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WORKSHEETS
ATTEMPT | CHECK | CORRECT | IMPROVE

OCR A A Level Dynamics: F = ma worksheet

35-40 minutes independent practice + 15-20 minutes review

Specification points covered

- 3.2.1(a) Apply Newton's second law, F = ma.
- 3.2.1(b) Define the newton as the unit of force.
- 3.2.1(c) Understand weight of an object, W = mg.
- 3.2.1(d) Define and identify tension, normal contact force, upthrust and friction.
- 3.2.1(e) Draw and interpret free-body diagrams.

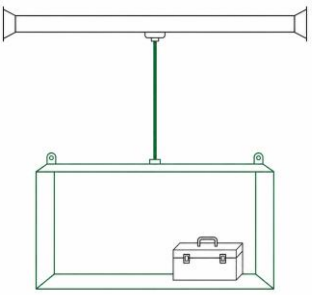
Main scenario

At a coastal monitoring centre, a service lift carries a 680 kg lift car, a 75.0 kg technician and 45.0 kg of instrument cases to a rooftop laboratory. The total mass is 800 kg. The lift is supported by one vertical cable. Take g = 9.81 m s^{-2} throughout.

Use throughout

Choose a positive vertical direction before calculating a resultant force. A quantity can increase, decrease or stay the same; a force can cause an acceleration, but a velocity does not 'accelerate'.

1. Initial journey: lift car and cable



1. Define one newton. [1 mark]

2. Calculate the total mass of the lift car, technician and instrument cases. [1 mark]

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1. Initial journey: lift car and cable continued

3. In the blank space below, draw a free-body diagram for the loaded lift car. Ignore air resistance. Label all forces acting on the lift car. [2 marks]

4. Calculate the weight of the loaded lift car. [1 mark]

5. The cable tension is 8400 N. Calculate the resultant force on the lift car. State its direction. [1 mark]

6. Use your answer to question 5 to calculate the acceleration of the lift car. [1 mark]

7. The cable tension is adjusted so that it equals the weight of the lift car. The lift is moving upwards. Describe its subsequent motion and explain your answer. [2 marks]

8. The cable tension is reduced to 7000 N. Calculate the acceleration of the lift car. State its direction. [2 marks]

9. The lift is still moving upwards when the cable tension is 7000 N. State how its speed changes. Use precise scientific language. [1 mark]

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2. Heavier lift load

New condition

Two further instrument cases, with a combined mass of 90.0 kg, are loaded into the lift. For questions 10-17, use the new total mass.

10. Two further instrument cases, with a combined mass of 90.0 kg, are added. Calculate (i) the new total mass and (ii) the new weight of the lift car and its load. [2 marks]

11. Calculate the cable tension required to accelerate the loaded lift car upwards at 0.850 m s^{-2}. [2 marks]

12. The cable has a safe maximum tension of 1.02×10^4 N. Determine whether it can accelerate the loaded lift car upwards at 1.80 m s^{-2}. Show your reasoning. [3 marks]

13. A pupil writes, 'The cable tension is 9.49×10^3 N, so this is the resultant force.' Explain why this is not correct. [2 marks]

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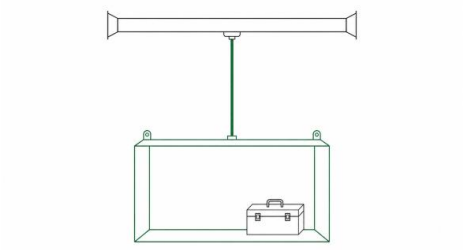
3. Return journey

New condition

The loaded lift car now travels downwards from the rooftop laboratory. Continue to identify the direction of the resultant force before applying F = ma.



14. The loaded lift car descends at constant velocity. Calculate the cable tension. [1 mark]

15. While the loaded lift car is descending, the cable tension is 9.20×10^3 N. Calculate its acceleration. State how its speed changes. [3 marks]

16. While the loaded lift car is descending, the cable tension is 7.60×10^3 N. Calculate its acceleration. State how its speed changes. [3 marks]

17. A pupil writes, 'The velocity is accelerating upwards' for the situation in question 15. Rewrite this statement using correct scientific language. [2 marks]

Review and improve

- □ I can identify a resultant force before using F = ma.
- □ I can distinguish weight, tension and resultant force.
- □ I can describe velocity and acceleration using precise scientific language.

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