

**MARK SCHEME for the October/November 2011 question paper  
for the guidance of teachers**

**9702 PHYSICS**

**9702/22**

Paper 2 (AS Structured Questions), maximum raw mark 60

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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- 1 (a) average velocity =  $540 / 30$   
=  $18 \text{ m s}^{-1}$  C1  
A1 [2]
- (b) velocity zero at time  $t = 0$  B1  
positive value and horizontal line for time  $t = 5 \text{ s}$  to  $35 \text{ s}$  B1  
line / curve through  $v = 0$  at  $t = 45 \text{ s}$  to negative velocity B1  
negative horizontal line from  $53 \text{ s}$  with magnitude less than positive value and  
horizontal line to time =  $100 \text{ s}$  B1 [4]
- 2 (a) (i) force is rate of change of momentum B1 [1]
- (ii) work done is the product of the force and the distance moved in the direction  
of the force B1 [1]
- (b) (i)  $W = Fs$  or  $W = mas$  or  $W = m(v^2 - u^2) / 2$  or  $W = \text{force} \times \text{distance}$  s A1 [1]
- (ii)  $as = (v^2 - u^2) / 2$  any subject M1  
 $W = mas$  hence  $W = m(v^2 - u^2) / 2$  M1  
RHS represents terms of energy or with  $u = 0$   $\text{KE} = \frac{1}{2}mv^2$  A1 [3]
- (c) (i) work done =  $\frac{1}{2} \times 1500 \times [(30)^2 - (15)^2]$  (=506250) C1  
distance =  $\text{WD} / F = 506250 / 3800 = 133 \text{ m}$  A1 [2]  
or  $F = ma$   $a = 2.533 \text{ (ms}^{-2}\text{)}$  C1  
 $v^2 = u^2 + 2as$   $s = 133 \text{ m}$  A1
- (ii) the change in kinetic energy is greater or the work done by the force has to  
be greater, hence distance is greater (for same force) A1 [1]
- allow: same acceleration, same time, so greater average speed and greater  
distance
- 3 (a) (i) stress = force / (cross-sectional) area B1 [1]
- (ii) strain = extension / original length or change in length / original length B1 [1]
- (b) point beyond which material does not return to the original length / shape / size  
when the load / force is removed B1 [1]

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- (c) UTS is the maximum force / original cross-sectional area  
wire is able to support / before it breaks M1  
A1 [2]
- allow one: maximum stress the wire is able to support / before it breaks
- (d) (i) straight line from (0,0) M1  
correct shape in plastic region A1 [2]
- (ii) only a straight line from (0,0) B1 [1]
- (e) (i) ductile: initially force proportional to extension then a large extension for  
small change in force B1  
brittle: force proportional to extension until it breaks B1 [2]
- (ii) 1. does not return to its original length / permanent extension (as entered  
plastic region) B1  
2. returns to original length / no extension (**as no plastic region / still in  
elastic region**) B1 [2]
- 4 (a) electric field strength = force / positive charge B1 [1]
- (b) (i) at least three equally spaced parallel vertical lines B1  
direction down B1 [2]
- (ii)  $E = 1500 / 20 \times 10^{-3} = 75000 \text{ V m}^{-1}$  A1 [1]
- (iii)  $F = qE$  C1  
( $W = mg$  and)  $qE = mg$  C1  
 $q = mg / E = 5 \times 10^{-15} \times 9.81 / 75000$   
 $= 6.5 \times 10^{-19} \text{ C}$  A1  
negative charge A1 [4]
- (iv)  $F > mg$  or  $F$  now greater B1  
drop will move upwards B1 [2]
- 5 (a) (i)  $I_1 + I_3 = I_2$  A1 [1]
- (ii)  $E_1 = \frac{I_2 R_2}{2} + \frac{I_1 R_2}{2} + I_1 R_1 + I_1 r_1$  A1 [1]
- (iii)  $E_1 - E_2$  B1  
 $= -I_3 r_2 + I_1 (R_1 + r_1 + R_2 / 2)$  B1 [2]
- (b) p.d. across BJ of wire changes / resistance of BJ changes B1  
there is a difference in p.d. across wire and p.d. across cell  $E_2$  B1 [2]
- 6 (a) waves overlap B1  
(resultant) displacement is the sum of the displacements of each of the waves B1 [2]

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- (b) waves travelling in opposite directions overlap / incident and reflected waves overlap  
 (allow superpose or interfere for overlap here) B1  
 waves have the same speed and frequency B1 [2]

- (c) (i) time period =  $4 \times 0.1$  (ms) C1  
 $f = 1 / T = 1 / 4 \times 10^{-4} = 2500$  Hz A1 [2]

- (ii) 1. the microphone is at an antinode and goes to a node and then an antinode / maximum amplitude at antinode and minimum amplitude at node B1 [1]  
 2.  $\lambda / 2 = 6.7$  (cm) C1  
 $v = f\lambda$  C1  
 $v = 2500 \times 13.4 \times 10^{-2} = 335 \text{ m s}^{-1}$  A1 [3]

incorrect  $\lambda$  then can only score second mark

- 7 (a) (i) the half life / count rate / rate of decay / activity is the same no matter what external factors / environmental factors **or** two named factors such as temperature and pressure changes are applied B1 [1]  
 (ii) the observations of the count rate / count rate / rate of decay / activity / radioactivity during decay shows variations / fluctuations B1 [1]

(b)

property	$\alpha$ -particle	$\beta$ -particle	$\gamma$ -radiation
charge	<b>(+)2e</b>	<b>-e</b>	0
mass	$4u$	<b><math>9.11 \times 10^{-31} \text{ kg}</math></b>	0
speed	<b>0.01 to 0.1 c</b>	up to 0.99 c	<b>c</b>

one mark for each correct line B3 [3]

- (c) collision with molecules B1  
 causes ionisation (of the molecule) / electron is removed B1 [2]