Problems from A17.1 Energy:

$E_p = mV_g$ $E_p = qV_e$ $W = m\Delta V_g$ $W = q\Delta V_e$

1. A 2.30 kg mass is moved from a potential of 45.0 J/kg to -12.0 J/kg. What work was done? (-131 J)
2. A -1.20 μC charge is moved doing +47.0 J of work. What was the change in electrical potential? (-3.92×10^7 V or J/C)
3. You do +0.132 J of work moving a charge from a potential of +45.0 V to +12.0 V. What is the charge? (-4.00×10^{-3} C)
4. You do -62.0 J of work moving a mass from a potential of +78.0 J/kg to 53.0 J/kg. What is the mass? (2.48 kg)
5. A +3500. μC charge is moved doing -0.0780 J of work. If it started at a potential of 100. V, what was the final potential? (+77.7 V)
6. What work would you need to do to move a 2.30 kg mass from a potential of -895 J/kg to -145 J/kg? (+1725 J)
7. If you do +45.0 J of work moving a 15.0 kg mass, what is the change in potential? (+3.00 J/kg)
8. What work would you do moving a -4.50 μC charge from a potential of -120. V to a potential of +480. V? (-2.7×10^{-3} J)

$E_p = qV_e$ $E_k = \frac{1}{2}mv^2$ - Look up mass and charge in your data packet. Practice so you know where they are.

9. What is the velocity of an electron accelerated through 13.0 Volts from rest? (2.14×10^6 m/s)
10. Through what potential must you accelerate an electron from rest to make it go 3.80×10^5 m/s? (0.411 V)
11. What is the velocity of an electron accelerated through 820. Volts from rest? (1.70×10^7 m/s)
12. A particle with a charge of 0.0280 μC is accelerated through 1520 V from rest and ends up going 37.5 m/s. What is its mass? (6.05×10^{-8} kg)
13. A particle is accelerated through 1500. V and attains a velocity of 3.80×10^5 m/s. If it has a mass of 6.64×10^{-27} kg, what is the charge on it? (3.20×10^{-19} C)
14. What is the velocity of a proton accelerated through 150,000 V? (5.36×10^6 m/s)
15. A proton accelerated from rest is going 6.50×10^6 m/s. Through what voltage was it accelerated? (2.21×10^5 V)
16. What is the velocity of a proton accelerated through 5000. V? (9.79×10^5 m/s)

$E_k = \frac{1}{2}mv^2$, $E_p = -\frac{Gm_1m_2}{r}$ $E_p = \frac{kq_1q_2}{r}$

17. 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)
18. 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)
19. 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)
20. 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)
21. An alpha particle with a mass of 6.64×10^{-27} kg and a charge of +2e (e = 1.602×10^{-19} C) is needs what speed to get 1.30×10^{-15} m from a gold nucleus with a charge of +79e. Assume the gold nucleus does not move. (9.19×10^7 m/s)

6 - 8: The mass of the moon: 7.35×10^{22} kg, The radius of the moon: 1.737×10^6 m

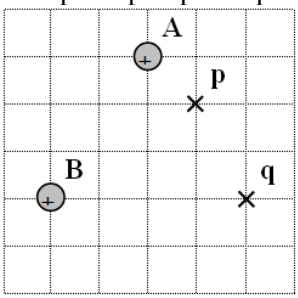
22. A rifle bullet with a mass of 4.20 grams is fired straight up off the surface of the moon at a speed of 560. m/s. What is the greatest height the bullet will rise to above the surface before coming back down? What is its speed when is has gone 50.0 km straight up? What speed would the bullet need to be able to escape the gravity of the moon? (1.02×10^5 m, 394 m/s, 2380 m/s)
23. 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)
24. 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)
25. A 13,500 kg spaceship orbits a 4.50×10^{24} kg planet in an elliptical orbit. At one point, its speed is 6910 m/s when it is 7.60×10^6 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 8.50×10^6 m from the center of the planet, what is the velocity of the spaceship? (9.87×10^6 m, 6280 m/s)

26. A 120. kg space probe orbits a 3.60×10^{24} 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 7.50×10^{8} m from the planet? (7.50×10^{6} m, -1.92×10^{9} J, 8.00×10^{3} m/s, 0 J, 3.00×10^{7} m, 800. m/s)

$V_e = \frac{kq}{r}$, $W = q\Delta V_e$ or $V_g = -\frac{GM}{r}$, $W = m\Delta V_g$ Potentials in an array add as scalars. (Numbers)

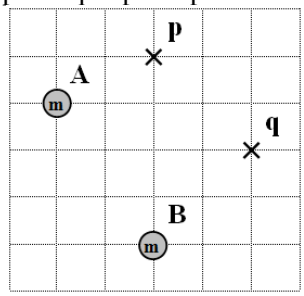
27. Each grid line is a meter. Calculate the potential at points p and q.

A. Charge A is +1.50 μC, B is +2.10 μC
What work would it take to move a -140. μC charge from point p to point q?



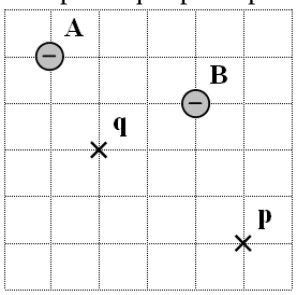
Vp: +1.48E+04 V, Vq: +8.46E+03 V, W: +0.884 J

B. Mass A is 5.40×10^{12} kg, mass B is 1.90×10^{12} kg
What work would it take to move a 1.70 kg mass from point q to point p?



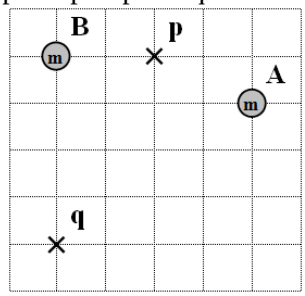
Vp: -193 J/kg, Vq: -132 J/kg, W = -103 J

C. Charge A is -6.30 μC, B is -1.10 μC
What work would it take to move a +520. μC charge from point q to point p?



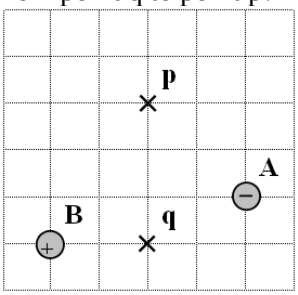
Vp: -1.31E+04 V, Vq: -2.98E+04 V, W: +8.64 J

D. Mass A is 5.10×10^{12} kg, mass B is 1.80×10^{12} kg
What work would it take to move a 2.90 kg mass from point p to point q?



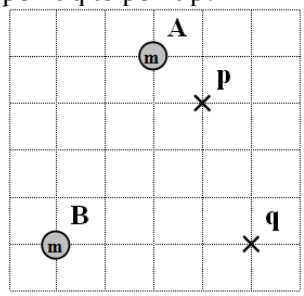
Vp: -212 J/kg, Vq: -98.0 J/kg, W: +331 J

E. Charge A is -3.20 μC, B is +2.50 μC
What work would it take to move a -640. μC charge from point q to point p?



Vp: -3.94E+03 V, Vq: -1.63E+03 V, W: +1.48 J

F. Mass A is 8.90×10^{12} kg, mass B is 2.70×10^{12} kg
What work would it take to move a 4.20 kg mass from point q to point p?



Vp: -462 J/kg, Vq: -178 J/kg, W: -1195 J