

19.

Particle	Atomic Number	Atomic Mass	Number of protons	Number of neutrons	Number of electrons
${}_{24}^{52}\text{Cr}$	24	52	24	28	24
${}_{86}^{222}\text{Rn}$	86	222	86	136	86
${}_{31}^{70}\text{Ga}$	31	70	31	39	31
${}_{13}^{27}\text{Al}$	13	27	13	14	13
${}_{79}^{197}\text{Au}^{3+}$	79	197	79	118	76
${}_{33}^{75}\text{As}^{3-}$	33	75	33	42	36
${}_{83}^{209}\text{Bi}^{6+}$	83	209	83	126	78

20. (a) heavy water is $\frac{27.65}{25.00} = 1.106$ times heavier than ordinary water
 (b) molar mass of ordinary water = 18.0 g, so heavy water's molar mass = $1.106 \times 18.0 \text{ g} = 19.908 \text{ g}$.
 (c) heavy water = $\text{D}_2\text{O} = 2\text{D} + \text{O} = 19.908 \text{ g}$, so that: $2\text{D} + 16.0 \text{ g} = 19.908 \text{ g}$ and: $\text{D} = 1.95 \text{ g}$
 (d) ${}^2_1\text{D}$
 (e) For D: # of $e^- = 1$, # of $p = 1$, # of $n = 1$ For H: # of $e^- = 1$, # of $p = 1$, # of $n = 0$
 Since both H and D have one proton, they are both "hydrogen" but the extra neutron makes D a heavier version of hydrogen.

21. Sample 2 is $\frac{1.670}{1.539} = 1.085$ times heavier than Sample 1

molar mass of Sample 1 = $2 \times 1.008 + 32.066 = 34.082 \text{ g}$

molar mass of Sample 2 = $34.082 \text{ g} \times 1.085 = 36.983 \text{ g}$

mass of artificial S-isotope = $36.983 - 2 \times 1.008 = 34.97 \text{ g}$

22.

	Symbol	Atomic Mass	Atomic Number	Number of protons	Number of neutrons	Number of electrons
(a)	${}_{36}^{84}\text{Kr}$	84	36	36	48	36
(b)	${}_{35}^{80}\text{Br}$	80	35	35	45	35
(c)	${}_{53}^{127}\text{I}^-$	127	53	53	74	54
(d)	${}_{27}^{59}\text{Co}$	59	27	27	32	27
(e)	${}_{30}^{66}\text{Zn}$	66	30	30	36	30
(f)	${}_{48}^{112}\text{Cd}^{2+}$	112	48	48	64	46
(g)	${}_{38}^{88}\text{Sr}^{2+}$	88	38	38	50	36
(h)	$X^{2-} = {}_{52}^{127}\text{Te}^{2-}$	127	52	52	75	54
(i)	$X^{3+} = {}_{45}^{103}\text{Rh}^{3+}$	103	45	45	58	42
(j)	$X^{3-} = {}_{33}^{75}\text{As}^{3-}$	75	33	33	42	36

23. (a) 10.8 g (c) 108.0 g (e) 65.4 g (g) 95.9 g
 (b) 69.8 g (d) 72.7 g (f) 91.3 g

24. Average mass = $0.9890 \times 12.000\ 000 + 0.0110 \times 13.003\ 355 = 12.011\ \text{g}$

25. Average mass = $0.9223 \times 27.976\ 927 + 0.0467 \times 28.976\ 495 + 0.0310 \times 29.973\ 770 = 28.0855\ \text{g}$

26. (a) $P (1s^2 2s^2 2p^6 3s^2 3p^3)$
 (b) $Ti (1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^2)$
 (c) $Co (1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^7)$
 (d) $Br (1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5)$
 (e) $Sr (1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2)$
 (f) $Ar (1s^2 2s^2 2p^6 3s^2 3p^6)$
 (g) $K (1s^2 2s^2 2p^6 3s^2 3p^6 4s^1)$
 (h) $Cd (1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10})$
 (i) $Ca (1s^2 2s^2 2p^6 3s^2 3p^6 4s^2)$
 (j) $Xe (1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6)$
 (k) $Cs (1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^1)$
 (l) $Pb (1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^2)$
 (m) $Ga (1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^1)$
 (n) $Mn (1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5)$
 (o) $Zr (1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^2)$

27. (a) $P ([Ne] 3s^2 3p^3)$ (f) $Ar ([Ne] 3s^2 3p^6)$ (k) $Cs ([Xe] 6s^1)$
 (b) $Ti ([Ar] 4s^2 3d^2)$ (g) $K ([Ar] 4s^1)$ (l) $Pb ([Xe] 6s^2 4f^{14} 5d^{10} 6p^2)$
 (c) $Co ([Ar] 4s^2 3d^7)$ (h) $Cd ([Kr] 5s^2 4d^{10})$ (m) $Ga ([Ar] 4s^2 3d^{10} 4p^1)$
 (d) $Br ([Ar] 4s^2 3d^{10} 4p^5)$ (i) $Ca ([Ar] 4s^2)$ (n) $Mn ([Ar] 4s^2 3d^5)$
 (e) $Sr ([Kr] 5s^2)$ (j) $Xe ([Kr] 5s^2 4d^{10} 5p^6)$ (o) $Zr ([Kr] 5s^2 4d^2)$

28. (a) $H^- (1s^2)$ (e) $Ti^{2+} ([Ar] 3d^2)$ (i) $Fe^{3+} ([Ar] 3d^5)$
 (b) $Sr^{2+} ([Ar] 4s^2 3d^{10} 4p^6)$ (f) $N^{2-} ([He] 2s^2 2p^5)$ (j) $Ge^{2+} ([Ar] 4s^2 3d^{10})$
 (c) $Br^- ([Ar] 4s^2 3d^{10} 4p^6)$ (g) $Mn^{2+} ([Ar] 3d^5)$ (k) $Ru^{3+} ([Kr] 4d^5)$
 (d) $N^{3+} ([He] 2s^2)$ (h) $Ge^{4+} ([Ar] 3d^{10})$ (l) $Sb^{3+} ([Kr] 5s^2 4d^{10})$

29. (a) 6 (c) 5 (e) 0 (g) 6 (i) 2 (k) 0 (m) 3 (o) 7
 (b) 5 (d) 2 (f) 2 (h) 0 (j) 6 (l) 0 (n) 2 (p) 2

30. The actual properties of Germanium are as follows. How close were your estimates?
 atomic mass = 72.6 ; density = 5.35 ; density of oxide = 4.23 ; formula of chloride = $GeCl_4$;
 density of chloride = 1.84 ; color = greyish white ; lustre = metallic

31. (a) noble gases (d) alkali metals (g) alkali metals
 (b) alkaline earth metals (e) halogens (h) halogens
 (c) transition metals (f) transitions metals
32. (a) two of Li, K, Rb, Cs and Fr (c) two of Be, Ca, Sr, Ba and Ra
 (b) two of He, Ne, Kr, Xe and Rn (d) two of F, Cl, I and At
33. (a) two of Li, Be, B, N, O, F and Ne (b) two of Na, Mg, Al, Si, P, Cl and Ar