Problems from A16.2 Vector Fields:

$E = \frac{F}{q}$ $g = \frac{F}{m}$ $E = -\frac{\Delta V_e}{\Delta r}$ $g = -\frac{\Delta V_g}{\Delta r}$ (Assume all these fields are uniform)

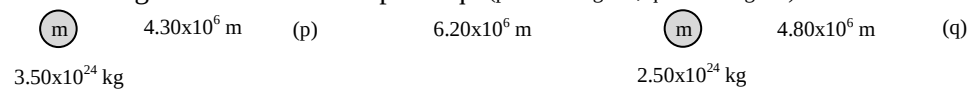
1. A gravitational field increases the potential of a mass from 35.0 J/kg at point A to 89.0 J/kg at point B in a vertical distance of 2.50 m. What is the field strength, and what force does it exert on a 23.0 kg mass? Does the field point toward B or A? (21.6 N/kg, 497 N, toward A)
2. An electric field exerts a Southerly force of 1.30 N on a +780. μC charge. What is the change in potential if you displace yourself 5.30 m to the north? (+8830 V)
3. A gravitational field exerts a force of 140. N on a 17.0 kg mass away from point B and toward point A that is vertically displaced from B a distance of 45.0 m. What is the field strength? What is the change in gravitational potential if you go from B to A? (8.24 N/kg, -371 J/kg)
4. An upward electric field has a strength of 23,400 N/C. What is the change in potential if you displace yourself upward 3.40 cm? What force will it exert on an electron? A proton? (-796 J/C or V, 3.75×10^{-15} N down, 3.75×10^{-15} N up)
5. If you move 12.0 m West in an electrical field, your electrical potential drops by 340. V. What is this electrical field? What force does this field exert on a charge of -56.0 μC? (28.3 V/m (or N/C) to the West, 1.59×10^{-3} N East)
6. A gravitational field has a strength of 1.10×10^{-7} N/kg to the right. If I move a mass 2.30 m to the left, what is the change in gravitational potential? What force does this exert on a 1.00 gram object? ($+2.53 \times 10^{-7}$ J/kg, 1.10×10^{-10} N)
7. An electrical field changes electrical potential from 210. V to 560. V when you move down 4.50 cm. What is the magnitude and direction of the electrical field, and what force does it exert on a +2.40 μC charge? (7780 V/m (or N/C) up, 0.0187 N up)
8. An electrical field exerts a force of 78.0 N to the left on a -12.0 μC charge. What is the magnitude and direction of this electrical field? What is the change in electrical potential if you move 13.0 cm to the left? (6.50×10^{6} N/C right, $+8.45 \times 10^{5}$ V)
9. The leftmost of two vertical parallel plates is held at -12.0 V, and the rightmost is held at +16.0 V. If they are separated by 3.20 cm, what is the electrical field between them? What force would it exert on an electron between the plates? (875 V/m to the left, 1.40×10^{-16} N to the right)
10. If you move a mass vertically from point A to point B in a uniform gravitational field, the potential changes from -45.0 J/kg to -12.0 J/kg in a distance of 3.40 m. What is the gravitational field strength, and which point is at a higher elevation, A or B? Does the field point toward A or B? What force does it exert on a 2.30 kg mass (g = 9.71 N/kg toward A, B is higher, 22.3 N)

$g = \frac{GM}{r^2}$ $E = \frac{kq}{r^2}$ (← not in data packet - memorize this!!!!)

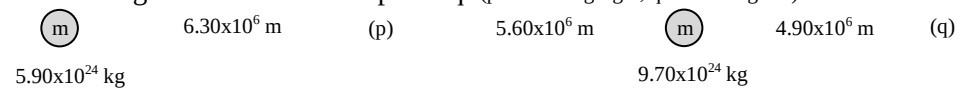
11. The electric field is 52.0 N/C downwards 54.0 cm above a charge. What is the charge, and is it positive or negative? (-1.69×10^{-9} C, negative)
12. What is the electric field 230. m above a +21.0 μC charge? What direction is it? (3.57 N/C up)
13. Near a -18.0 μC charge there is an upward electric field of 450. N/C. How far away is the point where this happens, and where is it, above or below the charge? (19.0 m, below)
14. There is an electric field of 310. N/C upwards 88.0 cm above an unknown charge. What is the charge, and is it positive or negative? (2.67×10^{-8} C, positive)
15. What is the electric field 2.70 m to the left of a +8.20 μC charge? What direction is it? (1.01×10^{4} N/C, left)
16. At what distance from the center of a 6.90×10^{24} kg planet is the gravitational field 4.50 N/kg? (1.01×10^{7} m)
17. What is the acceleration of gravity on the surface of a planet with a mass of 6.39×10^{23} kg and a radius of 3.39×10^{6} m? (Mars) (3.71 N/kg)
18. What is the gravitational field 4.50 m to the right of a 2.80×10^{12} kg point mass? What direction? (9.22 N/kg left)
19. Near a 3.40×10^{12} kg point mass there is a field of 5.60 N/kg to the left. What distance are we from the point mass, and where is the mass in relation to us? (6.36 m, the mass is to our left)
20. There is a gravitational field of 14.0 N/kg to the right, 7.20 m from a point mass. What is the mass, and where are we in relation to the mass? (1.09×10^{13} kg, we are to the left of the mass)

21.

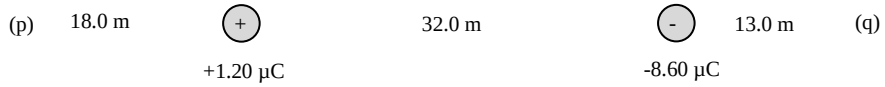
A. Find the gravitational field at p and q: (p: 8.29 N/kg left, q: 8.23 N/kg left)



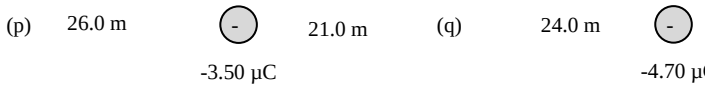
B. Find the gravitational field at p and q: (p: 10.7 N/kg right, q: 28.3 N/kg left)



C. Find the electrical field at p and q: (p: 2.37 N/C left, q: 452 N/C left)

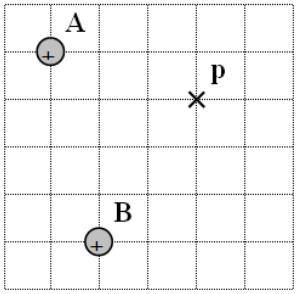


D. Find the electrical field at p and q: (p: 54.9 N/C right, q: 2.01 N/C right)



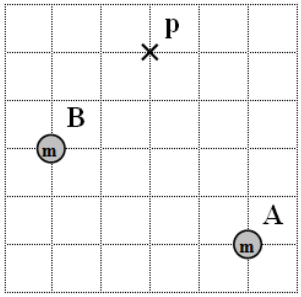
22. Each grid line is a meter. Calculate the field at point p.

A. Charge A is +1.30 µC, B is +3.10 µC



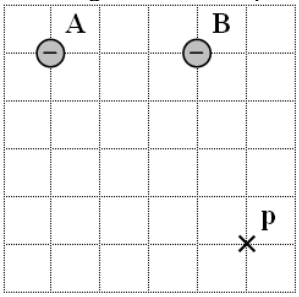
2698 N/C up and right at 31.6° with the x axis

B. Mass A is 9.40×10^{12} kg, mass B is 1.80×10^{12} kg



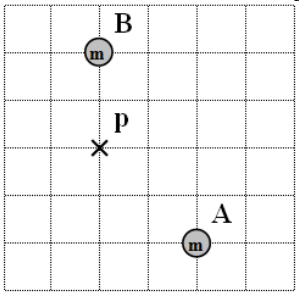
38.8 N/kg down and right (barely) at 85.0° with the x axis

C. Charge A is -6.50 µC, B is -4.10 µC



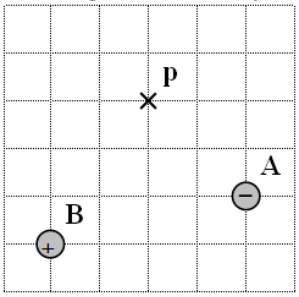
3850 N/C, up and left at 61.8° with the x axis

D. Mass A is 1.40×10^{12} kg, mass B is 1.20×10^{12} kg



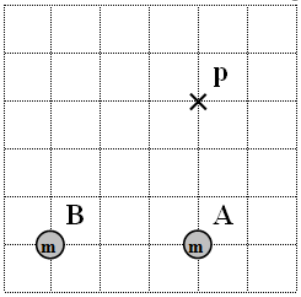
14.4 N/kg to the right and up at 54.9° with the x axis

E. Charge A is -3.70 µC, B is +5.30 µC



4970 N/C right and up (barely) at 1.26° with the x axis

F. Mass A is 2.90×10^{12} kg, mass B is 8.70×10^{12} kg



49.8 N/kg left and down at 62.8° with the x axis