Covering teacher guide

Work done by forces

Start here / subject briefing

Before this lesson: Consolidation after work done, force directions, balanced forces, energy stores and cm-to-m conversion have been taught. Both courses/tiers use the same route. The omitted GPE result is supplied; no mgh, spring or trigonometric calculation is required.

Work is energy transferred by a force through displacement. For a constant force along motion use W=Fs, naming which force is involved. If movement is perpendicular to a force, the distance along it is zero and so is its work. Zero resultant force does not mean each force does zero work: a pull can transfer energy while friction increases thermal stores and kinetic energy stays constant. A braking energy amount is a positive magnitude, not a kinetic-energy gain.

Words and symbols you will need

Term	Plain-English meaning
Work W, joule J	Energy transferred mechanically by a force. W here is the quantity work, not watts.
Force F, newton N	The named push/pull, rather than automatically the resultant.
Distance s, metre m	Movement along the force. Convert cm to m by dividing by 100.
Resultant / balanced	The overall force after combining forces. Zero here means unchanged velocity.
Thermal store	Energy retained in warmer objects/surroundings; energy is not destroyed.

Help pupils choose a method

1. Name the force and compare its direction with the movement.
2. Choose the distance along that force and convert it to metres.
3. Use W=Fs, F=W/s or s=W/F; state J, N or m for the unknown.
4. Explain receiving stores separately from any change in speed.

Use the supplied model - pupil page 2

Pupil page 2's 20 N pull does 30 J. The separate unknown-force model converts 30 cm to 0.30 m and gives 60 N. Vertical gravity does zero work on horizontal motion. These are different tests, not one combined energy account.

Pulling work=20×1.5=30 J. In the separate test convert 30 cm to 0.30 m, then F=W/s=18/0.30=60 N. For horizontal motion at fixed height, distance along vertical gravity is zero, so gravity does zero work. Select the named force; total path length does not apply to every force.

If pupils are still stuck

Use the matching Say/Ask/Expect coaching, then the named fresh retry in its replacement time. If still insecure, help label the named force, direction and units before selecting the equation. Record the exact remaining difficulty for the usual teacher. Keep D for next lesson; do not extend today's lesson.

Turn to teacher page 2 for the timed run sheet. Keep this guide separate from the pupil booklet.

Run the lesson from this page

Work done by forces

Print the complete 8-page pupil booklet, one per pupil, stapled in order. Double-sided printing is fine.

Read teacher page 1, then use the timed run sheet on page 2. Keep the 10-page teacher guide separate from pupil copies.

Pupils need pens, a ruler and a calculator. Reading, data and figures are supplied. No login, pupil devices or practical apparatus are required.

Min	Pupil page / Q	Read aloud / check	Next action and answer key
0-5	1 / 1-3	Start from memory; check work, conversion and unit.	If insecure A uses first 2 reading minutes. Answers: teacher page 3. Coaching: page 7.
5-15	2 / reading	Read the named-force rules and complete models.	Check A if used; distinguish work W from watts.
15-20	3 / 4	Commit to both work values and reasons; stop.	If insecure B replaces 5-6. Answers: teacher page 3. Coaching: page 8.
20-30	4 / 5-8	Calculate work, distance and force for separate tests.	If B used, complete 7-8 only; leave 5-6 blank. Answers: teacher page 4.
30-33	5 / 9	Find force independently, then explain gravity's work.	If insecure C replaces 10-11. Answers: teacher page 4. Coaching: page 9.
33-45	6-7 / 10-15	Use the supplied GPE gain and complete the constant-speed application.	If C used leave 10-11 blank; complete 12-15. Answers: teacher page 5.
45-55	8 / 16	Share practice keys; correct and explain a physical reason.	Keep independent exit answers hidden. Answers: teacher page 5.
55-60	8 / 17	Cover earlier work and complete the exit independently.	Collect all booklets. D is next lesson only. Answers: teacher page 6. Coaching: page 10.

Estimated 60 minutes. Practice: 10 minutes, 3-minute mid-check and 12 minutes. A uses reading time; B replaces 5-6; C replaces 10-11; D is next lesson only. Timings not classroom-trialled.

Entry and hinge - pupil pages 1 and 3

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

1. (pupil p1) 12×3.0=36 J.

2. (pupil p1) 40/100=0.40 m.

3. (pupil p1) Joule (J). 1 N m=1 J. Work is an amount of transferred energy, not power in watts.

4. (pupil p3) C: gravity does 0 J because motion has no vertical displacement; the pull does 10×2=20 J. The zero resultant does not make work by each individual force zero.

Try again A - pupil page 1

Only if directed. Use the first 2 reading minutes, then continue on page 2.

(a) 0.20 m. (b) 8.0×2.0=16 J. (c) Joules; 1 N m=1 J.

Try again B - pupil page 3

Only if directed. Complete B instead of questions 5-6 on page 4; then answer 7-8.

Gravity: 0 J, because no vertical displacement. Pull: 6.0×3.0=18 J despite zero resultant force. Use each named force and the distance along it.

First work practice and independent mid-check

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

5. (pupil p4) W=Fs=30×5.0=150 J.

6. (pupil p4) Energy transferred=50×0.40=20 J. This is the positive magnitude of braking work, not a gain in kinetic energy.

7. (pupil p4) s=W/F=96/24=4.0 m.

8. (pupil p4) 25 cm=0.25 m. F=W/s=5.0/0.25=20 N.

9. (pupil p5) 75 cm=0.75 m; F=45/0.75=60 N. The vertical weight does 0 J because the motion has no displacement along the weight.

Try again C - pupil page 5

Only if directed. Complete C instead of questions 10-11 on page 6. Then answer 12-15.

40 cm=0.40 m; F=32/0.40=80 N. Gravity does 0 J: horizontal displacement has no component along vertical weight.

Lift, constant-speed trolley and review

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

10. (pupil p6) Cable work=240×2.5=600 J, equal to the supplied GPE gain. Use the cable force, not the resultant force. No mgh calculation is needed.

11. (pupil p6) Weight acts vertically and displacement is horizontal. Distance along the weight is zero, so work done by gravity is zero. Do not multiply weight by the horizontal path length.

12. (pupil p6) 750-600=150 J increases thermal stores of the hoist and surroundings. Energy is dissipated into less useful stores, not destroyed; the complete account conserves energy.

13. (pupil p7) W=18×4.0=72 J. Use the pulling force, not the zero resultant force.

14. (pupil p7) The pull still does 72 J of work while the opposing forces balance. Kinetic energy is unchanged; friction transfers energy to thermal stores of trolley/surface/surroundings. Energy is not destroyed.

15. (pupil p7) 72 N m=72 J because 1 N m=1 J. Accept consistent numerical follow-through from question 13.

16. (pupil p8) Accept a correction with a physical reason, not a copied answer. All-correct: a pull can do work while friction transfers energy to thermal stores; balanced forces mean unchanged velocity/kinetic energy, not no individual transfers.

Independent exit and next-lesson follow-up

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

17. (pupil p8) (a) 18×1.5=27 J. (b) 0 J: no vertical displacement along gravity. (c) Kinetic energy is unchanged; 27 J is transferred through friction to thermal stores of trolley/surface/surroundings, not destroyed. (d) 60 cm=0.60 m; F=36/0.60=60 N. Accept consistent follow-through for the amount in (c).

Try again D - next lesson - pupil page 8

Leave this today. Your usual teacher may direct it next lesson.

Pulling work=12×2=24 J. Gravity does 0 J with no vertical displacement. Kinetic energy stays constant; friction transfers energy to thermal stores of trolley/surface/surroundings, not destruction. Separate force: 25 cm=0.25 m; F=20/0.25=80 N.

Collect and follow up

Collect every named booklet with working/corrections. Record who needs support with conversions/rearrangement, force direction, or frictional stores and who needs Try again D next lesson.

Source provenance - for the usual teacher

Pupil question	Original worksheet part / page
5	WS-06 Q4(a) / source p4
6	WS-06 Q4(b) / source p4
7	WS-06 Q4(c) / source p4
8	WS-06 Q4(d) / source p4
10	WS-06 Q4(e) / source p5
11	WS-06 Q4(f) / source p5
12	WS-06 Q4(g) / source p5

Selected practice is reformatted from the maintained PhysicsUK worksheet. Required context is included; unassigned parts are omitted.

Source worksheet | Maintained solutions | Revision notes

The omitted Q3(a) context and 600 J GPE gain are supplied for source Q4(e). Source Q4(g) is explicitly a different lift. The original trolley task is integrated as pupil 13-15; its unit-equivalence prompt uses the pupil's result to avoid revealing question 13's answer in advance.

Check 1: Entry

Question 1, Question 2, Question 3

Look for: Q1 36 J; Q2 0.40 m; Q3 joule and 1 N m=1 J.

If secure: Continue to page 2 reading/model.

If: Divides force by distance or gives watts/newtons for work.

Likely issue: The equation or difference between force, work and power is insecure.

Say: Work is the energy a named force transfers through movement. For a constant force along the movement multiply newtons by metres; the result is joules, not watts.

Ask: For question 1, what is 12×3 and which unit measures transferred energy?

Expect: 36 J. One newton metre is one joule.

Next: Use page 2's equation/units, then complete Try again A on page 1 in the first 2 reading minutes.

Pupil page 2, W=Fs and units rows.

If: Uses 40 m or 0.04 m for question 2.

Likely issue: The centimetre conversion is wrong.

Say: There are 100 centimetres in one metre. Divide the centimetre number by 100 before using the work equation.

Ask: In question 2, what is 40/100, and is 40 cm less than a metre?

Expect: 0.40 m; yes.

Next: Use page 2's equation/units, then complete Try again A on page 1 in the first 2 reading minutes.

Pupil page 2, conversions row.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Check 2: Hinge

Question 4

Look for: C with gravity 0 J from perpendicular displacement and pull 20 J despite balanced forces.

If secure: Continue to questions 5-8.

If: A: gravity does 200 J.

Likely issue: Horizontal path length has been used with vertical weight.

Say: Work uses distance along the force. The trolley does not rise or fall, so the distance along vertical gravity is zero.

Ask: For question 4, how much vertical displacement does the trolley have?

Expect: Zero, so gravity does 0 J.

Next: Use page 2's named-force and direction rules, then complete Try again B on page 3 instead of 5-6; complete 7-8.

Pupil page 2, perpendicular-force rule.

If: B: the pull does zero work because forces balance.

Likely issue: Resultant force has replaced the named force in the work equation.

Say: The pull is still 10 N through 2 m. Balanced forces keep the speed unchanged; they do not make each force's energy transfer zero.

Ask: For question 4, which force is named for pulling work and what is 10×2?

Expect: The 10 N pull; work is 20 J.

Next: Use page 2's named-force and direction rules, then complete Try again B on page 3 instead of 5-6; complete 7-8.

Pupil page 2, balanced-forces rule.

If: D, or C without an explanation.

Likely issue: The force values may be swapped or the correct letter guessed.

Say: Label each force and its direction before calculating. Weight is vertical; the pull is the smaller horizontal force. Use neither force in place of the other.

Ask: In question 4, pair the vertical weight and horizontal pull with their distances along the force.

Expect: Weight: 0 m, giving 0 J. Pull: 2 m, giving 20 J.

Next: Use page 2's named-force and direction rules, then complete Try again B on page 3 instead of 5-6; complete 7-8.

Pupil page 2, named-force model.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Check 3: Mid Practice

Question 9

Look for: 0.75 m; F=45/0.75=60 N; vertical weight does 0 J with direction reason.

If secure: Continue to 10-15, using the supplied lift givens.

If: Gives 0.60 N, 33.75 N or uses the unrearranged equation.

Likely issue: Conversion or solving for force is insecure.

Say: Convert the distance before rearranging. Since W=Fs, divide the work by the distance in metres to recover F.

Ask: For question 9, what is 75 cm in metres, and then 45/0.75?

Expect: 0.75 m and 60 N.

Next: Use page 2's conversion/rearrangement and direction model, then complete Try again C on page 5 instead of 10-11; complete 12-15.

Pupil page 2, conversions and rearranged model.

If: Gives nonzero work by the vertical weight.

Likely issue: Force direction has not been matched to displacement.

Say: The 90 N weight is a separate vertical force. Horizontal motion contains zero displacement along that force, regardless of the weight's size.

Ask: In question 9, is any rise or fall stated? What work follows for weight?

Expect: No rise/fall; gravity does 0 J.

Next: Use page 2's conversion/rearrangement and direction model, then complete Try again C on page 5 instead of 10-11; complete 12-15.

Pupil page 2, perpendicular-force rule.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Check 4: Exit

Question 17

Look for: Q17: pulling 27 J; gravity 0 J; friction warms named thermal stores with constant kinetic energy; separate force 60 N.

If secure: Record secure calculations, named-force reasoning and energy-transfer explanation.

If: Pulling work or separate force is wrong, especially after using 60 as metres.

Likely issue: Equation choice, conversion or rearrangement needs follow-up.

Say: For work, multiply named force by distance along it. For an unknown force, convert distance to metres then divide work by that distance.

Ask: For question 17, what is 18×1.5, and what is 36 divided by 0.60?

Expect: 27 J and 60 N.

Next: Next lesson revisit the relevant page 2 rules, then complete Try again D independently on page 8.

Pupil page 2, equation/units and rearranged model.

If: Gravity does work, or claims no energy transfer/destruction because resultant is zero.

Likely issue: Direction or individual energy transfers remain insecure.

Say: Gravity has no displacement along it here. The pull still transfers energy, balanced by frictional transfers to thermal stores; constant speed means unchanged kinetic energy.

Ask: For question 17, which force acts along the movement and which objects warm?

Expect: Pull/friction act horizontally; trolley/surface/surroundings gain thermal energy. Gravity does 0 J; energy is not destroyed.

Next: Next lesson revisit the relevant page 2 rules, then complete Try again D independently on page 8.

Pupil page 2, direction, balanced forces and friction reading.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Specification and review

AQA 8463: 4.5.2 | AQA 8464: 6.5.2. Both courses and tiers: work by a constant named force, distance along its line of action, units, rearrangement and frictional energy transfer. Supplied GPE result; no mgh, spring or trigonometric calculations.

PhysicsUK original cover lesson. Reviewed 2026-11-01. Timings estimated.