Math Placement Exam

Topics that May Appear on the RIT Math Placement Exam

I. Algebra
Students should be able to
- Manipulate exponents
- Simplify algebraic expressions
- Perform operations with polynomials, including division with remainders
- Factor polynomials
- Complete the square
- Use Quadratic Formula
- Solve systems of equations
- Solve equations and inequalities
- Solve equations with rational expressions
- Construct algebraic expressions that represent quantities (word problems)

II. Functions
Students should be familiar with
- Domain and range
- Function notation and evaluation
- Function types, including
- absolute value
- polynomial
- rational
- exponential
- logarithmic
- trigonometric
- Composition of functions
- Graphs of functions

III. Trigonometry
Students should be familiar with
- Pythagorean Theorem
- Radian measure
- Unit circle / reference angles
- Sine, cosine, tangent of any angle
- Law of Cosines and Law of Sines

IV. Geometry

Students should be familiar with
- Equations of lines and parabolas
- Similar triangles
- Areas of simple figures, such as triangles, rectangles, trapezoids, and circles
- Volumes of simple solids, such as a box, a cylinder, or sphere

Sample Test for Mathematics
Rochester Institute of Technology, Dubai
Student's Name:
Students' ID:

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the equation.

1) $1 - \dfrac{10}{7x} = \dfrac{8}{4}$

1) _____

   A) $\left\{ \dfrac{40}{7} \right\}$ B) $\{10\}$ C) $\left\{ -\dfrac{10}{7} \right\}$ D) $\left\{ \dfrac{10}{7} \right\}$

Match the equation of the parabola with the appropriate description.

2) $y - 8 = 2(x + 7)^2$

2) _____

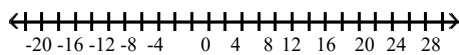   A) Vertex at (8, -7)   B) Vertex at (7, -8)
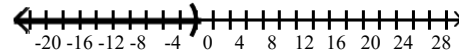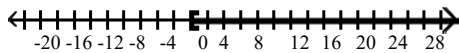   C) Vertex at (-7, 8)   D) Vertex at (-8, 7)

Solve and graph the inequality. Give answer in interval notation.

3) $\dfrac{x-1}{12} \geq \dfrac{x-2}{18} + \dfrac{1}{36}$
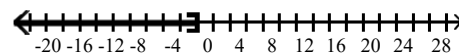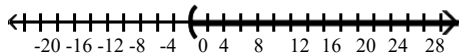
3) _____

   A) $[0, \infty)$ B) $(-\infty, 0)$

   C) $(0, \infty)$ D) $(-\infty, 0]$

We take $0 \leq t < \dfrac{\pi}{2}$ and sin t is given. Use the Pythagorean identity $\sin^2 t + \cos^2 t = 1$ to find cos t.

4) $\sin t = \dfrac{\sqrt{5}}{3}$

4) _____

   A) $\dfrac{3}{2}$ B) $\dfrac{\sqrt{5}}{2}$ C) $\dfrac{2\sqrt{5}}{5}$ D) $\dfrac{2}{3}$

Solve this equation.

5) $\sqrt{p^2 - 5p + 36} = p + 1$

5) _____

   A) $\left\{ -\dfrac{5}{2} \right\}$ B) $\{-5\}$ C) $\{5\}$ D) $\{6\}$

Evaluate the composition of functions.

6) Let $f(x) = x^2 + 4$ and $g(x) = 3x + 5$. Find $(g \circ f)(6)$.

6) _____

   A) 115   B) 125   C) 45   D) 533

Solve the problem.

7) $4(5 - 3x) = \dfrac{1}{256}$　　　　　　　　　　　　　　　　　　　7) _____

　　A) $\left\{\dfrac{8}{3}\right\}$　　　　　B) $\left\{-\dfrac{1}{64}\right\}$　　　　　C) $\{-3\}$　　　　　D) $\left\{\dfrac{3}{4}\right\}$

Solve the given equation for x.

8) $\log_4 \sqrt{4^3} = x$　　　　　　　　　　　　　　　　　　　8) _____

　　A) $\{\sqrt{3}\}$　　　　　B) $\left\{\dfrac{3}{2}\right\}$　　　　　C) $\{12\}$　　　　　D) $\left\{\dfrac{2}{3}\right\}$

Rewrite the given expression as a single logarithm. Assume that all variables are defined in such a way that variable expressions are positive and bases are positive numbers not equal to 1.

9) $(\log_x x - \log_x y) + 2 \log_x z$　　　　　　　　　　　　　9) _____

　　A) $\log_x xz^2 y$　　　　B) $\log_x \dfrac{xz^2}{y}$　　　　C) $\log_x \dfrac{2xz}{y}$　　　　D) $\log_x \dfrac{x}{z2y}$

Use the LCD to clear fractions and solve the given equation.

10) $\dfrac{x}{7} = \dfrac{x}{3} + \dfrac{10}{7}$　　　　　　　　　　　　　　　　　10) _____

　　A) -15^2　　　　B) 0　　　　C) $-\dfrac{15}{2}$　　　　D) $-\dfrac{10}{7}$

Solve for y, as appropriate.

11) $\ln(y - 9) - \ln 7 = x + \ln x$　　　　　　　　　　　　　　11) _____

　　A) $7xe^x + 9$　　　B) $e^x + 7x + 9$　　　C) $(x + 7)e^x + 9$　　　D) $2x + 16$

Factor the polynomial completely, given that the binomial is a factor.

12) $x - 7, \ x^3 + 5x^2 - 48x - 252$　　　　　　　　　　　　　12) _____

　　A) $(x - 7)(x^2 - 12x + 36)$　　　　　　　B) $(x + 7)(x - 6)(x - 6)$

　　C) $(x - 7)(x^2 + 36)$　　　　　　　　　　D) $(x - 7)(x + 6)(x + 6)$

Find all of the real and imaginary zeros for the polynomial function.

13) $f(x) = x^3 - 7x^2 + x - 7$　　　　　　　　　　　　　　　13) _____

　　A) $7, -i, i$　　　B) $-7, 7, i$　　　C) $-7, -i, i$　　　D) $-1, 1, 7$

Use division to write the rational expression in the form quotient + remainder/divisor.

14) $\dfrac{x^2 + 10x + 19}{x + 7}$　　　　　　　　　　　　　　　14) _____

　　A) $x + 4$　　　B) $x + 3 - \dfrac{2}{x + 7}$　　　C) $x + 3 + \dfrac{2}{x + 7}$　　　D) $\dfrac{x + 3}{x + 7}$

Solve the problem.

15) The polynomial function $I(t) = -0.1t^2 + 1.4t$ represents the yearly income (or loss) from a real estate investment, where t is time in years. After what year does income begin to decline?　　15) _____

　　A) 7　　　B) 9.33　　　C) 14　　　D) 6

Use ordinary division of polynomials to find the quotient and remainder when the first polynomial is divided by the second.

16) $x^4 + 5x^3 + 5x^2 + 5x + 4$, $x^2 + 1$

16) _____

    A) $x^2 - 5x + 4$ B) $x^2 - 5x + 4$; $20x - 16$

    C) $x^2 + 5x + 4$; $20x - 16$ D) $x^2 + 5x + 4$

Find all real solutions to the equation.

17) $(x - 1)^{-1/2} = \dfrac{1}{3}$

17) _____

    A) $\left\{\dfrac{1}{3}\right\}$ B) $\{10\}$ C) $\{8\}$ D) $\left\{\dfrac{8}{9}\right\}$

Find all real and imaginary solutions to the equation.

18) $(2m + 1)^2 - 4(2m + 1) - 21 = 0$

18) _____

    A) $\{2,3\ \}$ B) $\{-4\ \ \}$ C) $\{-7, 3\}$ D) $\{4,3\ \}$

Solve the absolute value equation.

19) $\left| x^2 + 3x - 20 \right| = 20$

19) _____

    A) $\{-5, 8\}$ B) $\{-8, 5\}$ C) $\{-3, 0\}$ D) $\{-8, -3, 0, 5\}$

Find the domain and range of the function.

20) $f(x) = -2 + \sqrt{x}$

20) _____

    A) D: $[0,\infty)$, R: $(-\infty, \infty)$ B) D: $(-\infty, \infty)$, R: $[-2,\infty)$

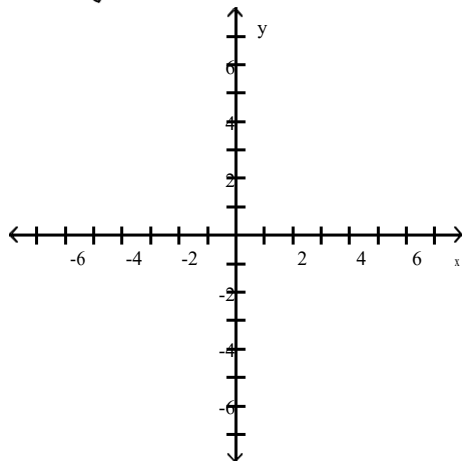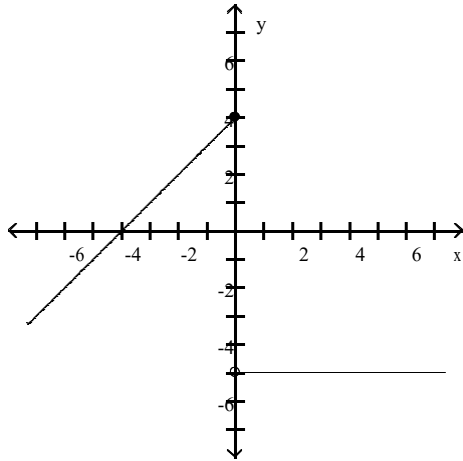   C) D: $[0,\infty)$, R: $[-2,\infty)$ D) D: $(-\infty,0]$, R: $(-\infty,-2]$

Graph the function.

21) $g(x) = \begin{cases} -5 & x \le 0 \\ x + 4, & x > 0 \end{cases}$

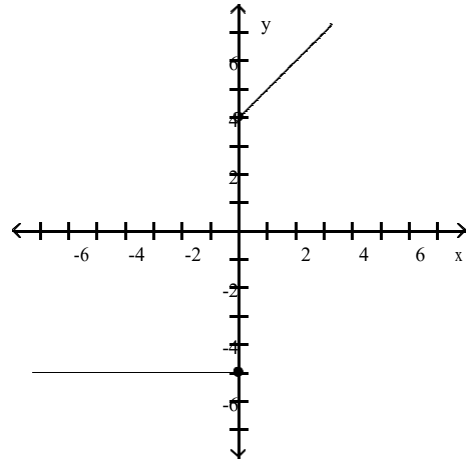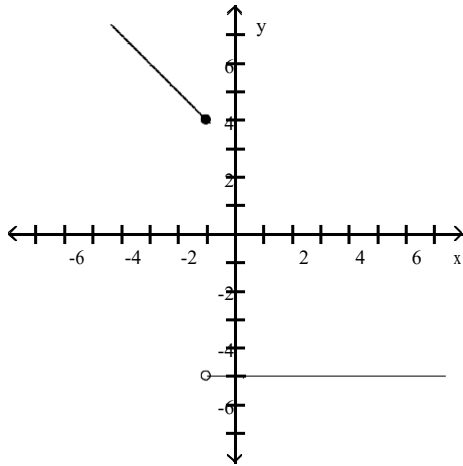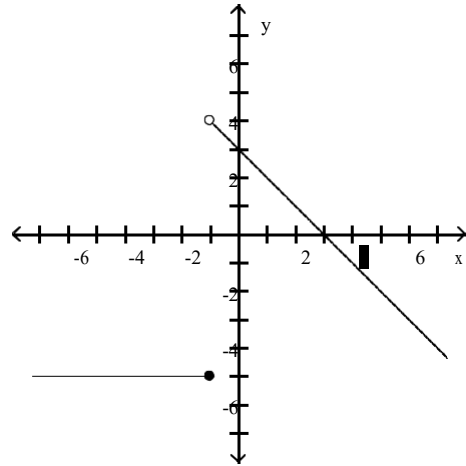21) _____

A)

B)

C)

D)

Graph the function. Determine the symmetry, if any, of the function.

22) $y = (-x)^{3/2}$

22) _____

4
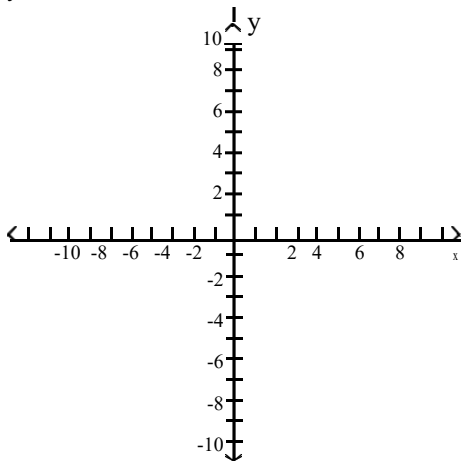
A) Symmetric about the y-axis
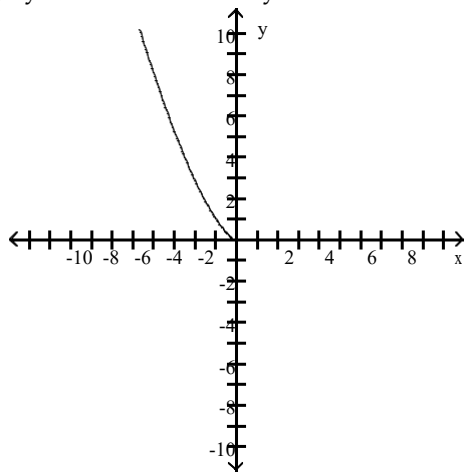
B) No symmetry
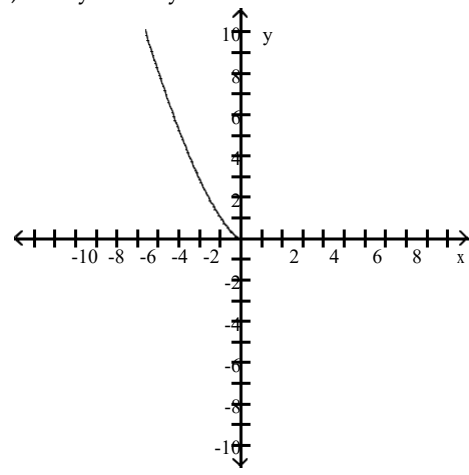
C) No symmetry
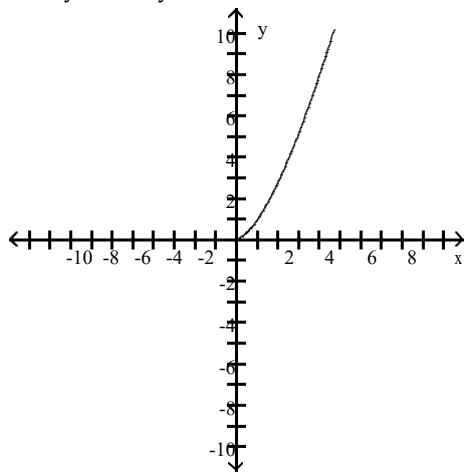
D) Symmetric about the y-axis
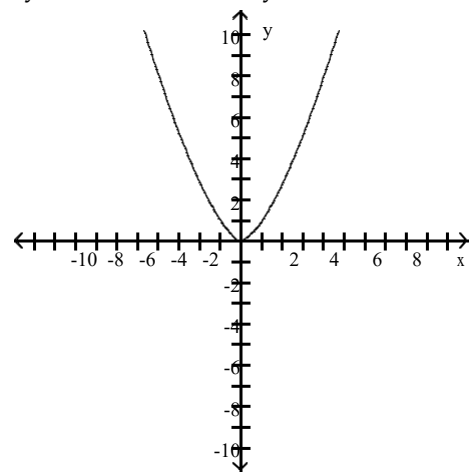
Match the equation with its graph.

23) $y = 4^x$

23) _____

A)
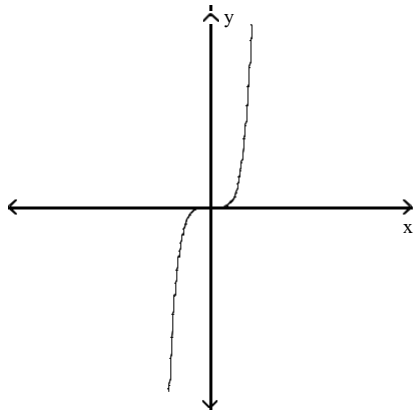
B)
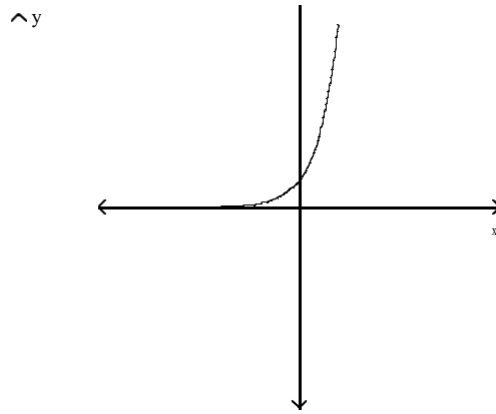
C)
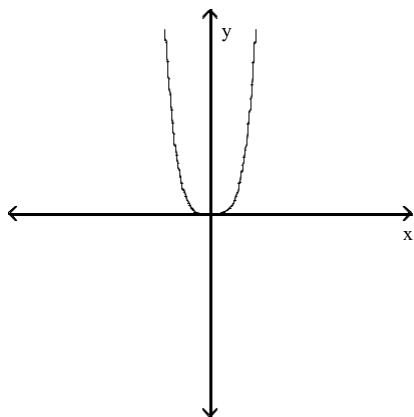
D)
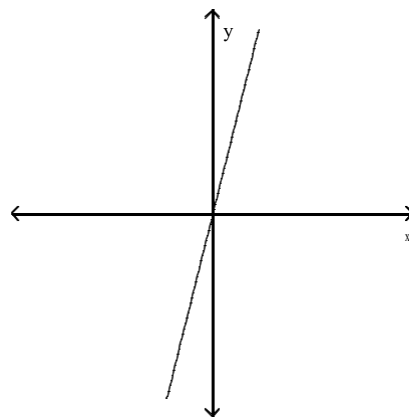
Solve the problem.

24) The accompanying figure shows the graph of $y = x^2$ shifted to a new position. Write the equation for the new graph.

24) _____
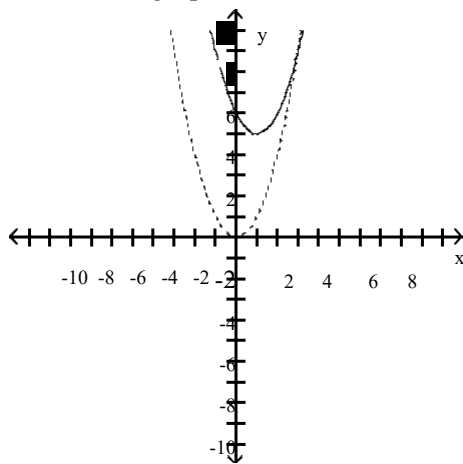
A) $y = (x - 5)^2 - 1$ B) $y = (x - 1)^2 - 5$ C) $y = (x + 1)^2 + 5$ D) $y = (x - 1)^2 + 5$

The problem tells how many units and in what direction the graph of the given equation is to be shifted. Give an equation for the shifted graph. Then sketch the original graph with a dashed line and the shifted graph with a solid line.

6

25) $y = x^3$ Down 4, left 4
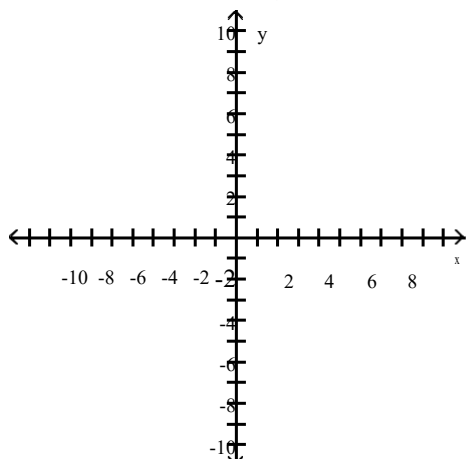
A) $y - 4 = (x + 4)^3$
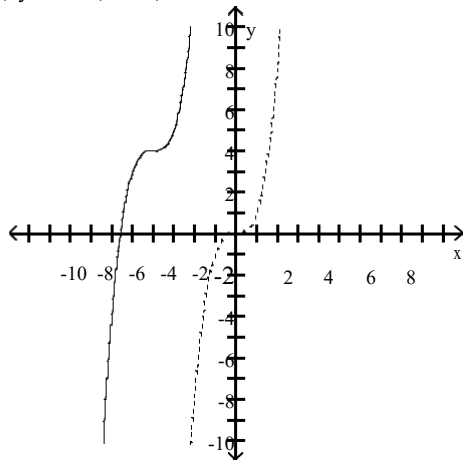
B) $y - 4 = (x - 4)^3$
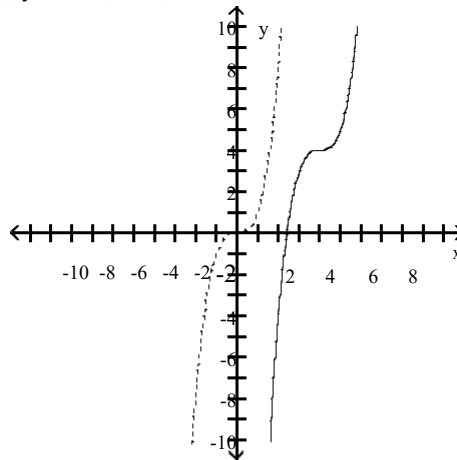
C) $y + 4 = (x - 4)^3$
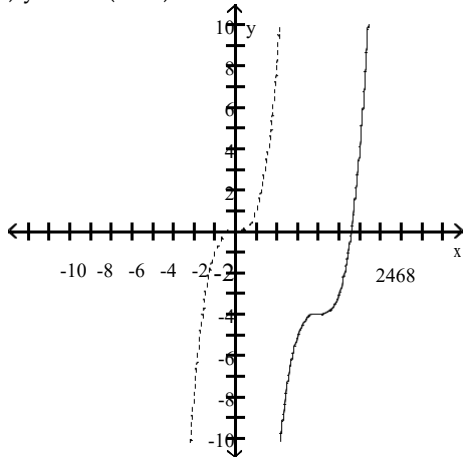
D) $y + 4 = (x + 4)^3$
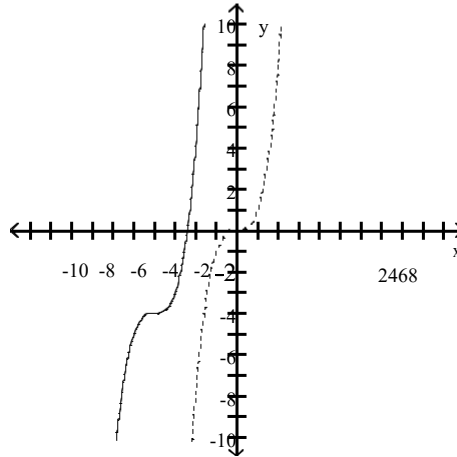
Match the equation of the ellipse with the appropriate description.

26) $\dfrac{x^2}{25} = 1 - \dfrac{y^2}{49}$

A) x-intercepts ±7; y-intercepts ±5
B) x-intercepts ±49; y-intercepts ±25
C) x-intercepts ±5; y-intercepts ±7
D) x-intercepts ±25; y-intercepts ±49

Choose the equation that matches the graph.

27)
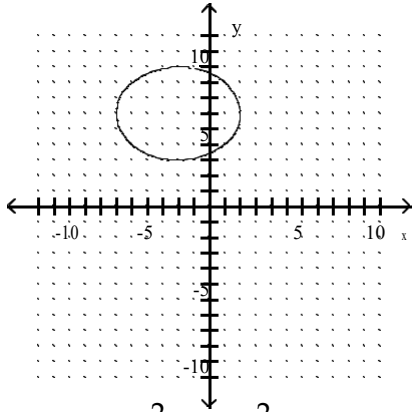
A) $\dfrac{(x+2)^2}{9} + \dfrac{(y-6)^2}{16} = 1$

B) $\dfrac{(x+2)^2}{16} - \dfrac{(y-6)^2}{9} = 1$

C) $\dfrac{(x+2)^2}{16} + \dfrac{(y-6)^2}{9} = 1$

D) $\dfrac{(y-6)^2}{9} - \dfrac{(x+2)^2}{16} = 1$

Solve the problem.

28) A tunnel is in the shape of a parabola. The maximum height is 27 m and it is 19 m wide at the base. What is the vertical clearance 8 m from the edge of the tunnel?
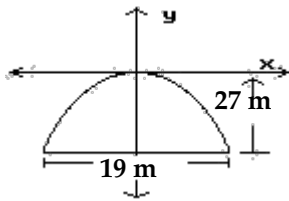
A) 26.3 m   B) 26.2 m   C) 0.7 m   D) 0.8 m

Write an equation for the hyperbola.

29) vertices at (-5, 2) and (-1, 2), passing through the point (-6, 4)

A) $\dfrac{(x+3)^2}{4} - \dfrac{(y-2)^2}{\frac{36}{5}} = 1$

B) $\dfrac{(x+3)^2}{4} - \dfrac{(y-2)^2}{\frac{16}{5}} = 1$

C) $\dfrac{(x+3)^2}{\frac{36}{5}} - \dfrac{(y-2)^2}{4} = 1$

D) $\dfrac{(x+3)^2}{\frac{16}{5}} - \dfrac{(y-2)^2}{4} = 1$

Factor by grouping.

30) $6x^4 - 10x^2y^5 + 9x^2y^5 - 15y^{10}$

A) $(6x^2 + 3y^5)(x^2 - 5y^5)$

B) $(2x^2 + 3y^5)(3x^2 - 5y^5)$

C) $(2x^2 + 3y)(3x^2 - 5y^{10})$

D) $(2x^2 - 3y^5)(3x^2 + 5y^5)$

Answer Key

1) C
2) C
3) A
4) D
5) C
6) B
7) D
8) B
9) B
10) C
11) A
12) D
13) A
14) B
15) A
16) D
17) B
18) A
19) D
20) C
21) B
22) B
23) B
24) D
25) D
26) C
27) C
28) A
29) B
30) B

Topics that May Appear on RIT-Dubai Physics Placement Exam

Physics and Measurement
Standards of Length, Mass, and Time
Conversion of Units

Motion in One Dimension
Position, Velocity, and Speed
Particle Under Constant Velocity
Acceleration
Particle Under Constant Acceleration
Freely Falling Objects
Kinematic Equations

Motion in Two Dimensions
Projectile Motion
Uniform Circular Motion

The Laws of Motion
The Concept of Force
Newton's First Law and Inertial Frames
Mass
Newton's Second Law
The Gravitational Force and Weight
Newton's Third Law
Analysis Models Using Newton's Second Law
Forces of Friction

Mechanical Energy
Work Done by a Constant Force
Kinetic Energy and the Work–Kinetic Energy Theorem
Potential Energy

Conservation of Energy
Power

Linear Momentum and Collisions
Linear Momentum
Collisions in One Dimension

Rotation of a Rigid Object About a Fixed Axis
Torque
Rigid Object Under a Net Torque

Universal Gravitation
Newton's Law of Universal Gravitation

The Principles of Ray Optics
Reflection
Refraction
Total Internal Reflection

Image Formation
Images Formed by Flat Mirrors
Images Formed by Spherical Mirrors
Images Formed by Thin Lenses

Topics that May Appear on RIT-Dubai Physics Placement Exam

Electric Fields
Properties of Electric Charges
Charging Objects by Induction
Coulomb's Law
The Electric Field
Electric Field of a Continuous Charge Distribution
Electric Field Lines
Motion of a Charged Particle in a Uniform Electric Field

Gauss's Law
Electric Flux
Gauss's Law
Conductors in Electrostatic Equilibrium

Electric Potential
Electric Potential and Potential Difference
Potential Difference in a Uniform Electric Field
Electric Potential and Potential Energy Due to Point Charges

Capacitance
Definition of Capacitance
Calculation of Capacitance
Combinations of Capacitors

Current and Resistance
Electric Current
Resistance
Resistance and Temperature
Superconductors
Electrical Power

Direct-Current Circuits
Electromotive Force
Resistors in Series and Parallel
Kirchhoff's Rules

Magnetic Fields
Magnetic Fields and Forces
Motion of a Charged Particle in a Uniform Magnetic Field
Magnetic Force Acting on a Current-Carrying Conductor

Sources of the Magnetic Field
The Magnetic Force Between Two Parallel Conductors
Ampère's Law
The Magnetic Field of a Solenoid

Faraday's Law
Faraday's Law of Induction
Motional emf
Lenz's Law
Induced emf and Electric Fields
Generators and Motors

Inductance
Self-Induction and Inductance

MULTIPLE CHOICE

1) Suppose that a car traveling to the west (the -x direction) begins to slow down as it approaches a   1) _____
traffic light. Which statement concerning its acceleration in the x direction is correct?
     A) Its acceleration is negative but its velocity is positive.
     B) Its acceleration is positive but its velocity is negative.
     C) Both its acceleration and its velocity are positive.
     D) Both its acceleration and its velocity are negative.
----

2) Suppose that an object is moving with constant nonzero acceleration. Which of the following is an   2) _____
accurate statement concerning its motion?
     A) In equal times it moves equal distances.
     B) In equal times its velocity changes by equal amounts.
     C) A graph of its velocity as a function of time is a horizontal line.
     D) A graph of its position as a function of time has a constant slope.
     E) In equal times its speed changes by equal amounts.
----

3) If an object travels at a constant speed in a circular path, the acceleration of the object is   3) _____
     A) in the same direction as the velocity of the object.
     B) in the opposite direction of the velocity of the object.
     C) larger in magnitude the smaller the radius of the circle.
     D) zero.
     E) smaller in magnitude the smaller the radius of the circle.
----

4) The acceleration due to gravity is lower on the Moon than on Earth. Which one of the following   4) _____
statements is true about the mass and weight of an astronaut on the Moon's surface, compared to
Earth?
     A) Both mass and weight are less.   B) Mass is less, weight is the same.
     C) Both mass and weight are the same.   D) Mass is the same, weight is less.
----

5) An object of weight W is in freefall close to the surface of Earth. The magnitude of the force that   5) _____
the object exerts on Earth is
     A) less than W.
     B) zero.
     C) cannot be determined without knowing the relative masses of the object and the earth.
     D) equal to W.
     E) greater than W.
----

6) Which one has larger kinetic energy: a 500-kg object moving at 40 m/s or a 1000-kg object moving   6) _____
at 20 m/s?
     A) The 500-kg object
     B) The 1000-kg object
     C) Both have the same kinetic energy.
----

7) You swing a bat and hit a heavy box with a force of 1500 N. The force the box exerts on the bat is   7) _____
     A) exactly 1500 N whether or not the box moves.
     B) greater than 1500 N if the box moves.
     C) greater than 1500 N if the bat bounces back.
     D) less than 1500 N if the box moves.
     E) exactly 1500 N only if the box does not move.
----

8) A baseball is thrown vertically upward and experiences no air resistance. As it rises
    A) its kinetic energy is conserved, but its momentum is not conserved.
    B) its gravitational potential energy is not conserved, buts its momentum is conserved.
    C) its momentum is not conserved, but its mechanical energy is conserved.
    D) both its momentum and its kinetic energy are conserved.
    E) both its momentum and its mechanical energy are conserved.

8) _____

----

9) In an INELASTIC collision between two objects
    A) the kinetic energy of each object is conserved.
    B) the momentum of the system is conserved but the kinetic energy of the system is not conserved.
    C) the momentum of each object is conserved.
    D) both the momentum and the kinetic energy of the system are conserved.
    E) the kinetic energy of the system is conserved, but the momentum of the system is not conserved.

9) _____

----

10) A ray of light goes from one transparent material into another, as shown in the figure. What can you conclude about the indices of refraction of these two materials?

10) _____
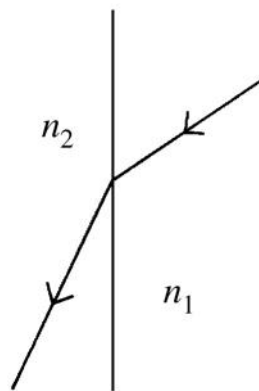
    A) $n2 \geq n1$ B) $n1 \geq n2$ C) $n1 > n2$ D) $n1 = n2$ E) $n2 > n1$

----

11) When light goes from one material into another material having a HIGHER index of refraction
    A) its speed increases, its wavelength decreases, and its frequency stays the same.
    B) its speed and wavelength decrease, but its frequency stays the same.
    C) its speed decreases but its wavelength and frequency both increase.
    D) its speed decreases but its frequency and wavelength stay the same.
    E) its speed, wavelength, and frequency all decrease.

11) _____

----

12) As you walk away from a vertical plane mirror, your image in the mirror
    A) decreases in height.
    B) is always a real image, no matter how far you are from the mirror.
    C) changes from being a virtual image to a real image as you pass the focal point.
    D) may or may not decrease in height, depending on where the observer is positioned.
    E) is always the same height.

12) _____

----

13) An object is placed in front of a lens which forms an image of the object.
    A) If the image is real, then it is also upright.
    B) If the image is virtual, the lens must be a diverging lens.
    C) If the image is real, then it is also inverted.
    D) If the lens is convex, the image cannot be virtual.
    E) If the image is virtual, then it is also inverted.

13) _____

----

14) Two identical small charged spheres are a certain distance apart, and each one initially   14) _____
experiences an electrostatic force of magnitude F due to the other. With time, charge gradually
leaks off of both spheres. When each of the spheres has lost half its initial charge, the magnitude
of the electrostatic force will be
   A) 1/4 F.   B) 1/2 F.   C) 1/16 F.   D) 1/8 F.

----

15) The figure shows two unequal point charges, q and Q, of opposite sign. Charge Q has greater   15) _____
magnitude than charge q. In which of the regions X, Y, Z will there be a point at which the net
electric field due to these two charges is zero?
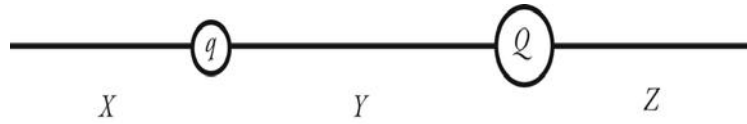
   A) only region Y
   B) only regions X and Z
   C) only region X
   D) only region Z
   E) all three regions

----

16) A negative charge is moved from point A to point B along an equipotential surface. Which of the   16) _____
following statements must be true for this case?
   A) No work is required to move the negative charge from point A to point B.
   B) The work done on the charge depends on the distance between A and B.
   C) Work is done in moving the negative charge from point A to point B.
   D) The negative charge performs work in moving from point A to point B.
   E) Work is required to move the negative charge from point A to point B.

----

17) A negative charge, if free, will tend to move   17) _____
   A) toward infinity.
   B) away from infinity.
   C) from low potential to high potential.
   D) from high potential to low potential.
   E) in the direction of the electric field.

----

18) An electron is initially moving to the right when it enters a uniform electric field directed   18) _____
upwards. Which trajectory shown below will the electron follow?
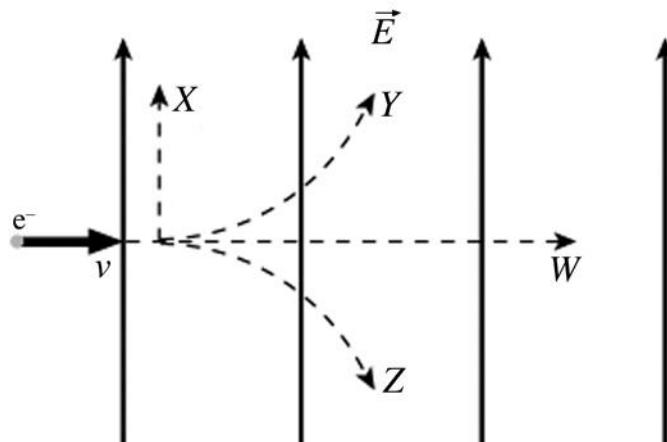
   A) trajectory X B) trajectory Z C) trajectory W D) trajectory Y

----

19) Suppose a region of space has a uniform electric field, directed towards the right, as shown in the figure. Which statement about the electric potential is true?

19) _____
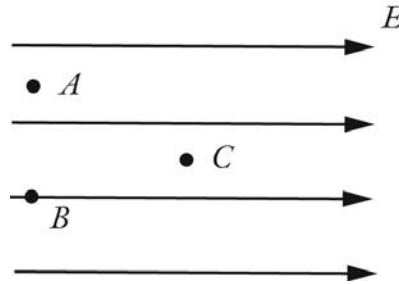
A) The potential at points A and B are equal, and the potential at point C is higher than the potential at point A.

B) The potential at points A and B are equal, and the potential at point C is lower than the potential at point A.

C) The potential at point A is the highest, the potential at point B is the second highest, and the potential at point C is the lowest.

D) The potential at all three locations (A, B, C) is the same because the field is uniform.

----

20) Which of the following will increase the capacitance of a parallel-plate capacitor?

20) _____

A) a decrease in the potential difference between the plates

B) an increase in the potential difference between the plates

C) an increase in the charge on the plates

D) an increase in the plate area and a decrease in the plate separation

E) a decrease in the plate area and an increase in the plate separation

----

21)

21) _____
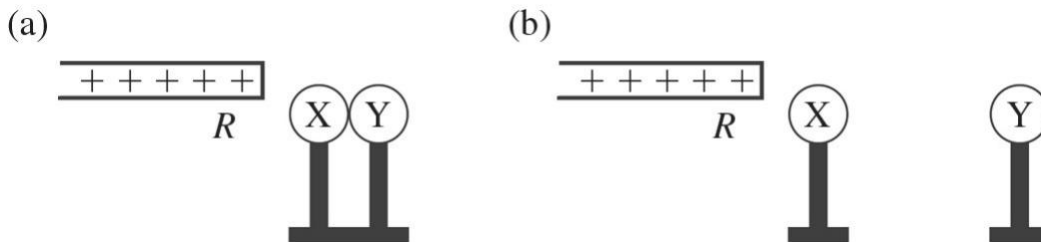
X and Y are two initially uncharged metal spheres on insulating stands, and they are in contact with each other. A positively charged rod R is brought close to X as shown in part (a) of the figure. Sphere Y is now moved away from X, as shown in part (b). What are the final charge states of X and Y?

A) X is positive and Y is neutral.

B) Both X and Y are negative.

C) Both X and Y are neutral.

D) X is neutral and Y is positive.

E) X is negative and Y is positive.

----

22) Identical ideal batteries are connected in different arrangements to the same light bulb, as shown   22) _____
in the figure. For which arrangement will the bulb shine the *brightest*?

A)A B)B C)C --- 23) Consider
two copper wires of equal cross-sectional area. One wire has 3 times the length of the other. How do
the resistivities of these two wires compare?   23) _____

A) The longer wire has 3 times the resistivity of the shorter wire.
B) The longer wire has 27 times times the resistivity of the shorter wire.
C) The longer wire has 9 times times the resistivity of the shorter wire.
D) Both wires have the same resistivity.
----

24) Which one of the following quantities is equivalent to 1 Ω?   24) _____
   A) 1 J/s   B)1V·A   C) 1 A · s   D) 1 W/A   E) 1 V/A
----

25) What fundamental fact underlies the operation of essentially all electric motors?   25) _____
A) Iron is the only element that is magnetic.
B) A magnetic north pole carries a positive electric charge, and a magnetic south pole carries
   a negative electric charge.
C) A current-carrying conductor placed perpendicular to a magnetic field will experience a
   force.
D) Opposite electric charges attract and like charges repel.
E) Alternating current and direct current are both capable of doing work.
----

26) What is the conversion factor between km/h and m/s?   26) _____
A) 3.60 (m/s)/(km/h)
B) 7.72×10^{-5} (m/s)/(km/h)
C) 16.7 (m/s)/(km/h)
D) 2.78×10^{-1} (m/s)/(km/h)
E) 1.30×10^{4} (m/s)/(km/h)
----

27) A bar magnet is oriented above a copper ring, as shown in the figure. If the magnet is pulled upward, what is the direction of the current induced in the ring, as viewed from above?

27) _____

   A) There is no current in the ring.
   B) counterclockwise
   C) clockwise

----

28) A 35-N bucket of water is lifted vertically 3.0 m and then returned to its original position. How much work did gravity do on the bucket during this process?

28) _____

   A) 180 J   B) 900 J   C)90J   D)45J   E)0J

----

29) A tiger is running in a straight line. If we double both the mass and speed of the tiger, the magnitude of its momentum will increase by what factor?

29) _____

   A) 4   B) 16   C) 8   D) 2   E) $\sqrt{2}$

----

30) An object is moving with constant non-zero velocity. Which of the following statements about it *must* be true?

30) _____

   A) A constant force is being applied to it in the direction opposite of motion.
   B) The net force on the object is zero.
   C) A constant force is being applied to it perpendicular to the direction of motion.
   D) A constant force is being applied to it in the direction of motion.
   E) Its acceleration is in the same direction as it velocity.

Answer Key

1) B
2) B
3) C
4) D
5) D
6) A
7) A
8) C
9) B
10) C
11) B
12) E
13) C
14) A
15) C
16) A
17) C
18) B
19) B
20) D
21) E
22) C
23) D
24) E
25) C
26) D
27) B
28) E
29) A
30) B