Physics Session 1 Questions

SI units and Derived Units

Q1.

Which of the following is the unit for tension expressed in SI base units?

(1)

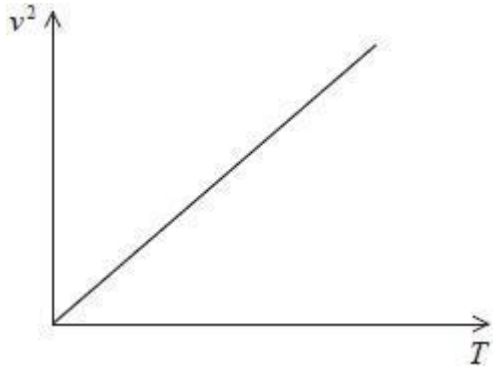
- ☒ **A** N
- ☒ **B** N s
- ☒ **C** kg m s^{-1}
- ☒ **D** kg m s^{-2}

(Total for question = 1 mark)

Q2.

This question refers to an experiment to investigate stationary waves on a string and uses the equation $v = \sqrt{\frac{T}{\mu}}$

Corresponding values of v^2 against T are plotted. A straight line graph is obtained, as shown.



Which of the following expressions for the mass per unit length μ of the string is correct?

- ☒ **A** $\mu = \text{gradient}$
- ☒ **B** $\mu = \sqrt{\text{gradient}}$
- ☒ **C** $\mu = \frac{1}{\text{gradient}}$
- ☒ **D** $\mu = \frac{1}{\sqrt{\text{gradient}}}$

(Total for question = 1 mark)

Q3.

The Hooke's law equation is:

$$\Delta F = k\Delta x$$

Which of the following gives the base units of k?

- ☒ **A** kg s^{-2}
- ☒ **B** kg m s^{-2}
- ☒ **C** N m
- ☒ **D** N m^{-1}

(Total for question = 1 mark)

Q4.

All quantities may be expressed in terms of SI base units.

Select the row of the table that states the SI base units for the given quantity.

	Quantity	SI base unit
☐ **A**	charge	C
☐ **B**	charge	A s^{-1}
☐ **C**	power	J s^{-1}
☐ **D**	power	kg m^2 s^{-3}

(Total for question = 1 mark)

Q5.

Which of the following is a correct unit for resistance?

- ☒ **A** J C^{-1}
- ☒ **B** V C^{-1} s^{-1}
- ☒ **C** J C^{-2} s
- ☒ **D** J C^{-2} s^{-1}

(Total for question = 1 mark)

Q6.

A student measured the mass, in grams, of a small projectile, and its velocity in kilometres per hour.

To calculate the kinetic energy E_k of the projectile he substituted these quantities into the equation $E_k = ½ mv^2$.

Which of the following should the student multiply the answer by to obtain an answer in joules?

☐ **A** $\frac{1000}{3600^2}$

☐ **B** $\left(\frac{1000}{3600}\right)^2$

☐ **C** $\frac{3600^2}{1000}$

☐ **D** $\left(\frac{3600}{1000}\right)^2$

(Total for question = 1 mark)

Rearranging Equations

1. Using the equation Young Modulus = Stress/ Strain, where a cable experiences a stress of 18MPa. The Young modulus of the material of the cable is 200 GPa.
   Calculate the strain in the cable.

2. Using the equation EMF = I(R + r). In a circuit, the EMF is 9V, the terminal resistance (R) is 20Ω and the internal resistance (r) is 0.8Ω, calculate the circuit flowing in the circuit. Give your answer in mA.

3. Using the equation $F = GMm/r^2$. If the mass of the Sun (M) is 2.0×10^{30} kg and the mass of the Earth (m) is 6.0×10^{24} kg, and the gravitational force (F) experienced by the Earth is 4.1×10^{22} N, calculate the distance (r) between the Sun and the Earth.
   Use your equation sheet to find the value for G.

4. Using $s = ut + \frac{1}{2} at^2$ If an object with initial velocity of $3ms^{-1}$ has a displacement of 24m in a time of travel of 6 seconds, what is the acceleration of the object?

5. Using the equation I = nAve (where I = current; n = charge carrier density; A = cross-sectional area; v = drift velocity of charge carriers and e = charge of the electron)
   Calculate the drift velocity of an electron when the current of 90mA flows through a cylindrical wire made of a material with charge density $1.2 \times 10^{23}\ m^{-3}$ and radius of 4mm.

Resolving Vectors

1) Find the horizontal and vertical components of these forces:

Start by drawing a not-to-scale sketch diagram

a) 12N at 45º above the horizontal

b) 360N at 20º below the horizontal

c) 0.25 N at 35º above the horizontal

2) After take-off, an aircraft climbs with a velocity of 150 ms^{-1} at an angle of 30º to the ground.

(a) What are the magnitudes of the horizontal and vertical components of its velocity?

(b) How high will the aircraft be after 20 seconds of travelling at this speed?

3) Steve runs 340m due north then 200m due east. Sketch this journey and add the vectors to find

(a) total displacement

(b) the angle of his displacement, measured from north

Q1.

Which of the following gives a correct unit for $\left(\frac{g^2}{G}\right)$? (Use your equation booklet to check the units of these two constants)

A N ⬭

B N kg^{-1} ⬭

C N m ⬭

D N m^{-2} ⬭

(Total 1 mark)

Q2.

The units of physical quantities can be expressed in terms of the fundamental (base) units of the SI system. In which line in the table are the fundamental units correctly matched to the physical quantity?

	Physical quantity	**Fundamental units**	
A	charge	A s^{-1}	⬭
B	power	kg m^2 s^{-3}	⬭
C	potential difference	kg m^2 s A^{-1}	⬭
D	energy	kg m^2 s^{-1}	⬭

(Total 1 mark)

Q3.

Which of the following is **not** a unit of power?

A N m s^{-1} ⬭

B kg m^2 s^{-3} ⬭

C J s^{-1} ⬭

D kg m^{-1} s^{-1} ⬭

(Total 1 mark)

Q4.

A student carries out an experiment to determine the resistivity of a metal wire.
She determines the resistance from measurements of potential difference between the ends of the wire and the corresponding current. She measures the length of the wire with a ruler and the diameter of the wire using a micrometer. Each measurement is made with an uncertainty of 1%

Which measurement gives the largest uncertainty in the calculated value of the resistivity?

A current ⬭

B diameter ⬭

C length ⬭

D potential difference ⬭

(Total 1 mark)

Q5.

Which list puts the forces in order of increasing magnitude?

A 2 pN < 2 fN < 2 TN < 2 GN ⬭

B 2 pN < 2 fN < 2 GN < 2 TN ⬭

C 2 fN < 2 pN < 2 TN < 2 GN ⬭

D 2 fN < 2 pN < 2 GN < 2 TN ⬭

(Total 1 mark)

Q6.

Measurements are made to determine the tension, length and mass per unit length of a string stretched between two supports. The percentage uncertainties in these measurements are shown below.

Quantity	Percentage uncertainty
Length	0.80%
Tension	4.0%
Mass per unit length	2.0%

A stationary wave is formed on the string. What is the percentage uncertainty in the calculated value of the frequency of the first harmonic?

A 1.8% ⬭

B 3.8% ⬭

C 6.8% ⬭

D 13% ⬭

(Total 1 mark)

Q7.

Which is equivalent to the ohm?

A $J\ C^{-2}\ s^{-1}$ ⬭

B $J\ C^{-2}\ s$ ⬭

C $J\ s$ ⬭

D $J\ s^{-1}$ ⬭

(Total 1 mark)

Q8.

What is the approximate average kinetic energy of a cyclist in a race?

A 10 J ⬭

B 10 kJ ⬭

C 10 MJ ⬭

D 10 TJ ⬭

(Total 1 mark)

Q9.

Which row shows SI unit prefixes in order of smallest value to largest value?

	Smallest			Largest	
A	p	n	c	μ	⬭
B	p	n	μ	c	⬭
C	n	p	c	μ	⬭
D	n	p	μ	c	⬭

(Total 1 mark)

Q10.

Water waves of wavelength λ and wave speed v are related by $v = \sqrt{k\lambda}$ where k is a constant.

What is a possible SI unit for k?

A $m\ s^{-2}$ ⬭

B $m\ s^{-1}$ ⬭

C $m^{\frac{3}{2}}\ s^{-1}$ ⬭

D $m^{\frac{1}{2}}\ s^{-1}$ ⬭

(Total 1 mark)

Mark Schemes

SI Units and Derived Units

Q1.

Question Number	Acceptable Answer	Additional Guidance	Mark
	D kg m s^{-2}		1

Q2.

Question Number	Answer	Mark
	C - $\mu = \frac{1}{\text{gradient}}$	1
	Incorrect Answers: A – incorrect use of $v = \sqrt{\frac{T}{\mu}}$ B – incorrect use of $v = \sqrt{\frac{T}{\mu}}$ D - incorrect use of $v = \sqrt{\frac{T}{\mu}}$	

Q3.

Question Number	Answer	Mark
	A kg s^{-2}	1
	Incorrect Answers: B – base units for N C – incorrect units and not base units D – correct units but not base units	

Q4.

Question Number	Answer	Mark
	D power kg m^2 s^{-3}	1
	Incorrect Answers: A – Coulombs is not an SI base unit B – Incorrect, as the unit for charge in SI base units is A s C – J s^{-1} is not in SI base units	

Q5.

Question Number	Answer	Mark
	C	1

Q6.

Question Number	Acceptable answers	Additional guidance	Mark
	A		1

Rearranging Equations

1. Strain = 3.6×10^{18}
2. Current = 40mA
3. Distance from Earth to Sun (r) = 140×10^{9} m
4. Acceleration = $0.33 ms^{-2}$
5. Drift velocity = $0.09 ms^{-1}$

Resolving Vectors

1) a) $F_x = 12 \cos 45 = 8.5N$ $F_y = 12 \sin 45 = 8.5N$

b) $F_x = 360 \cos 20 = 340N$ $F_y = 360 \sin 20 = -120N$

c) $F_x = 0.25 \cos 35 = 0.20N$ $F_y = 0.25 \sin 35 = 0.14N$

2) (a) $v_x = 150 \cos 30 = 130 ms^{-1}$ $v_y = 150 \sin 30 = 75 ms^{-1}$

(b) Vertical speed = $75 ms^{-1}$ So distance = speed x time = 75 x 20 = 1500m

3) (a) Displacement = 395m

(b) 30^0

Stretch & Challenge

Q1.

D

[1]

Q2.

B

[1]

Q3.

D

[1]

Q4.

B

[1]

Q5.

D

[1]

Q6.

B

[1]

Q7.

B

[1]

Q8.

B

[1]

Q9.

B

[1]

Q10.

A

[1]