Conservation of Energy

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1. A +130. µC charge with a mass of 12.5 grams is at rest 45.0 cm from a +390. µC fixed charge. The first charge is released from its position and flies away. What is its velocity when it is 95.0 cm from the second charge? What is its velocity when it is very far away? Assume that no other force acts on the moving charge. (292 m/s, 403 m/s)
2. A +160. µC charge with a mass of 230. g is approaching another fixed +160. µC charge directly. If it is moving at a speed of 34.0 m/s when it is 2.00 m away, what is its speed when it is 1.00 m away? how close will it get before it is stopped by the repulsion? What will be its speed later when it is very far away? Assume no other force acts on the moving charge. (12.5 m/s, 0.928 m, 46.4 m/s)
3. Two identical charges each with a charge of +45.0 µC and a mass of 56.0 grams are placed 34.0 cm from each other. If they are released simultaneously, what speed do they have when they are 50.0 cm from each other? What speed do they have when they are very far away? Assume no other forces act on the charges. (17.5 m/s, 30.9 m/s)
4. A charge of +46.0 µC is at rest 1.80 m from a -52.0 µC charge that is also at rest. Each charge has a mass of 48.0 g. If they are released simultaneously, what is their velocity when they are 1.00 m from each other? With what velocity do they collide if they each have a radius of 2.50 cm? (14.1 m/s, 93.3 m/s)
5. An alpha particle with a mass of 6.64x10-27 kg and a charge of +2e (e = 1.602x10-19 C) is needs what speed to get 1.30x10-15 m from a gold nucleus with a charge of +79e. Assume the gold nucleus does not move. (9.19x107 m/s)

**6 - 8: The mass of the moon: 7.35x1022 kg, The radius of the moon: 1.737x106 m**

1. A rifle bullet with a mass of 4.20 grams is fired straight up off the surface of the moon at a speed of 560. m/s. What is the greatest height the bullet will rise to above the surface before coming back down? What is its speed when is has gone 50.0 km straight up? What speed would the bullet need to be able to escape the gravity of the moon? (1.02x105 m, 394 m/s, 2380 m/s)
2. A 12.0 kg piece of rock headed directly toward the moon is going 870. m/s at an elevation of 100. km above the moon. With what speed does it strike the surface? What was its speed when it was 50.0 km above the surface? (1030 m/s, 952 m/s)
3. A 2.80 g rifle bullet leaves the surface of the moon with a speed of 1050 m/s going straight up. What is the greatest height it reaches? What is its height when it is going 780. m/s? What velocity is it going when it reaches a height of 300. km above the moon's surface? What speed would it need to escape the moon's gravity? What is its height when it is going only 100. m/s? (422 km, 167 km, 521 m/s, 2380 m/s, 417 km)
4. A 13,500 kg spaceship orbits a 4.50x1024 kg planet in an elliptical orbit. At one point, its speed is 6910 m/s when it is 7.60x106 m from the planet's center. If later in its orbit is moving 5440 m/s, what is its distance to the center of the planet? If part of its orbit is at a distance of 8.50x106 m from the center of the planet, what is the velocity of the spaceship? (9.87x106 m, 6280 m/s)
5. A 120. kg space probe orbits a 3.60x1024 kg planet in a circular orbit at a speed of 5660 m/s. What distance is it from the planet? What is its total energy (kinetic and potential) ? What speed would it need to escape gravity from this distance from the planet? What would its total energy be at this speed? Suppose it somehow attained escape velocity at this distance from the planet, and was escaping on some trajectory, at what distance from the planet's center would it be when it was going 4000. m/s? What would be its speed when it was 7.50x108 m from the planet? (7.50x106 m, -1.92x109 J, 8.00x103 m/s, 0 J, 3.00x107 m, 800. m/s)