

ASP formula sheet with worked examples

23 formulas for the calculation tasks in BCSP's ASP11 blueprint. Each worked example is computed by code and checked against the source. Checked 2026-10-16.

At the exam, BCSP says: “For any question requiring a mathematical formula, the formula will be included within the exam question (unless the question is specifically testing your knowledge of a formula). You will not be provided or permitted to bring a formula sheet.” (BCSP, What to Expect When Sitting for a BCSP Exam (item 7), <https://www.bcsp.org/bcsp-news/about/bcsp-news/what-to-expect-when-sitting-for-a-bcsp-exam>)

1. Incidence rate (TRIR)

$$IR = (N \times 200,000) \div EH$$

N = recordable injuries and illnesses; EH = total hours worked by all employees in the year; 200,000 = 100 full-time workers × 40 h × 50 weeks.

Example. BLS example: 7 recordable cases and 400,000 hours worked.

$$(7 \times 200,000) \div 400,000 = 3.5$$

Source: BLS, How To Compute Your Firm's Incidence Rate for Safety Management.

<https://www.bls.gov/iif/overview/compute-nonfatal-incidence-rates.htm>

2. DART rate

$$DART = (N \times 200,000) \div EH$$

N = cases with days away from work, job restriction or transfer (OSHA 300 Log columns H + I); EH = total hours worked.

Example. BLS example: 3 such cases and 400,000 hours worked.

$$(3 \times 200,000) \div 400,000 = 1.5$$

Source: BLS, How To Compute Your Firm's Incidence Rate for Safety Management.

<https://www.bls.gov/iif/overview/compute-nonfatal-incidence-rates.htm>

3. Noise dose

$$D = 100 \times (C1/T1 + C2/T2 + \dots + Cn/Tn)$$

C = hours at a given sound level; T = OSHA reference duration for that level from Table G-16a (90 dBA = 8 h, 95 dBA = 4 h).

Example. 4 h at 90 dBA and 4 h at 95 dBA.

$$100 \times (4/8 + 4/4) = 150\%$$

Source: 29 CFR 1910.95, Appendix A. <https://www.ecfr.gov/current/title-29/section-1910.95>

4. Noise TWA from dose

$$TWA = 16.61 \times \log_{10}(D \div 100) + 90$$

D = dose in percent. A 100% dose is a 90 dBA TWA; a 50% dose is 85 dBA, the hearing conservation action level.

Example. A 150% dose (the example above).

$$16.61 \times \log_{10}(1.5) + 90 = 92.9 \text{ dBA}$$

1910.95 Table A-1 lists 92.9 dBA for a 150% dose.

Source: 29 CFR 1910.95, Appendix A. <https://www.ecfr.gov/current/title-29/section-1910.95>

5. Reference duration for a sound level

$$T = 8 \div 2^{((L - 90) \div 5)}$$

L = A-weighted sound level in dBA. Each 5 dB above 90 halves the allowed time (OSHA's 5-dB exchange rate).

Example. L = 95 dBA.

$$8 \div 2^{((95 - 90) \div 5)} = 4.0 \text{ h}$$

Table G-16a lists 4 hours for 95 dBA. eCFR shows this formula as an image under the table.

Source: 29 CFR 1910.95, Appendix A, Table G-16a. <https://www.ecfr.gov/current/title-29/section-1910.95>

6. 8-hour TWA exposure (air contaminants)

$$E = (C_a \times T_a + C_b \times T_b + \dots + C_n \times T_n) \div 8$$

C = concentration during a period; T = hours at that concentration. E may not exceed the substance's 8-hour TWA in Subpart Z.

Example. OSHA example: 2 h at 150 ppm, 2 h at 75 ppm, 4 h at 50 ppm; limit 100 ppm.

$$(2 \times 150 + 2 \times 75 + 4 \times 50) \div 8 = 81.25 \text{ ppm, under 100 ppm}$$

Source: 29 CFR 1910.1000(d)(1)(i). [https://www.ecfr.gov/current/title-29/section-1910.1000#p-1910.1000\(d\)\(1\)\(i\)](https://www.ecfr.gov/current/title-29/section-1910.1000#p-1910.1000(d)(1)(i))

7. Mixture of air contaminants

$$E_m = C_1/L_1 + C_2/L_2 + \dots + C_n/L_n$$

E_m must not exceed 1

C = measured concentration of each substance; L = its exposure limit from Subpart Z.

Example. OSHA example: 500 ppm (limit 1,000), 45 ppm (limit 200), 40 ppm (limit 200).

$$0.500 + 0.225 + 0.200 = 0.925, \text{ under 1, so within limits}$$

Source: 29 CFR 1910.1000(d)(2)(i). [https://www.ecfr.gov/current/title-29/section-1910.1000#p-1910.1000\(d\)\(2\)\(i\)](https://www.ecfr.gov/current/title-29/section-1910.1000#p-1910.1000(d)(2)(i))

8. NIOSH recommended weight limit (U.S. units)

$$RWL = 51 \times HM \times VM \times DM \times AM \times FM \times CM$$

$$HM = 10/H, VM = 1 - 0.0075|V - 30|$$

$$DM = 0.82 + 1.8/D, AM = 1 - 0.0032A$$

$$LI = \text{load} \div RWL$$

H, V, D in inches; A in degrees; FM and CM from the manual's frequency and coupling tables. LI above 1 means elevated risk.

Example. H = 20 in, V = 15 in, D = 25 in, A = 30°, one lift every 5 min for 8 h (FM 0.85), fair coupling below 30 in (CM 0.95), 30 lb load.

$$51 \times 0.50 \times 0.8875 \times 0.892 \times 0.904 \times 0.85 \times 0.95 = 14.7 \text{ lb; } LI = 30 \div 14.7 = 2.0$$

Source: NIOSH, Applications Manual for the Revised NIOSH Lifting Equation (DHHS Pub. No. 94-110). <https://stacks.cdc.gov/view/cdc/110725>

9. Wet bulb globe temperature (WBGT)

Outdoors: $WBGT = 0.7 \text{ tnwb} + 0.2 \text{ tg} + 0.1 \text{ ta}$

Indoors: $WBGT = 0.7 \text{ tnwb} + 0.3 \text{ tg}$

tnwb = natural wet bulb; tg = globe; ta = dry bulb (air) temperature, all in the same units.

Example. Outdoors, tnwb 78°F, tg 100°F, ta 88°F.

$$0.7 \times 78 + 0.2 \times 100 + 0.1 \times 88 = 83.4^\circ\text{F}$$

The same readings indoors (no ta term): $0.7 \times 78 + 0.3 \times 100 = 84.6^\circ\text{F}$.

Source: NIOSH, Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments (Pub. 2016-106), PDF p. 145. <https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf#page=145>

10. Wind chill

$$WC = 35.74 + 0.6215T - 35.75V^{0.16} + 0.4275T \times V^{0.16}$$

T = air temperature in °F; V = wind speed in mph.

Example. T = 20°F, V = 15 mph.

$$35.74 + 12.43 - 55.14 + 13.19 = 6^\circ\text{F}$$

Source: NOAA/National Weather Service: Wind Chill calculation.
<https://www.weather.gov/media/epz/wxcalc/windChill.pdf>

11. Dilution ventilation

$$qd = (387 \times \text{lbs}) \div (\text{MW} \times \text{min} \times d)$$

$$Qd = (qd \times Km \times 10^6) \div Ca$$

lbs = pounds evaporated; MW = molecular weight; min = minutes; d = density correction (1 at standard air); Km = mixing factor (2 to 5); Ca = acceptable concentration in ppm (typically half the PEL).

Example. 2 lb of toluene (MW 92.14) evaporates in 60 min, d = 1, Km = 3, Ca = 50 ppm.

$$qd = 774 \div 5,528.4 = 0.140 \text{ cfm}; Qd = 0.140 \times 3 \times 10^6 \div 50 = 8,400 \text{ cfm}$$

Source: OSHA Technical Manual, Section III, Chapter 3 (Ventilation Investigation), General Exhaust (Dilution) Ventilation Systems. <https://www.osha.gov/otm/section-3-health-hazards/chapter-3>

12. Velocity from a smoke tube

$$V = D \div T$$

D = distance the smoke travels (ft); T = time (min). Convert seconds to minutes first.

Example. OSHA example: smoke travels 2 ft in 2 seconds.

$$2 \text{ ft} \div (2/60 \text{ min}) = 60 \text{ fpm}$$

Source: OSHA Technical Manual, Section III, Chapter 3 (Ventilation Investigation), IV.F.3.d and Appendix III:3-2. <https://www.osha.gov/otm/section-3-health-hazards/chapter-3>

13. Secondary containment capacity

Capacity $\geq$ the greater of 10% of total container volume or the largest container

Hazardous waste container storage areas under 40 CFR 264.175. Containers without free liquids are not counted.

Example. 20 drums of 55 gal each.

$$\max(0.10 \times 1,100, 55) = 110 \text{ gal}$$

Source: 40 CFR 264.175(b)(3). [https://www.ecfr.gov/current/title-40/section-264.175#p-264.175\(b\)\(3\)](https://www.ecfr.gov/current/title-40/section-264.175#p-264.175(b)(3))

14. Excavation sloping (simple slope, 20 ft or less)

Horizontal run = depth $\times$ H:V ratio

Type A 3/4:1, Type B 1:1, Type C 1½:1

Maximum allowable slopes from Subpart P, Appendix B, for excavations 20 ft deep or less.

Example. A 12 ft deep trench in Type C soil.

$$12 \text{ ft} \times 1.5 = 18 \text{ ft of horizontal setback on each side}$$

Source: 29 CFR 1926 Subpart P, Appendix B (Figure B-1). <https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1926/subpart-P/appendix-Appendix%20B%20to%20Subpart%20P%20of%20Part%201926>

15. Choker hitch capacity by angle of choke

Capacity = choker rating × angle factor

Over 120° 100%, 90–120° 87%, 60–89° 74%, 30–59° 62%, 0–29° 49%

Grade 80 alloy chain choker ratings (OSHA Table 3) apply at angles of choke over 120°.

Example. 1/2 in Grade 80 chain, single-leg choker (9,600 lb), angle of choke 75°.

$$9,600 \text{ lb} \times 0.74 = 7,104 \text{ lb}$$

Source: OSHA, Guidance on Safe Sling Use: Tables and Figures, Table 3 and Fig. 2 (Angle of Choke). <https://www.osha.gov/safe-sling-use/tables-figures>

16. Personal fall arrest distances

Free fall ≤ 6 ft

Deceleration distance ≤ 3.5 ft

Limits for personal fall arrest systems in construction, 29 CFR 1926.502(d)(16).

Example. The longest fall the two limits allow before the worker stops.

$$6 \text{ ft} + 3.5 \text{ ft} = 9.5 \text{ ft}$$

Clearance below must also cover the worker's height below the D-ring, harness stretch and a margin. 1926.502 doesn't set those as numbers; use the equipment maker's figures.

Source: 29 CFR 1926.502(d)(16)(iii)-(iv). [https://www.ecfr.gov/current/title-29/section-1926.502#p-1926.502\(d\)\(16\)\(iii\)](https://www.ecfr.gov/current/title-29/section-1926.502#p-1926.502(d)(16)(iii))

17. Radioactive decay

$$A_t = A_0 \times e^{(-\lambda t)}$$

$$\lambda = 0.693 \div T_{1/2}$$

A_0 = starting activity; t = elapsed time; $T_{1/2}$ = half-life, in the same time units as t .

Example. 100 mCi source, half-life 8 days, after 24 days.

$$100 \times e^{-(0.693 \div 8) \times 24} = 12.5 \text{ mCi}$$

24 days is three half-lives: $100 \rightarrow 50 \rightarrow 25 \rightarrow 12.5$.

Source: OSHA, Ionizing Radiation: Introduction to Health Physics handout.
<https://www.osha.gov/ionizing-radiation/introduction/handout>

18. Inverse square law

$$I_2 = I_1 \times (d_1 \div d_2)^2$$

I = intensity or dose rate at distance d from a point source.

Example. 100 mR/h at 2 ft; what at 6 ft?

$$100 \times (2 \div 6)^2 = 11.1 \text{ mR/h}$$

Source: OSHA, Ionizing Radiation: Introduction to Health Physics handout.

<https://www.osha.gov/ionizing-radiation/introduction/handout>

19. Shielding with half-value layers

$$I = I_0 \times e^{(-\mu x)}$$

$$\mu = 0.693 \div \text{HVL}$$

I_0 = unshielded intensity; x = shield thickness; HVL = thickness that halves intensity (same units as x).

Example. 80 mR/h, lead HVL 0.5 in, 1.5 in of lead.

$$80 \times e^{-(0.693 \div 0.5) \times 1.5} = 10.0 \text{ mR/h}$$

1.5 in is three HVLs: 80 → 40 → 20 → 10.

Source: OSHA, Ionizing Radiation: Introduction to Health Physics handout.

<https://www.osha.gov/ionizing-radiation/introduction/handout>

20. Mean, median and sample standard deviation

$$\text{Mean} = \Sigma x \div n$$

$$s = \sqrt{(\Sigma(x - \text{mean})^2 \div (n - 1))}$$

The median is the middle value of the sorted data (the average of the two middle values when n is even).

Example. Data: 2, 4, 4, 4, 5, 5, 7, 9.

$$\text{mean} = 40 \div 8 = 5; \text{median} = 4.5; s = \sqrt{(32 \div 7)} = 2.14$$

Source: NIST/SEMATECH e-Handbook of Statistical Methods, 1.3.5.1 Measures of Location and 1.3.5.6 Measures of Scale.

<https://www.itl.nist.gov/div898/handbook/eda/section3/eda356.htm>

21. Fault tree gates (independent events)

OR gate: $P = P(A) + P(B) - P(A)P(B)$

AND gate: $P = P(A) \times P(B)$

P = probability of each independent basic event.

Example. $P(A) = 0.1$, $P(B) = 0.2$.

OR: $0.1 + 0.2 - 0.02 = 0.28$; **AND:** $0.1 \times 0.2 = 0.02$

Source: NUREG-0492, Fault Tree Handbook (U.S. NRC, 1981), Chapter VII.

<https://www.nrc.gov/docs/ML1007/ML100780465.pdf>

22. Force from mass and deceleration

$F = m \times a = m \times (v1 - v0) \div t$

m = mass (kg); v = velocity (m/s); t = time (s); F in newtons. The sign shows direction; use the magnitude.

Example. 80 kg stopped from 5 m/s in 0.25 s.

$80 \times (0 - 5) \div 0.25 = -1,600$ N, so 1,600 N

Source: NASA Glenn Research Center, Beginner's Guide to Aeronautics: Newton's Second Law of Motion. <https://www.grc.nasa.gov/WWW/k-12/BGP/newton2.html>

23. Unit conversions

1 ft = 0.3048 m, 1 in = 2.54 cm

1 gal = 3.785412 L, 1 lb = 0.4535924 kg

$^{\circ}\text{C} = (^{\circ}\text{F} - 32) \div 1.8$

Exact or standard factors from NIST SP 811.

Example. Convert 55 gal to liters.

$55 \times 3.785412 = 208.2$ L

$95^{\circ}\text{F} = (95 - 32) \div 1.8 = 35^{\circ}\text{C}$.

Source: NIST Special Publication 811, Guide for the Use of the International System of Units, Appendix B.8. <https://www.nist.gov/pml/special-publication-811/nist-guide-si-appendix-b-conversion-factors/nist-guide-si-appendix-b8>

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