Rustin Science Olympiad Invitational – January 6, 2018

Optics: Division B
Answer Key

1. E (1pt)
2. A (1pt)
3. C (1pt)
4. C (1pt)
5. E (1pt)
6. C (1pt)
7. B (1pt)
8. C (1pt) [Tie Breaker: 1]
9. C (1pt)
10. B (1pt) [Tie Breaker: 2]
11. A (1pt)
12. C (1pt)
13. E (1pt)
14. B (1pt)
15. D (1pt) [Tie Breaker: 3]
16. D (1pt)
17. B (1pt)
18. A (1pt)
19. A (1pt) [Tie Breaker: 4]
20. C (1pt)
21. G (1pt)
22. E (1pt)
23. C (1pt) [Tie Breaker: 5]
24. A (1pt)
25. C (1pt)
26. A (1pt)
27. D (1pt)
28. A (1pt)
29. B (1pt) [Tie Breaker: 6]
30. A (1pt)
31. A (1pt)
32. D (1pt)
33. C (1pt)
34. B (1pt)
35. G (1pt)

36. 3pts for drawing the images and rays [0.5pt per person]. A. E and F (0.5pt); B. E and F (0.5pt); C. C, D, E and F (1pt); D. C, D and E (0.75pt); E. A, B, C, D and E (1.25pt); F. B, C, D and E (1pt) [remove 0.25pt if wrong/missing person to each question. Make negative points to 0. Total points is 8]

37. F = -15/2 = -7.5cm; di = 1/(1/-0.075 – 1/2) = -0.072m; A. Image is 7.2cm behind the mirror (3pts, -0.072m also accepted; remove 0.5pt for no unit; remove 0.5pt for no negative sign or no mention of 'behind'); B. hi = (0.072/2)*3.3 = 0.12m (3pts ; remove 0.5pt for no unit)

38. A. Magnification= hi/ho=(-2.5m/0.010m)=-250 (3pts; remove 0.5pt for no negative sign) B. Focal Length = 1/(1/5+1/0.02)=0.02m or 20mm (3pts; remove 0.5pt for no unit) [Tie Breaker: 7]

39. A. Reduced upright Virtual image can only be formed by Concave Lens. (2pts). B. Find di. M = -di/do. di = -20/4 = -5cm. (2pt; remove 0.5pt for no unit; remove 0.5pt for no negative sign). Find f. f = 1/(1/-5 + 1/20) = -6.67cm. (1pt; remove 0.5pt for no unit; remove 0.5pt for no negative sign).

40. Find do. Given hi=-0.00825m (note negative sign as image is inverted), ho=1.75m. m = -0.00825/1.75=-0.0047. Also m=-di/do, so di=0.0047do. using 1/f=1/di+1/do, do=44.755m or do=45m. So the reporter was standing 45m away from the celebrity. He was not trespassing her private property and was not found guilty. (4pts; remove 0.5pt for no unit; give 1 pt. if steps are right but with math error)