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CAMBRIDGE IGCSE PHYSICS 0625

Motion, Forces & Energy

1. High-Yield Revision

1.1 Quantities, units and equation sprint

Quantity	Equation	SI unit
speed	$v = s / t$	m/s
acceleration	$a = \Delta v / \Delta t$	m/s ²
weight	$W = mg$	N
resultant force	$F = ma$	N
moment	$M = Fd$	N m
momentum	$p = mv$	kg m/s
impulse	$F\Delta t = \Delta p$	N s
kinetic energy	$E_k = \frac{1}{2}mv^2$	J
change in GPE	$\Delta E_p = mg\Delta h$	J
work	$W = Fd$	J
power	$P = W/t = \Delta E/t$	W
efficiency	useful output / total input × 100%	%
pressure	$p = F/A$	Pa
liquid pressure change	$\Delta p = \rho g\Delta h$	Pa

Exam trap Convert units before substitution. High-risk conversions: cm → m; cm² → m² (divide by 10 000); g → kg; min → s; kJ → J; kW → W.

1.2 Motion and motion graphs

$$\text{speed} = \text{distance} / \text{time} \quad \text{acceleration} = \text{change in velocity} / \text{time}$$

Three graph rules to memorise:

- Distance–time graph: gradient = speed.
- Speed–time graph: gradient = acceleration.
- Speed–time graph: area under graph = distance travelled.

Graph feature	Physical meaning
horizontal distance–time line	stationary
straight rising distance–time line	constant speed
steeper distance–time line	greater speed
horizontal speed–time line	constant speed; acceleration = 0
positive gradient on speed–time	positive acceleration
negative gradient on speed–time	deceleration / negative acceleration

MINI-CALCULATION

Velocity changes from 4.0 m/s to 16 m/s in 6.0 s.

$$a = (16 - 4) / 6 = 2.0 \text{ m/s}^2$$

Common wrong answer 16/6. Acceleration requires change in velocity, not final velocity divided by time.

1.3 Forces

$$\text{resultant force } F = ma$$

- If resultant force = 0, the object may be stationary OR moving at constant velocity.
- Weight is a force: $W = mg$. Mass is measured in kg; weight in N.
- In $F = ma$, F means resultant force, not automatically the engine force or largest force shown.

MINI-CALCULATION

A 1200 kg car has a driving force of 4500 N and resistive forces of 1500 N.

$$F_{\text{resultant}} = 4500 - 1500 = 3000 \text{ N} \Rightarrow a = 3000/1200 = 2.5 \text{ m/s}^2$$

Exam trap Using 4500 N directly in $F = ma$. First find the resultant force.

1.4 Moments (21–27 min)

$$\text{moment} = \text{force} \times \text{perpendicular distance from the pivot}$$

- Unit: N m.
- For equilibrium: total clockwise moment = total anticlockwise moment.
- Distance must be perpendicular to the line of action of the force.

MINI-CALCULATION

A 300 N child sits 2.0 m from a pivot. A 400 N child balances the beam on the other side.

$$300 \times 2.0 = 400 \times d \Rightarrow d = 1.5 \text{ m}$$

1.5 Momentum and impulse (27–34 min)

$$\text{momentum } p = mv \quad \text{impulse } F\Delta t = \Delta p$$

- Momentum is a vector: direction matters.
- In an isolated system, total momentum before = total momentum after.
- For rebounds, choose a positive direction before calculating.
- Increasing collision time reduces average force for the same change in momentum.

MINI-CALCULATION

A 2.0 kg trolley moving at 4.0 m/s hits a stationary 6.0 kg trolley and they stick together.

$$(2 \times 4) + (6 \times 0) = (2 + 6)v \Rightarrow v = 1.0 \text{ m/s}$$

Exam trap Treating a rebound speed as positive. If “towards the wall” is positive, motion away from the wall is negative.

1.6 Energy, work and power

$$E_k = \frac{1}{2}mv^2 \quad \Delta E_p = mg\Delta h \quad W = Fd \quad P = E/t$$

- Energy cannot be created or destroyed; it is transferred between stores.
- If speed doubles, kinetic energy becomes four times larger because v is squared.
- Work done is energy transferred.
- Power is the rate of energy transfer: “how fast”, not “how much”.
- Efficiency = useful output / total input $\times 100\%$.

MINI-CALCULATION

A machine transfers 12 000 J in 30 s.

$$P = 12\,000 / 30 = 400 \text{ W}$$

Exam trap Confusing energy and power. Joule (J) measures energy; watt (W) measures energy transferred per second.

1.7 Pressure + final retrieval check (41–45 min)

$$\text{solid pressure } p = F/A \quad \text{liquid pressure change } \Delta p = \rho g \Delta h$$

- Pressure unit: $\text{Pa} = \text{N/m}^2$.
- Same force on smaller area gives greater pressure.
- Liquid pressure increases with depth and density.

FOUR-QUESTION RETRIEVAL SPRINT

Question	Answer
A car travels 150 m in 12 s. Average speed?	12.5 m/s
A 6.0 kg object has resultant force 18 N. Acceleration?	3.0 m/s ²
A 200 N force acts 0.40 m from a pivot. Moment?	80 N m

A machine transfers 3600 J in 12 s. Power?

300 W

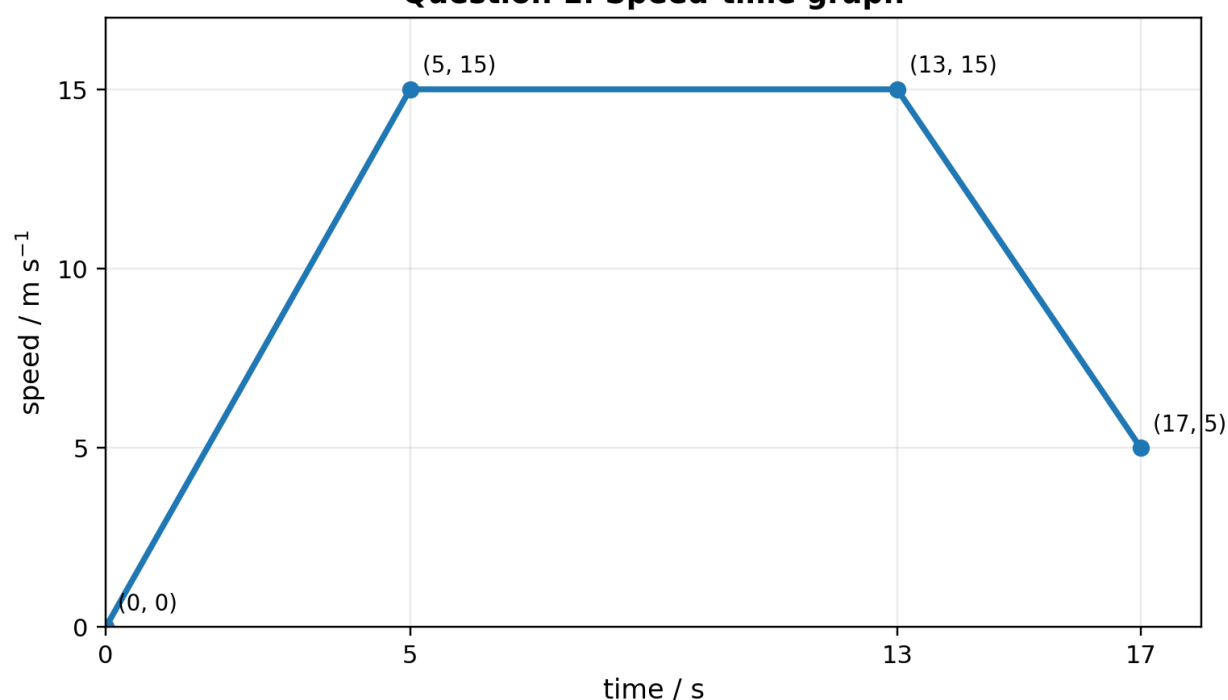
PART 2 • TUTOR-LED PAST-PAPER CLINIC • 45 MINUTES

2. Past-Paper Clinic

Clinic routine For each question: 1) name the skill, 2) identify the command word, 3) underline the relevant data, 4) select the equation/concept, 5) work in mark-scheme steps, 6) expose the most likely wrong answer.

QUESTION 1 • MOTION GRAPH • 9 MARKS

Question 1: Speed-time graph



A boat has the speed-time graph shown above.

(a) Calculate the acceleration during the first 5.0 s. [2]

Working: _____

(b) Calculate the distance travelled during the first 13 s. [4]

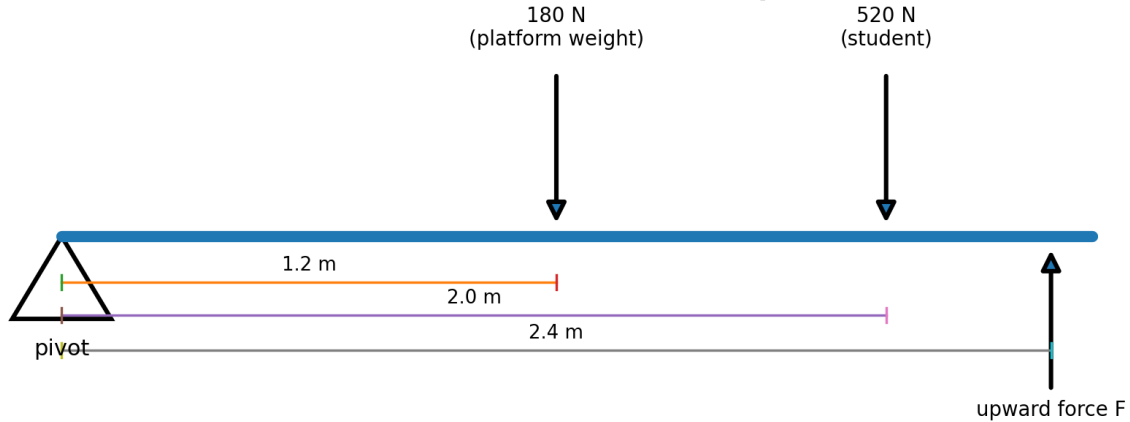
Working: _____

(c) Calculate the deceleration between 13 s and 17 s. [2]

Working: _____

(d) State what the horizontal section between 5 s and 13 s tells you about the motion. [1]

Working: _____

QUESTION 2 • FORCES & MOMENTS • 8 MARKS**Question 2: Platform in rotational equilibrium**

The horizontal platform is pivoted at one end. Its weight is 180 N and acts 1.2 m from the pivot. A student of weight 520 N stands 2.0 m from the pivot. An upward force F acts 2.4 m from the pivot and keeps the platform horizontal.

(a) State the condition involving moments when the platform is in equilibrium. [1]

Working: _____

(b) Calculate the upward force F . [4]

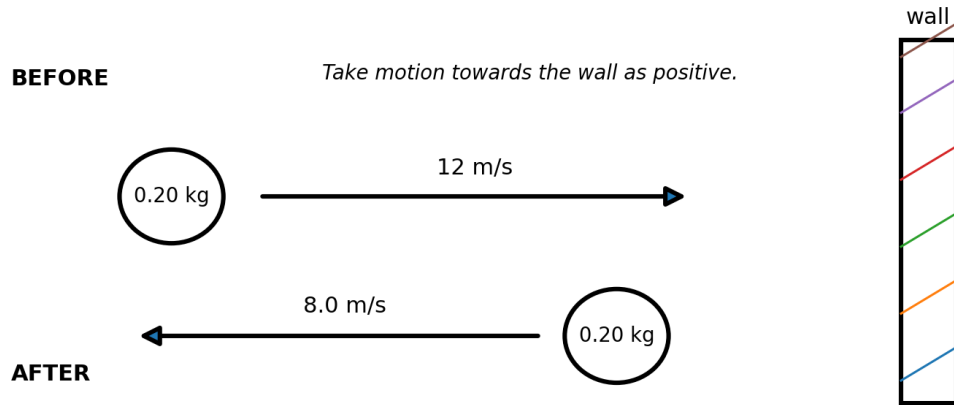
Working: _____

(c) The student steps off. The upward force remains unchanged for an instant. Explain why the platform begins to rotate. [2]

Working: _____

(d) State the SI unit of moment. [1]

Working: _____

QUESTION 3 • MOMENTUM & ENERGY • 10 MARKS**Question 3: Ball rebounds from a wall**

A ball of mass 0.20 kg moves horizontally towards a wall at 12 m/s. It rebounds in the opposite direction at 8.0 m/s. The collision lasts 0.050 s. Take motion towards the wall as positive.

(a) Calculate the momentum of the ball before the collision. [2]

Working: _____

(b) Calculate the change in momentum of the ball. [3]

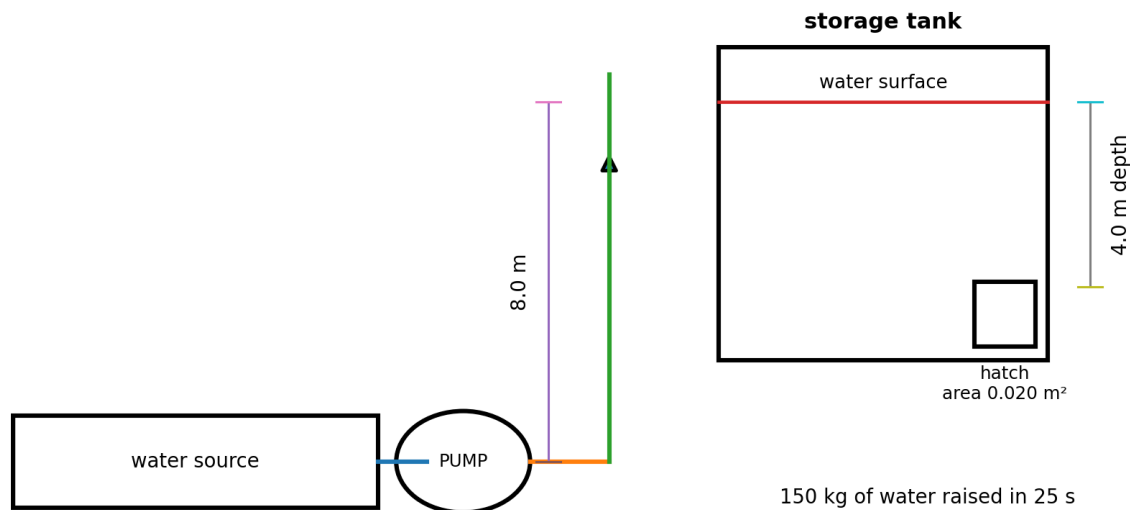
Working: _____

(c) Calculate the average force exerted on the ball. [2]

Working: _____

(d) Calculate the kinetic energy of the ball before and after the collision. [3]

Working: _____

QUESTION 4 • ENERGY, POWER & PRESSURE • 10 MARKS**Question 4: Pump, energy, power and pressure**

A pump raises 150 kg of water through a vertical height of 8.0 m in 25 s. Take $g = 9.8 \text{ N/kg}$.

(a) Calculate the increase in gravitational potential energy of the water. [3]

Working: _____

(b) Calculate the useful power of the pump. [2]

Working: _____

The water is stored in a tank. The depth of water above a hatch is 4.0 m. Density of water = 1000 kg/m^3 .

(c) Calculate the increase in pressure due to the water at the hatch. [2]

Working: _____

The area of the hatch is 0.020 m^2 .

(d) Calculate the force exerted on the hatch due to this pressure. [3]

Working: _____