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WORKSHEETS
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Work done and energy transfers worksheet

AQA AS 7407 and first-year A Level 7408 | OCR A AS H156 and A Level H556

35–40 minutes independent practice + 15–20 minutes review | 37 marks

Specification points covered

- AQA 7407 / 7408: 3.4.1.7 selected work and force–displacement areas; 3.4.1.8 selected conservation of energy, gravitational energy and resistance.
- OCR A H156 / H556: 3.3.1(a)–(e) work and energy conservation; 3.3.2(b) selected uniform-field gravitational energy. Power and efficiency are not assessed here.

The Lumen Line installation

A team installs a moving light sculpture in a former railway tunnel. Different stages involve a rail trolley, a counterweight and a display carriage. Treat stated forces as constant unless a graph shows otherwise.

Show working and signs. Use g = 9.81 N kg^{-1} and keep guard digits. Use blank space for calculations and ruled lines for explanations.

A Language and direction

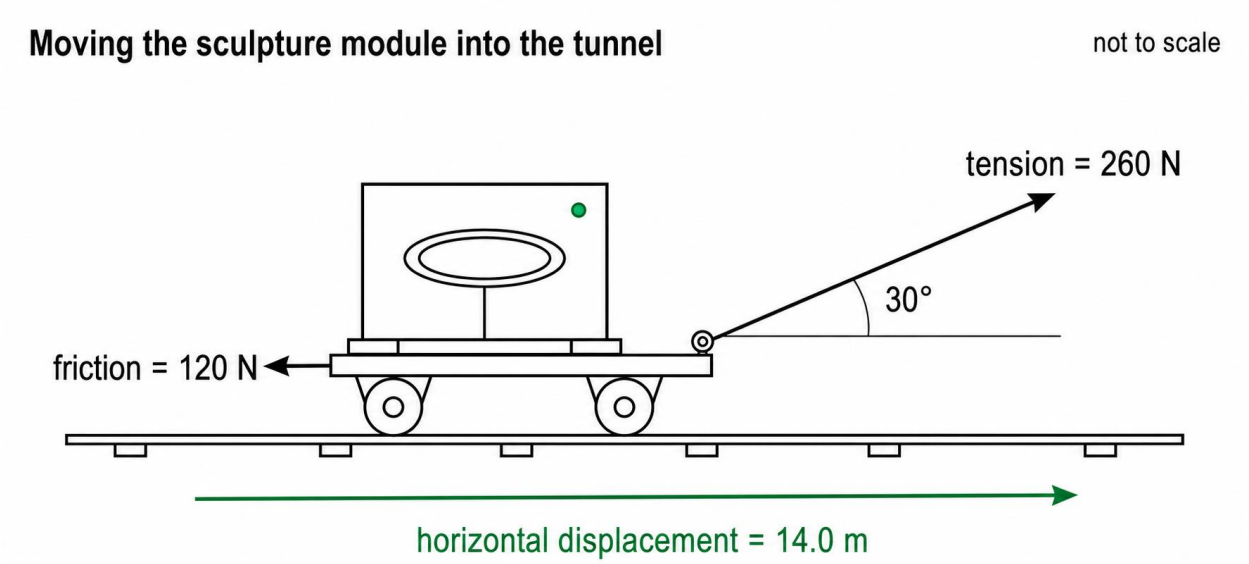
1. Define work done by a force. State what it means for one joule of work to be done. [2 marks]

2. A technician walks 25 m horizontally while supporting equipment with an upward force of 180 N. Calculate the work done by this upward force and explain your answer. [2 marks]

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B Moving the sculpture module

The trolley moves horizontally. The diagram shows the cable tension, friction and displacement. Its weight and normal contact force are vertical.



3. Use the trolley diagram. Calculate the work done on the trolley by the cable tension during the 14.0 m movement. [2 marks]

4. Calculate the work done on the trolley by the 120 N frictional force during this movement. Include its sign. [1 mark]

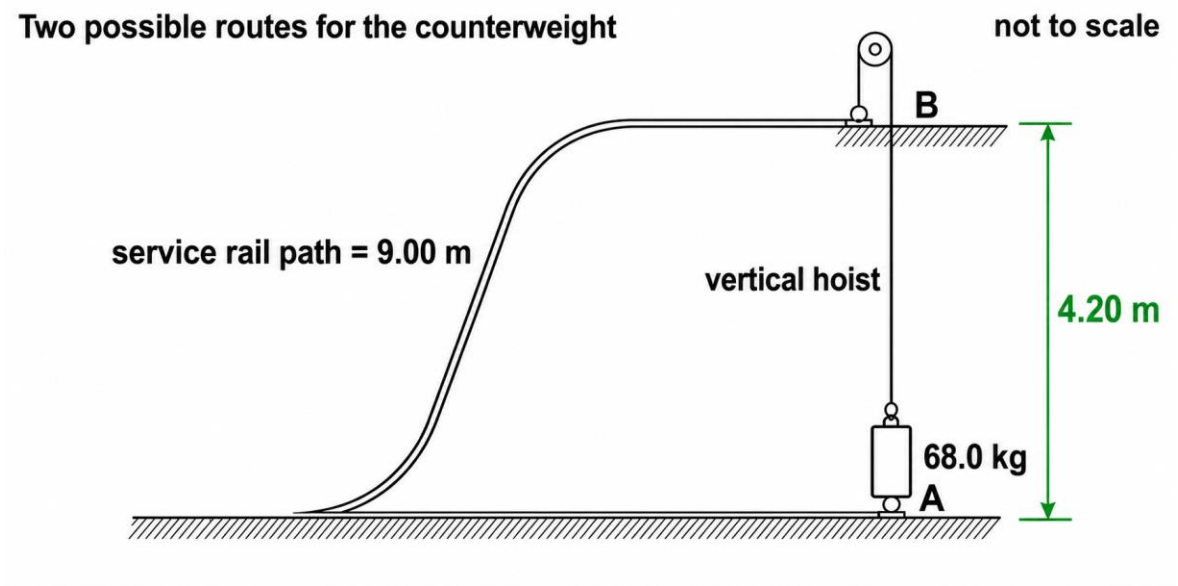
5. Calculate the net work done on the trolley by all forces. State which of the trolley's energy stores increases. [2 marks]

6. Explain why the weight and normal contact force each do zero work on the trolley during its horizontal movement. [1 mark]

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C Raising the counterweight

The two routes connect the same lower point A and upper point B. The counterweight gains the same vertical height by either route.



7. The 68.0 kg counterweight moves from A to B. Identify the distance relevant to its weight, then calculate the work done against gravity. Use g = 9.81 N kg^{-1}. [2 marks]

8. During the vertical lift, the hoist pulls upwards with a constant force of 760 N through 4.20 m. The counterweight moves at constant speed against resistance. Apart from the gravitational increase, all energy supplied by the hoist is transferred to thermal stores. Calculate that thermal transfer. [2 marks]

9. If resistive forces are ignored, explain why the work done against gravity is the same for the vertical route and the longer service-rail route. Does that prove that total hoist work is always the same for the two real routes? [2 marks]

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D Cable alignment and energy recovery

10. During cable alignment, a force of 190 N does 870 J of work while the module moves 8.50 m. Determine the angle between this force and the displacement. [2 marks]

11. A 95 N braking force then acts directly opposite to the module's motion over 2.60 m. Calculate the work done by this force. [1 mark]

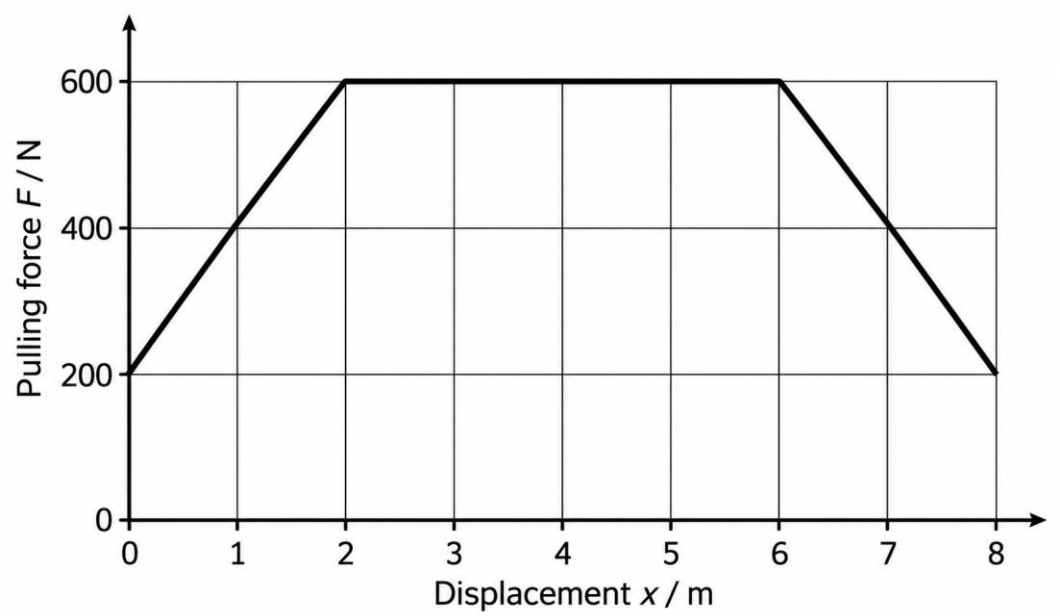
12. In a separate constant-speed regenerative descent, the counterweight's gravitational energy decreases by 5.60 kJ. The battery gains 4.10 kJ. All remaining energy is transferred to thermal stores. Calculate this transfer and explain why the remaining energy has not been destroyed. [2 marks]

13. Two arrangements tow a display carriage through the same horizontal distance of 16.0 m. A uses 310 N at 20° to the motion; B uses 360 N at 42°. Calculate the work done by each and decide which transfers more energy to the carriage. [3 marks]

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E A variable-force pull

In a separate horizontal test, the controller varies its pulling force with displacement as shown. The plotted force is parallel to the carriage's displacement and is not the resultant force.



14. For the variable-force test shown, determine the work done by the pulling force from x = 0 to x = 8.0 m. Show how you divide the graph into areas. [3 marks]

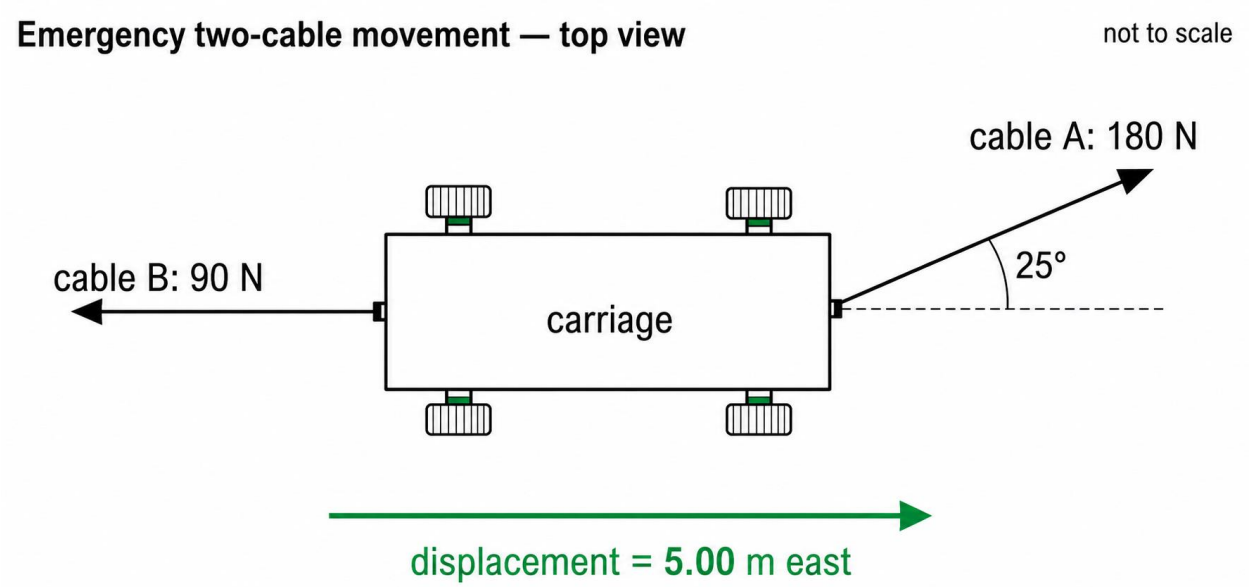
15. In that same 8.0 m horizontal test, a constant 150 N resistance also acts opposite to the motion. Other forces do no work. Calculate the change in the carriage's kinetic energy. [2 marks]

16. A technician models the variable pull by 200 N, the mean of its endpoint values. Explain why this underestimates the work. Determine the constant force that would do the same work over 8.0 m. [2 marks]

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F The emergency two-cable test

This top view shows two cable forces acting while the carriage moves east. Determine the work done by each cable, then evaluate the technician's claim.



17. In the emergency two-cable diagram, the carriage moves 5.00 m east. Calculate the work done by cable A. [2 marks]

18. Calculate the work done by cable B and hence the total work done by the two cables on the carriage. [2 marks]

19. A technician says, "Both cables transfer energy to the carriage because both exert a force on it." Evaluate this statement using the force and displacement directions. [2 marks]

Review: identify the force, its direction and the displacement before calculating work. Net work changes kinetic energy; energy transferred by one force may have several destinations.

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