

Science Olympiad
GGSO Invitational

January 31, 2026

Machines C Answer Key



ANSWER KEY ANSWER KEY
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Section A [42 points]

1. (a) [3 pts] 2.88
(b) [7 pts] 2.97 s
2. (a) [2 pts] 323 W
(b) [3 pts] 0.854 N m
3. (a) [1 pt] Class 1
(b) [4 pts] 7.91 (Partial credit for 7.51)
4. (a) [2 pts] The tension on the upper lever arms does not counteract the weight of the mass.
(b) [3 pts] 16
(c) [5 pts] Place the heavier mass on the upper beam, 60 cm from the fulcrum, and the lighter mass on the lower beam, 37.5 cm from the fulcrum. This gives a worst-case percent error of 0.434 %.
Note that placing the heavier mass 40 cm and the lighter mass 25 cm from the fulcrum gives a worst-case percent error of 0.652 %.
5. (a) [2 pts] 4 teeth
(b) [3 pts] 14 rps, same direction
(c) [5 pts] 0.752 (Partial credit for 0.797)
6. [2 pts] Round dry sand, angular dry sand, gravel, wet sand

Section B [58 points]

7. (a) [2 pts] Hollow cylinder, hollow ball, disk, solid ball
(b) [2 pts] Same time
(c) [5 pts] Object: a/\sqrt{b}
Hollow cylinder: $1/\sqrt{2}$
Hollow ball: $2/\sqrt{15}$
Disk: $1/\sqrt{6}$
Solid ball: $2/\sqrt{35}$
8. [8 pts] 21.4° , counterclockwise
9. [6 pts] $F_{A,x} = 150 \text{ N}$ (right), $F_{A,y} = 1515 \text{ N}$ (down), $F_{B,x} = 150 \text{ N}$ (left), $F_{B,y} = 584 \text{ N}$ (up)
10. [4 pts] 2.34 kg
11. [8 pts] 4.12 m/s^2 (down)
12. [5 pts] 39.0 rad/s^2
13. (a) [5 pts] 34.6 cm
(b) [3 pts] $\sqrt{(3/2)(g/l)}$
14. (a) [4 pts] $\ell\mu/\sqrt{1 + \mu^2}$
(b) [6 pts] m : $0.205g$ (right), M : $0.355g$ (down)