

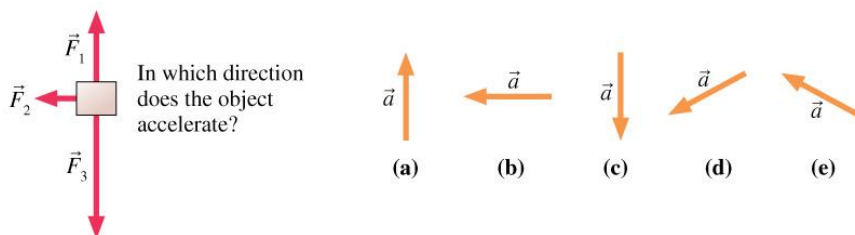
LAST NAME: _____ UOTTAWA ID: _____

VERSION BB Part 1. In the scantron sheet answer all MC questions below.

Best 6 count towards 48% of your test mark.

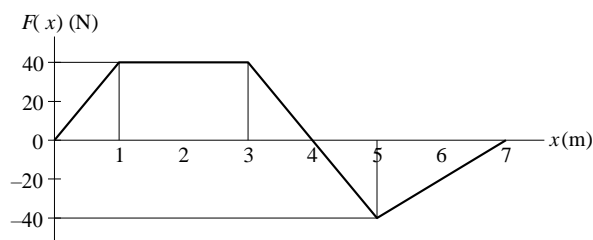
Use your exam booklet for necessary calculations.

1. A particle moving in a circle is subjected to a total acceleration that has a magnitude of 9m/s^2 . If its tangential acceleration has a magnitude of 3m/s^2 , what is the magnitude of its radial acceleration in m/s^2 ?
a) 8.8 b) 8.5 c) 7.7 d) 7.5 e) 7.3
2. An astronaut on the moon tosses a moon rock in the air while running forward at a constant speed of 3.2 m/s . The acceleration of gravity on the moon is 1.6m/s^2 . She catches the rock 6.93 seconds after it is thrown. The angle at which she threw the rock (relative to the forward direction and the surface of the moon) is:
a) 30° b) 45° c) 60° d) 75° e) none of the above
3. The tension in a string from which a 3.0-kg object is suspended in an elevator is equal to 36 N . What is the acceleration of the elevator?
a) 2.2 m/s^2 upward b) 1.2 m/s^2 upward c) 1.2 m/s^2 downward
d) 2.2 m/s^2 downward e) none of the above
4. Three forces act on an object. In which direction does the object accelerate?



5. A body moves in a circle at constant speed. The work done on the body by the centripetal force in one quarter of the full revolution is:
a) 0 b) $\frac{1}{2}\pi mv^2$ c) Ft d) $\frac{v^2}{r}$ e) $\frac{mv^2}{r}$
6. An object of mass 2 kg moving at $v_x = +1\text{m/s}$ is subjected to a single force $F(x)$ shown in the diagram below. What is the magnitude of its velocity (in m/s) when it is at position $x=4\text{m}$?

- a) 121
- b) 120
- c) 60
- d) 11
- e) none of the above



7. A refrigerator has a coefficient of performance 3.0. How much heat is exhausted to the hot reservoir when 300kJ of heat are removed from the cold reservoir?
a) 500kJ b) 400kJ c) 100kJ d) 80kJ
e) not enough information is given to answer the question

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PART 2 In the examination booklets solve 4 out of 5 problems below. Each question has the same weight. (13p)
For full marks you need a neat diagram (when applicable) and all steps to be clearly demonstrated.

- 1 In a game of bangoo, one ball is dropped from rest from a height h above the ground. Another ball is shot from a special bangoo-gun vertically upwards from the ground, at the instant the first ball is released. Determine the initial speed of the second ball if the two balls are to meet at a height $h/2$ above the ground.

- 2 A race car starts from rest on a flat circular track. The car increases its speed at a constant rate a_t as it goes once around the track. Find the angle that the total acceleration of the car makes with the radius connecting the center of the track and the car, at the moment when the car completes half of the circle.

- 3 Draw clear Free Body Diagrams (FBD) for each of the following cases, determine whether object is in an equilibrium or not, and write the proper scalar equations for relevant force components.
 - a) object of mass M on the frictionless incline ($\alpha = 20^\circ$). (3p)
 - b) object mass m moving with constant speed on the rough horizontal surface pushed by the F_{app} directed at 30° above horizontal. (3p)
 - c) an object of Mass M is hanging from a massless knot attached to two strings making angles of 40° and 53° with ceiling of the accelerating elevator. (3p)
 - d) an object of Mass M on the frictionless incline ($\alpha=20^\circ$) accelerated up by the force F_{app} applied at the end of massless cord (angle 60° below the horizontal.) (4p)

- 4 A skier of mass 70.0 kg is pulled up a frictionless slope by a motor-driven cable.
 - a) How much work is required to pull the skier up a distance of 60.0 m along a 30.0° slope at a constant speed of 2.00 m/s? (5p)
 - b) A motor of what power is required to perform this task? (3p)

The skier then goes down reaching the maximum speed on the frictionless slope (she does not try to stop at all!) and while having this maximum speed she enters flat, rough patch of mixed snow and sand, which causes her to stop after 15 meters.

 - c) what is the coefficient of kinetic friction between the skier and the patch? (2p)
 - d) what is the change of the entropy due to friction forces (presume the constant temperature of -3°C) (3p)

- 5 Carnot Engine operating between the two reservoirs at kept at temperatures of 27°C and 227°C respectively is using 4.81mole of ideal gas. During the operation the gas expand isothermally from the initial state of $V_a=40.0\text{ l}$ to $V_b=120.0\text{ l}$, from which it expands adiabatically to 160.0 l. The isothermal compression takes the gas to the volume of 150.0 l followed by an adiabatic compression to the initial volume.
 - a) What is the efficiency of the engine (7P)
 - b) What is the entropy change in one cycle? (6P)

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VERSION AA

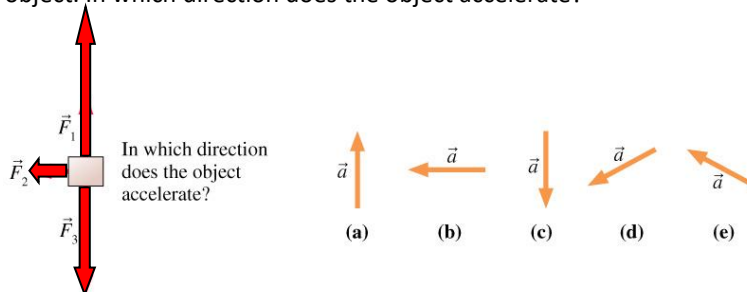
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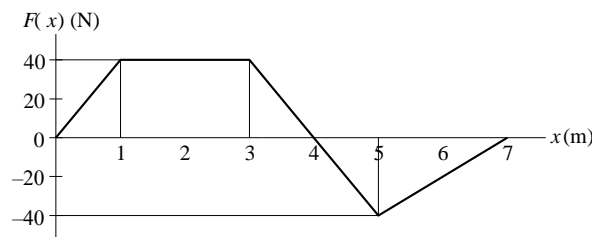
/Use your exam booklet for necessary calculations./

1. A particle moving in a circle is subjected to a total acceleration that has a magnitude of 8.2 m/s^2 . If its radial acceleration has a magnitude of 3.3 m/s^2 , what is the magnitude of its tangential acceleration in m/s^2 ?
a) 8.8 b) 8.5 c) 7.7 d) 7.5 e) 7.3
2. An astronaut on the moon tosses a moon rock in the air while running forward at a constant speed of 3.2 m/s . The acceleration of gravity on the moon is 1.6 m/s^2 . She catches the rock 4.0 seconds after it is thrown. The angle at which she threw the rock (relative to the forward direction and the surface of the moon) is:
a) 30° b) 45° c) 60° d) 75° e) none of the above
3. The tension in a string from which a 4.0-kg object is suspended in an elevator is equal to 44 N. What is the acceleration of the elevator?
a) 11 m/s^2 upward b) 1.2 m/s^2 upward c) 1.2 m/s^2 downward
d) 10 m/s^2 upward e) 2.4 m/s^2 downward

4. Three forces act on an object. In which direction does the object accelerate?



5. A body moves in a circle at constant speed. The work done on the body by the centripetal force in one half of the revolution is:
a) $\pi m v^2$ b) $\frac{1}{2} \pi m v^2$ c) $\frac{1}{4} \pi m v^2$ d) $\frac{m v^2}{r}$ e) 0
6. An object of mass 2 kg moving at $v_x = +2.236 \text{ m/s}$ is subjected to a single force $F(x)$ shown in the diagram below. What is the magnitude of its velocity v_x (in m/s) when it is at position $x=1\text{m}$?
a) 3.234
b) 5.0
c) 21.0
d) 25.0
e) none of the above



7. A refrigerator has a coefficient of performance 5.0. How much heat is exhausted to the hot reservoir when 500kJ of heat are removed from the cold reservoir?
a) 600kJ b) 500kJ c) 400kJ d) 100kJ
e) not enough information is given to answer the question

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 - a) object of mass M on the frictionless incline ($\alpha = 20^\circ$). (3p)
 - b) object mass m moving with constant speed on the rough horizontal surface pushed by the F_{app} directed at 60° above horizontal. (3p)
 - c) an object of Mass M is hanging from a massless knot attached to two strings making angles of 37° and 53° with ceiling of the accelerating elevator. (3p)
 - d) an object of Mass M on the frictionless incline ($\alpha=20^\circ$) accelerated up by the force F_{app} applied at the end of massless cord (angle 50° below the horizontal.) (4p)

- 4 A skier of mass 65.0 kg is pulled up a frictionless slope by a motor-driven cable.
 - a) How much work is required to pull the skier up a distance of 70.0 m along a 37.0° slope at a constant speed of 3.00 m/s? (5p)
 - b) A motor of what power is required to perform this task? (3p)

The skier then goes down reaching the maximum speed on the frictionless slope (she does not try to stop at all!) and while having this maximum speed she enters flat, rough patch of mixed snow and sand, which causes her to stop after 17 meters.

 - c) what is the coefficient of kinetic friction between the skier and the patch? (2p)
 - d) what is the change of the entropy due to friction forces (presume the constant temperature of -3°C) (3p)

- 5 Carnot Engine operating between the two reservoirs at kept at temperatures of 77°C and 227°C respectively is using 4.81 mole of ideal gas. During the operation the gas expand isothermally from the initial state of $V_a=40.0\text{ l}$ to $V_b=120.0\text{ l}$, from which it expands adiabatically to 160.0 l. The isothermal compression takes the gas to the volume of 150.0 l followed by an adiabatic compression to the initial volume.
 - a) What is the efficiency of the engine (7P)
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