



# McRoberts Secondary



## Circular Motion and Gravity Test 2025-11-14



### Personal Data

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| Family Name: |
| Given Name:  |
| Signature:   |
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### Registration Number

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In this section **no** changes or modifications must be made!

### Scrambling

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Exam ID(Physics 12)

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**Only clearly marked and positionally accurate crosses will be processed!**

### Answers 1 - 15

|    | a                        | b                        | c                        | d                        |
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| 13 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|    | a                        | b                        | c                        | d                        |

### Answers 16 - 16

|    | a                        | b                        | c                        | d                        |
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| 16 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|    | a                        | b                        | c                        | d                        |





1. What are the units of  $G$ , the universal gravitational constant?
  - a.  $\text{m}^3 \text{kg}^{-1} \text{s}^{-2}$
  - b.  $\text{kg m/s}^2$
  - c.  $\text{m s}^{-2}$
  - d.  $\text{kg m/s}$
2. A 438-kg satellite is in a circular orbit at an altitude of 615 km around the earth. How much energy (kinetic and potential) would it release if it were to crash down onto the surface of the earth?
  - a. 18.6 GJ
  - b. 16.7 GJ
  - c. 14.9 GJ
  - d. 21.8 GJ
3. What is the escape speed on Mars? The mass of Mars is  $6.39 \times 10^{23} \text{ kg}$  and its radius is  $3.39 \times 10^6 \text{ m}$ .
  - a. 3.55 km/s
  - b. 2.59 km/s
  - c. 5.01 km/s
  - d. 4.13 km/s
4. An asteroid orbits the sun with a period of 2.36 years. What is the asteroid's average distance from the sun? Note: One astronomical unit (au) is the average distance from the earth to the sun.
  - a. 1.95 au
  - b. 1.29 au
  - c. 1.77 au
  - d. 1.59 au
5. A rocket is launched straight up from earth's surface at a speed of 22 km/s. What is its speed when it is very far away from the earth? Consider only the effect of the earth's gravity in your answer. The mass of the earth is  $5.97 \times 10^{24} \text{ kg}$  and its radius is  $6.38 \times 10^6 \text{ m}$ .
  - a. 20.8 km/s
  - b. 18.9 km/s
  - c. 19.4 km/s
  - d. 20.1 km/s
6. A pilot makes an outside vertical loop (in which the path of the plane traces out the top half of a circle with centre of the loop is beneath the plane) of radius 4888 m. At the top of his loop, he is pushing down on his seat with only  $1/3$  of his normal weight. How fast is he going?
  - a. 246 m/s
  - b. 179 m/s
  - c. 198 m/s
  - d. 267 m/s

7. An asteroid orbits the sun at an average distance of 19.8 au. What is the period of the asteroid's orbit? Note: One astronomical unit (au) is the average distance from the earth to the sun.
- 88.1 years
  - 67.5 years
  - 76.9 years
  - 116.4 years
8. What is the radius of the geosynchronous orbit around Jupiter? The mass of Jupiter is  $1.898 \times 10^{27}$  kg. A "day" on Jupiter lasts 9 hours and 55 minutes.
- $231 \times 10^3$  km
  - $187 \times 10^3$  km
  - $138 \times 10^3$  km
  - $160 \times 10^3$  km
9. An object is moving in a circle with a constant speed. Its acceleration is
- tangent to the circle.
  - opposite the direction of its velocity.
  - directed away from the centre of the circle.
  - directed towards the centre of the circle.
10. An object is moving in a circle with a constant speed. Its velocity is
- directed towards the centre of the circle.
  - in the same direction as its acceleration.
  - opposite the direction of its acceleration.
  - tangent to the circle.
11. A pilot, of mass  $m$ , executes a vertical dive, then follows a semi-circular arc until the plane is going straight up. Just as the plane is at its lowest point, the force that the pilot's seat exerts on him is
- less than  $mg$  and pointing up
  - less than  $mg$  and pointing down
  - more than  $mg$  and pointing up
  - more than  $mg$  and pointing down
12. The maximum speed around a level circular curve is 79.0 km/h. What is the maximum speed around a curve with 5 times the radius? Assume all other factors remain unchanged.
- 176.7 km/h
  - 64.0 km/h
  - 375.8 km/h
  - 35.3 km/h
13. A rock, of mass  $m$ , is attached to a string and whirled in a vertical circle of radius  $r$ . At the top of the circle, the tension in the string is 3 times the rock's weight. The rock's speed at this point is given by
- $\sqrt{4gr}$
  - $\sqrt{2gr}$
  - $\sqrt{3gr}$
  - $3\sqrt{gr}$

14. Consider a satellite moving in a circular orbit of radius  $r$  around a planet of mass  $M$ . Which expression gives the satellite's orbital speed?
- a.  $\sqrt{GM/r}$
  - b.  $GM/r$
  - c.  $\sqrt{Gr}$
  - d.  $GM/r^2$
15. Halley's comet is in a highly elliptical orbit around the sun. Its speed
- a. is constant.
  - b. increases as it nears the sun.
  - c. decreases as it nears the sun.
  - d. is zero when it reaches its furthest point from the sun.
16. A planet has 6 times the earth's mass and 6 times the earth's radius. If an object weighs 100 N on earth, how much would it weigh on this planet?
- a. 30.2 N
  - b. 26.6 N
  - c. 100.0 N
  - d. 16.7 N