

Mechanical comprehension: applied practice: open practice pack

20 untimed questions across 4 authored sections.

Detail	Value
Pack	applied-practice-mechanical-comprehension
Source	applied-practice
Pack version	v1
Worksheet items	20
Authored hints	0
Worked explanations	20

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Learner worksheet

Each item describes a machine or an arrangement of forces in words. Nothing needs to be drawn, and no formula sheet is required: the relationships you need (moments balance, gear ratios, pressure transmitted equally through a fluid) are the ones the lesson works through. Take as long as you like; nothing here is timed.

Choose one answer for each item. On a judgement item, more than one option is often defensible. Pick the one you would rate most effective, then check the worked explanation for why the runner-up is weaker.

Levers, gears, and simple machines

Start with the two ideas that most mechanical items are built from: turning moments balance about a pivot, and a gear ratio trades speed against turning force.

1. mechanical-comprehension-applied-s01-q01

A plank pivots on a fulcrum. A 60 kg load sits 1 m from the fulcrum on one side. A person pushes down 3 m from the fulcrum on the other side. Ignoring the plank's own weight, what downward force must the person apply to just balance the load?

- A. The equivalent of 180 kg
- B. The equivalent of 60 kg
- C. The equivalent of 20 kg
- D. The equivalent of 30 kg

Your answer: _____

2. mechanical-comprehension-applied-s01-q02

A 30-tooth spur gear meshes directly with a 15-tooth spur gear. The 30-tooth gear turns clockwise at 60 rpm. How does the 15-tooth gear turn?

- A. 120 rpm, counter-clockwise
- B. 120 rpm, clockwise
- C. 30 rpm, counter-clockwise
- D. 30 rpm, clockwise

Your answer: _____

3. mechanical-comprehension-applied-s01-q03

A wheelbarrow is lifted by its handles. Its wheel is the pivot, the bricks sit over the tray, and the hands lift at the handles. Which arrangement does this describe?

- A. The effort is between the pivot and the load
- B. The pivot is between the effort and the load
- C. The load and the effort act at the same point on opposite sides of the pivot
- D. The load is between the pivot and the effort

Your answer: _____

4. mechanical-comprehension-applied-s01-q04

Gear A (20 teeth) meshes with gear B (40 teeth), and gear B meshes with gear C (10 teeth). Gear A is driven clockwise. How does gear C turn?

- A. Counter-clockwise, at twice gear A's speed
- B. Clockwise, at twice gear A's speed
- C. Clockwise, at half gear A's speed
- D. Counter-clockwise, at half gear A's speed

Your answer: _____

5. mechanical-comprehension-applied-s01-q05

A straight ramp 6 m long is used to raise a drum 1.5 m onto a loading bay. Ignoring friction, what is the ideal mechanical advantage of the ramp?

- A. 4
- B. 4.5
- C. 7.5
- D. 9

Your answer: _____

Pulleys, belts, and mechanical advantage

Work through rope and belt systems. The recurring trap is assuming that mechanical advantage creates energy: it always trades distance for force.

6. mechanical-comprehension-applied-s02-q01

A rope runs over a single pulley bolted to a ceiling beam. The load hangs on one end and a worker pulls down on the other. What does this pulley achieve?

- A. It halves the force needed to raise the load
- B. It changes the direction of the pull without reducing the force needed
- C. It doubles the height the load rises for each metre of rope pulled
- D. It reduces the weight of the load

Your answer: _____

7. mechanical-comprehension-applied-s02-q02

A 200 N load hangs from a movable pulley, supported by two sections of the same rope. Ignoring friction and the pulley's weight, what effort is needed and how much rope must be pulled to raise the load 1 m?

- A. 400 N, and 0.5 m of rope
- B. 200 N, and 1 m of rope
- C. 100 N, and 1 m of rope
- D. 100 N, and 2 m of rope

Your answer: _____

8. mechanical-comprehension-applied-s02-q03

A block and tackle is rigged so that four sections of rope support the movable block. Ignoring friction, roughly what effort raises a 600 N load?

- A. 2400 N
- B. 600 N
- C. 150 N
- D. 300 N

Your answer: _____

9. mechanical-comprehension-applied-s02-q04

Rigging extra pulleys into a hoist reduces the effort needed. Which statement about that system is correct?

- A. The effort moves farther than the load, so the total work done is not reduced
- B. The total work done is reduced in proportion to the pulley count
- C. The load's weight is reduced by each added pulley
- D. Rope tension rises with each added pulley

Your answer: _____

10. mechanical-comprehension-applied-s02-q05

An open (uncrossed) belt connects a 200 mm driver pulley to a 50 mm driven pulley. The driver turns at 300 rpm. How does the driven pulley turn?

- A. 75 rpm, in the same direction
- B. 1200 rpm, in the same direction
- C. 1200 rpm, in the opposite direction
- D. 75 rpm, in the opposite direction

Your answer: _____

Fluids, pressure, and hydraulics

Pressure in a confined fluid is transmitted equally in all directions. These items apply that to presses, pipework, and floating loads.

11. mechanical-comprehension-applied-s03-q01

In a hydraulic press, the input piston has an area of 2 cm squared and the output piston an area of 50 cm squared. A force of 40 N is applied to the input piston. What force appears at the output piston?

- A. 40 N
- B. 80 N
- C. 500 N
- D. 1000 N

Your answer: _____

12. mechanical-comprehension-applied-s03-q02

Two open tanks hold water to the same depth. One is a narrow cylinder, the other a wide rectangular tank. What determines the pressure on the base of each?

- A. The total volume of water each tank holds
- B. The surface area of the tank's base
- C. The depth of water and the density of the liquid
- D. The shape of the tank walls

Your answer: _____

13. mechanical-comprehension-applied-s03-q03

In a sealed hydraulic jack the output piston has five times the area of the input piston. The input piston is pushed in 20 cm. How far does the output piston move?

- A. 4 cm
- B. 20 cm
- C. 100 cm
- D. 25 cm

Your answer: _____

14. mechanical-comprehension-applied-s03-q04

Water flows steadily along a full pipe that narrows from 100 mm to 50 mm diameter. What happens to the speed of the water in the narrow section?

- A. It slows down
- B. It speeds up
- C. It is unchanged
- D. It stops until pressure builds

Your answer: _____

15. mechanical-comprehension-applied-s03-q05

A rectangular block floats in fresh water with one quarter of its height above the surface. What is the block's density relative to water?

- A. 0.25
- B. 0.5
- C. 0.75
- D. 1.33

Your answer: _____

Forces, friction, and stability

Finish with loads in motion and at rest: how a beam shares a load, why friction and momentum matter, and what makes something tip.

16. mechanical-comprehension-applied-s04-q01

A uniform 4 m beam weighing 200 N rests on a support at each end. A 400 N crate sits 1 m from the left support. What load does the left support carry?

- A. 400 N
- B. 300 N
- C. 500 N
- D. 200 N

Your answer: _____

17. mechanical-comprehension-applied-s04-q02

A heavy crate must be slid across a concrete floor. Which change most reduces the force needed to move it?

- A. Adding ballast so the crate is heavier and more stable
- B. Putting rollers underneath so sliding friction becomes rolling friction
- C. Pushing at a steeper downward angle
- D. Standing the crate on its narrow end to reduce contact area

Your answer: _____

18. mechanical-comprehension-applied-s04-q03

An empty van and a fully loaded van of the same model travel at the same speed and brake with the same braking force. Which takes longer to stop, and why?

- A. Neither; stopping distance depends only on speed
- B. The empty van, because it has less grip
- C. Neither; the extra weight increases grip in proportion
- D. The loaded van, because more mass at the same speed means more momentum to remove

Your answer: _____

19. mechanical-comprehension-applied-s04-q04

What is the purpose of a flywheel on a single-cylinder engine?

- A. To raise the engine's maximum speed

- B. To reduce the engine's total mass
- C. To store rotational energy and even out the variation in speed between power strokes
- D. To reverse the direction of rotation on the exhaust stroke

Your answer: _____

20. mechanical-comprehension-applied-s04-q05

A tall shelving unit is being tilted onto a trolley. At what point does it topple rather than settle back?

- A. When its total weight exceeds the trolley's rated capacity
- B. As soon as it is tilted at all
- C. When the top shelf is loaded more heavily than the bottom shelf
- D. When the vertical line through its centre of gravity falls outside its base of support

Your answer: _____

Authored hints

This applied practice source does not publish separate authored hints: the rationale is attached to each item as a worked explanation instead. Every item is therefore listed as missing a hint, and no hint text is generated or inferred.

20 worksheet items do not have an authored hint. No hint text was generated for them.

Answer key

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Mechanical comprehension: applied practice: open practice pack answer key

Item	Choice	Answer
mechanical-comprehension-applied-s01-q01	C	The equivalent of 20 kg
mechanical-comprehension-applied-s01-q02	A	120 rpm, counter-clockwise
mechanical-comprehension-applied-s01-q03	D	The load is between the pivot and the effort
mechanical-comprehension-applied-s01-q04	B	Clockwise, at twice gear A's speed
mechanical-comprehension-applied-s01-q05	A	4
mechanical-comprehension-applied-s02-q01	B	It changes the direction of the pull without reducing the force needed
mechanical-comprehension-applied-s02-q02	D	100 N, and 2 m of rope
mechanical-comprehension-applied-s02-q03	C	150 N
mechanical-comprehension-applied-s02-q04	A	The effort moves farther than the load, so the total work done is not reduced
mechanical-comprehension-applied-s02-q05	B	1200 rpm, in the same direction
mechanical-comprehension-applied-s03-q01	D	1000 N
mechanical-comprehension-applied-s03-q02	C	The depth of water and the density of the liquid
mechanical-comprehension-applied-s03-q03	A	4 cm
mechanical-comprehension-applied-s03-q04	B	It speeds up

mechanical-comprehension-applied-s03-q05	C	0.75
mechanical-comprehension-applied-s04-q01	A	400 N
mechanical-comprehension-applied-s04-q02	B	Putting rollers underneath so sliding friction becomes rolling friction
mechanical-comprehension-applied-s04-q03	D	The loaded van, because more mass at the same speed means more momentum to remove
mechanical-comprehension-applied-s04-q04	C	To store rotational energy and even out the variation in speed between power strokes
mechanical-comprehension-applied-s04-q05	D	When the vertical line through its centre of gravity falls outside its base of support

Worked explanations

mechanical-comprehension-applied-s01-q01: Moments balance about the fulcrum: force x distance on one side equals force x distance on the other. $60 \times 1 = F \times 3$, so F is the equivalent of 20 kg. The 180 kg answer multiplies where it should divide. That is the force you would need if the load were the one on the long arm.

mechanical-comprehension-applied-s01-q02: Directly meshed gears always turn in opposite directions, and speed varies inversely with tooth count: half the teeth means twice the speed, so 120 rpm counter-clockwise. Answers that keep the direction the same describe a belt or chain drive, not meshed teeth.

mechanical-comprehension-applied-s01-q03: Wheel (pivot), tray (load), handles (effort) sit in that order along the barrow, so the load is between the pivot and the effort: the second-class lever arrangement, which is why the handles need less force than the bricks weigh. 'Pivot between effort and load' describes a seesaw or a pair of scissors instead.

mechanical-comprehension-applied-s01-q04: Direction alternates at each mesh, so A clockwise makes B counter-clockwise and C clockwise again. Speed depends only on the first and last gear when the middle one is simply passed through: 20 teeth driving 10 teeth doubles the speed. The middle gear changes direction, not the overall ratio.

mechanical-comprehension-applied-s01-q05: An inclined plane's ideal mechanical advantage is its length divided by its height: $6 / 1.5 = 4$. The 4.5 answer subtracts the height from the length, which is the horizontal run, not the ratio that matters.

mechanical-comprehension-applied-s02-q01: A fixed pulley does not move with the load, so no rope section other than the one holding the load takes any share of the weight: the only gain is that pulling down is easier to do with body weight than pulling up. Halving the force needs a movable pulley, where two rope sections support the load.

mechanical-comprehension-applied-s02-q02: Two supporting sections share the load, so the effort is halved to 100 N, but each section must shorten by 1 m, so 2 m of rope is pulled. The '100 N and 1 m' answer is the tempting one because it keeps the force saving and forgets the distance cost, which would mean getting energy for nothing.

mechanical-comprehension-applied-s02-q03: Mechanical advantage equals the number of rope sections supporting the moving block, so $600 \text{ N} / 4 = 150 \text{ N}$. The 300 N answer counts only the two sections you can see moving fastest rather than all four that carry load.

mechanical-comprehension-applied-s02-q04: Mechanical advantage trades distance for force: halving the effort doubles the rope pulled, so work in still equals work out (a little more, once friction is counted). Answers that reduce the total work or the load's weight would create energy out of the rigging.

mechanical-comprehension-applied-s02-q05: Belt speed is common to both pulleys, so rpm varies inversely with diameter: $300 \times (200 / 50) = 1200 \text{ rpm}$. An open belt keeps both pulleys turning the same way; only a

crossed belt reverses the driven pulley.

mechanical-comprehension-applied-s03-q01: Pressure is the same throughout the fluid: $40 \text{ N} / 2 \text{ cm squared} = 20 \text{ N per cm squared}$, and $20 \times 50 = 1000 \text{ N}$. The 500 N answer halves the area ratio, treating the input piston as 4 cm squared.

mechanical-comprehension-applied-s03-q02: Liquid pressure depends on depth and density only, so both bases sit at the same pressure despite very different volumes. Volume is the intuitive wrong answer: the wide tank holds far more water, but that extra weight is carried by the wider base, leaving pressure unchanged.

mechanical-comprehension-applied-s03-q03: The fluid is effectively incompressible, so the volume pushed out of the small cylinder equals the volume entering the large one: five times the area means one fifth of the travel, 4 cm. The 100 cm answer multiplies by the ratio, which would produce both more force and more distance.

mechanical-comprehension-applied-s03-q04: The same volume must pass every cross-section each second, so a smaller area forces a higher speed. 'Unchanged' confuses steady flow rate with steady velocity. The flow rate is constant, which is exactly why the velocity has to rise.

mechanical-comprehension-applied-s03-q05: A floating body displaces its own weight, so the submerged fraction equals the relative density: three quarters submerged means 0.75. The 0.25 answer reads off the part above the surface, which is the fraction that is not doing the supporting.

mechanical-comprehension-applied-s04-q01: The beam's own weight acts at its midpoint and splits evenly, giving 100 N per support. The crate is 1 m from the left and 3 m from the right, so the left support takes three quarters of it: 300 N. Total 400 N. The 300 N answer forgets the beam's own weight.

mechanical-comprehension-applied-s04-q02: Rolling friction is a small fraction of sliding friction for the same load, so rollers cut the required force sharply. Reducing the contact area is the plausible-sounding distractor, but dry friction depends on the normal force and the surface pair, not on how much area is touching, and a narrow end also makes the crate easy to tip.

mechanical-comprehension-applied-s04-q03: With the braking force held fixed by the question, a larger mass decelerates more slowly and carries more momentum, so it travels farther. The 'grip increases in proportion' answer is the real-world subtlety, but it only applies when braking is limited by tyre grip rather than by a stated fixed force.

mechanical-comprehension-applied-s04-q04: A single cylinder delivers power in short bursts; the flywheel's rotational inertia absorbs energy during the power stroke and releases it between strokes, so the shaft turns smoothly. It adds mass rather than reducing it, which is the point, a lighter flywheel smooths less.

mechanical-comprehension-applied-s04-q05: While that vertical line stays inside the base, gravity produces a restoring moment and the unit settles back; once it passes outside, the same weight becomes an overturning moment. Loading the top shelf heavily raises the centre of gravity and so reduces the tilt needed, but it is not by itself the tipping condition.

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