

YEAR 2 | MODULE 5 | PACK 02

Centripetal force and contact forces

Official past-paper questions

2017-2023 | OCR A H556 | 5.2.2(a)-(d)(i)

29 marks | 5 question entries

One practice session

Use: attempt the session after learning its content. Try without notes; record any help used. Mark the session, identify the reason for lost marks, then revisit those questions after a few days.

Format: all MCQs appear first with their complete answer boxes. Written extracts retain the original paper's answer space. Only the subparts named in the source reference are assigned.

Reserved: all 2024 and 2025 papers are excluded. These files contain official examination questions only; no sample, specimen or practice papers.

Name: _____

First attempt: _____ Score: _____ / 29

[Official data, formulae and relationships booklet](#)

Question index

CM identifiers are stable across the question packs and mark schemes; Q numbers refer to this pack. This core pack has no selected MCQs.

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Q01 | CM10C

3 marks

June 2018 | H556/01 | Q21(c)

21 Fig. 21 shows the drum of a washing machine.

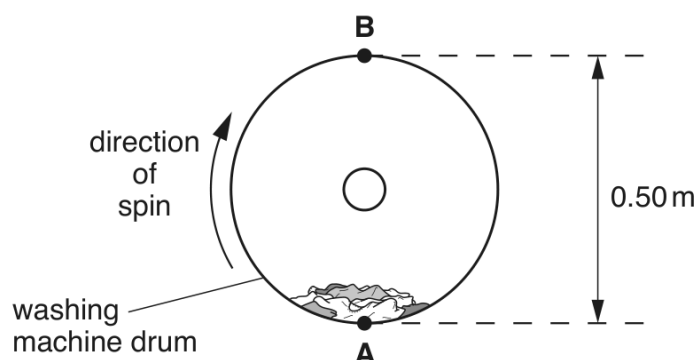


Fig. 21

The clothes inside the drum are spun in a **vertical** circular motion in a clockwise direction.

- (c) The washing machine is switched off and the speed of the drum slowly decreases. The clothes at the top of the drum at point **B** start to drop off at a certain speed v .

At this speed v , the normal contact force on the clothes is zero.

Calculate the speed v .

$$v = \dots\dots\dots \text{ms}^{-1} \text{ [3]}$$

Only (c) is assigned. The original diagram gives the drum diameter of 0.50 m; no answer from (b) is required.

Q02 | CM23B3

3 marks

June 2022 | H556/03 | Q1(b)(iii)

- 1 The table shows some data on the planet Venus.

Mass / kg	4.87×10^{24}
Radius / km	6050
Density of atmosphere at surface / kg m^{-3}	65
Period of rotation about its axis / hours	5830

- (b) Two identical space probes, **A** and **B**, land on a flat surface on Venus.

Probe **A** lands at the north pole. Probe **B** lands on the equator.

Each probe has mass 760 kg and volume 1.7 m^3 .

- (ii) The atmosphere exerts the same upthrust on each probe.

- (iii) Explain which probe will experience the greater normal contact force from the surface of Venus.

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.....

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.....

.....

..... [3]

Only (b)(iii) is assigned. The original probe locations and the statement that both probes have equal upthrust are retained. Numerical answers to omitted (a) and (b)(ii) are not required.

Q03 | CM14

6 marks

June 2019 | H556/03 | Q4(b)

- 4 At an airport, the conveyor belt for suitcases moves at a constant speed of 1.5 m s^{-1} . In Fig. 4.1, a suitcase of mass 8.0 kg has reached the line labelled **XX'**.

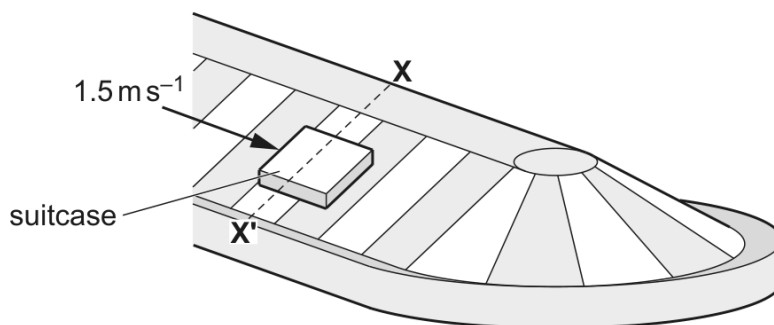


Fig. 4.1

Fig. 4.2 shows the situation in vertical cross-section. The frictional force F prevents the suitcase of weight W from sliding to the bottom of the belt. The normal contact force on the suitcase is R . The belt is inclined at an angle of 30° to the horizontal.

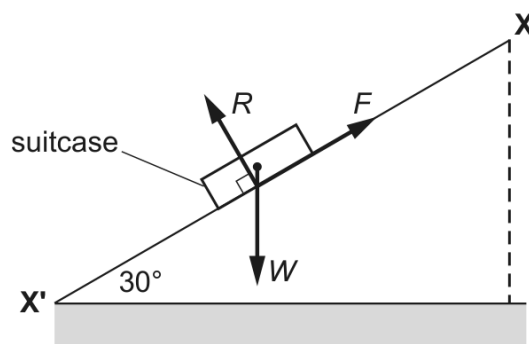


Fig. 4.2 (not to scale)

Only (b) is assigned. The original speed, mass and force diagrams from (a) are retained; the comparison can be explained without its numerical answers.

Q03 | CM14 - continued

6 marks

June 2019 | H556/03 | Q4(b)

(b) Fig. 4.3 shows the suitcase and the forces acting on it at the line labelled **YY'**.

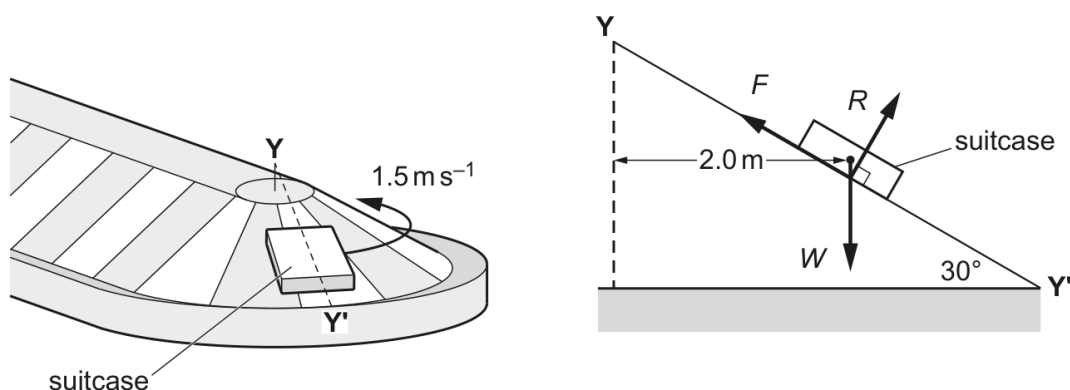


Fig. 4.3

The centre of mass of the suitcase is now moving at 1.5 m s^{-1} along a semi-circular arc of radius 2.0 m .

(i) Calculate the magnitude of the centripetal force acting on the suitcase.

centripetal force = ... N [2]

(ii) When the suitcase is at line **YY'**, the magnitude of force F is larger and the magnitude of force R is smaller than at **XX'**.

Explain why this is so.

[4]

Only (b) is assigned. The original speed, mass and force diagrams from (a) are retained; the comparison can be explained without its numerical answers.

Q04 | CM19

10 marks

November 2021 | H556/01 | Q22

- 22 (a)** A particle-accelerator uses a ring of electromagnets to keep protons moving continuously in a **circle**.

The speed v of the protons depends on the frequency f of rotation of the protons in the circular orbit.

Fig. 22 shows data points plotted on a v against f grid.

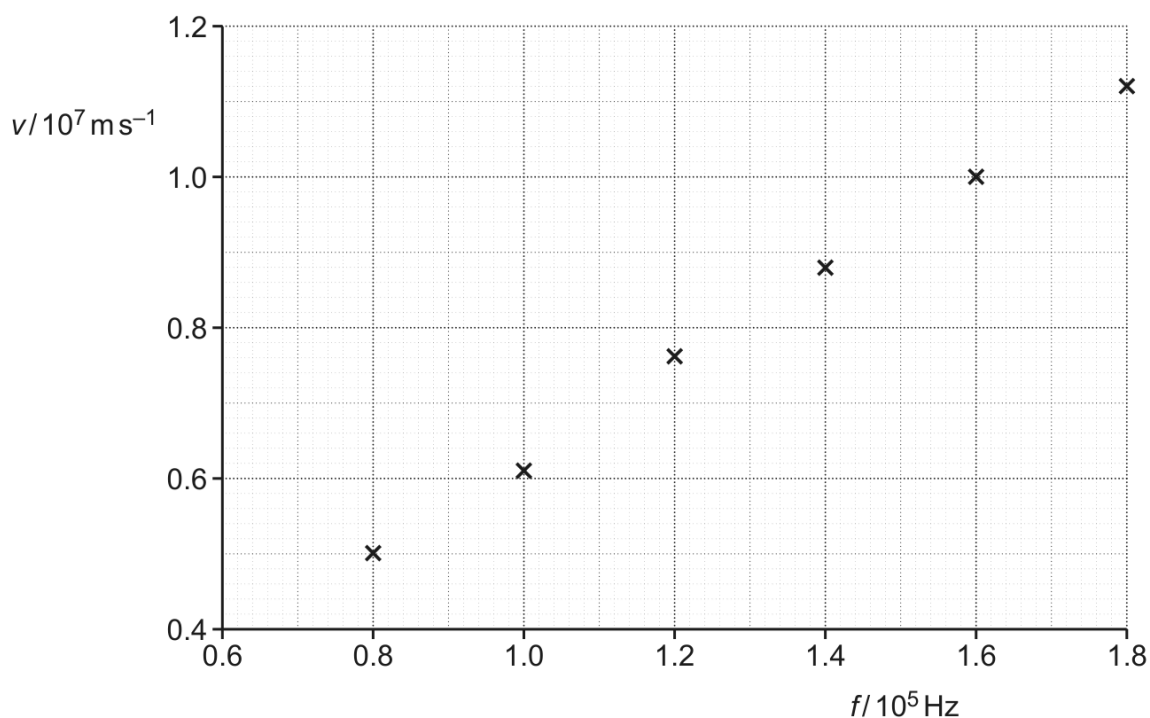


Fig. 22

- (i) Show that the gradient of the graph of v against f is equal to $2\pi r$, where r is the radius of the circular path of the protons.

[2]

The complete question is assigned, so (b) retains the radius and force calculations it depends on. Its accelerator context requires no magnetic-force equation.

Q04 | CM19 - continued

10 marks

November 2021 | H556/01 | Q22

- (ii) Show that r is about 10 m by determining the gradient of the line of best fit through the data points in **Fig. 22**.

[3]

- (iii) The maximum speed of the protons from this accelerator is $2.0 \times 10^7 \text{ m s}^{-1}$.

Calculate the maximum centripetal force F acting on a proton at this speed.

- mass of proton = $1.7 \times 10^{-27} \text{ kg}$.

$F = \dots\dots\dots \text{ N}$ [3]

- (b) A new particle-accelerator is now built for moving the protons in a circle of a radius 20 m.

The ring of electromagnets for this new accelerator provides the same **maximum** centripetal force as the accelerator in (a).

Calculate the maximum speed of the protons in this new accelerator.

maximum speed = $\dots\dots\dots \text{ m s}^{-1}$ [2]

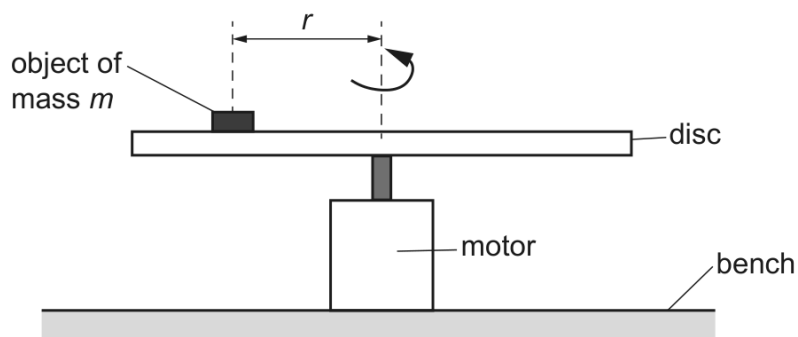
The complete question is assigned, so (b) retains the radius and force calculations it depends on. Its accelerator context requires no magnetic-force equation.

Q05 | CM16

7 marks

November 2020 | H556/01 | Q20

- 20** A small object of mass m is placed on a rotating horizontal metal disc at a distance r from the centre of the disc.



The frequency of rotation is adjusted using a motor attached to the disc.

The frequency of rotation of the disc is slowly increased from zero, until the object slips off. At this point, the friction F acting on the object is equal to the centripetal force.

The friction F is given by the expression $F = kmg$, where k is a constant and g is the acceleration of free fall. The constant k has no units.

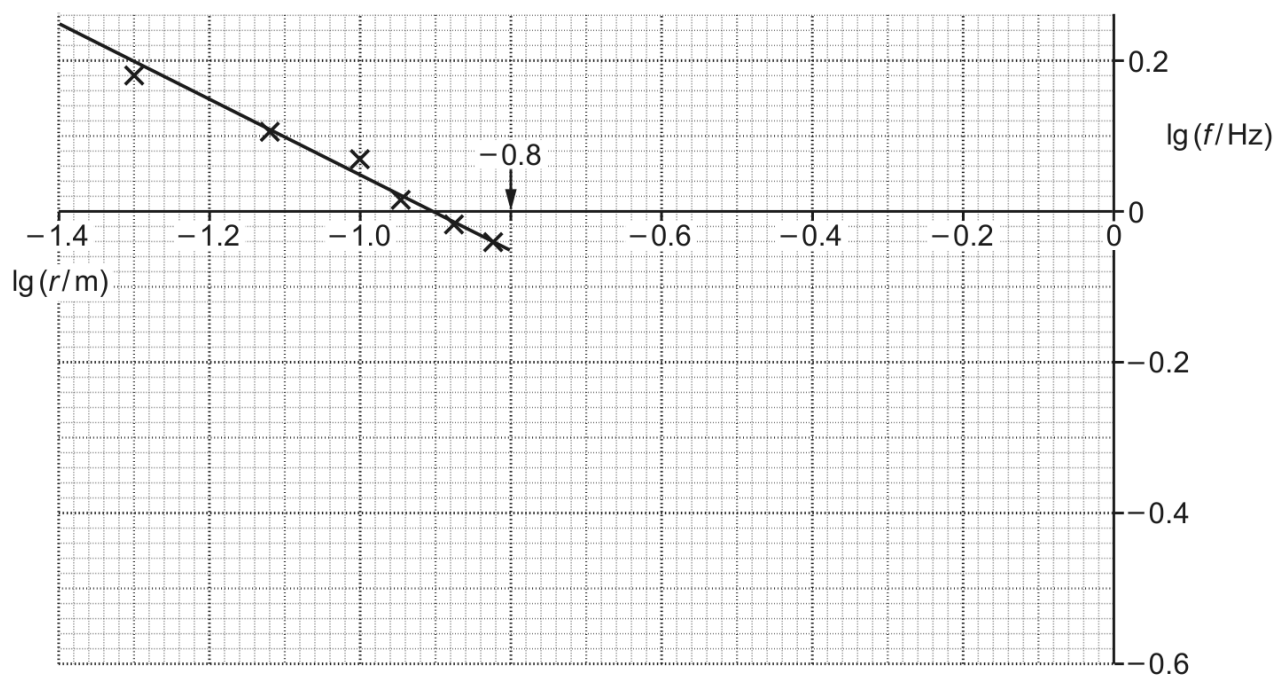
- (a)** Show that the frequency f at which the object slips off is given by the equation $f^2 = \left(\frac{gk}{4\pi^2} \right) \times \frac{1}{r}$.

[3]

Q05 | CM16 - continued

7 marks

November 2020 | H556/01 | Q20

(b) A student plots a graph of $\lg(f/\text{Hz})$ against $\lg(r/\text{m})$.

For this graph: $y\text{-intercept} = \frac{1}{2} \times \lg\left(\frac{gk}{4\pi^2}\right)$

Use the graph to determine the constant k . Write your answer to 2 significant figures.

$k = \dots\dots\dots$ [4]