Section A (60 points)

1. E	2. B	3. C	4. B	5. C
6. B	7. C	8. D	9. C	10. C
11. A, D	12. C	13. A	14. A	15. D
16. C, D	17. B	18. C, E	19. B	20. D
21. E	22. E	23. A	24. D	25. A, D
26. B	27. B	28. B	29. D	30. E

Section B (90 points)

1. (a) Left-handed

   (b) 43.4 %

   (c) 341 J

   (d) The IMA of the machine would increase **[1]** as a cone has a smaller surface area, increasing the force it exerts **[1]** .

2. Rubric outlined in solutions.

3. (a) 1 kg
   49 N

   (b) AMA $= F_{out}/F_{in} = (m_E g + 157\,\text{N})/(m_E g + 98\,\text{N})$

   (c) 39.2 N

   (d) $4\,\text{m}\,\text{s}^{-2}$, upwards

4. (a) 2.86:1, 2.29:1, 1.43:1, 1.14:1, 0.914:1, 0.571:1 **[0.5 each]**

   (b) 2.14

   (c) i. $0.529\,\text{m}\,\text{s}^{-1}$

   ii. Cadence decreases **[1]** . Since her power stays the same and the bicycle's IMA decreases, she must apply a greater force with a lower speed **[1]** .

   (d) i. 39.8°

   ii. 205 N

   iii. $a = 0.643$, $b = 2$, $c = 11.1$, $d = 0.5$ **[3 each]**