Physics Honors Midterm Review (Regents Exam June 2022)

1 Which terms identify two scalar quantities?

(1) force and acceleration
(2) impulse and distance
(3) mass and velocity
(4) energy and time

2 A motorcyclist, initially traveling east at 15 meters per second, accelerates uniformly at a rate of 3.0 meters per second squared east to a velocity of 21 meters per second east. How far does the motorcyclist travel while accelerating?

(1) 1.0 m
(2) 2.0 m
(3) 36 m
(4) 72 m

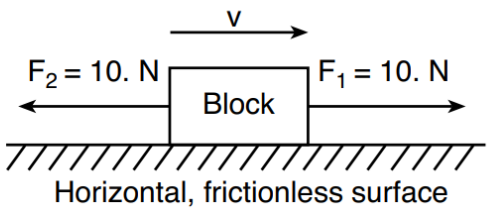
3 A battery-powered electric motor is used to cause the wheels of a toy car to rotate. In this motor, there is a conversion of

(1) mechanical energy to electric energy
(2) electric energy to chemical energy
(3) thermal energy to electric energy
(4) electric energy to mechanical energy

4 A projectile is launched horizontally from a height of 65 meters with an initial horizontal speed of 35 meters per second. What is the projectile's horizontal speed after it has fallen 25 meters? [Neglect friction.]

(1) 22 m/s
(2) 35 m/s
(3) 41 m/s
(4) 280 m/s

5 The diagram below represents two forces, F_1 and F_2, acting concurrently on a block sliding on a horizontal, frictionless surface.



Which statement describes the motion of the block?

(1) The block is accelerating to the right.
(2) The block is accelerating to the left.
(3) The block is moving to the right with constant speed.
(4) The block is moving to the left with decreasing speed.

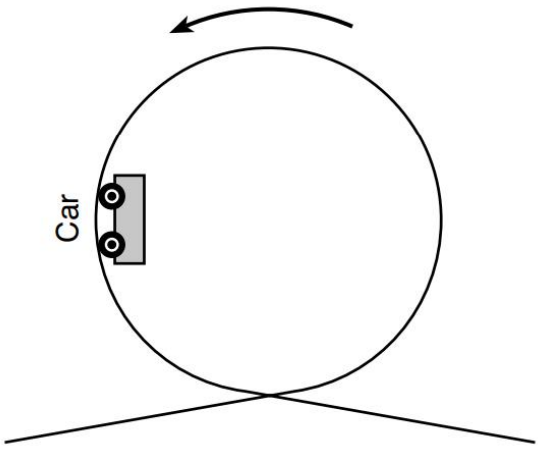
6 The magnitude of an unbalanced force applied to a 4.0-kilogram crate is 10. newtons. If the magnitude of this applied unbalanced force is doubled, the inertia of the crate is

(1) halved
(2) unchanged
(3) doubled
(4) quadrupled

7 A 60.-kilogram man is pushing a 30.-kilogram lawn mower. Compared to the magnitude of the force exerted on the lawn mower by the man, the magnitude of the force exerted on the man by the lawn mower is

(1) one-quarter as great
(2) one-half as great
(3) the same
(4) twice as great

8 The diagram below represents a roller coaster car traveling counterclockwise in a vertical circle.



When the car is in the position shown, what are the directions of the centripetal force acting on the car and the velocity of the car?

(1) The centripetal force is directed to the right and the velocity is directed downward.
(2) The centripetal force is directed downward and the velocity is directed to the right.
(3) The centripetal force and velocity are both directed to the right.
(4) The centripetal force and velocity are both directed downward.

9 An electric motor with a power rating of 6.48×10^4 watts is used to raise an elevator weighing 2.80×10^4 newtons at constant speed. What is the total time required for the motor to raise the elevator a vertical distance of 20.0 meters?

(1) 0.116 s
(2) 2.31 s
(3) 8.64 s
(4) 46.3 s

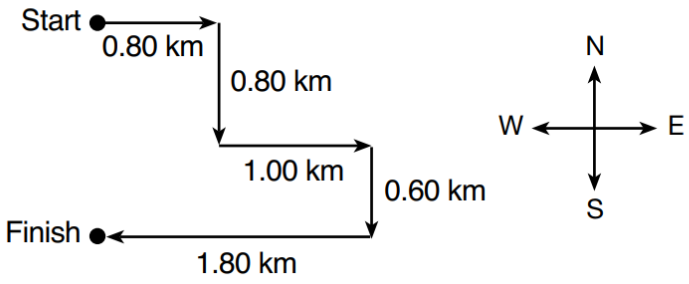
13 A net force of one newton will

(1) accelerate a 1-kg mass at 1.0 m/s^2
(2) accelerate a 1-kg mass at 9.8 m/s^2
(3) lift a l-kg mass vertically at a constant speed of 1.0 m/s
(4) lift a 1-kg mass vertically at a constant speed of 9.8 m/s

14 The elongation of a spring will be quadrupled if the magnitude of the force elongating the spring is

(1) quartered
(2) halved
(3) doubled
(4) quadrupled

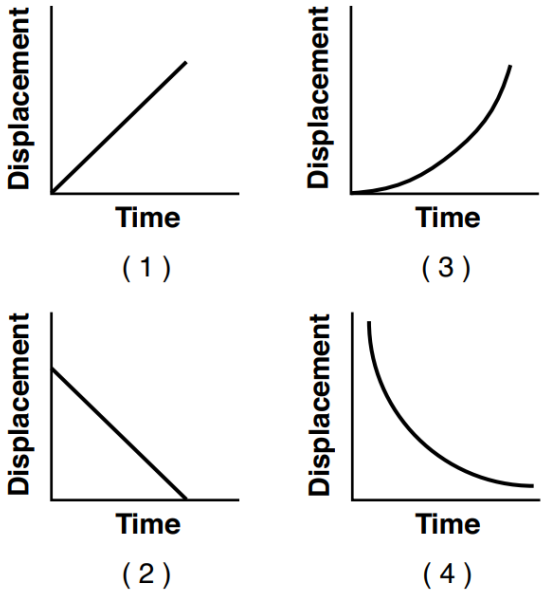
15 The vector diagram below represents the path and distances run by a student in a cross-country race.



The displacement of the student from start to finish is

(1) 1.40 km north
(2) 1.40 km south
(3) 5.00 km north
(4) 5.00 km south

36 Which graph best represents the motion of an object traveling at a constant positive velocity?



37 A cannonball is fired with an initial velocity of 100. meters per second at an angle of 15.0° above the horizontal. What are the horizontal (v_x) and vertical (v_y) components of this velocity?

(1) v_x = 96.6 m/s, v_y = 25.9 m/s
(2) v_x = 25.9 m/s, v_y = 96.6 m/s
(3) v_x = 76.0 m/s, v_y = 65.0 m/s
(4) v_x = 65.0 m/s, v_y = 76.0 m/s

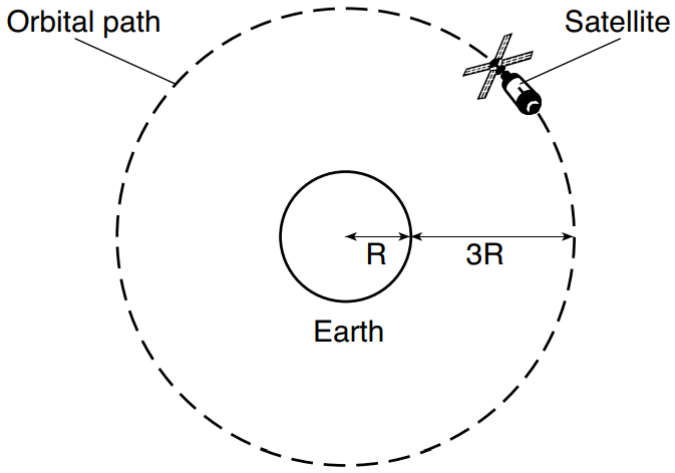
38 A 1200-kilogram car is moving at 10. meters per second when a braking force of 3000. newtons is applied. How much time is required to bring the car to rest?

(1) 0.40 s
(2) 2.5 s
(3) 25 s
(4) 4.0 s

40 A student uses a string to whirl a 0.25-kilogram mass in a horizontal circular path that has a 0.80-meter radius. If the magnitude of the centripetal force exerted on the mass with the string is 25 newtons, the speed of the mass is

(1) 2.8 m/s
(2) 8.9 m/s
(3) 11 m/s
(4) 80. m/s

42 A gravitational force of magnitude F exists between Earth and a satellite on Earth's surface. The satellite is sent into orbit at a distance of three Earth radii above Earth's surface, as shown in the diagram below.



What is the magnitude of the gravitational force between Earth and the satellite when the satellite is in orbit?

(1) $\frac{1}{16}F$
(2) $\frac{1}{9}F$
(3) $3F$
(4) $4F$

43 As part of an investigation on quantization, a student measured and recorded the mass of five identical containers, each holding a different number of pennies. The table shows the student's data.

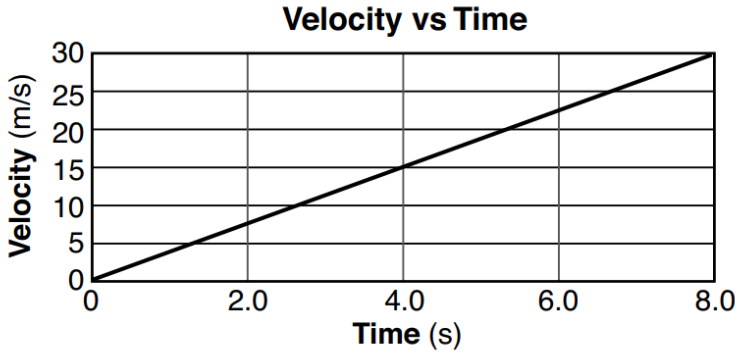
Data Table

Container	Mass (g)
1	35.2
2	64.0
3	48.0
4	38.4
5	41.6

Based on the data, what is the most likely mass of one penny?

(1) 3.2 g
(2) 6.4 g
(3) 9.6 g
(4) 12.8 g

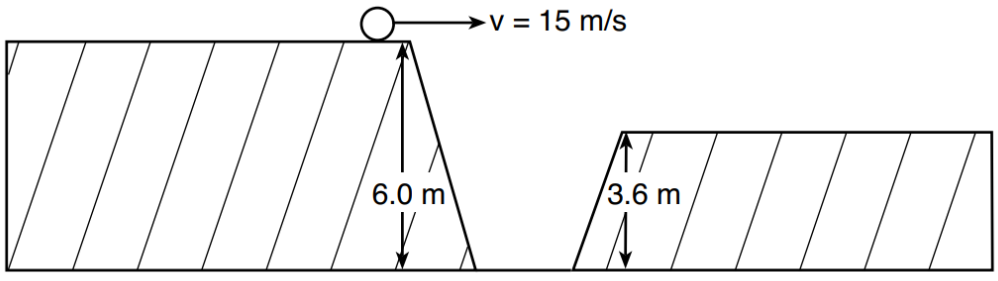
47 The graph below represents the motion of an airplane that starts from rest and takes off from a straight runway.



Which quantity is represented by the slope of the graph?

(1) total distance traveled
(2) displacement
(3) average speed
(4) acceleration

48 The diagram below represents two horizontal platforms that are at different heights above level ground. A ball rolls off the taller platform with a horizontal speed of 15 meters per second and travels through the air, landing on the top of the shorter platform.



What is the total time the ball is in the air? [Neglect friction.]

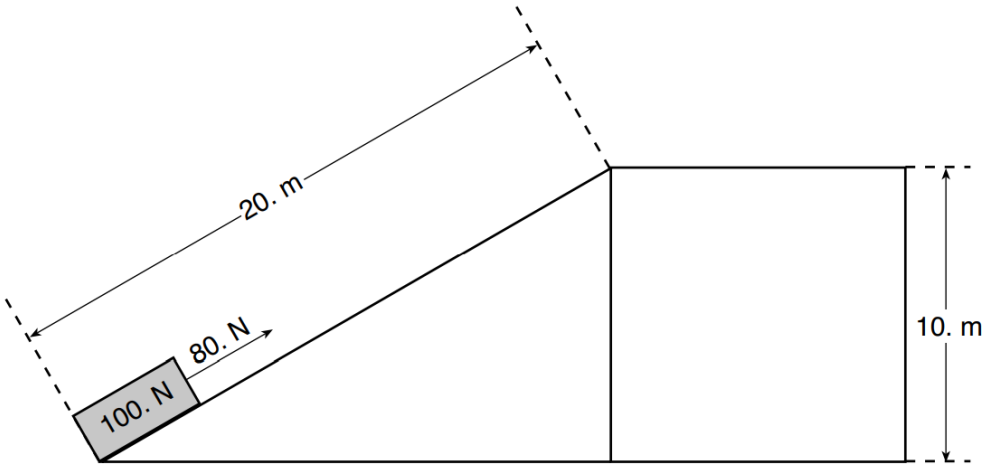
(1) 0.16 s
(2) 0.49 s
(3) 0.70 s
(4) 1.1 s

A 55-kilogram ice skater slides across a level ice surface and the force of friction acting on the skates has a magnitude of 11 newtons.

53 Determine the magnitude of the weight of the ice skater. [1]

54–55 Calculate the coefficient of kinetic friction between the ice skater and the ice. [Show all work, including the equation and substitution with units.] [2]

A 100.-newton box is pulled up a 20.-meter-long incline by a constant force of 80. newtons. The vertical height gained by the box is 10. meters.

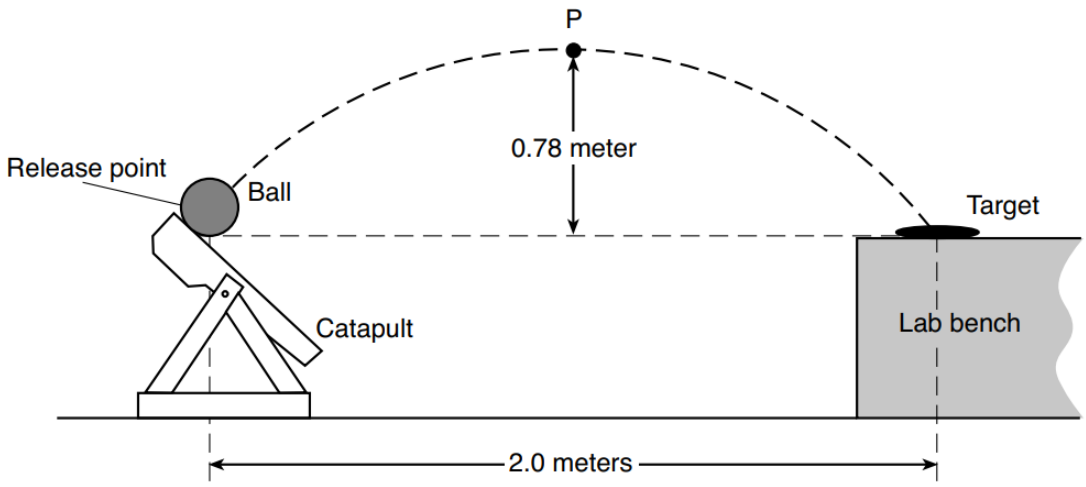


58 Determine the total work done, in joules, by the 80.-newton force in pulling the box to the top of the incline. [1]

59 Determine the total amount of gravitational potential energy, in joules, gained by the box as it is pulled to the top of the incline. [1]

60 Explain why there is a difference between the total work done by the 80.-newton force in pulling the box to the top of the incline and the amount of gravitational potential energy gained by the box as it was pulled to the top of the incline. [1]

A group of students constructs a catapult that launches a ball at a target placed on a lab bench. The students measure 0.80 second from the time the ball is released until it strikes the target, located a horizontal distance of 2.0 meters from the release point. The ball reaches a maximum height at point *P*, which is 0.78 meter above the ball's release point. The target is at the same height as the release point. [Neglect friction.]



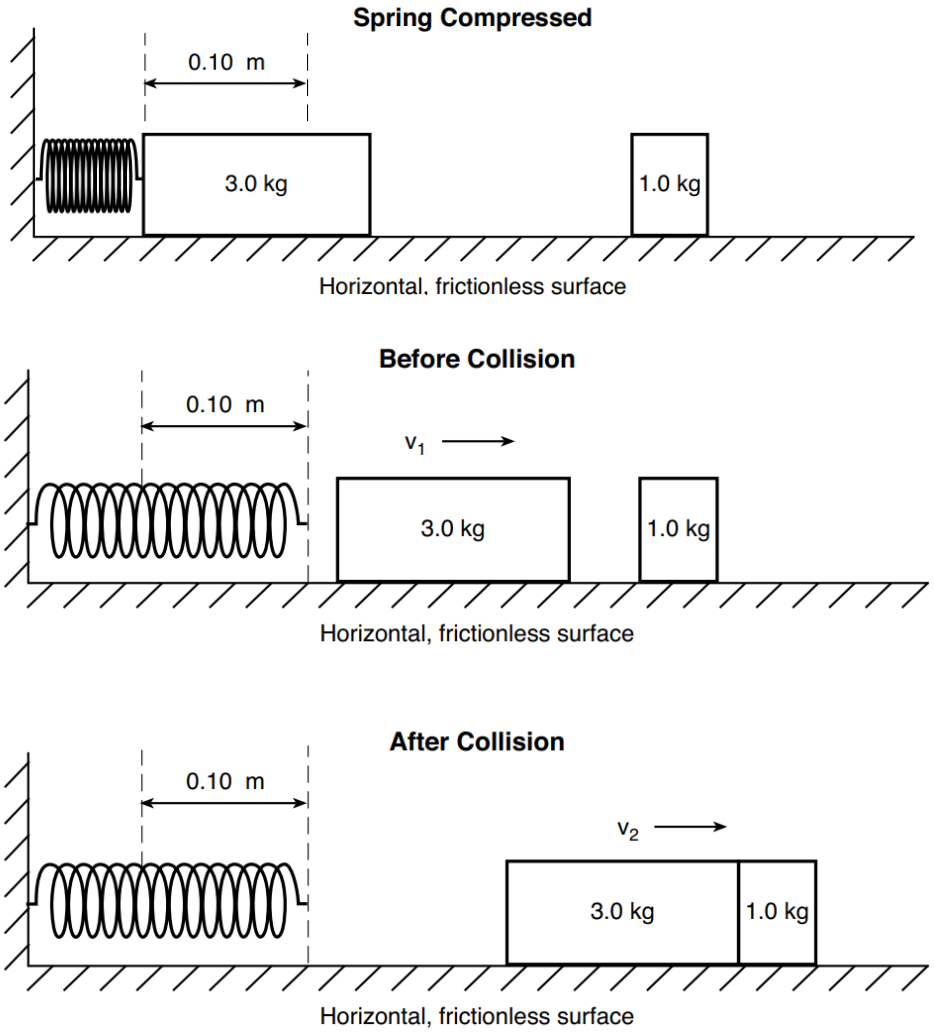
(Not drawn to scale)

66–67 Calculate the horizontal component of the ball's initial velocity. [Show all work, including the equation and substitution with units.] [2]

68–69 Calculate the vertical component of the ball's initial velocity. [Show all work, including the equation and substitution with units.] [2]

70 On the diagram *in your answer booklet*, draw an arrow originating at point *P* that represents the direction of the ball's acceleration at point *P*. [1]

A spring with a spring constant of 2600 newtons per meter is compressed 0.10 meter from its unstretched position. The spring is released, propelling a 3.0-kilogram block along a horizontal, frictionless surface. This block then collides with a stationary 1.0-kilogram block. The blocks remain joined and move together as shown in the diagram below.



71 Determine the total amount of elastic potential energy stored in the spring when the spring is compressed 0.10 meter. [1]

72–73 Assuming all of the spring's energy is transferred to the 3.0-kilogram block, calculate the speed, v_1, of the 3.0-kilogram block immediately after it is propelled by the spring. [Show all work, including the equation and substitution with units.] [2]

74–75 Calculate the speed, v_2, of the two blocks after the collision. [Show all work, including the equation and substitution with units.] [2]