

Summer Exam Information

The Summer Exam is a two-hour written exam. The exam is in a multiple-choice format. There will be assigned no grade to the exam, there is no resit exam (DK: reeksamen), just like with lab reports. There is a final grade after the Winter Exam, which is an overall grade depending on the written exams and the submitted lab journals. There are two types of questions. In the form you fill out for the exam, it is possible to see whether the question allows for only one answer or more answers.

- 1) The first type of question has a single correct answer. Some options may give partial credit. Incorrect answers lower the assessment.
- 2) In the other type of question, the correct answer is to pick one or more options. You will still get partial credit if you only pick a subset of the correct answer. Incorrect answers lower the assessment.

The first type of question is exemplified in questions 1 and 14 below. The second type of question is exemplified in questions 4 and 9 below.

Question 1.

A student traveling to Japan gets a little bored on the train ride and measures with an app on his phone that the Japanese high-speed train "Shinkansen" accelerates from rest to a constant speed of 80 m/s in two stages. In the first stage, the acceleration is 2.0 m/s^2 and in the second stage, the acceleration is 1.0 m/s^2 . The two stages take the same amount of time.

How long does it take for the train to reach its constant speed?

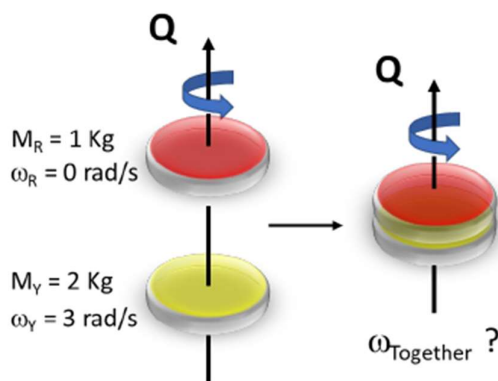
- A) 30 s
- B) 37 s
- C) 40 s
- D) 50 s
- E) 53 s
- F) 62 s
- G) 76 s
- H) 80 s
- I) Do not know.

Question 14.

A yellow, solid disc with radius $R = 10$ cm and mass $M_Y = 2.0$ kg rotates at 3.0 rad/s through an axis Q that passes through its center of mass (see Figure). Above this yellow disc there is a red non-rotating, solid disc with the same radius and mass $M_R = 1.0$ kg. Shortly after the red disc is deposited on top of the yellow disc, both discs rotate with the same angular velocity.

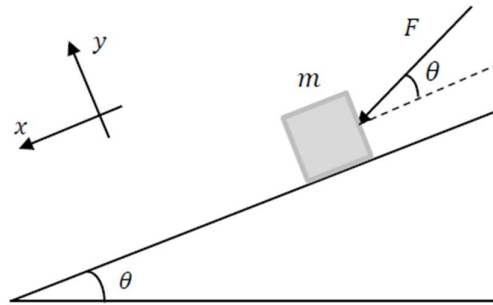
What is the angular velocity of the discs once they are rotating together?

- A) $\omega = 1.0$ rad/s
- B) $\omega = 2.0$ rad/s
- C) $\omega = 3.0$ rad/s
- D) $\omega = 4.0$ rad/s
- E) $\omega = 5.0$ rad/s
- F) $\omega = 6.0$ rad/s
- G) $\omega = 7.0$ rad/s
- H) $\omega = 8.0$ rad/s
- I) $\omega = 9.0$ rad/s
- J) Don't know



Question 4.

A box of mass, m , moves down an inclined plane with a smooth surface. The inclined plane makes an angle θ with the horizontal. A person pushes the box with a constant force, F , whose direction makes an angle θ with the inclined plane.



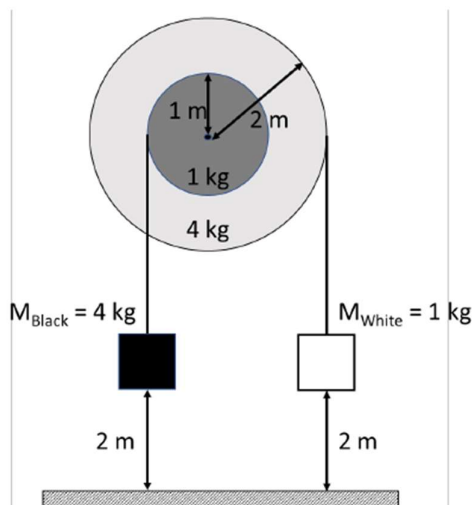
Which of the following equations corresponds to Newton's second law either down parallel to the inclined plane (x direction in the figure) or perpendicular to the inclined plane (y direction in the figure)?

- A) $ma_x = mg \cos \theta - F$
- B) $ma_x = mg \sin \theta - F \sin \theta$
- C) $ma_x = mg \sin \theta - F \cos \theta$
- D) $ma_x = mg \sin \theta + F$
- E) $ma_x = mg \sin \theta + F \sin \theta$
- F) $ma_x = mg \sin \theta + F \cos \theta$
- G) $ma_y = n \cos \theta - mg + F \cos \theta = 0$
- H) $ma_y = n - mg \sin \theta + F \cos \theta = 0$
- I) $ma_y = n - mg \cos \theta + F \sin \theta = 0$
- J) $ma_y = n - mg \cos \theta - F \sin \theta = 0$
- K) Do not know.

Question 9.

The system in the figure consists of two solid disks stuck to each other. They are able to rotate around a fixed, horizontal axis that passes through the center of the disks. The small disk has a radius of $R_{\text{small}} = 1 \text{ m}$ and mass $M_{\text{small}} = 1 \text{ kg}$. The big disk has a radius of $R_{\text{big}} = 2 \text{ m}$ and mass $M_{\text{big}} = 4 \text{ kg}$. There is a black box with mass $M_{\text{Black}} = 4 \text{ kg}$ hanging from the small disk. The white box, with mass $M_{\text{White}} = 1 \text{ kg}$, is hanging from the big disk. Both boxes are 2 m above the floor. The system is freed from rest.

Which of the following statements is true?



- A) The white box will move down and the black box will move up.
- B) The white box will move up and the black box will move down.
- C) Just before the first box touches the floor the speed of the white box will be larger than that of the black box.
- D) Just before the first box touches the floor the speed of the white box will be smaller than that of the black box.
- E) Just before the first box touches the floor the speed of the white box will be the same as that of the black box.
- F) The boxes never move.
- G) Do not know.