{x0}^2 + 2a_x(x(t) - x_0) \qquad v_y^2(t) = v_{y0}^2 + 2a_y(y(t) - y_0) \qquad v_z^2(t) = v_{z0}^2 + 2a_z(z(t) - z_0)$$

Newton's Law and Weight

$\vec{F}_{net} = m\vec{a}$ (m = mass) $\quad$ Weight (near the surface of the Earth) = W = mg (use g = 9.8 m/s^2)

Magnitude of the Frictional Force

(μ_s = static coefficient of friction, μ_k = kinetic coefficient of friction)

Static: $(f_s)_{\max} = \mu_s F_N$ $\quad$ Kinetic: $f_k = \mu_k F_N$ $\quad$ (F_N is the magnitude of the normal force)

Uniform Circular Motion (Radius R, Tangential Speed v = Rω, Angular Velocity ω)

Centripetal Acceleration & Force: $a = \dfrac{v^2}{R} = R\omega^2$ $\quad F = \dfrac{mv^2}{R} = mR\omega^2$ $\quad$ Period: $T = \dfrac{2\pi R}{v} = \dfrac{2\pi}{\omega}$

Projectile Motion

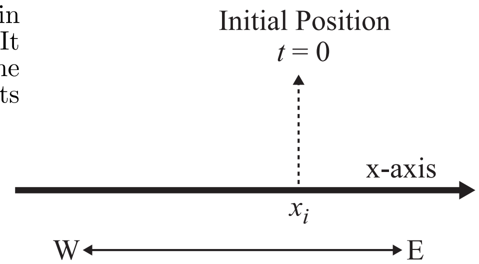
(horizontal surface near Earth, v_0 = initial speed, θ_0 = initial angle with horizontal)

Range: $R = \dfrac{v_0^2\sin(2\theta_0)}{g}$ $\quad$ Max Height: $H = \dfrac{v_0^2\sin^2\theta_0}{2g}$ $\quad$ Time (of flight): $t_f = \dfrac{2v_0\sin\theta_0}{g}$

Quadratic Formula

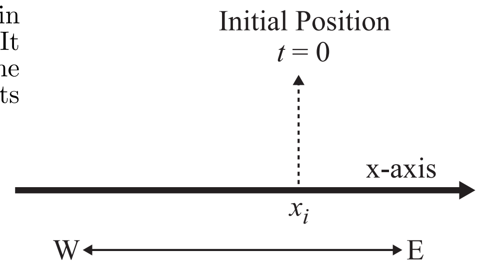
If: $ax^2 + bx + c = 0$ $\quad$ Then: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

1. A train traveling along the x-axis is initially at the point x_i at $t = 0$. The train then travels a distance d_E to the East (*i.e.,* right) as shown in the figure. It then reverses direction and travels a distance d_W to the West (*i.e.,* left) to the final point x_f. If the train's average speed for this trip was 15 km/h and its average velocity for the trip was -10 km/h, what was the distance d_W?



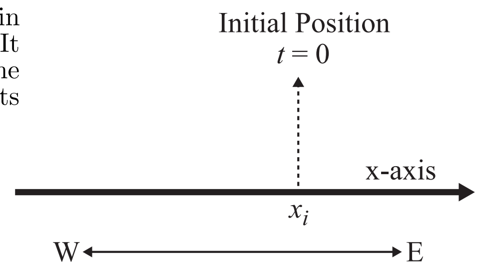
(1) $5d_E$ (2) $3d_E$ (3) $2d_E$ (4) d_E (5) $4d_E$

2. A train traveling along the x-axis is initially at the point x_i at $t = 0$. The train then travels a distance d_E to the East (*i.e.,* right) as shown in the figure. It then reverses direction and travels a distance d_W to the West (*i.e.,* left) to the final point x_f. If the train's average speed for this trip was 20 km/h and its average velocity for the trip was -10 km/h, what was the distance d_W?



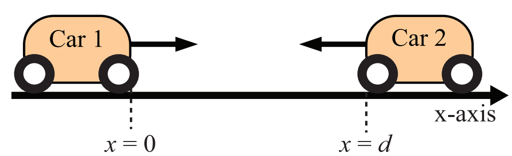
(1) $3d_E$ (2) $5d_E$ (3) $2d_E$ (4) d_E (5) $4d_E$

3. A train traveling along the x-axis is initially at the point x_i at $t = 0$. The train then travels a distance d_E to the East (*i.e.,* right) as shown in the figure. It then reverses direction and travels a distance d_W to the West (*i.e.,* left) to the final point x_f. If the train's average speed for this trip was 30 km/h and its average velocity for the trip was -10 km/h, what was the distance d_W?



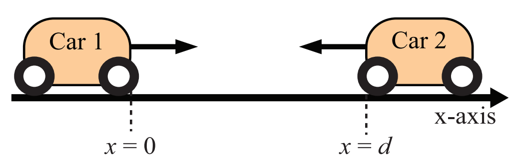
(1) $2d_E$ (2) $5d_E$ (3) $3d_E$ (4) d_E (5) $4d_E$

4. Two automobiles start from rest on the x-axis as shown in the figure. Car 1 is at $x = 0$ and car 2 is at $x = d$. At $t = 0$ the two cars begin to move toward each other at constant accelerations. If the magnitude of the acceleration of car 2 is twice the magnitude of the acceleration of car 1, at what point along the x-axis will the two cars collide?



(1) $x = d/3$ (2) $x = d/4$ (3) $x = d/5$ (4) $x = d/2$ (5) $x = d/6$

5. Two automobiles start from rest on the x-axis as shown in the figure. Car 1 is at $x = 0$ and car 2 is at $x = d$. At $t = 0$ the two cars begin to move toward each other at constant accelerations. If the magnitude of the acceleration of car 2 is three times the magnitude of the acceleration of car 1, at what point along the x-axis will the two cars collide?



(1) $x = d/4$ (2) $x = d/3$ (3) $x = d/5$ (4) $x = d/2$ (5) $x = d/6$

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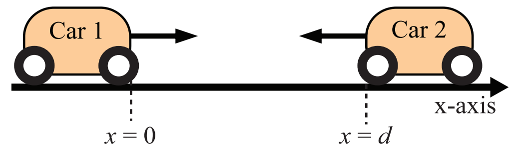
6. Two automobiles start from rest on the x-axis as shown in the figure. Car 1 is at $x = 0$ and car 2 is at $x = d$. At $t = 0$ the two cars begin to move toward each other at constant accelerations. If the magnitude of the acceleration of car 2 is four times the magnitude of the acceleration of car 1, at what point along the x-axis will the two cars collide?



(1) $x = d/5$ (2) $x = d/3$ (3) $x = d/4$ (4) $x = d/2$ (5) $x = d/6$

7. At $t = 0$, you lean over a cliff and throw a ball UP with a speed 10 m/s, and simultaneously throw a ball DOWN with a speed 10 m/s. Which of the following gives the distance between them (in meters) as a function of time (in seconds)?

(1) $20t$ (2) $5t^2$ (3) $20t - 5t^2$ (4) 20 (5) $10t$

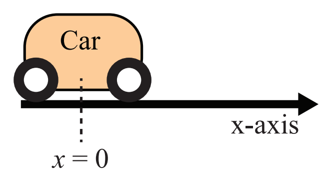
8. At $t = 0$, you lean over a cliff and throw a ball UP with a speed 5 m/s, and simultaneously throw a ball DOWN with a speed 5 m/s. Which of the following gives the distance between them (in meters) as a function of time (in seconds)?

(1) $10t$ (2) $5t^2$ (3) $20t - 5t^2$ (4) 10 (5) $20t$

9. At $t = 0$, you lean over a cliff and throw a ball UP with a speed 3 m/s, and simultaneously throw a ball DOWN with a speed 3 m/s. Which of the following gives the distance between them (in meters) as a function of time (in seconds)?

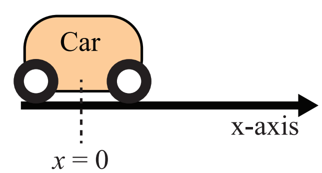
(1) $6t$ (2) $3t^2$ (3) $5t^2 - 3t^2$ (4) 6 (5) $10t$

10. An automobile starts from rest on the x-axis as shown in the figure. At $t = 0$ it begins to move along the x-axis with a velocity that depends on time according to the formula $v_x(t) = v_1 t - v_2 t^2$, where v_1 and v_2 are constants. If $v_1 = 4$ m/s^2 and $v_2 = 1$ m/s^3, at what time t (in s) does the car return to its starting point?



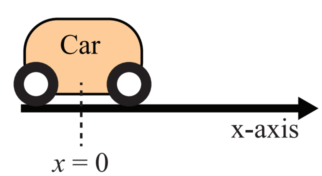
(1) 6 (2) 9 (3) 12 (4) 3 (5) 16

11. An automobile starts from rest on the x-axis as shown in the figure. At $t = 0$ it begins to move along the x-axis with a velocity that depends on time according to the formula $v_x(t) = v_1 t - v_2 t^2$, where v_1 and v_2 are constants. If $v_1 = 6$ m/s^2 and $v_2 = 1$ m/s^3, at what time t (in s) does the car return to its starting point?



(1) 9 (2) 6 (3) 12 (4) 3 (5) 16

12. An automobile starts from rest on the x-axis as shown in the figure. At $t = 0$ it begins to move along the x-axis with a velocity that depends on time according to the formula $v_x(t) = v_1 t - v_2 t^2$, where v_1 and v_2 are constants. If $v_1 = 8$ m/s^2 and $v_2 = 1$ m/s^3, at what time t (in s) does the car return to its starting point?



(1) 12 (2) 6 (3) 9 (4) 3 (5) 16

13. Near the surface of the Earth, a startled armadillo leaps vertically upward at time $t = 0$. At time $t = 0.15$ s, it is a height of 2 m above the ground. What maximum height (in m) above the surface will the armadillo reach during the leap?

(1) 10.1 (2) 6.2 (3) 4.3 (4) 12.8 (5) 3.2

14. Near the surface of the Earth, a startled armadillo leaps vertically upward at time $t = 0$. At time $t = 0.20$ s, it is a height of 2 m above the ground. What maximum height (in m) above the surface will the armadillo reach during the leap?

(1) 6.2 (2) 10.1 (3) 4.3 (4) 12.8 (5) 3.2

15. Near the surface of the Earth, a startled armadillo leaps vertically upward at time $t = 0$. At time $t = 0.25$ s, it is a height of 2 m above the ground. What maximum height (in m) above the surface will the armadillo reach during the leap?

(1) 4.3 (2) 10.1 (3) 6.2 (4) 12.8 (5) 3.2

16. If the vector $\vec{C} = \vec{A} + \vec{B}$ and the vector $\vec{D} = \vec{A} - \vec{B}$, and if the magnitudes of $\vec{A}$ and $\vec{B}$ are $|\vec{A}| = 3$ and $|\vec{B}| = 2$, what is the scalar (dot) product $\vec{C} \cdot \vec{D}$?

(1) 5 (2) 12 (3) 21 (4) 4 (5) 13

17. If the vector $\vec{C} = \vec{A} + \vec{B}$ and the vector $\vec{D} = \vec{A} - \vec{B}$, and if the magnitudes of $\vec{A}$ and $\vec{B}$ are $|\vec{A}| = 4$ and $|\vec{B}| = 2$, what is the scalar (dot) product $\vec{C} \cdot \vec{D}$?

(1) 12 (2) 5 (3) 21 (4) 4 (5) 13

18. If the vector $\vec{C} = \vec{A} + \vec{B}$ and the vector $\vec{D} = \vec{A} - \vec{B}$, and if the magnitudes of $\vec{A}$ and $\vec{B}$ are $|\vec{A}| = 5$ and $|\vec{B}| = 2$, what is the scalar (dot) product $\vec{C} \cdot \vec{D}$?

(1) 21 (2) 5 (3) 12 (4) 4 (5) 29

19. If the angle between the vector $\vec{A} = 3\hat{\imath} - 4\hat{\jmath}$ and the vector $\vec{B} = 2\hat{\imath} + b_y\hat{\jmath}$ is 90°, what is b_y?

(1) 1.5 (2) 1.2 (3) 1.0 (4) 2.0 (5) 0.5

20. If the angle between the vector $\vec{A} = 3\hat{\imath} - 5\hat{\jmath}$ and the vector $\vec{B} = 2\hat{\imath} + b_y\hat{\jmath}$ is 90°, what is b_y?

(1) 1.2 (2) 1.5 (3) 1.0 (4) 2.0 (5) 0.5

21. If the angle between the vector $\vec{A} = 3\hat{\imath} - 6\hat{\jmath}$ and the vector $\vec{B} = 2\hat{\imath} + b_y\hat{\jmath}$ is 90°, what is b_y?

(1) 1.0 (2) 1.5 (3) 1.3 (4) 2.0 (5) 0.5

22. A boat is sailing in the ocean at a constant velocity $\vec{V}_{\text{boat}} = 10\hat{\imath} + 5\hat{\jmath}$ with respect to the shore. The water current in the ocean has a velocity $\vec{V}_{\text{water}} = 5\hat{\imath} + 10\hat{\jmath}$ (also measured with respect to the shore). All velocity components are in m/s. What is the magnitude of the velocity (in m/s) of the boat with respect to the water?

(1) 7.1 (2) 8.5 (3) 11.3 (4) 21.2 (5) 19.8

23. A boat is sailing in the ocean at a constant velocity $\vec{V}_{\text{boat}} = 10\hat{\imath} + 4\hat{\jmath}$ with respect to the shore. The water current in the ocean has a velocity $\vec{V}_{\text{water}} = 4\hat{\imath} + 10\hat{\jmath}$ (also measured with respect to the shore). All velocity components are in m/s. What is the magnitude of the velocity (in m/s) of the boat with respect to the water?

(1) 8.5 (2) 7.1 (3) 11.3 (4) 21.2 (5) 19.8

24. A boat is sailing in the ocean at a constant velocity $\vec{V}_{\text{boat}} = 10\hat{\imath} + 2\hat{\jmath}$ with respect to the shore. The water current in the ocean has a velocity $\vec{V}_{\text{water}} = 2\hat{\imath} + 10\hat{\jmath}$ (also measured with respect to the shore). All velocity components are in m/s. What is the magnitude of the velocity (in m/s) of the boat with respect to the water?

(1) 11.3 (2) 7.1 (3) 8.5 (4) 21.2 (5) 17.0

25. The position vector as a function of time, t, of a running back on the football field is $\vec{r}(t) = (25 + 3t^2)\hat{\imath} + (10 - 2t^3)\hat{\jmath}$, where time is measured in seconds and length in meters. What is the magnitude of the average acceleration (in m/s^2) of the player between $t = 0$ and $t = 2$ s?

(1) 13.4 (2) 19.0 (3) 24.7 (4) 36.5 (5) 8.5

26. The position vector as a function of time, t, of a running back on the football field is $\vec{r}(t) = (25 + 3t^2)\hat{\imath} + (10 - 2t^3)\hat{\jmath}$, where time is measured in seconds and length in meters. What is the magnitude of the average acceleration (in m/s^2) of the player between $t = 0$ and $t = 3$ s?

(1) 19.0 (2) 13.4 (3) 24.7 (4) 36.5 (5) 8.5

27. The position vector as a function of time, t, of a running back on the football field is $\vec{r}(t) = (25 + 3t^2)\hat{\imath} + (10 - 2t^3)\hat{\jmath}$, where time is measured in seconds and length in meters. What is the magnitude of the average acceleration (in m/s^2) of the player between $t = 0$ and $t = 4$ s?

(1) 24.7 (2) 13.4 (3) 19.0 (4) 36.5 (5) 48.4

28. A particle moves in the xy-plane with position coordinates given by $x(t) = 3t^2 - 8t + 4$ and $y(t) = 8t$, where the time t is measured in seconds and distance in meters. At $t = 2$ s, what is the magnitude of its velocity (in m/s)?

(1) 8.94 (2) 12.81 (3) 17.89 (4) 5.69 (5) 19.99

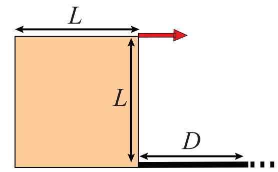
29. A particle moves in the xy-plane with position coordinates given by $x(t) = 3t^2 - 8t + 4$ and $y(t) = 8t$, where the time t is measured in seconds and distance in meters. At $t = 3$ s, what is the magnitude of its velocity (in m/s)?

(1) 12.81 (2) 8.94 (3) 17.89 (4) 5.69 (5) 19.99

30. A particle moves in the xy-plane with position coordinates given by $x(t) = 3t^2 - 8t + 4$ and $y(t) = 8t$, where the time t is measured in seconds and distance in meters. At $t = 4$ s, what is the magnitude of its velocity (in m/s)?

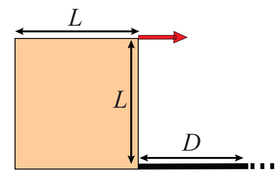
(1) 17.89 (2) 8.94 (3) 12.81 (4) 5.69 (5) 19.99

31. Near the surface of the Earth, a remote controlled toy car accelerates from rest with constant acceleration, $a = 9.8\ \mathrm{m/s^2}$, under the power of its own wheels on the horizontal roof of a square building with sides of length L as shown in the figure. If the car starts from rest on the far edge of the roof, a distance L from the end of the building, what is the horizontal distance D from the point it left the roof to where the car lands on level ground?



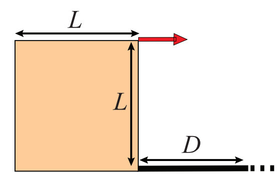
(1) $2L$ (2) L (3) $L/2$ (4) $4L$ (5) $L/3$

32. Near the surface of the Earth, a remote controlled toy car accelerates from rest with constant acceleration, $a = 2.45\ \mathrm{m/s^2}$, under the power of its own wheels on the horizontal roof of a square building with sides of length L as shown in the figure. If the car starts from rest on the far edge of the roof, a distance L from the end of the building, what is the horizontal distance D from the point it left the roof to where the car lands on level ground?



(1) L (2) $2L$ (3) $L/2$ (4) $4L$ (5) $L/3$

33. Near the surface of the Earth, a remote controlled toy car accelerates from rest with constant acceleration, $a = 0.6125\ \mathrm{m/s^2}$, under the power of its own wheels on the horizontal roof of a square building with sides of length L as shown in the figure. If the car starts from rest on the far edge of the roof, a distance L from the end of the building, what is the horizontal distance D from the point it left the roof to where the car lands on level ground?



(1) $L/2$ (2) $2L$ (3) L (4) $4L$ (5) $L/3$

34. At time $t = 0$ a projectile is released with an initial speed v_0 at an angle θ with the flat horizontal surface of the Earth as shown in the figure. If the maximum height above the surface reached by the projectile is 19.6 m, at what time t (in s) does it hit the surface?

(1) 4 (2) 5 (3) 6 (4) 2 (5) 8

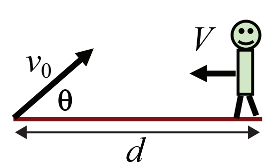
35. At time $t = 0$ a projectile is released with an initial speed v_0 at an angle θ with the flat horizontal surface of the Earth as shown in the figure. If the maximum height above the surface reached by the projectile is 30.6 m, at what time t (in s) does it hit the surface?

(1) 5 (2) 4 (3) 6 (4) 2 (5) 8

36. At time $t = 0$ a projectile is released with an initial speed v_0 at an angle θ with the flat horizontal surface of the Earth as shown in the figure. If the maximum height above the surface reached by the projectile is 44.1 m, at what time t (in s) does it hit the surface?

(1) 6 (2) 4 (3) 5 (4) 2 (5) 8

37. On a flat horizontal soccor field near the surface of the Earth the goal keeper kicks the ball with initial speed $v_0 = 10$ m/s at an angle $\theta = 45°$ with the horizontal towards a teammate that is at rest a distance $d = 20$ m away as shown in the figure. At the instant the ball is kicked the teammate begins running at a constant speed V toward the ball. What constant speed V (in m/s) must the teammate run in order to reach the ball at the instant it hits the ground?



(1) 6.8 (2) 10.3 (3) 13.7 (4) 4.8 (5) 15.2

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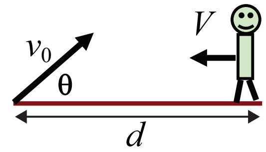
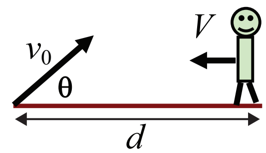
38. On a flat horizontal soccor field near the surface of the Earth the goal keeper kicks the ball with initial speed $v_0 = 10$ m/s at an angle $\theta = 45°$ with the horizontal towards a teammate that is at rest a distance $d = 25$ m away as shown in the figure. At the instant the ball is kicked the teammate begins running at a constant speed V toward the ball. What constant speed V (in m/s) must the teammate run in order to reach the ball at the instant it hits the ground?



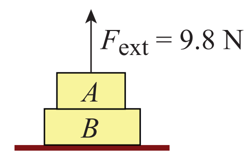
(1) 10.3 (2) 6.8 (3) 13.7 (4) 4.8 (5) 15.2

39. On a flat horizontal soccor field near the surface of the Earth the goal keeper kicks the ball with initial speed $v_0 = 10$ m/s at an angle $\theta = 45°$ with the horizontal towards a teammate that is at rest a distance $d = 30$ m away as shown in the figure. At the instant the ball is kicked the teammate begins running at a constant speed V toward the ball. What constant speed V (in m/s) must the teammate run in order to reach the ball at the instant it hits the ground?



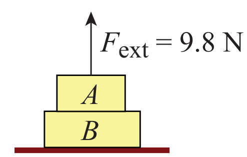
(1) 13.7 (2) 6.8 (3) 10.3 (4) 4.8 (5) 15.2

40. Near the surface of the Earth, two blocks (A and B) are at rest on a horizontal table. Block A is at rest on top of block B and block B is at rest on the table as shown in the figure. An upward vertical external force $F_{ext} = 9.8$ N acts on block A. If $M_A = 2$ kg and $M_B = 1$ kg, what is the magnitude of the normal force exerted by the table on block B (in N)?



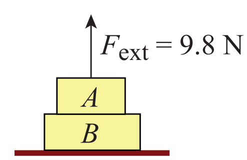
(1) 19.6 (2) 29.4 (3) 39.2 (4) 9.8 (5) 49.0

41. Near the surface of the Earth, two blocks (A and B) are at rest on a horizontal table. Block A is at rest on top of block B and block B is at rest on the table as shown in the figure. An upward vertical external force $F_{ext} = 9.8$ N acts on block A. If $M_A = 3$ kg and $M_B = 1$ kg, what is the magnitude of the normal force exerted by the table on block B (in N)?



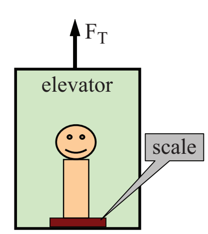
(1) 29.4 (2) 19.6 (3) 39.2 (4) 9.8 (5) 49.0

42. Near the surface of the Earth, two blocks (A and B) are at rest on a horizontal table. Block A is at rest on top of block B and block B is at rest on the table as shown in the figure. An upward vertical external force $F_{ext} = 9.8$ N acts on block A. If $M_A = 4$ kg and $M_B = 1$ kg, what is the magnitude of the normal force exerted by the table on block B (in N)?



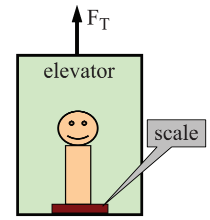
(1) 39.2 (2) 19.6 (3) 29.4 (4) 9.8 (5) 49.0

43. When at rest on the ground, Ian's weight is measured to be 650 N. When Ian is on a moving elevator near the surface of the Earth, his apparent weight is 500 N (see the figure). If the combined mass of the system (Ian and the elevator) is 1050 kg, what is the tension in the elevator cable (in N)?



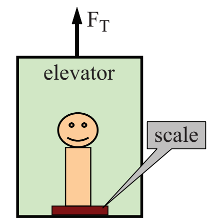
(1) 7,915 (2) 9,498 (3) 11,082 (4) 6,507 (5) 2,020

44. When at rest on the ground, Ian's weight is measured to be 650 N. When Ian is on a moving elevator near the surface of the Earth, his apparent weight is 600 N (see the figure). If the combined mass of the system (Ian and the elevator) is 1050 kg, what is the tension in the elevator cable (in N)?



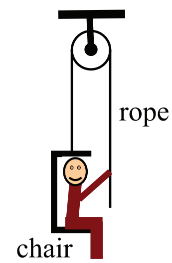
(1) 9,498 (2) 7,915 (3) 11,082 (4) 6,507 (5) 2,020

45. When at rest on the ground, Ian's weight is measured to be 650 N. When Ian is on a moving elevator near the surface of the Earth, his apparent weight is 700 N (see the figure). If the combined mass of the system (Ian and the elevator) is 1050 kg, what is the tension in the elevator cable (in N)?



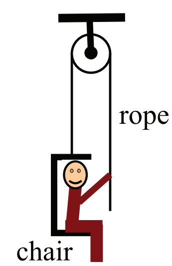
(1) 11,082 (2) 7,915 (3) 9,498 (4) 6,507 (5) 2,020

46. Near the surface of the Earth a man is sitting in a boson's chair that dangles from a massless rope, which runs over a massless, frictionless pulley and back down to the man's hand as shown in the figure. If the combined mass of the man and the chair is 90 kg, with what force (in N) must the man pull on the rope if he is to rise at a constant velocity?



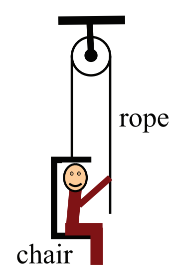
(1) 441
(2) 588
(3) 686
(4) 882
(5) 1,176

47. Near the surface of the Earth a man is sitting in a boson's chair that dangles from a massless rope, which runs over a massless, frictionless pulley and back down to the man's hand as shown in the figure. If the combined mass of the man and the chair is 120 kg, with what force (in N) must the man pull on the rope if he is to rise at a constant velocity?



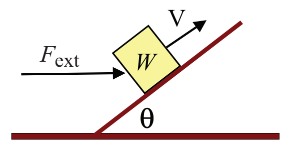
(1) 588
(2) 441
(3) 686
(4) 882
(5) 1,176

48. Near the surface of the Earth a man is sitting in a boson's chair that dangles from a massless rope, which runs over a massless, frictionless pulley and back down to the man's hand as shown in the figure. If the combined mass of the man and the chair is 140 kg, with what force (in N) must the man pull on the rope if he is to rise at a constant velocity?



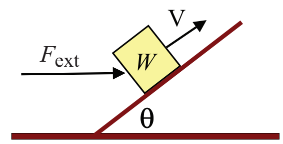
(1) 686
(2) 441
(3) 588
(4) 882
(5) 1,176

49. A block with weight $W = 980$ N is being pushed up a frictionless ramp with angle $\theta = 30°$ relative to the horizontal at a constant speed by a horizontal force as shown in the figure. What is the magnitude of the force (in N) that the ramp exerts on the block?



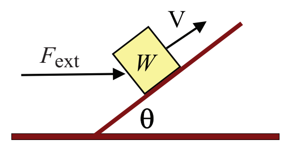
(1) 1131.6 (2) 1385.9 (3) 1960.0 (4) 565.8 (5) 980.0

50. A block with weight $W = 980$ N is being pushed up a frictionless ramp with angle $\theta = 45°$ relative to the horizontal at a constant speed by a horizontal force as shown in the figure. What is the magnitude of the force (in N) that the ramp exerts on the block?



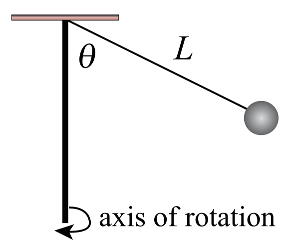
(1) 1385.9 (2) 1131.6 (3) 1960.0 (4) 565.8 (5) 980.0

51. A block with weight $W = 980$ N is being pushed up a frictionless ramp with angle $\theta = 60°$ relative to the horizontal at a constant speed by a horizontal force as shown in the figure. What is the magnitude of the force (in N) that the ramp exerts on the block?



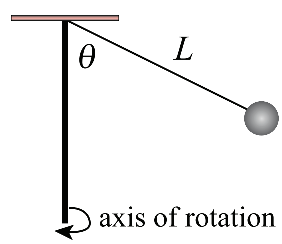
(1) 1960.0 (2) 1131.6 (3) 1385.9 (4) 565.8 (5) 980.0

52. Near the surface of the Earth, a ball with weight W is attached to a thin rope with negligible mass and length $L = 4.9$ m. The ball and rope are attached to a vertical pole and the entire apparatus, including the pole, rotates with a constant angular velocity about the pole's symmetry axis, as shown in the figure. If the tension in the thin rope is $2W$, how long (in seconds) does it take the ball to make one complete revolution?



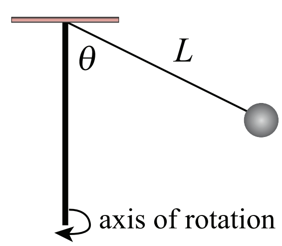
(1) 3.14 (2) 2.22 (3) 1.81 (4) 1.16 (5) 4.02

53. Near the surface of the Earth, a ball with weight W is attached to a thin rope with negligible mass and length $L = 4.9$ m. The ball and rope are attached to a vertical pole and the entire apparatus, including the pole, rotates with a constant angular velocity about the pole's symmetry axis, as shown in the figure. If the tension in the thin rope is $4W$, how long (in seconds) does it take the ball to make one complete revolution?



(1) 2.22 (2) 3.14 (3) 1.81 (4) 1.16 (5) 4.02

54. Near the surface of the Earth, a ball with weight W is attached to a thin rope with negligible mass and length $L = 4.9$ m. The ball and rope are attached to a vertical pole and the entire apparatus, including the pole, rotates with a constant angular velocity about the pole's symmetry axis, as shown in the figure. If the tension in the thin rope is $6W$, how long (in seconds) does it take the ball to make one complete revolution?



(1) 1.81 (2) 3.14 (3) 2.22 (4) 1.16 (5) 4.02

55. Near the surface of the Earth, a car is traveling at a constant speed v around a flat circular race track with a radius of 50 m. If the coefficients of kinetic and static friction between the car's tires and the road are $\mu_k = 0.1$, $\mu_s = 0.4$, respectively, what is the maximum speed the car can travel without sliding off the circular track?

(1) 14 m/s (2) 28 m/s (3) 56 m/s (4) 22 m/s (5) 7 m/s

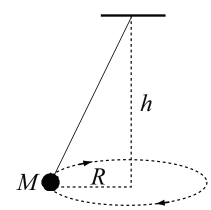
56. Near the surface of the Earth, a car is traveling at a constant speed v around a flat circular race track with a radius of 200 m. If the coefficients of kinetic and static friction between the car's tires and the road are $\mu_k = 0.1$, $\mu_s = 0.4$, respectively, what is the maximum speed the car can travel without sliding off the circular track?

(1) 28 m/s (2) 14 m/s (3) 56 m/s (4) 22 m/s (5) 7 m/s

57. Near the surface of the Earth, a car is traveling at a constant speed v around a flat circular race track with a radius of 800 m. If the coefficients of kinetic and static friction between the car's tires and the road are $\mu_k = 0.1$, $\mu_s = 0.4$, respectively, what is the maximum speed the car can travel without sliding off the circular track?

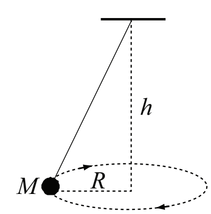
(1) 56 m/s (2) 14 m/s (3) 28 m/s (4) 22 m/s (5) 7 m/s

58. Near the surface of the Earth, a 2 kg mass is whirled around at a constant speed on the end of a string to form the conical pendulum as shown in the figure. The vertical height of the pendulum is $h = 3$ m and the radius of the circle that the mass travels in is $R = 2$ m. What is the speed of the mass (in m/s) as it travels around the circle?



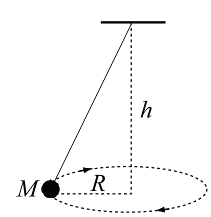
(1) 3.61 (2) 3.13 (3) 2.80 (4) 4.05 (5) 1.75

59. Near the surface of the Earth, a 2 kg mass is whirled around at a constant speed on the end of a string to form the conical pendulum as shown in the figure. The vertical height of the pendulum is $h = 4$ m and the radius of the circle that the mass travels in is $R = 2$ m. What is the speed of the mass (in m/s) as it travels around the circle?



(1) 3.13 (2) 3.61 (3) 2.80 (4) 4.05 (5) 1.75

60. Near the surface of the Earth, a 2 kg mass is whirled around at a constant speed on the end of a string to form the conical pendulum as shown in the figure. The vertical height of the pendulum is $h = 5$ m and the radius of the circle that the mass travels in is $R = 2$ m. What is the speed of the mass (in m/s) as it travels around the circle?



(1) 2.80 (2) 3.61 (3) 3.13 (4) 4.05 (5) 1.75

FOLLOWING GROUPS OF QUESTIONS WILL BE SELECTED AS ONE GROUP FROM EACH TYPE
TYPE 1
Q# S 1
Q# S 2
Q# S 3
TYPE 2
Q# S 4
Q# S 5
Q# S 6
TYPE 3

Q# S 7
Q# S 8
Q# S 9
TYPE 4
Q# S 10
Q# S 11
Q# S 12
TYPE 5
Q# S 13
Q# S 14
Q# S 15
TYPE 6
Q# S 16
Q# S 17
Q# S 18
TYPE 7
Q# S 19
Q# S 20
Q# S 21
TYPE 8
Q# S 22
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Q# S 24
TYPE 9
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Q# S 28
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TYPE 20
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