University of Salahaddin-Erbil
College of Science
Department of Chemistry
1st Year

Final Exam – Second Trial

Academic Year (2023-2024)
Examination in:
Physics for Chemists
Time: 2 hours

Q.1) Choose the correct answer: (**ONLY 10**) ***[10 Marks]***

1. Identify which of the following quantities can be described fully by its magnitude.

Displacement, Force, Velocity, Distance

2. The dimensions of Focal length is same as that of

Force, Pressure, Wavelength, Work

3. If F1= -20ĵ, F2= -10î, and F3 = 5î + 10ĵ, what is the sum F1 + F2 + F3 ?

-15î + 10ĵ , -5î - 10ĵ , 5î , 5î - 10ĵ

4. Which of the following has the smallest inertia?

An electron, a paper, an atom , a book

5. Two physical quantities whose dimensions are same, can be:

Added or subtrscted , Multiplied with each other, Divided, all of them.

6. Which of the following is not a unit of temperature?

Celsius, Farad, Fahrenheit, Kelvin

7. A ball is dropped from a height 'h' above the ground. Its speed just before hitting the ground will be:

√2ghm, √2g(h-y) , 2gh, 2g(h-y)

8. If the work done on a system is positive, energy is

transfer from the system, remains constant, transfer to the system, none of them

9. The energy associated with an objects temperature is:

Potential energy, kinetic energy, mechanical energy, internal energy.

10. The gravitational force between two particles ……… with increase the distance between them.

Increase, decrease, depend on the particles masses , remain constant.

11. Which of the following is not the name of physical quantity?

Kilogram, Density, Force, Energy

Q.2) Give a short answer for the following: ***[10 Marks]***

1. What is the difference between Vector and Sculler quantities in physics?

   Scalars are quantities that are fully described by a magnitude (or numerical value) alone. Vectors are quantities that are fully described by both a magnitude and a direction.

2. What is the difference between isolated and non-isolated system?

An isolated system is one that does not exchange energy or matter with its surroundings, while a non- isolated system does allow for such exchanges.

3. Starting from Universal Gravitational constant (G), find gravity due to earth (g).

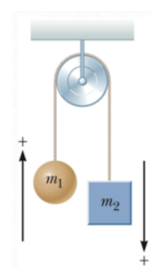
$$mg = G\frac{M_E m}{R_E^2} \rightarrow g = G\frac{M_E}{R_E^2}$$

Substitute for the mass of earth M_E = 5.98 × 10^{24} kg and the radius of the earth R_E = 6.38 × 10^6m

$$\therefore g = G\frac{M_e}{R_e^{\,2}} = 6.67\times10^{-11}\frac{5.98\times10^{24}}{6.38\times10^{6}} = 9.8m/s^2$$

4. Force classified into two groups; mention them and give an example to each of them.
   a. contact force (push, pull, hit, shoot)
   b. field force (electric force, nuclear f., magnetic f. , gravitational f.)

5. Assume two objects connected by a light string on Atwood's Machine as shown in the figure.
   What is the relation between their acceleration a_1 and a_2 ?
   What is the relation between the tension force upon each string?



   $a_1 = a_2$

   $T_1 = T_2$

Q.3A) Check the following equation is it dimensionally correct or not? ***[5 Marks]***

$x = x_0 + vt + (1/2)\, at^2$

where, x is displacement at given time t

x_0 is the displacement at $t = 0$, v is the velocity at $t = 0$, a represents the acceleration

Checking the dimensions on both sides, L.H.S.= $[M^0L^1T^0]$

R.H.S. = $[LT^{-1}]\,[T]+[LT^{-2}][T2] = [M^{\circ}L^1T^{\circ}]+[M^{\circ}L^1T^{\circ}] = [M^{\circ}L^1T^{\circ}]$

Comparing the L.H.S. and R.H.S.

Hence the formula is dimensionally correct.

Q.3B) The Cartesian coordinates of a point in the $(x,y) = (-3.5, -2.5)$ m. Find the polar coordinates (r,θ) of this point. ***[5 Marks]***

$$r = \sqrt{x^2 + y^2}$$
$$= \sqrt{(-3.50\text{ m})^2 + (-2.50\text{ m})^2}$$
$$= 4.30\text{ m}$$

and from Equation 3.3,

$$\tan\theta = \frac{y}{x} = \frac{-2.50\text{ m}}{-3.50\text{ m}} = 0.714$$
$$\theta = 216^\circ \quad \text{(signs give quadrant)}$$

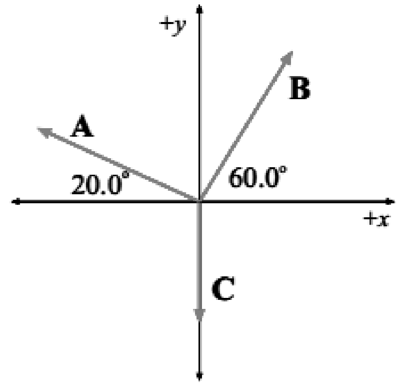
Q4) Calculate the minimum energy required to send a 3000kg spacecraft from the earth to a distance point in space where earth's gravity is negligible.
If the journey takes three weeks, what average power would the engine have to supply? ***[10 Marks]***

(a) $$v_{esc} = \sqrt{\frac{2GM_e}{R_e}} = 1.12\times10^4 \text{m/s}$$

$$K = \frac{1}{2}mv_{esc}^2 = \frac{1}{2}\times 3000\times(1.12\times10^4)^2$$
$$= 1.88\times10^{11}\,J$$

(b) $$P_{av} = \frac{K}{\Delta t} = \frac{1.88\times10^{11}}{21\text{days}\times 8.64\times10^4\,s/\text{day}} = 103kW$$

Q.5) Find the resultant of the three displacement vectors in Fig. by means of the component method. The magnitudes of the vectors are A =5 m, B =5 m and C = 4m. ***[10 Marks]***

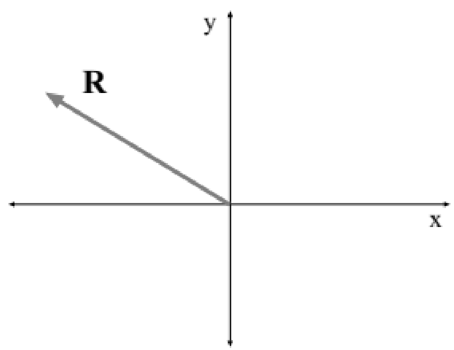


$$A_x = -(5.00\,\text{m})\cos(20.0°) = -4.698\,\text{m}$$
$$A_y = +(5.00\,\text{m})\sin(20.0°) = +1.710\,\text{m}$$
$$B_x = +(5.00\,\text{m})\cos(60.0°) = +2.500\,\text{m}$$
$$B_y = +(5.00\,\text{m})\sin(60.0°) = +4.330\,\text{m}$$
$$C_x = 0 \quad \text{and} \quad C_y = -4.00\text{ m}$$

The resultant (sum) of all three vectors (which we call R)

$$R_x = A_x + B_x + C_x$$
$$= -4.698\,\text{m} + 2.500\,\text{m} + 0\,\text{m}$$
$$= -2.198\,\text{m}$$
$$R_y = A_y + B_y + C_y$$
$$= +1.710\,\text{m} + 4.330\,\text{m} - 4.000\,\text{m}$$
$$= 2.040\,\text{m}$$

$$R = \sqrt{R_x^2 + R_y^2}$$
$$= 3.00\,\text{m}$$
$$= \sqrt{(-2.198\,\text{m})^2 + (2.040\,\text{m})^2}$$



If the direction of R (as measured from the +x axis) is θ, *then*

$$\tan\theta = \frac{2.040}{(-2.198)} = -0.928$$

$$\theta = -42.9° + 180° = 137.1°$$

Earth/Radius= 6,371 km

Earth/Mass= 5.972 × 10^{24} kg

G = 6.674×10^{-11} N·m^2/kg^2

Good luck *Lecturer: Jala Muhamed*