

Science Olympiad  
GGSO Invitational

January 31, 2026

# Machines C 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]  $21.4^\circ$ , 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]  $2.34 \text{ kg}$
11. [8 pts]  $4.12 \text{ m/s}^2$  (down)
12. [5 pts]  $39.0 \text{ rad/s}^2$
13. (a) [5 pts]  $34.6 \text{ cm}$   
(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)