1) A beam made up of charged particles of mass m and charge q is accelerated from rest by a voltage U. It then enters a region with a homogeneous magnetic field B perpendicular to the beam's velocity. The radius of the trajectory is given by :

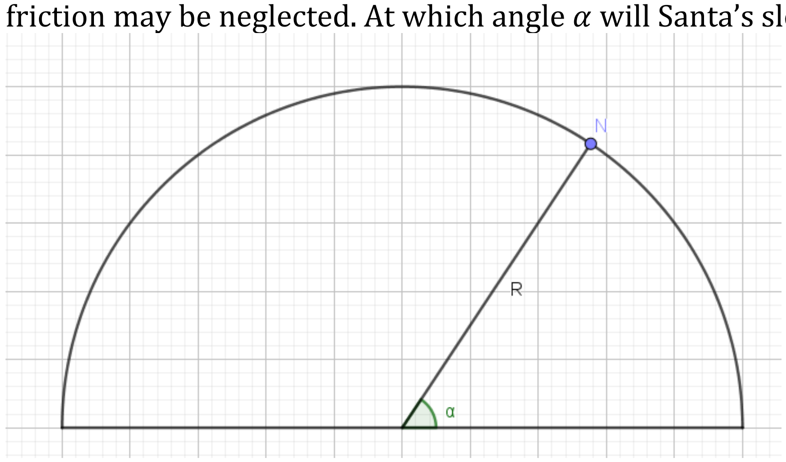
a) $r = \frac{2qU}{\mathrm{mB}}$

b) $r = \sqrt{\frac{2qU}{mB^2}}$

c) $r = \sqrt{\frac{\mathrm{mU}}{2qB^2}}$

d) $\mathbf{r} = \sqrt{\frac{\mathbf{2}\mathrm{mU}}{\mathbf{qB^2}}}$

2) Santa Clause on his sledge, shown on the diagram as point N, rests on the top of a snowy hemispherical mountain of radius R. He starts his descent without any initial speed and friction may be neglected. At which angle α will Santa's sledge take off ?



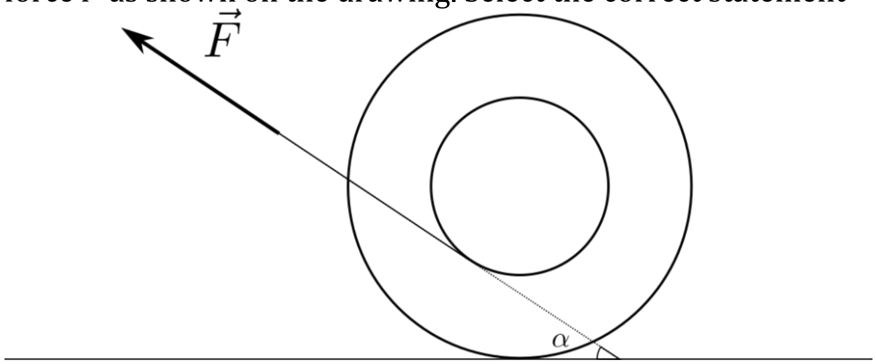
a) $\alpha = 19{,}5°$

b) $\alpha = 30°$

c) $\boldsymbol{\alpha} = \mathbf{41{,}8}°$

d) $\alpha = 48{,}2°$

3) A roll of thread can roll on a surface without slipping. One pulls on the thread with a force $\vec{F}$ as shown on the drawing. Select the correct statement



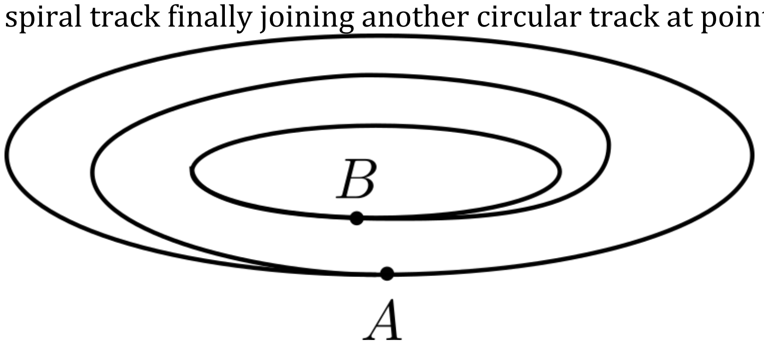
a) The roll accelerates to the left.

b) The roll accelerates to the right.

c) The roll stays at rest.

d) It depends on the magnitude of $\vec{F}$

4) A train moves on a circular track without friction. At point A, the train is deviated via a spiral track finally joining another circular track at point B. Select the correct statement.



a) The train's speed increases.

b) The train's speed decreases.

c) The train's speed remains constant.

d) None of the above.

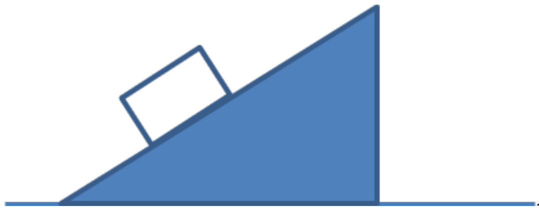
5) A sample of mass m made of an unknown material has a melting point of 10°C. In a first step a thermal energy of Q is provided to it and $\frac{3}{4}$ of the mass melts. In a next step an equal thermal energy Q is provided to the sample and sample ends up in the liquid state at 50°C. What is the ratio between the latent heat of fusion and the specific heat capacity of the liquid?

a) **80**

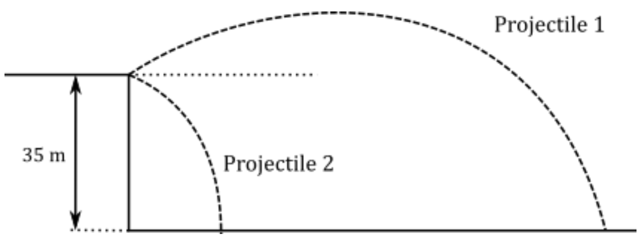
b) 60

c) 50

d) 40

6)  An inclined plane (ramp) is placed on a horizontal surface. Friction between the and the surface is negligeable. A block starts from rest at the top of the ramp and slides down without friction. During the movement down the ramp the center of mass of the system block-ramp

a) does not move
b) moves horizontally at constant speed
c) moves horizontally with increasing speed
d) moves vertically with increasing speed
e) moves horizontally and vertically

7) 

Two projectiles are launched from a height of 35 m with the same initial speed of 50 m/s as shown in the diagram below. Projectile 1 is launched at an angle of 37° with respect to the horizontal upwards; projectile 2 is launched at an angle of 37° with respect to the horizontal downwards. What is the best estimate for the difference in times of flight to the ground $t_1 - t_2$.

a) 3 s

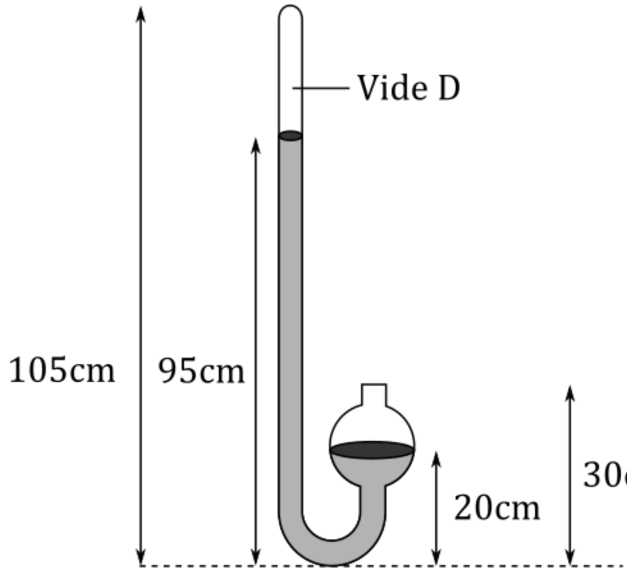
b) 5 **s**

c) **6 s**

d) 8 s

e) 10 s

8)



This figure shows a diagram of a mercury barometer. Using the correct heights, calculate the ambient pressure. $\rho_{Hg} = 13{,}6\frac{g}{cm^3}$ et $g = 9{,}81\frac{N}{kg}$

a) 734 hPa

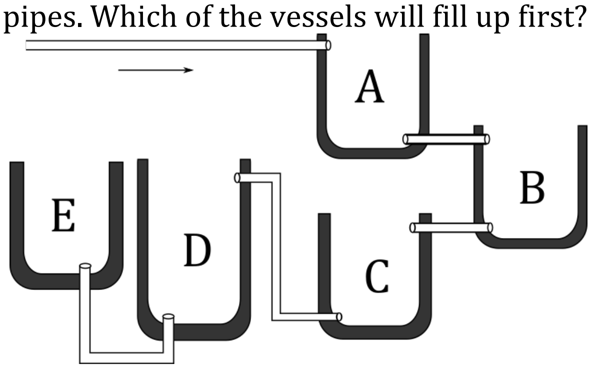
b) 867 hPa

c) 1001 hPa

d) 1134 hPa

e) 1267 hPa

9) Water is slowly flowing into vessel A in the set-up below. The vessels are connected by pipes. Which of the vessels will fill up first?



a) vessel A

b) vessel B

c) vessel C

d) vessels C and D simultaneously

e) all the vessels simultaneously

10) You place a thermometer filled with alcohol into water at ambient temperature. You wait until thermal equilibrium has set in. Now you remove the thermometer and observe the level of the alcohol. What will you observe?

a) the level rises

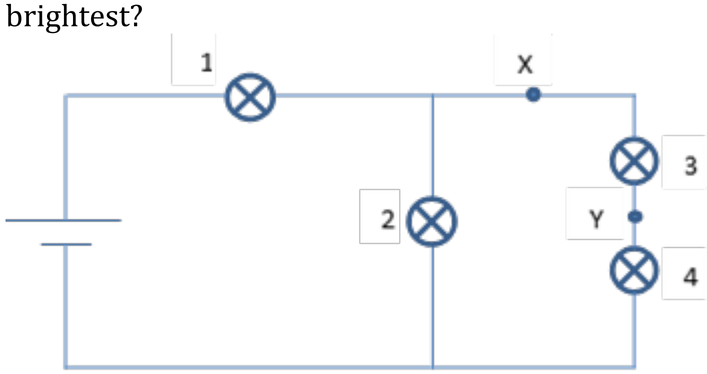
b) first the level goes down then rises

c) the level goes down

d) first the level rises then goes down

e) the level stays the same

11) In the following circuit a metal filament is placed between points X and Y. The lamps are all identical. When the wire is fixed between X and Y, which of the lamps will be the brightest?



a) only lamp 2

b) only lamp 4

c) only lamps 1 and 4

d) only lamps 2 and 4

12) The heart of an ordinary adult man pumps nearly 160 milliliters of blood per beat. It beats about 70 times per minute and performs roughly 1 J of work per beat. The work done in 1 day is

a) 10^5 J
b) $6\text{x}10^6$ J
c) 1440 J
d) None of these answers

13) A body free to move and subjected to zero net force…

a) is accelerated.

b) is in uniform linear motion.

c) revolves around its center of mass.

d) is in uniform linear motion and rotates uniformly around its center of mass.

e) none of the above.

14) Ten scales, each weighing 10 N, are stacked one on top of the other. The displayed values of the top and bottom scale and the reaction of the ground are respectively:

a) 0 N, 100 N, 100 N

b) 10 N, 90 N, 100 N

c) 0 N, 90 N, 100 N

d) none of the above.

15) A flat metal disc has a small hole offset from its center. If we heat the disc,

a) the disk expands and so does the hole.

b) the disk expands but the hole contracts.

c) the disk expands but the hole remains unchanged.

d) the disk remains unchanged but the hole expands.

e) none of the above.

16) A 24W, 12 V lamp with a temperature independent resistance is connected to a 6 V generator. The electric current is

a) 2 A

b) 1 A

c) 0,5 A

d) none of the above.

17) A person stands at the edge of a horizontal merry-go-round with a radius of 4.5 m rotating at 0.8 rad/s. She throws a ball towards the center at 30 m/s in the frame of the platform. By how much does it miss the center?

a) $0.12cm$
b) $0.36cm$
c) $0.53cm$
d) $0.65cm$

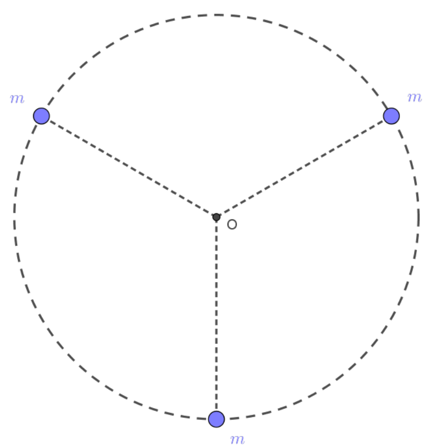
18) A sphere floats in water ($\rho_{water} = 1\frac{g}{cm^3}$) with 60% of its volume submerged. If it floats in oil, 70% of its volume is submerged. What is the density of the oil? $\rho_{water} = 1\frac{g}{cm^3}$

a) $0.78\ g/cm^3$
b) $0.86\ g/cm^3$
c) $0.91\ g/cm^3$
d) $1.05\ g/cm^3$

19) Two pendulums have lengths of 81 cm and 64 cm respectively. They are released from the same angular position at the same instant. How long does it take before both pendulums return to their original position at the same time?

a) $14.5s$
b) $17s$
c) $22.5s$
d) $27s$

20) Consider the unstable state consisting of 3 equidistant stars, of mass m, which revolve on a circular orbit of radius r around their center of mass.



The squared modulus of the angular velocity is given by

a) $\omega^2 = \frac{G\cdot m}{\sqrt{3}r^3}$
b) $\omega^2 = \frac{G\cdot m}{2r^3}$
c) $\omega^2 = \frac{G\cdot m}{\sqrt{3}r^2}$
d) $\omega^2 = \frac{G\cdot m^2}{\sqrt{3}r^3}$