

Final Exam **Name** _____

Student Number _____

- This exam comprises **one** stand-alone (one-part) multiple-choice question and **five** scaffolded (three-part) multiple-choice questions.
 - The duration of the exam is **3 hours**.
 - You should initially receive **(i)** this test paper consisting of **8** numbered pages and **16** questions and **(ii)** a one-sided formula sheet. All other information required should be either known to you or given in a question.
 - Write your name and student number clearly in the space above and place your photo ID on the desk in front of you.
 - Calculators (**not** cellphones) may be used for computations, and must not contain formulas.
 - Portable communications devices of all types are prohibited. All such devices must be turned off and placed with your belongings at the front of the room.
 - Giving or receiving any aid during a test or exam is a violation of university rules and results in a failing grade and/or expulsion from the university.
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- **Take your time with each question. Use your exam booklet and/or the spaces provided below for your sketches and scribbles. Answer each question carefully before looking at the possible answers provided. We recommend covering the provided answers until you have found your own answer.**
 - After 20-30 minutes you will receive your scratch card; immediately check it for scratches or blemishes and if needed request a new card. Any minor scratches or blemishes will count as full selections, so be careful when handling your card. Write your name and student number on this card.
 - Record your answers with the card using **your student card to scratch** (coins don't work so well).
 - Keep your scratch card face down on the desk when you are not using it.
 - Make sure each answer you scratch corresponds to the question number on the test. Making a mistake here is impossible to undo!
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- Your aim is to take your time and answer each question with as few scratches as possible.
 - For each question: if the correct answer (a star) is visible in one scratch: **100%**; in two: **75%**; in three: **50%**; in four **25%**
 - If you need to scratch more than once, carefully reconsider the question from the beginning before selecting another answer.
 - By scratching until you find a star you should be able to proceed through the test knowing the correct answers to all previous questions.

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Upon receiving your scratch card, first scratch question 25 (this is **not** for marks): the star should be in box “B”. If not, raise your hand to speak to an invigilator.

1) Which of the following best describes Eq. (7.1) from the formula sheet?

- A. The work done on a system is the energy lost when an object is moved due to an external force and is given by the distance moved by the object multiplied by the cosine of the angle to the horizontal
- B. The work done on a system by an external force is a scalar quantity and is equal to the magnitude of the force multiplied by the magnitude of the displacement of the point of application of the force multiplied by the cosine of the angle between them
- C. The work done on a system is a scalar quantity and is equal to the magnitude of the normal force multiplied by the magnitude of the displacement of the system multiplied by the cosine of the angle between them
- D. The work done on a system is a vector quantity and is equal to the magnitude of the external force multiplied by the magnitude of the displacement of the system multiplied by the cosine of the angle between them
- E. The work done on a system is a scalar quantity and is equal to the magnitude of any internal force, F , in the system multiplied by the magnitude of the point of application of the force multiplied by the cosine of the angle between them

Qu's 2 -4. A rugby player passes a ball 7 m across a field, where it is caught at the same height as it was thrown. Treat the effect of air resistance to be negligible.

2) Which of the following is the angle above the horizontal that the ball was thrown if its initial speed was 11 m/s, assuming the smaller of the two possible angles was used?

- A.** 17° **B.** 10° **C.** 26° **D.** 11° **E.** 8.9°

3) Which of the following is the other angle that gives the same range?

- A.** 81° **B.** 68° **C.** 73° **D.** 78° **E.** 76°

4) Which of the following is the difference in flight times between these two trajectories?

- A.** 1.83 s **B.** 1.48 s **C.** 1.77 s **D.** 2.3 s **E.** 0.95 s

Qu's 5 -7. Suppose a gymnast of mass 77 kg climbs a rope hooked from a ceiling of height 11 m. The rope is the same length as the ceiling is high and we can treat its mass to be negligible. Treat the upward direction to be positive.

5) Which of the following is the tension in the rope if he climbs at a constant speed?

- A. 657 N B. 853 N C. 461 N D. 755 N E. 559 N

6) Which of the following is the tension in the rope if he instead accelerates at a rate of 1.43 m/s^2 ?

- A. 865 N B. 548 N C. 521 N D. 782 N E. 965 N

7) Suppose the gymnast slides down the rope when he reaches the top. If the magnitude of the force of friction is 283 N, which of the following is the new acceleration as he slides down the rope?

- A. -4.8 m/s^2 B. -3.8 m/s^2 C. -5.6 m/s^2 D. -6.5 m/s^2 E. -6.1 m/s^2

Qu's 8 -10. Suppose you have a wooden crate of mass 110 kg resting on a wood floor for which the coefficient of static friction is 0.5, and the coefficient of kinetic friction is 0.3.

8) Which of the following is the maximum magnitude of the force you can apply horizontally on the crate without moving it?

- A.** 539 N **B.** 686 N **C.** 490 N **D.** 637 N **E.** 441 N

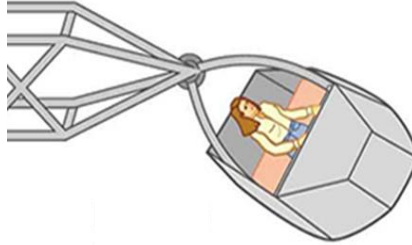
9) Which of the following is the magnitude of the acceleration of the crate if you continue to apply this force after the crate starts to slide?

- A.** 0.98 m/s^2 **B.** 0.78 m/s^2 **C.** 1.96 m/s^2 **D.** 2.16 m/s^2 **E.** 1.76 m/s^2

10) If you continue applying this force, which of the following is the time it takes to push the crate 4 m ?

- A.** 2.86 s **B.** 2.47 s **C.** 2.67 s **D.** 2.26 s **E.** 2.02 s

Qu's 11 -13. A large centrifuge is used so aspiring astronauts can experience accelerations similar to those during rocket launches and reentries into the Earth's atmosphere. The rider's cage hangs on a pivot at the end of the arm, allowing it to swing outward during rotation. Suppose the centripetal acceleration of the rider is $11 \times g$ and they are a distance 540 m from the axis of rotation.



11) Which of the following is the angular speed under these conditions?

- A.** 0.38 rad/s **B.** 0.41 rad/s **C.** 0.47 rad/s **D.** 0.36 rad/s **E.** 0.45 rad/s

12) Which of the following is the period of rotation under these conditions?

- A.** 14.1 s **B.** 13.6 s **C.** 15.1 s **D.** 17.3 s **E.** 16.5 s

13) By considering the forces acting on the cage, which of the following is the angle below the horizontal at which the cage will hang under these conditions?

- A.** 7.1° **B.** 4.8° **C.** 5.2° **D.** 6.3° **E.** 8.1°

Qu's 14 -16. A car of mass 970 kg is travelling on flat ground with an initial speed of 115 km/h . The car reaches a hill with a slope of 6° above the horizontal, disengages its engine and coasts up the hill..

14) If the effect of friction were negligible, which of the following would be the maximum vertical height that the car can coast up the hill?

- A.** 34 m **B.** 31.9 m **C.** 52.1 m **D.** 37.8 m **E.** 45.9 m

15) If the effect of friction is not negligible, which of the following is the amount of thermal energy generated by friction if the car is observed to coast up the hill to a height of 25 m above its starting point?

- A.** 1.59×10^5 J **B.** 8.37×10^4 J **C.** 1.78×10^5 J **D.** 2.57×10^5 J **E.** 2.37×10^5 J

16) Which of the following is the magnitude of the average force of friction on the car if it is observed to coast up the hill to this height of 25 m?

- A.** 515 J **B.** 360 J **C.** 1470 J **D.** 1076 J **E.** 656 J