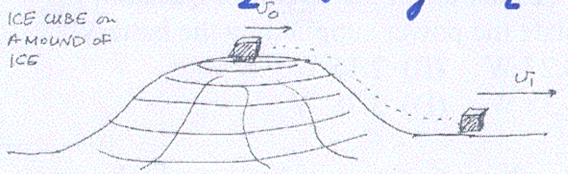
Exam 2 - Summer 2007

/1/ An ice cube slides down a mound of ice, as shown. (Friction is negligible.) The height of the mound is H and the speed of the ice cube on the top of the mound is v_0. The speed at the bottom (v_1) is

(A) $v_0 + \sqrt{2gH}$ (B) $v_0^2 + 2gH$

(C) $\sqrt{v_0^2 + 2gH}$ (D) $\sqrt{v_0 + 2gH}$

$\frac{1}{2}mv_0^2 + mgH = \frac{1}{2}mv_1^2$



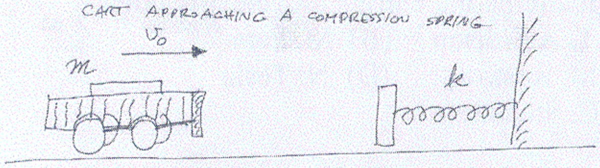
/2/ A man picks up a box of 15 kg from the floor, to height 1.2 m, carries it 5 m across the room, and then lowers it carefully to the floor. What is the total net work done by the man?

(A) 176.4 J (B) 176.4 W
(C) 909 J (D) 735 W
(E) 0 J

$W = +176.4\,J + 0 - 176.4\,J$
$= 0\,J$

/3/ A cart is moving toward a compression spring, as shown (mass m = 20 kg; speed v_0 = 10 m/s; Hooke's constant = 2.0×10^5 N/m). How far will the spring be compressed when the cart contacts the spring?

(A) 10 cm (B) 15 cm
(C) 20 cm (D) 25 cm



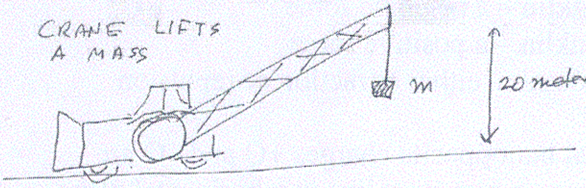
$\frac{1}{2}mv_0^2 = \frac{1}{2}kx^2$

$x = \sqrt{\frac{mv_0^2}{k}} = 0.1\,m$

/4/ A crane lifts a mass (m = 100 kg) from ground level to height 20 m in time 16 seconds. What power is supplied to lift the mass?

(A) 1.38×10^3 W (B) 1.43×10^4 W
(C) 1.18×10^4 W (D) 1.23×10^3 W

$P = \frac{\Delta U}{\Delta t}$
$= \frac{mg\Delta h}{\Delta t}$



/5/ Slide a rubber eraser across a desk surface. It will gradually slow down and eventually come to rest. What happened to the kinetic energy?

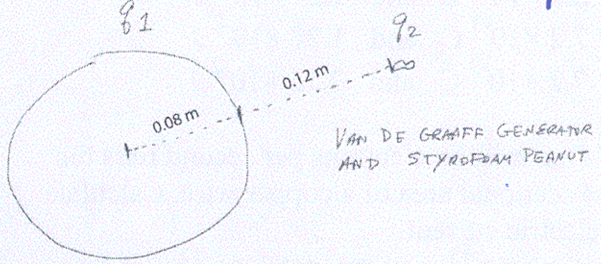
(A) Became inactive
(B) Converted to energy of molecular motion
(C) Became active
(D) Converted to potential energy
(E) Was used up because of friction

Energy is conserved.

/6/ The globe of a van de Graaff generator has charge $q_1 = -1.2 \times 10^{-5}$ C. A Styrofoam peanut with charge $q_2 = -0.7 \times 10^{-6}$ C is located at distance r = 0.2 m from the center of the globe. Calculate the electric force on the Styrofoam peanut.

(A) 2.8 N (B) 1.9 N
(C) 3.7 N (D) 0.6 N

$F = \frac{Kq_1q_2}{r^2}$



/7/ Consider again the van de Graaff generator in Question 6. Calculate the electric field at the position of the Styrofoam peanut.

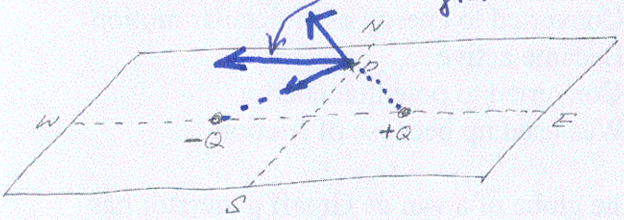
(A) 1.6×10^6 N/C (B) 3.8×10^5 N/C
(C) 4.1×10^4 N/C (D) 3.3×10^5 N/C
(E) 2.7×10^6 N/C

$E = \frac{F}{q_2}$ or $\frac{Kq_1}{r^2}$

/8/ After two different materials have been rubbed together, they may exert electric forces on one another. Who discovered this fact, and what kind of force would be observed?
(A) Gilbert – a weak attraction
(B) Gilbert – a weak repulsion
(C) Franklin – a negative force
(D) Franklin – a positive force
(E) Coulomb – either attraction or repulsion

/9/ Equal but opposite charges +Q and –Q are located on an east-west line in a horizontal plane. Determine the direction of the electric field at the point P, which is on a north-south line equidistant from Q and –Q, as shown.
(A) North (B) South
(C) East (D) West

net field

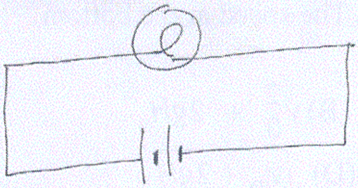


/10/ A capacitor ($\boldsymbol{C}$ = 1.2 x 10^{-3} F) is charged by a battery ($\boldsymbol{V}$ = 6 volts). Calculate the charge and energy of the capacitor.
(A) 6.3 $\times 10^{-3}$ C and 2.16 $\times 10^{-2}$ J
(B) 6.3 $\times 10^{-3}$ C and 1.27 $\times 10^{-2}$ J
(C) 7.2 $\times 10^{-3}$ C and 1.27 $\times 10^{-2}$ J
(D) 7.2 $\times 10^{-3}$ C and 2.16 $\times 10^{-2}$ J

/11/ One million electrons per second pass the cross sectional area of a copper wire. Calculate the electric current.
(A) 1.3 × 10^{-13} A (B) 1.3 × 10^{-12} A
(C) 0.8 × 10^{-13} A (D) 0.8 × 10^{-12} A
(E) 1.6 × 10^{-13} A

/12/ The emf of the battery is 6 volts and the resistance of the light bulb is 11 ohms. Calculate the current.
(A) 0.43 A (B) 0.62 A
(C) 0.55 A (D) 0.71 A

$I = V/R$



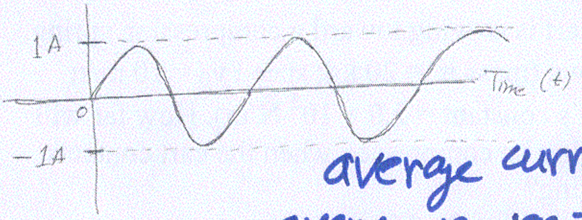
LIGHT BULB AND BATTERY

/13/ Consider again the circuit in Question 11. Calculate the power supplied by the battery.
(A) 3.27 W (B) 2.15 W
(C) 4.35 W (D) 3.78 W

$P = IV$

/14/ An alternating current is shown in the graph, varying between +1 A and -1 A as a function of time. This current flows in a circuit with resistance R = 10 ohms. Calculate the *average current* and *average power.*
(A) 1 A and 10 W (B) 2 A and 10 W
(C) 0 A and 5 W (D) 0 A and 10 W
(E) 2 A and 20 W

GRAPH OF AN ALTERNATING CURRENT



average current = 0A
average power = $\frac{1}{2} I_0^2 R$
= 5W

/15/ Which inventor developed the technologies for use of alternating current (ac) electric power?
(A) T. A. Edison (B) M. Faraday
(C) M. Rostow (D) N. Tesla
(E) C. Steinmetz

Nikola Tesla