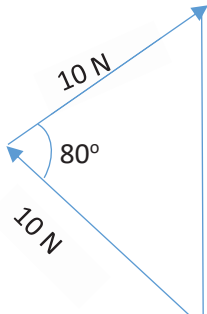
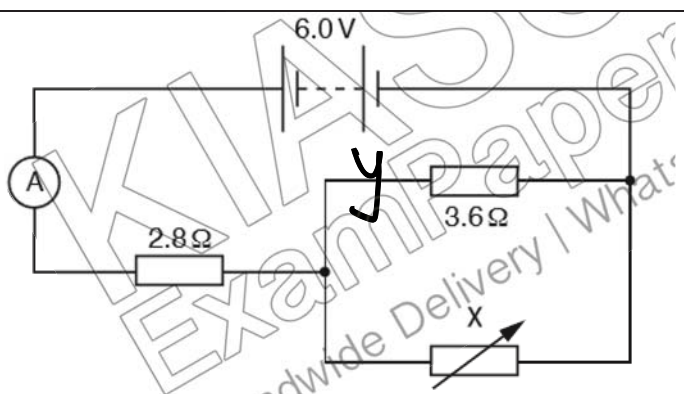


4E SciPhy Prelim 2020 Answer Key

	Answer	Marks/Remarks
1a	$4.47 - 4.16 = 0.31 \text{ cm}$ $0.31 / 2 = 0.155 \text{ cm}$	M1 A1
b	It is difficult to ensure the ruler is placed such that it passes through the centre of the circular (plane of the) pipe to measure its true diameter. Note: Often, ruler measures the chord length rather than the diameter as the ruler fails to pass through the origin of the circular plane of the pipe. Do not accept Vernier calipers can measure to more d.p. Accuracy and precision are different thing.	A1
		Q1: 3 marks
2	Distance and time.	B1
		Q2: 1marks
3a	The speed of the object increases uniformly/accelerates uniformly from 0 m/s to 30 m/s. The speed of the object increases at a decreasing rate/ the object undergoes decreasing acceleration from 30 m/s to 40 m/s.	B1 B1
b	acceleration from t= 25 min to 40 min is chosen/ considered $a = \frac{v - u}{t} = \frac{0 - 40}{15 \times 60} = -0.0444 \text{ m/s}^2$	B1 M1 A1
c	distance= area under graph $= 40 \times (15 \times 60)$ $= 36\,000 \text{ m}$	M1 A1
		Q3: 7 marks
4	 Weight of bag= 12.9 N Accept (11.5 N to 14.5 N)	B1- Scale B1- label angle B1- label forces with correct arrows B1- Weight
		Q4: 4 marks
5a	At t= 0s.	B1

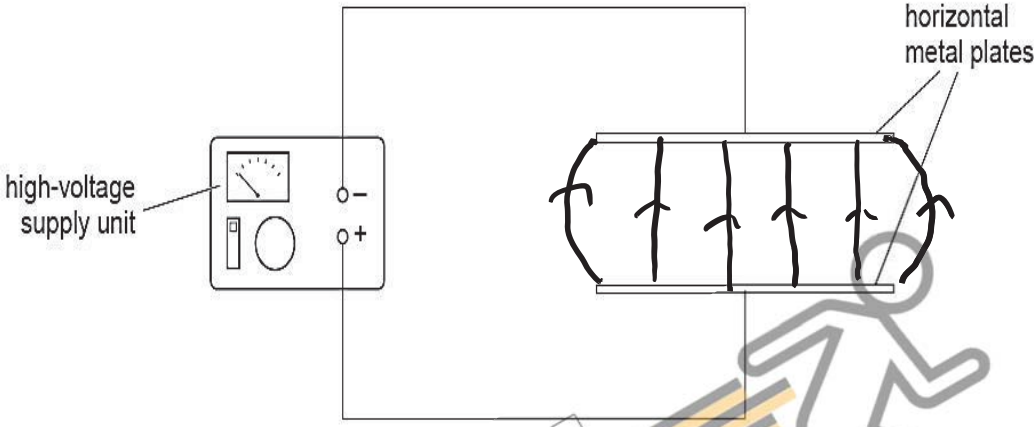
	The forward force is at 3000N and resistive force is zero as the car is not moving at that instant. Thus, the resultant force at this instant is the greatest and by $F=ma$, the acceleration of the car is maximum.	B1
b	3 000 N	B1
c	$F_{\text{net}} = Ma$ $3000 - f = 1500 \times 1.5$ $f = 750 \text{ N}$	M1 A1
		Q5: 5 marks
6a	Weight of water = density x volume x gravitational field strength $= 1000 \times 2.4 \times 10^{-2} \times 10$ $= 240 \text{ N}$ Total weight = 240 + mg $= 240 + (1 \times 10)$ $= 250 \text{ N}$	M1 M1 A1
bi	Moment = $F \times D$ $= 250 \times 0.12$ $= 30 \text{ Nm}$	M1 (ecf) A1
bii	A.C.W moment = C.W moment $30 \text{ Nm} = F \times 0.40$ $F = 75 \text{ N}$	M1 (ecf) A1
c	W.D = $F \times D$ $= 250 \times 6$ $= 1500 \text{ J}$	M1 (ecf 6a) A1
		Q6: 9 marks (allow ecf)
7a	Evaporation	B1
b	It occurs at any temperature below the boiling point of a liquid. It occurs only on the surface of the liquid. O.E for evaporation process.	B1 B1
		Q7: 3 marks
8a	$1.6 = \frac{\sin(60)}{\sin(r)}$ $r = \sin^{-1}\left(\frac{\sin 60}{1.6}\right)$ $= 32.8^\circ$	M1 A1
b	$n = \frac{1}{\sin c}$ $c = \sin^{-1}\left(\frac{1}{1.6}\right)$ $= 38.7^\circ$	M1 A1
c	Total internal reflection occurs.	

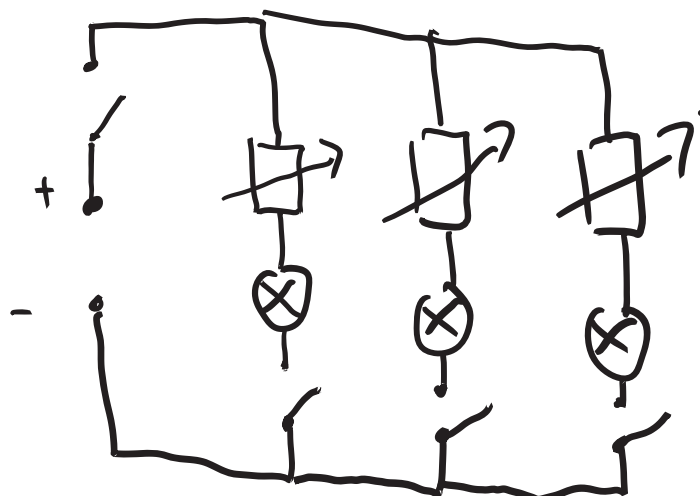
	Since light travels in an optically denser medium (glass) towards an optically less dense medium (air) and the angle of incidence in the optically denser medium, $\theta = 57.2^\circ$ is greater than critical angle of the glass, total internal reflection occurs.	B1 B1
d	The wavelength of the light decreases. As speed of light decreases as it enters the glass and frequency of light does not change , by $v = f\lambda$, wavelength decreases.	B1
e	Light do not require a medium to propagate in.	B1 (o.e)
		Q8: 8 Marks
9a	$R_T = \left(\frac{1}{3.6} + \frac{1}{1.8}\right)^{-1} + 2.8$ $= 4.0 \Omega$	M1 A1
b	$I_T = \frac{e.m.f}{R_T}$ $= \frac{6.0}{4.0}$ $= 1.5 A$	M1 A1
c		B1 (o.e)
		Q9: 5 marks

Section B

10a	Principle of conservation of energy states that energy cannot be created or destroyed. It can only be transferred from one body to another or transformed from one form to another. The total amount of energy remains a constant.	B1
b	$GPE_B = mgh = \frac{1}{2}(100)$ $= 50 J$ $KE_B = 50 J$	M1 A1 B1

c	Position of ball	GPE / J	KE / J	
	C	50	50	B1
	D	0	100	B1
d	$KE = \frac{1}{2} mv^2 = \frac{1}{2} (2)(v^2) = 50$ $v = 7.07 \text{ m/s}$			M1 A1
e	$KE = \frac{1}{2} mv^2$ When v is doubled, $KE = \frac{1}{2} m(2v)^2 = \frac{1}{2} m(4v^2)$. Accept substitution of numbers for working. KE will be quadrupled.			M1 A1
11ai				B1 (equal no of charges)
aii	The positive charges at the bottom of the cloud induces negative charges at the top of the tree as unlike charges attract. The charges build up until the electric field between the tree and the cloud is so strong that there is a discharge of electrons from the tree to the cloud. (This process is known as return stroke. The main discharge actually occurs from the bottom object all the way up to the cloud.)			B1 B1

aiii	Current = Charge / Time $= 620 / (2.5 \times 10^{-4})$ $= 2.48 \times 10^6 \text{ A}$	M1 A1
bi		B1- field direction B1- Slight curve at the edges
bii	It is a region where an electric charge experiences an electrical force.	B1
biii	As like charges repels, the positively charged droplet experienced a repulsion force upward due to the positively charged plate below. (accept attraction with top plate, O.E) Since this upward force is larger than the weight (downward) of the the oil droplet, there is a resultant upward force. By $F=ma$, the oil drop accelerates upward.	B1 B1
12a	It is the work done by the source to drive unit charge around a complete circuit. or It is the amount of non-electrical energy converted to electrical energy to drive unit charge around a complete circuit.	B1

b		B1-use rheostat B1- 4 switches in correct places. B1- 3 lamps parallel
ci	When $I = 0.70 \text{ A}$, $V = 2.0 \text{ V}$ $R = V/I$ $= 2.0/0.70$ $= 2.9 \Omega$	M1 A1
cii	Resistance of lamp increases. As voltage increases, current flowing through the lamp increases at a decreasing rate. Thus, by $R=V/I$, resistance has to increase.	B1 B1
ciii	Fuse. It consist of a thin piece of wire which will melt and break open the circuit when the current flowing through the fuse exceeds its rating.	B1 B1

