MARKING SCHEME: NOV 2009.
9188/5

NCE 101

1 (a) (i) $\lambda = \frac{h}{p}$ h = λp accept. Accept word equation wavelength = Planck's / momentum — B1

(ii) 1. $\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34}}{50 \text{ kg} \times 7.9 \text{ ms}^{-1}}$ — C1

$= 1.68 \times 10^{-36}$m — A1

2. No diffraction — ~~B1~~ A1
Wavelength too small compared with the dimensions of aperture. — ~~B1~~ M1

For diffraction pattern to be observed wavelength and aparture must be of same order. — ~~B1~~ M1

3. Diffraction of electrons — B1
through thin carbon or nickel in — B1
an evacuated tube — B1

(b) (i) 1. $n = \frac{PV}{RT} = \frac{1.5 \times 10^{6} \times 0.8 \times 10^{-3}}{8.31 \times 320}$ pV = NkT — C1

Number of molecules = $0.451 \times 6.02 \times 10^{23}$ — C1

$= 2.72 \times 10^{23}$ — A1

2. $T = \frac{PV}{nR}$ T = 533K — C1

$Ek = \frac{3}{2}NkT = \frac{3\ NkPV}{2\ \ nR} = \frac{3}{2} \times PV$ — C1

$= \frac{3}{2} \times 2.5 \times 10^{6} \times 0.8 \times 10^{-3}$

$=$ 3 000 J — A1

(ii) Any two assumptions of the kinetic theory — B2

(c) (i) magnetic flux Number of magnetic field lines passing

- ϕ = BA terms explained = BA sin θ provided θ is explained — B1

magnetic flux density:

- Magnetic force acting **per** unit current length — B1

B = F/IL terms explained B = F/IL

(ii) Charge carriers moving in a magnetic field experience a force — B1

The force deflects them to one side — B1

			Charge accumulates on one side leaving a deficit of the charge on the other side hence the potential difference.			B1
		(iii)	B	=	$\frac{V_H}{\upsilon d}$	C1
				=	$\frac{10\times10^{-6}}{6\times10^{-4}\times5\times10^{-3}}$	C1
				=	3.33 T Wb/m²	A1
2	(a)		ΣE	=	ΣIr	B1
			ΣI	=	0	B1
	(b)	(i)	$15 - 12 = 2.1I + 1.5I_1$			
			$3 = 2.1I + 1.5I_1$		(1)	C1
			$15 = 2.1I + 6I_2$ check student loops		(2)	C1
			$I = I_1 + I_2$		(3)	C1
			From equation (1), (2) and (3) Solve simultaneous equations			C1
			$I_1 = 0.296A$			A1
			$I_2 = 1.94A$			A1
			$I = 1.64A$			A1
		(ii)	$V = I_2 \times 6$			C1
		(ii)	$V = 11.6\ V$ e.c.f			A1
		(iii)	$P = I^2R = 22.6W$			A1
3	(a)	(i)	Sum of its molecules' kinetic energy and potential energy			B1
		(ii)	Doing work (on or by gas), transferring of heat (to or from gas)			B1B1
	(b)	(i)	Random motion of smoke particles bright spot			B1
			Smoke particles being knocked by (invisible) air molecules			B1
			Air molecules are in random motion (have E_k)			B1
		(ii)	Speed of smoke particles reduced			~~M1~~ B1

Kinetic energy ∝ Temperature B1 ~~A1~~

(c) Copper contains free electrons B1
free electrons diffuse B1
through a Temperature gradient B1
In both copper and wood, atoms
Vibrate through Temperature gradient B1

4 (a) Elastic – material returns to its original length when stress is removed B1

plastic – material suffers permanent strain B1

(b) (i) $E = \frac{\sigma}{\varepsilon} = \frac{FL}{ADL}$ $\Delta L \times A$ C1

$= \frac{0.4 \times 9.81 \times 3}{1 \times 10^{-7} \times 1 \times 10^{-3}}$ $kg\,m^{-1}s^{-2}$ C1

$= 1.17 \times 10^{11}$ Pa A1
1.18×10^{11} Pa

(ii) $\frac{\Delta L}{L} \times 100\% = \frac{1 \times 10^{-3}}{3} \times 100\%$ C1

$= 0.033\%$ 2 s.f. A1

(iii) $E = \frac{F}{A \times 0.033}$

$F = 1.17 \times 10^{11} \times 1.0 \times 10^{-7} \times 0.033$ C1

$= 386.1$ N A1
389 N

(iv) Force greater than breaking load B1
Calculation of force using Hooke's law / Cross-sectional area changes B1
Assumption not valid since elastic limit is exceeded B1

5 (a) A device which ~~produces~~ converts a potential difference dependant on a physical property. Converts energy from one form to another B1

Strain gauge; thermistor; LDR; etc windspeed / motor B1

(b) (i) Infinite resistance / does not draw current (reject high resistance) B1

(ii) Voltage follower B1
gain = 1 B1

(iii) high input impedance/
Infinit input impedance B1

Voltmeter amplifier must not draw current B1

(c) (i) NAND gate B1

(ii)

A	B	C	D	Q
0	0	1	1	0
1	0	1	1	0
0	1	1	1	0
1	1	0	0	1

4 scores 3

3 scores 2

2 scores 1

≤1 scores 0

max B3

B1 B1 B1

(iii) AND gate B1 A1