

SCHOOL: Your school name

SENIOR FOUR PHYSICS

END OF TERM EXAMINATION · FREE SAMPLE

MARKING SCHEME (TEACHER'S COPY)

Academic year: 20..... – 20.....

Date:/...../20.....

Duration: 2 hours 30 minutes

Total marks: 40

Content covered: Unit 1: Reflection and Refraction of Light · Unit 2: Optical Instruments · Unit 3: Moments and Equilibrium of Bodies · Unit 4: Conservation of Linear Momentum and Collision · Unit 9: Laws of Thermodynamics · Unit 10: General Structure of the Solar System

INSTRUCTIONS

1. A full paper has THREE sections and 100 marks: A 55 marks (all questions), B 30 marks (any three of four), C 15 marks (one of two).
2. This free sample shows one extract of each section.
3. Silent non-programmable calculators may be used.
4. Write your answers in the answer booklet provided.
5. Show all your working clearly.

SECTION A (extract of 55 marks)*Attempt ALL questions.*

1. A student 1.60 m tall, with eyes 1.50 m above the floor, wants to see her whole body in a vertical plane mirror on the dormitory wall. What is the shortest mirror she needs, and where must its top edge be? (3 marks)

Answer: 0.80 m long, top edge 1.55 m up

Model answer: The mirror only needs to cover half her height: $1.60 \div 2 = 0.80$ m. Its top must be halfway between her eyes and the top of her head: $(1.50 + 1.60) \div 2 = 1.55$ m.

Marking: Formula or method: 2 marks · correct answer with unit: 1 mark.

2. Without any equipment, how can an optician quickly tell whether a pair of spectacles is for short sight or long sight? (3 marks)

Answer: Look at print through them: magnified print means converging (long sight)

Model answer: A converging lens held close to print forms a magnified upright image; a diverging lens always makes the print look smaller.

Marking: 3 marks: correct answer with a clear reason.

3. A light rod 100 cm long carries a 2.0 kg mass at the 0 cm end and a 3.0 kg mass at the 100 cm end. Where is the centre of gravity of the system? (3 marks)

Answer: At the 60 cm mark

Model answer: $x = (m_1x_1 + m_2x_2)/(m_1 + m_2) = (2.0 \times 0 + 3.0 \times 100) \div 5.0 = 60$ cm, nearer the heavier mass.

Marking: Formula or method: 2 marks · correct answer with unit: 1 mark.

4. A rigid 2.0 L tank contains gas at 300 K and 1.0×10^5 Pa. It is heated to 450 K. What is the new pressure? (3 marks)

Answer: 1.5×10^5 Pa

Model answer: At constant volume P/T is constant: $P_2 = 1.0 \times 10^5 \times 450 \div 300 = 1.5 \times 10^5$ Pa.

Marking: Formula or method: 2 marks · correct answer with unit: 1 mark.

5. Two moons orbit the same planet. Moon B's orbit radius is 4 times that of moon A. Using Kepler's third law, how does B's orbital period compare with A's? (3 marks)

Answer: 8 times as long

Model answer: $T^2 \propto r^3$, so $T \propto r^{3/2} = 4^{3/2} = 8$.

Marking: Formula or method: 2 marks · correct answer with unit: 1 mark.

SECTION B (extract of 30 marks)Attempt any *THREE* questions.**6. Conservation of Linear Momentum and Collision (10 marks)**

- (a) A 50 kg girl and a 75 kg boy stand still on smooth ice. She pushes him and moves off at 1.5 m/s. What is the boy's velocity? (3 marks)

Answer: 1.0 m/s in the opposite direction

Model answer: Total momentum stays zero: $50 \times 1.5 = 75 \times v$, so $v = 75 \div 75 = 1.0$ m/s, opposite to the girl.

Marking: Formula or method: 2 marks · correct answer with unit: 1 mark.

- (b) On a smooth floor a 2.0 kg puck moving east at 3.0 m/s collides with a 1.0 kg puck moving north at 4.0 m/s, and they stick together. What is their velocity afterwards? (3 marks)

Answer: 2.4 m/s at 34° north of east

Model answer: East: $2.0 \times 3.0 = 6.0$ kg m/s; north: $1.0 \times 4.0 = 4.0$ kg m/s. $p = \sqrt{6.0^2 + 4.0^2} = 7.2$ kg m/s; $v = 7.2 \div 3.0 = 2.4$ m/s; $\tan \theta = 4.0 \div 6.0$, $\theta = 34^\circ$ north of east.

Marking: Formula or method: 2 marks · correct answer with unit: 1 mark.

- (c) A ball is dropped from rest from a height of 20 m ($g = 10$ m/s², ignore air resistance). What is its speed just before hitting the ground? (4 marks)

Answer: 20 m/s

Model answer: Using conservation of energy, $mgh = \frac{1}{2}mv^2$, so $v = \sqrt{2gh} = \sqrt{2 \times 10 \times 20} = \sqrt{400} = 20$ m/s.

Marking: Formula or method: 3 marks · correct answer with unit: 1 mark.

SECTION C (extract of 15 marks)Attempt only *ONE* question.**7. Laws of Thermodynamics (15 marks)**

- (a) An engine works between 500 K and 300 K. To raise its Carnot efficiency, is it better to raise the hot temperature by 50 K or to lower the cold temperature by 50 K? (5 marks)

Answer: Lower the cold temperature: 50% compared with 45%

Model answer: Lower T_c : $1 - 250/500 = 50\%$. Raise T_h : $1 - 300/550 \approx 45\%$. Lowering T_c helps more.

Marking: Formula or method: 4 marks · correct answer with unit: 1 mark.

- (b) A paddle wheel stirs a gas inside a rigid, insulated container, doing 200 J of work on it. Using $\Delta U = Q - W$ (W = work done BY the gas), what are Q , W and ΔU ? (5 marks)

Answer: $Q = 0$, $W = -200$ J, $\Delta U = +200$ J

Model answer: Insulated, so $Q = 0$; work is done on the gas, so $W = -200$ J; $\Delta U = 0 - (-200) = +200$ J.

Marking: Formula or method: 4 marks · correct answer with unit: 1 mark.

(c) Where does the heat removed from food in a refrigerator go? (5 marks)

Answer: To the kitchen air, through the hot grille at the back

Model answer: The fridge pumps heat from the inside to the coils at the back, which give it (plus the compressor work) to the room.

Marking: 5 marks: correct answer with a clear reason.

END