# ATAR course **Year 11 Physics**

## Practice Exam 2 (Unit 1 & 2) **Answers**

## Section one: **Short answer** (60 marks)

**Question 1** (2 marks)

Heat transfer is always from areas of higher temperature to lower temperature. Statement should read, 'Close the door, you are letting the heat out!'

**Question 2** (4 marks)

| | Average kinetic energy | Internal energy |
|---|---|---|
| **bucket** | same | less |
| **pool** | same | more |

**Question 3** (10 marks)

**a** $Q1 = m\,c\,\Delta\,t = 0.5 \times 4200 \times 25 = 52\,500$ J

**b** $Q2 = m\,L = 0.5 \times 336\,000 = 168\,000$ J

**c** Power $= \frac{\text{energy}}{\text{time}} = \frac{52500 + 168000}{8 \times 60} = 459\ \text{Js}^{-1}$ or 459 W

**d** Power $= \frac{\text{energy}}{\text{time}}$ therefore Energy = Power × time

Energy = 1200 × 120 = 144 000 J

$Q = m\,c\,\Delta\,T$

$144\,000 = 0.75 \times 4200\,(T_{final} - 10)$

$T_{final} = 55.7°$

**Question 4** (4 marks)

**a** FALSE (average kinetic energy of particles in a substance is related to temperature)

**b** TRUE

**c** FALSE (absolute zero where all kinetic energy of atoms cease has never been reached)

**d** FALSE (internal energy (sum of kinetic energy and potential energy) is increasing as the potential energy is increasing even though the kinetic energy remains constant)

**Question 5** (3 marks)

Materials useful for stopping α particles (such as paper/cardboard), β particles (such as aluminium) and γ rays (such as lead). Using the Geiger counter to count on a meter and depending on the material and the reduction, if any, a decision can be made as the type of emitter the unlabelled radioactive source is.

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**Question 6** (4 marks)

dose equivalent = absorbed dose × quality factor

absorbed dose = $\frac{\text{dose equivalent}}{\text{quality factor}}$

absorbed dose = $\frac{0.006}{1.5}$ = $4.00 \times 10^{-3}$ J kg$^{-1}$

energy = absorbed dose × mass = $4.00 \times 10^{-3} \times 50 = 2.00 \times 10^{-1}$ J

**Question 7** (4 marks)

**a** $^{1}_{0}n + ^{238}_{92}U \rightarrow ^{239}_{92}U$

**b** $^{239}_{92}U \rightarrow ^{239}_{93}Np + ^{0}_{-1}\beta$

**Question 8** (4 marks)

**a** Number of neutrons released is two.

**b** $E = mc^2$

$m = \frac{2.76 \times 10^{-11}}{[(3 \times 10^{8})^{2}]}$

$m = 3.07 \times 10^{-28}$ kg

**Question 9** (7 marks)

**a** $\frac{\text{potential difference across the } 20\Omega}{\text{potential difference across the } 10\Omega} = 1$

**b** $V = I \times R$

**c** $V = I \times R$ $\quad 6 = I \times 30$ $\quad I = 0.2\ A$

**d** $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ $\quad \frac{1}{R_T} = \frac{1}{10} + \frac{1}{20} + \frac{1}{30}$

$R_T = 5.45\Omega$

**Question 10** (3 marks)

$v^2 = u^2 + 2as$

$u = 110$ kmh$^{-1}$ = 30.556 ms$^{-1}$

$0^2 = (30.556)^2 + 2 \times a \times 1500$

$a = 0.311$ ms$^{-2}$

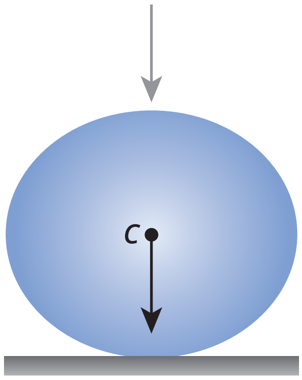
**Question 11** (2 marks)

$W = mg$

$1764 = m \times 9.80$

$m = 180$ kg

**Question 12** (3 marks)




- Weight force must be labelled and drawn downwards from C.
- Normal reaction force must be drawn perpendicular from the surface and labelled.
- Normal force MUST BE clearly larger in magnitude than Weight force.

**Question 13** (2 marks)

$P = \frac{V^2}{R} R = \frac{3.00^2}{0.900}$

$R = 10.0\ \Omega$

**Question 14** (8 marks)

**a** Amplitude = 3.00 m

**b** Wavelength = 0.8 m

**c** $v = f\lambda$

$1.5 = f \times 0.8$

$f = 1.875$ Hz $\qquad T = \frac{1}{f} \qquad T = 0.533$ s

**d** Longitudinal waves occur when particles of the medium vibrate in the same direction as the direction of travel of the medium. Example: Sound waves

Transverse waves are created when the direction of the particle of the medium is perpendicular to the direction of travel of the wave energy itself. Example: Water waves

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## Section two Problem solving (84 marks)

### Question 15 (12 marks)

**a** $a$ = gradient = 2.50 m s²

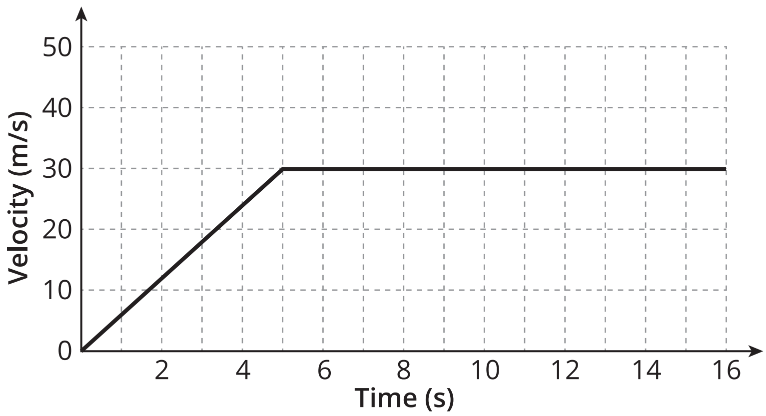
**b** $s$ = area under curve = $\frac{1}{2} \times 10 \times 25 + 13 \times 25 + \frac{1}{2} \times 25 \times 12 = 575$ m

**c** $F_{net} = m\,a = 1200 \times (-2.08) = -2500$ N

**d** $F_{net} = m\,a = 0$ N as car is travelling at a constant speed. Gradient of $v$ vs $t$ graph is 0.

### Question 16 (5 marks)

**a** Area under curve




$20\,t = \frac{1}{2} \times 30 \times 5 + (t - 5) \times 30$

$t = 7.5$ s

**b** distance = 20 × 7.5 = 150 m

### Question 17 (9 marks)

**a** 70°C

**b** $Q = mc\,\Delta T$

$c = \frac{100 \times 10^3}{2 \times (70 - 20)}$

$c = 1.00$ kJ kg$^{-10}$ °C$^{-1}$

**c** $Q = mL$

$L = \frac{Q}{m} = \frac{400 \times 10^3}{2}$

$L = 200$ kJ kg$^{-1}$

**d** The average, random kinetic energy of the molecules was not increasing. The energy is used to overcome the forces holding the particles together rather than increasing the temperature.

### Question 18 (9 marks)

**a** All atoms of a particular element with the same number of protons, but different number of neutrons. All strontium atoms have 38 protons, but different isotopes of strontium have different numbers of neutrons.

**b** $^{90}_{38}Sr \rightarrow\ ^{90}_{39}Y +\ ^{0}_{-1}\beta + v$ + energy

**c** Beta particles are not strongly penetrating. If the strontium-90 exposure was only external to humans, the damage would be minimal as they have poor penetrating ability. Internally, however, there is a much larger dose that is absorbed by the body (usually in gastrointestinal tract), which can lead to mutations and cancers.

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**d** 202 days is 4 half-lives

Activity = $\frac{150 \text{ MBq}}{2^4}$

Activity = 9.38 MBq

**e** The overall decay pattern is predictable but which individual atom will decay at any given time is unpredictable – a random process.

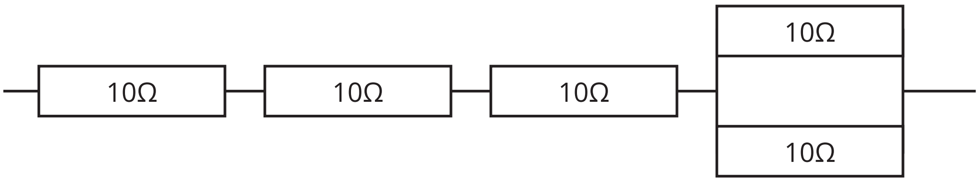
**Question 19** (7 marks)

**a** Component A is ohmic.

**b** Answer: 0.6 A

**c** Answer: 12 V across component A and because both in series both have a current of 0.6 A. From second graph the voltage across component B is 4 V. Therefore voltage is 16 A.

**Question 20** (3 marks)




**Question 21** (7 marks)

**a** $m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$

$0.15 \times 2 + 1.0 \times 0 = 0.15 \times 0.5 + 0.1$ v

$v_2 = 2.25$ m s$^{-1}$

**b** $E_{k\ before} = \frac{1}{2} \times 0.15 \times 2^2 + 0$

= 0.300 J

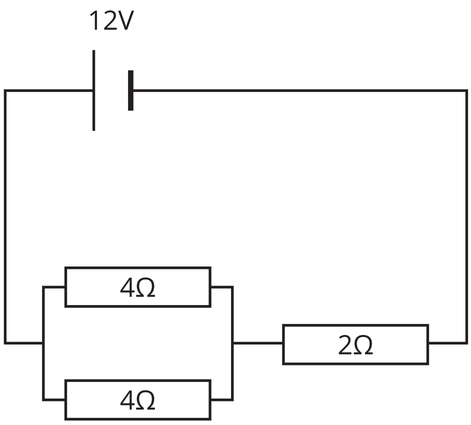
$E_{k\ after} = \frac{1}{2} \times 0.15 \times (0.5)2 + \frac{1}{2} \times 0.10 \times (2.25)^2$

= 0.272 J

Kinetic energy is not conserved (Kinetic energy before collision > Kinetic energy after collision) so the collision is inelastic.

**Question 22** (10 marks)

**a**




**b** Parallel component: $\frac{1}{R_T} = \frac{1}{4} + \frac{1}{4}$ $R_T = 2\ \Omega$

Total resistance: $R_T = 2 + 2 = 4\ \Omega$

**c** $V_T = I_T + R_T I_T = 3$ A

**d** $P = I^2 \times R = 3^2 \times 2 = 18$ W

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**Question 23** (14 marks)

**a** $F_{net} = m\,a = 5.0 \times 5 = 25$ N

**b** $F_{net} = m\,a$

$25 = 60 - f$

$f = 35$ N

**c** $s = ut + \frac{1}{2}a\,t^2$

$s = 0 \times 2 + \frac{1}{2} \times 5 \times 2^2$

$s = 10$ m

**d** $W = F_{applied} \times s$

$W = 60 \times 5$

$W = 300$ J

**e** $W = f \times s$

$W = 35 \times 5$

$W = 175$ J

**Question 24** (8 marks)

**a** 40 cm = 0.4 m

$\lambda = 4 \times 0.4 = 1.60$ m

$v = f \times \lambda$

$f = \frac{340}{1.6}$

$f = 213$ Hz

**b** $f = 3 \times 213 = 638$ Hz

**c** Resonance occurs when the forcing frequency equals the natural frequency of the pipe resulting in a **louder** sound. These frequencies depend on the length, 0.4 m.

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## Section three: **Comprehension** (36 marks)

**Question 25** (13 marks)

**a** $^{99}_{42}Mo \rightarrow {}^{99m}_{43}Tc + {}^{0}_{-1}\beta + v$

**b** $^{99m}_{43}Tc \rightarrow {}^{99}_{43}Tc + {}^{0}_{0}\gamma$

**c** If a radioactive isotope has too long a half-life, the patient and others around them would be subjected to a continuing radiation dose.

**d** Molydenum-99 will decay in transport so less will arrive at the hospital.

**e** Gamma emitters are hardly absorbed by the body, where are α and β are much less likely to emerge from the body. Gamma radiation can be detected by cameras outside the body.

**f** Activity = $\frac{500\ \text{MBq}}{2^4}$

Answer: 31.3 MBq

**Question 26** (10 marks)

**a** Crumple zones increase the time, therefore decreasing the force for the same change in momentum.

**b** 13.9 $ms^{-1}$

**c** Neither, in both situations the crash test dummy has the **same** change in momentum

$\Delta p = mv - mu = 80 \times 0 - 80 \times 13.889$

$= -1.11 \times 10^4$ kg m $s^{-1}$

**d** Tank: $\Delta p = F \times t$ $\quad -1.11 \times 10^4$ kg $ms^{-1} = F \times 0.01$

$F = -1.11 \times 10^6$ N

Car: $\Delta p = F \times t$ $\quad -1.11 \times 10^4$ kg $ms^{-1} = F \times 0.1$

$F = -1.11 \times 10^5$ N

The crash test dummy in the tank has the greatest stopping force.

**Question 27** (13 marks)

**a** $f = \frac{v}{2L} = \frac{340}{0.6} = 567$ Hz

**b** 1130 Hz, 1700 Hz and 2270 Hz

**c** Standing waves are the result of superposition of two waves of equal amplitude and frequency, travelling in opposite directions along the column of the flute.

**d** Pressure node: at an open end of pipes, sound waves are reflected. At an open end, a compression or rarefaction is reflected with a phase change of $\lambda/2$, resulting in destructive interference and, hence, a pressure node is created.

**e** Placement of fingers over holes
How the flute is blown

## End of answers

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