## Physics 2017 Solutions

## Section A Q1

a) As SHM will only occur for small angles (around $5^{\prime}$ ) of swing, it is to ensure the pendulum is executing SHM
b) Use a split cork to suspend the string
c) From the part emerging from the cork to the centre of the bob at the end of the string
d) 77.3 s is the most accurate value of t as it will have a smaller percentage error as it uses larger measurements


NB- Must show straight line through origin Label both axes including units Divide all values of $t$ by 40 and square them as it is time for 40 oscillations
f) Calculate slope of straight line on graph

Using two points $(0.5,0.12) \quad(2.4,0.6)=\left(x_{1}, y_{1}\right) \quad\left(\mathrm{x}_{2}, \mathrm{y}_{2}\right)$ $\mathrm{m}=0.25263$
Sub into formula $T^{2}=$ rearrange: $T^{2}()=1$
$\mathrm{m}=\quad 0.25263(4)=\mathrm{g} \quad 9.973 \mathrm{~m} / \mathrm{s}^{2} 9.8 \mathrm{~m} / \mathrm{s}^{2}$

Section A Q2

b) (i) length measured using metre stick between two bridges (l on diagram)
(ii)tension found by finding mass of weight on electronic balance and multiplying by $g$
c) By placing tuning forks of different frequency on the bridge until the loop of people placed midway between the bridges (at the antinode) begins to vibrate rapidly ie. when resonance occurs
d) By drawing a graph with $f$ on the $y$ axis and on the $x$ axis
e) A straight line through the origin shows that $f$ is directly proportional to
g) $\quad y=m x+c \quad y=f \quad x=$
square both sides of $m$ :
cross multiply:
divide:

Section A Q3
a) using an electronic balance find mass of the calorimeter+water and then mass of calorimeter+water +ice, subtract to find mass of ice
b) by ensuring the ice was crushed, melting and dried
c) use insulation such as styrofoam around calorimeter and use a lid
d)
$(0.0082)()+(0.0082)(4180)(12)=(0.0484)(4180)(14.5)+(0.0618)(390)(14.5)$
e) small heat capacity as experiment assumes no heat is absorbed by thermometer graduated to for more accurate readings

## Section A Q4


a)

b)
c) (i) at $0.5 \mathrm{~V} \quad \mathrm{I}=5.5 \mathrm{~mA}$
(ii) at $8.5 \mathrm{~V} \quad \mathrm{I}=70 \mathrm{~mA}$
d) between 4 V to 6 V (where graph begins to curve)
e) Current increases with potential difference (As more current goes through the bulb, its temperature will increase. This will cause increased resistance in the bulb

## Section B Q5

a) Boyle's Law states that pressure is inversely proportional to volume for a fixed mss of gas at a constant temperature.
b)
$(0.4)(6)+(.15)(-9)=(.4)(0)+(.15) v$
$1.05=.15 \mathrm{v}$
$7 \mathrm{~m} / \mathrm{s}=\mathrm{v}$
c) (i) emf (ii) length
d) Because the wavelength of sound is much longer than the wavelength of light so is more similar to everyday objects eg. Wavelength of sound similar to width of door so we can diffraction occurs
e) When charge accumulates at a point of an object ions in the surrounding are either attracted ot repelled to this charged point. Those of opposite charged that are attracted neutralise the charge on the point.
f)
g) Sound intensity is power per unit area
h) This is the number at which the current is cut off if the current in the live and neutral wires differs by more than 30 mA
i) The moderator slows down nuetrons so fission can occur
j) 1) Because gravitational force is dependent on mass and the mass of sub atomic particles is very small

Q6
a) The principle of conservation of energy states that energy cannot be created or destroyed it can only be converted from one form to another
b) $v=u+a t$
square both sides $v^{2}=u^{2}+2 u a t+a^{2} t^{2}$
take out $2 a: v^{2}=u^{2}+2 a\left(u t+a t^{2}\right)$
we know $s=u t+a t^{2}$ so $v^{2}=u^{2}+2 a s$
c) $v^{2}=u^{2}+2 a s \quad u=0 \quad a=9.8 \mathrm{~s}=16$
$v^{2}=(0)^{2}+2(9.8)(16) \quad v=17.71 \mathrm{~m} / \mathrm{s}$
d) Hooke's Law states that when an object is bent, stretched or compressed by displacement s the restoring force is directly proportional to the displacement
d) A body moves with SHM if its acceleration is directly proportional to its distance from a fixed point on its path
e) $\mathrm{F}=\mathrm{ks} \mathrm{F}=\mathrm{ma} \mathrm{ma}=\mathrm{ks}(60)(9.8)=(250)(\mathrm{s})$
$=s \quad 2.352 \mathrm{~m}=\mathrm{s}$ add full length of 32 m so $\mathrm{s}=34.352 \mathrm{~m}$
f) (i)

$$
=\quad(1.2) \mathrm{m} / \mathrm{s}^{2}
$$

(ii)


W
g)

Q7
a) Reflection is the bouncing of light off a surface
b) (i) blue and green
(ii) red
c) (i) black
(ii) red
d) Polarisation is the vibrating of a wave in one plane only
e) Take two polarising sheets. Hold them up to a light source. Rotate one plate until no light can be seen passing through.
f) It allows you to check for defects
g) In the second diagram the wave source is moving towards observer B. To observer A the wavelength appears longer and the freuency lower. To observer B the wavelength appears shorter and the frequency higher.

h) (observed is 1.15 times observed) cancel f from both sides cross multiply

## Q8

a) Resistance of a conductor is the ratio of the potential difference across it to the current flowing through it whereas resistivity of a conductor of length I , cross-sectional area A and resistance $R$ is given by the constant
b)
so resistance decreases by a factor of 9 when diameter increses by a factor of 3 because it is an inverse square
c) rms means root mean squared or average voltage
d) alternating current
e) (i)
$142.86+50=192.86$
(ii) Find current of whole circuit
f) The current will decrease as the resistance of the whole circuit will increase
g) (i) The current flowing will be reduced as the coil will produce a back emf which will increase resistance
(ii) The current will only flow in one direction as diodes only allow current to flow one way

## Q9

a) Rutherford fired alpha particles at gold foil. On the other side of the foil was a zinc sulphide screen. When alpha particles hit off this screen they caused flashes of light. Rutherford observed that most particles passed straight through the foil and others were deflected through small angles and a few deflected through angles of over 90 degrees.
b) He concluded that atoms have a very small, dense, positive core and are mostly empty space.
c) Atoms are given energy which allows the electrons to move up to a higher energy level. The electrons will then fall back down to their original level and emit light as they do, forming line spectra.
d)

(i) Using a vapour lamp as the light source will produce a line spectrum
(ii) Using a white light will produce a continuous spectrum
e) To find $\mathrm{n}: 300$ lines per $\mathrm{mm}=300^{\prime} 000$ lines per m d=
(1) $\left(58910^{-9}\right)=((\sin )$
$0.1767=\sin 10.177=$ multiply by two for both angles:

Q10
a) $X$-rays are high frequency electromagnetic radiation
b) They are produced by thermionic emission which is the giving off of electrons from the surface of a hot metal
c) The cathode filament
d) (i)
$\mathrm{E}=\mathrm{hf}$
(ii)
$1.4710^{8} \mathrm{~m} / \mathrm{s}=\mathrm{v}$
(iii) $V=62,000 \mathrm{~V}$
e)

f) when light of a suitable frecuency strikes the cathode electrons are emitted. These electrons are attracted to the anode which causes a small current to flow.
g)

$$
=7.510^{14} \text { electrons }
$$

## Q11

a)

b) The ampere is the current which, if flowing through two very long conductors placed one meter apart in a vacuum would produce a force of $210^{-7} \mathrm{Nm}^{-1}$.
c)

d) As it is not in a geostationary orbit so is not always in the same place
e) $(2.66060)^{2}=$
f) Light enters the optical fibre and strikes the boundary between the core and the coating at an angle of incidence greater than the critical angle. Total internal reflection occurs and light bounces back into the core this is repeated until the ray emerges out the end of the fibre.

g)
g) (i)electrons
(ii)photons
(iii) photons

Q12 A
a) The sum of the forces up and down must equal 0 . The clockwise moments must be equal to the anticlockwise moments
b) $(400)(1.2)+(330)(0.6)=678 \mathrm{Nm}$
c)
d) An object is in equilibrium if it is not accelerating. If a rotating object has a constant angular velocity it is not accelerating so if therefore in equilibrium.

Q12B
a) Radiation is the spontaneous disintegration of an unstable nucleus with the emission of one or more types of radiation
b) A Geiger-Müller tube can detect beta radiation. When beta radiation enters the tube it ionises the gas.
c)
d)

Q12C
a)

b)(i)

## (ii)

c) Because for it to be upright it must be placed inside the focal length which would produce a virtual image which cannot be viewed on a screen.

Q12D (i)
a) Protons were produced in a discharge tube
b) They were accelerated through a high voltage
c) They produced flashes on the zinc sulphide screen when they hit it
d)
e) lithium mass: $1.16510^{-26} \mathrm{~kg}$ loss in mass: $3.09 \quad 10^{-29} \mathrm{~kg}$
(Outline how you got the mass of the Lithium. Go to pg. 83 of log book, read off the mass of Lithium7 in atomic mass units and multiply this by the unified atomic mass unit value given on pg. 47 of the log book.)
f) This experiment was the first transmutation by an artificially accelerated particle and the first verification of

