Question 1
Not yet answered
Marked out of 1.00
Flag question
Edit question

Mechanics (+)
Consider a dam built across a river. The height of water in the reservoir is 4 m and the width of the dam is 50 m.
What is the force exerted by water on the dam?

Select one:

- a. 19 620 N
- b. 0.2 MN
- c. 0.7848 MN
- d. 3.924 MN
- e. 40×10^3 N

Question 2
Not yet answered
Marked out of 1.00
Flag question
Edit question

Mechanics (+)
Two cyclists have the same speed V = 10 km/h in a climb. The angle of the slope is 7°. The effects of aerodynamic friction are neglected. The masses of the cyclists are 60 kg and 75 kg respectively.
What is the difference of the powers that they produce during the climb?

Select one:

- a. 5.078 W
- b. 16.32 W
- c. 49.8 W
- d. 179.3 W
- e. 5.116 W

Question 3
Not yet answered
Marked out of 1.00
Flag question
Edit question

Mechanics (+)
A cyclist develops a power of 220 W. His cadence is 85 rotation/min.
Which torque is to be applied to the pedals?

Select one:

- a. 2.59 Nm
- b. 155.2 Nm
- c. 0.431 Nm
- d. 24.72 Nm
- e. 1870 Nm

Question 4
Not yet answered
Marked out of 1.00
Flag question
Edit question

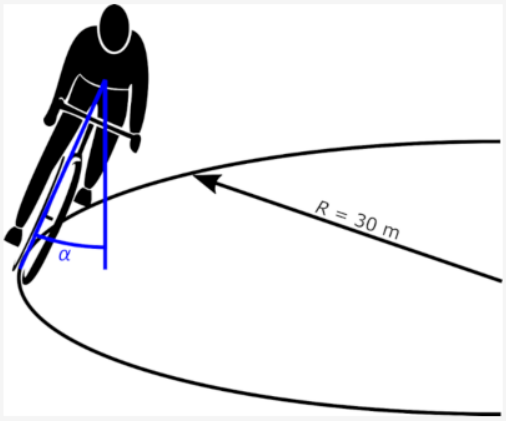
Mechanics (++)
Let approximate the trajectories of the planets of the solar system by circles. The distance from the planet Earth to the Sun is 150 million kilometers, whereas that of the planet Mars to the Sun is 228 million kilometers.
What is the duration of the martian year ? Give the result in terms of Earth's year.

Select one:

- a. 1.87
- b. 3.47
- c. 1.32
- d. 1.52
- e. 0.537

Question 5
Not yet answered
Marked out of 1.00
Flag question
Edit question

Mechanics (++)
A cyclist rides at a speed V = 40 km/h. The road is approximated to a circular arc with a radius R = 30 m. Any gyroscopic effect related to the spin of the wheels is disregarded. Let's consider the angle α with respect to the vertical direction of the plane that passes through the mass center of the system cyclist+bicycle and the contact points of the wheels with the road.



What is the value of this angle?

Select one:

- a. 3.18°
- b. 7.74°
- c. 22.8°
- d. 5.13°
- e. 27.2°

Question 6
Not yet answered
Marked out of 1.00
Flag question
Edit question

Mechanics (+++)
Consider a vertical linear elastic spring attached to a fixed point at its upper extremity. The maximal force of traction that the spring can sustain is R = 100 N. A mass m is attached to its lower extremity. The spring is first compressed by an upward displacement of the mass, until the compression force in the spring reaches the value of the weight of the mass. Then, the mass is released and falls downward with no initial velocity.

For which minimal value of m will the spring break?

Select one:

- a. 20.39 kg
- b. 3.398 kg
- c. 5.096 kg
- d. 10.19 kg
- e. 2.548 kg

Question 7
Not yet answered
Marked out of 1.00
Flag question
Edit question

Optics (+)
Considering two thin lenses of focal distances f_1 and f_2 separated by distance e, the equivalent focal of the system is given by

Select one:

- a. $f = f_1 + f_2 + \frac{f_1 f_2}{e}$
- b. $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{e}{f_1 f_2}$
- c. $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{e}{f_1 f_2}$
- d. $f = f_1 + f_2 - e$
- e. $f = f_1 + f_2 + e$

Question 8
Not yet answered
Marked out of 1.00
Flag question
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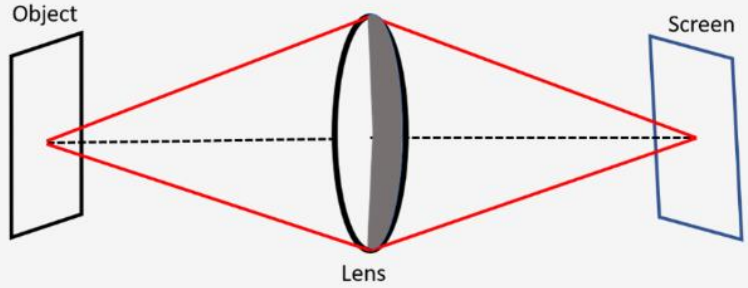
Optics (+)
An object is imaged with a lens on a screen, but as shown on the figure, half of the circle-aperture is occulted.



What do we observe on the screen?

Select one:

- a. The screen is uniformly illuminated
- b. Half of the object is seen
- c. The object is seen as in usual conditions
- d. The object is seen with half of the intensity
- e. The object is hidden

Question 9
Not yet answered
Marked out of 1.00
Flag question
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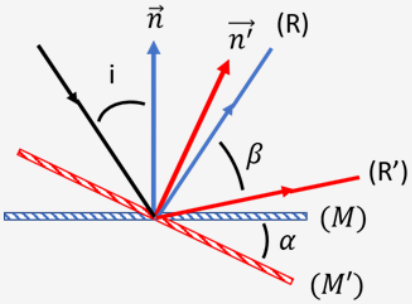
Optics (++)
An incoming ray is send onto a mirror *M*, making an incident angle *i* with its normal $\vec{n}$. The mirror is then rotated with an angle *α*.



What is the angular deviation *β* between the reflected rays *R* and *R'*?

Select one:

- a. $\beta = 2\alpha$
- b. $\beta = i + 2\alpha$
- c. $\beta = 2i$
- d. $\beta = i + \alpha$
- e. $\beta = i - \alpha$

Question 10
Not yet answered
Marked out of 1.00
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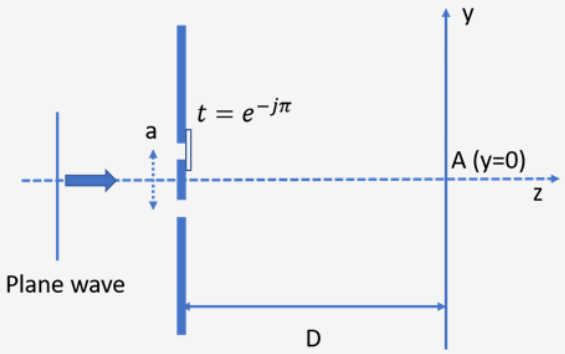
Optics (++)
In a classical Young's experiment, two narrow slits at $y = \pm a/2$ are equally illuminated with a monochromatic source λ. One observes the interference pattern on a screen at distance D. In addition, a dephasing plate (transmission $t = e^{j\pi}$) has been added on one of the slits.



Which of the following statements is correct?

Select one:

a. The entire screen is bright
b. The period of the fringes is $\Lambda = \frac{\lambda D}{a} + \frac{\lambda}{2}$
c. Point A ($y = 0$) is bright
d. Point A (in $y = 0$) is dark
e. The entire screen is dark

Question 11
Not yet answered
Marked out of 1.00
Flag question
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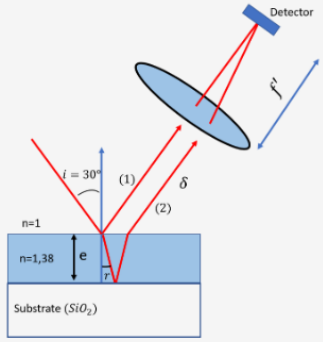
Optics (++)
A monochromatic plane wave is sent into a conventional Michelson interferometer (with a beam-splitter plate of 50% in intensity), the moving-mirror has a reflectivity of 60% in intensity, while the static-miror has a reflectivity of 90%, also in intensity. What is the contrast of interference signal when the mobile-miror moves?

Select one:

a. 0.98
b. 0.5
c. 0.72
d. 0.49
e. 0.36

Question 12
Not yet answered
Marked out of 1.00
Flag question
Edit question

Optics (++)
A dielectric material ($n = 1.38$) is deposited on a substrate, in order to create a thin layer. It is proposed to control the thickness of this deposition with an incident laser at 632.8 nm, making an angle of 30° with the normal of the substrate.
As shown on the figure, a detector is positioned at the focus of a lens and one measures the superposition of beams (1) and (2). One calls δ the path-difference between the two beams.



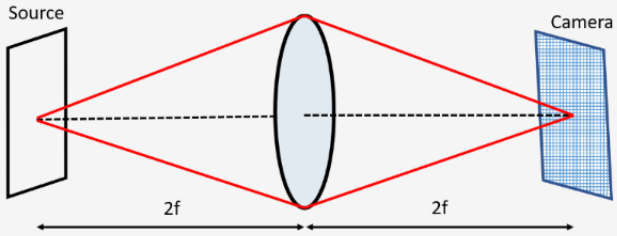
The signal on the detector is maximum each time the thickness has increased of

Select one:

a. 632.8 nm
b. 731 nm
c. 315.4 nm
d. 246.0 nm
e. 450 nm

Question 13
Not yet answered
Marked out of 1.00
Flag question
Edit question

Optics (+++)
A uniform source (size 5 × 5 mm^2) is conjugated with a lens on a camera in a 2f-2f scheme. The aperture of the lens limits the optical power on the camera (in watt) to only 1% of the total source emission. The camera is composed of $10^3 \times 10^3$) pixels, each one forming a square of 5 µm side. The datasheet of the camera indicates that a pixel response saturates if exposed to a power of 1 femtowatt during 1 s.



In order to avoid such a saturation with an exposure time of 20 µs, the source must not emit a total power larger than

Select one:

- a. 5 mW
- b. 1 µW
- c. 2 W
- d. 5 nW
- e. 2 pW

Question 14
Not yet answered
Marked out of 1.00
Flag question
Edit question

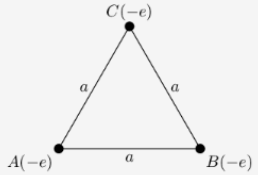
Electromagnetism/waves (+)
A electromagnetic source emits waves around 700 nm. Regarding into more details, this radiation contains two components whose distance in frequency is 30 GHz.
The corresponding distance in wavelength unit is approximately

Select one:

- a. 0.2 nm
- b. 20 nm
- c. 50 pm
- d. 5 nm
- e. 0.35 µm

Question 15
Not yet answered
Marked out of 1.00
Flag question
Edit question

Electromagnetism/waves (+)
Three electrons (charge −e) are arranged at the tops of an equilateral triangle (side length a = 0.4 nm). The magnitude of the electrostatic force at point A is



Select one:

- a. 2.5 nN
- b. 5.2 pN
- c. 0 N
- d. 1.6 mN
- e. 3.5 µN

Question 16
Not yet answered
Marked out of 1.00
Flag question
Edit question

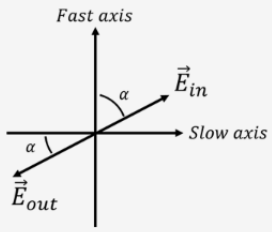
Electromagnetism/waves (++)

An electromagnetic wave is linearly polarized and propagates through a half-wave plate, the incident field $\vec{E}_{in}$ (wavelength λ) makes an angle α with the fast axis of the plate.

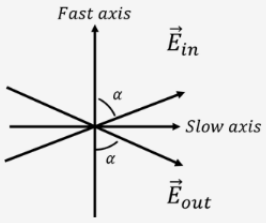
What is the correct orientation of the output field $\vec{E}_{out}$?

Select one:

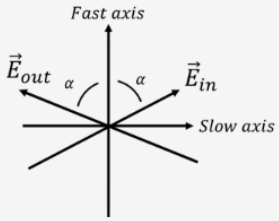
a.



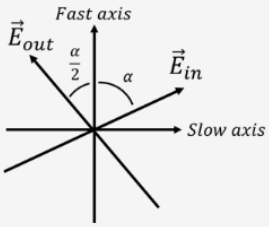
b.



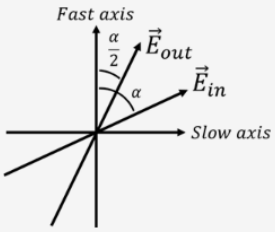
c.



d.



e.



Question 17
Not yet answered
Marked out of 1.00
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Electromagnetism/waves (++)

A static magnetic field *B* is applied to a moving electronic charge.

The characteristic radiant-frequency associated to this perturbation field is

Select one:

a. $\frac{eB}{m_e}$

b. $\frac{e\hbar B}{m_e}$

c. eB

d. $\frac{e\hbar}{m_e}$

e. $\frac{e}{B}$

Question 18
Not yet answered
Marked out of 1.00
Flag question
Edit question

Electromagnetism/waves (+++)

An incident electromagnetic plane wave $A_0 e^{j\omega(t-\frac{z}{c})}$ (corresponding to a Power P_0 = 1 W, wavelength λ = 7.5 cm) propagates through a medium of thickness l = 1 m that exhibits a complex refractive index $\tilde{n} = 2 - 0.01j$.

What happens on the wave just before exiting the medium?

Select one:

- a. The velocity is c/2 and the power is 1 W
- b. The velocity is c/2 and the power is 5.34 W
- c. The velocity is 2c and the power is 0.187 W
- d. The velocity is c/2 and the power is 0.187 W
- e. The velocity is c and the power is 1 W

Question 19
Not yet answered
Marked out of 1.00
Flag question
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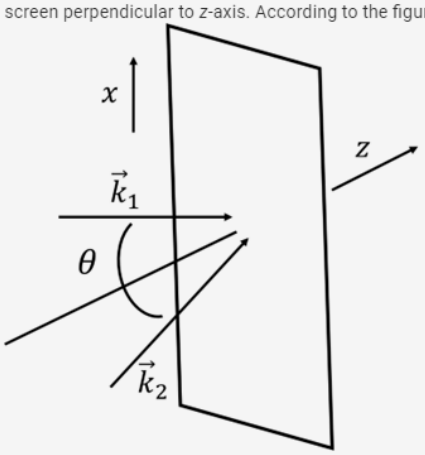
Electromagnetism/waves (+++)

Two electromagnetic waves of wave-vectors $\vec{k}_1$ and $\vec{k}_2$ ($|\vec{k}_1| = |\vec{k}_2| = \frac{2\pi}{\lambda}$) propagate in a (x,z) plane and recombine on a screen perpendicular to z-axis. According to the figure, the angle θ between these two waves can be adjusted.



The minimum-period that is observable on the screen cannot be smaller than

Select one:

- a. $2\pi\lambda$
- b. $\lambda/2$
- c. $\frac{\lambda}{2\pi}$
- d. 2λ
- e. λ

Question 20
Not yet answered
Marked out of 1.00
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Thermodynamics (+)

Among the following quantities, which one is not extensive?

Select one:

- a. Gravitational potential energy
- b. Mass
- c. Electric charge
- d. Pressure
- e. Entropy

Question 21
Not yet answered
Marked out of 1.00
Flag question
Edit question

Thermodynamics (++)
We compress m = 1 kg of air, at a constant temperature T = 27 °C, so that its initial volume is divided by 3. The air is considered an ideal gas with a molar mass M = 29 g/mol.

What is the work received by the air?

Select one:

a. W ≈ − 94 kJ
b. W ≈ 5 kJ
c. W ≈ − 5 kJ
d. W ≈ 60 kJ
e. W ≈ 94 kJ

Question 22
Not yet answered
Marked out of 1.00
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Thermodynamics (++)
For the cycle of a refrigerator (two-temperature machine), we denote W, Q_C and Q_H the work of compression and the heat transfers between the cold and hot sources and the fluid, respectively.

The efficiency of the refrigerator (or coefficient of performance) is expressed as

Select one:

a. $\frac{Q_C}{W}$
b. $-\frac{Q_H}{W}$
c. $1+\frac{Q_H}{Q_C}$
d. $1+\frac{Q_C}{Q_H}$
e. $-\frac{Q_C}{W}$

Question 23
Not yet answered
Marked out of 1.00
Flag question
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Thermodynamics (+++)
At what altitude h is the number of air molecules per unit volume equal to 9/10 of that at sea level? It is assumed that air is an ideal gas with a molar mass M = 29 g/mol at uniform temperature T = 293 K.

Select one:

a. h ≈ 1200 m
b. h ≈ 900 m
c. h ≈ 700 m
d. h ≈ 500 m
e. h ≈ 600 m

Question 24
Not yet answered
Marked out of 1.00
Flag question
Edit question

Thermodynamics (+++)
We heat one liter of water from T_1 = 290 K to T_2 = 363 K on a stove where the stove temperature is T_c = 1000 K. The specific heat capacity of water is C = 4.18 kJ/kg.

Calculate the entropy produced during this irreversible transformation.

Select one:

a. S^p ≈ 1200 J/K
b. S^p ≈ 900 J/K
c. S^p ≈ 300 J/K
d. S^p ≈ 1100 J/K
e. S^p ≈ 600 J/K

Question 25
Not yet answered
Marked out of 1.00
Flag question
Edit question

Quantum physics (+)
What is the link between the energy and the pulsation associated with the excitation energy?

Select one:

a. $E = \frac{h}{2}\omega$
b. $E = 2\pi h\omega$
c. $E = \frac{h}{\pi}\omega$
d. $E = h\omega$
e. $E = \frac{h}{2\pi}\omega$

Question 26
Not yet answered
Marked out of 1.00
Flag question
Edit question

Quantum physics (+)
If the position of a particule with a mass m = 1 ng is known with a precision better than Δx = 1 Å, quantum effects limit the precision Δv on the speed of the particule to

Select one:

a. $\Delta v \geq 10^{-15}$ m s^{-1}
b. $\Delta v \geq 10^{-12}$ m s^{-1}
c. $\Delta v \geq 10^{-6}$ m s^{-1}
d. $\Delta v \geq 10^{-9}$ m s^{-1}
e. $\Delta v \geq 10^{-18}$ m s^{-1}

Question 27
Not yet answered
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Quantum physics (++)
A particle with a mass m is in a semi-infinite potential well in one dimension: the potential $V(x)$ = 0 for $-L < x < +L$ and $V(x)$ = + ∞ everywhere else.

The energy E_p of the particle, with p an integer, is

Select one:

a. $E_p = \frac{p^2\pi^2\hbar^2}{mL^2}$
b. $E_p = \frac{p^2\pi^2\hbar^2}{2mL^2}$
c. $E_p = \frac{p^2\pi^2\hbar^2}{16mL^2}$
d. $E_p = \frac{p^2\pi^2\hbar^2}{8mL^2}$
e. $E_p = \frac{p^2\pi^2\hbar^2}{4mL^2}$

Question 28
Not yet answered
Marked out of 1.00
Flag question
Edit question

Quantum physics (++)
For the hydrogen atom, the emission wavelength between the energy E_{n_1} and energy E_{n_2} $(n_1 < n_2)$ follow the relation

Select one:

a. $\lambda_{n_1 n_2} = -R_H\left(\frac{1}{n_1} - \frac{1}{n_2}\right)$
b. $\lambda_{n_1 n_2} = R_H\left(n_2^2 - n_1^2\right)$
c. $\lambda_{n_1 n_2} = R_H\left(n_1^2 - n_2^2\right)$
d. $\lambda_{n_1 n_2} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$
e. $\lambda_{n_1 n_2} = R_H\left(\frac{1}{n_1} - \frac{1}{n_2}\right)$

Question 29
Not yet answered
Marked out of 1.00
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Quantum physics (+++)
In atoms, the interaction length between proton and neutron is of the order of L = 1 fm = 10^{-15} m, where the energy of the nuclear interaction is approximately

Select one:

- a. $\Delta E \approx 2$ keV
- b. $\Delta E \approx 200$ keV
- c. $\Delta E \approx 2$ TeV
- d. $\Delta E \approx 200$ MeV
- e. $\Delta E \approx 20$ GeV

Question 30
Not yet answered
Marked out of 1.00
Flag question
Edit question

Quantum physics (+++)
If an electron with kinetic energy E = 1 eV along Ox arrives at x = 0 on a rectangular potential barrier of height V = 5 eV and width Δx = 0.1 nm, the transmission coefficient T is

Select one:

- a. $T \approx 10\%$
- b. $T \approx 30\%$
- c. $T \approx 1\%$
- d. $T \approx 75\%$
- e. $T \approx 0.2\%$