2025 AHS Physics Prelim Paper 2 Answers

1 **(a)** (Electric) current, (thermodynamic) temperature, amount of substance (any two) [2]

(b) **(i)** Circle the value for the prefix *deci*.

10^{-9} 10^{-6} 10^{-3} 10^{-2} 10^{-1} 10^{3} 10^{6} 10^{9} 10^{12}

[1]

(ii) G , k , m , μ , n [1]

2 **(a)** Calculate the displacement of the car from point A at t = 90 s.

Displacement = area (+) – area (-)

= ½ (50 + 70) (30) - ½ (10) (20) [1]

= 1700 m [1]

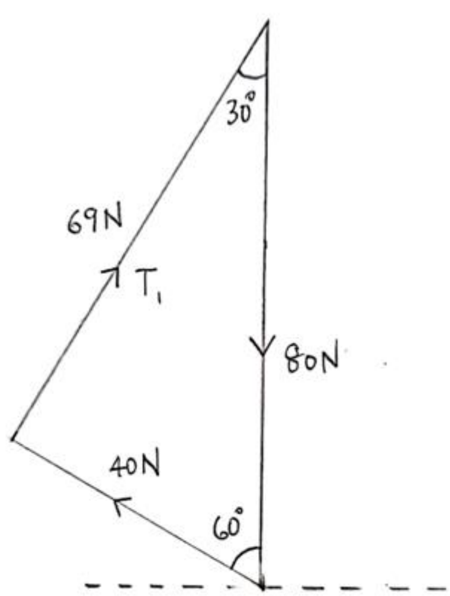
(b) Describe the motion of the car from t = 80 s to t = 90 s.

Travel backwards (to the West) [1] also accept opposite , (negative not accepted)

Accelerating at a constant rate / constant acceleration [1]

also accept descriptions using speed or velocity

3



Correct shape with correct angles [1]

Correct arrows + labels [1]

Magnitude = 69 N +/- 1 N [1]

4 **(a)** State the *principle of moments*.

For an object in equilibrium, [1]

The sum of clockwise moments about a pivot is equal to the sum of anticlockwise moments about the same pivot. [1]

(b) Determine the force exerted by the worker at point X.

Sum of anti-clockwise moments = sum of clockwise moments

$20 \times 1.3 = F \times 0.60 + 16 \times 0.85$ [1]

$F = 21$ N [1]

5 **(a)** Liquid B is mercury, which has a density of 13 600 kg / m^3. The gravitational field strength *g* is taken to be 10 N / kg.

Determine the density of liquid A.

Same atmospheric pressure, hence

$h_A \rho_A g = h_B \rho_B g$ [1 algebraic or numerical form]

$(120 - 15 - 20) \times \rho_A = (120 - 25 - 20) \times 13\,600$

$\rho_A = (75 / 85) \times 13\,600 = 12\,000$ kg / m^3 [1]

(b) Without using any additional apparatus, suggest how you can check that there is no air that is trapped at the top of any one of the inverted glass tubes, while it is at the same place.

<u>Tilt/ lean the inverted tube sideways/push inverted tube A downwards until the closed end is below 85 cm (liquid A) or 75 cm (liquid B) in height</u> [1]

Glass tube fully filled with liquid / no air bubble present [1]

Alternative answers. Push the tube down/ add liquids into the troughs/ tilt the tube sideways [1] ensure that the height of the liquid column remains constant[1]

6 **(a)** **(i)** Calculate the change in energy in the kinetic store of the skier as he travelled from point T to point B.

Change in E_k = E_k at B - E_k at T [1 algebraic or numerical must show difference, not just KE formula]

$= \frac{1}{2}(75)(30^2 - 2.0^2)$

= 33 600 J or 34 000 J [1]

(ii) Hence, determine the height of point T from point B.

Change in E_P = Change in E_K = 34 000

(75) (10) (h) = 34 000

h = 44.8 m or 45 m [1]

(b) Upon reaching point B, the skier digs his skis into the snow and comes to a stop at point P after moving horizontally for 33 m.

Calculate the average braking force that acts on the skier between points B and P.

F x 33 = ½ (75) (30^2)

F = 1020 N or 1000 N [1]

(c) Describe, using ideas about energy stores and transfer pathways, how energy was transferred as the skier moves from point B to point P.

Energy in the kinetic store (of skiers) is transferred to the internal store (of the skiers and the ground) [1]

mechanically (by friction acting over the distance BP) [1]

7 **(a)** Define the *focal length* of a converging lens.

The distance between the optical centre (of lens) and the focal point . [1]

(b) Describe briefly an experiment to determine the focal length of such a lens. You may include a diagram in your description.

Place a lens between a far away/distant object and a screen. (or shown in diagram) [1] also accept object at infinity

Adjust the distance between the lens and the screen until a focused/sharp image is formed. the distance between the lens and the screen is the focal length. [1]

OR

Place a lens between an object and a screen. Move the object and screen until the size of the object and sharp image are the equal/ the same. [1]

The distance between object and lens or image and lens is equal to twice the focal length. (hence divide object distance or image distance by 2 to get focal length. [1]

OR

Place a lens between an object and a screen. Move the screen until a sharp image is produced. Measure the distance between object and image, and the respective sizes of the object and image. [1]

By drawing a ray diagram using the details above, identify the focal point where the light ray cuts the principal axis. [1]

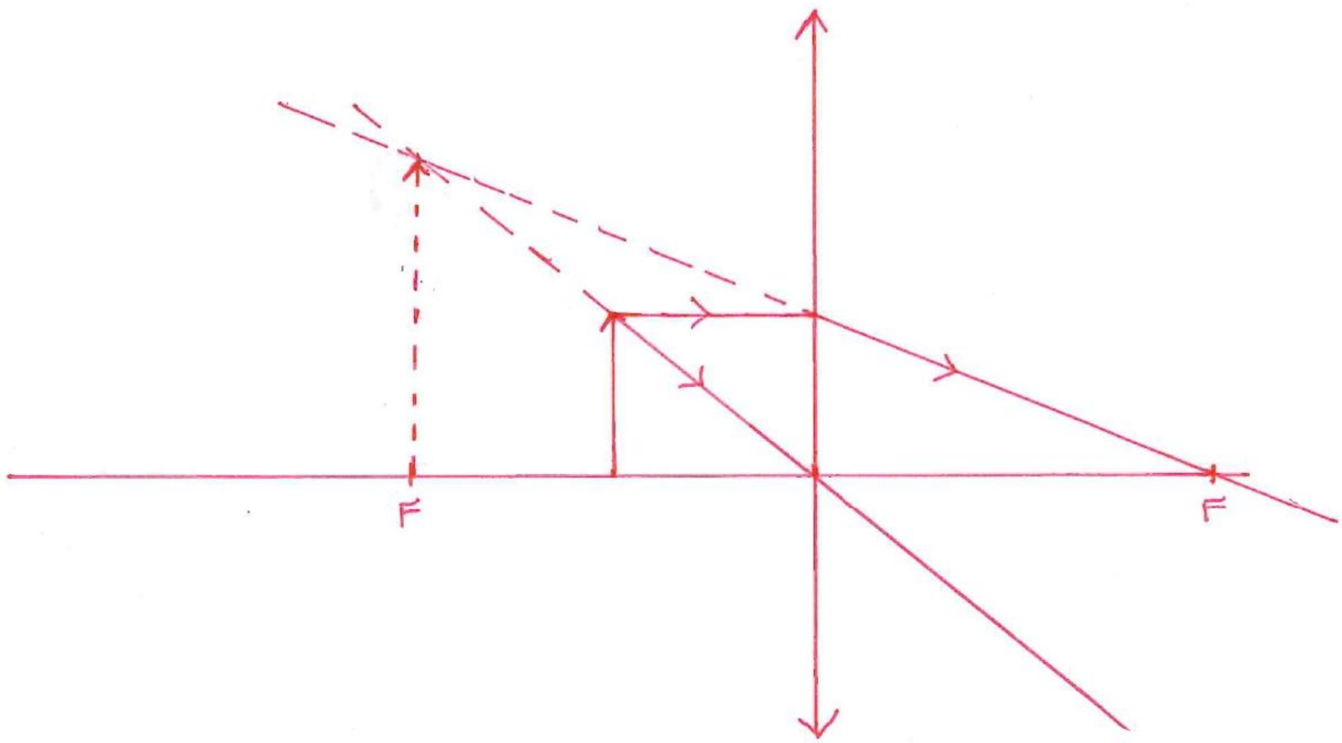
(c) A small object of height 4.0 cm is placed 5.0 cm away from a thin converging lens of focal length 10.0 cm. Using a suitable scale, draw a ray diagram to determine the size of the image.

Suggested scale 1cm:2cm

1 mark for each light ray [2]

1 mark for correct height 8.0 cm +- 0.2 cm (allowance of 1 mm based on scale used)

Penalise [maximum 1] for solid image or solid construction lines



(d) Other than the location and the magnification of the image, state two other characteristics of the image formed.

Virtual, upright [1] each [2]

8 **(a)** p.d.= 16 V[1]

(b)(i) Calculate the current in the ammeter.

$$I = \frac{V}{R}\ [1\ algebraic\ or\ numerical]$$

$$I = \frac{16}{1+3} = 4.0\ A\ [1]$$

(ii) Calculate the potential difference across the 3.0 Ω resistor.

$$12\ V\ [1]$$

(iii) The 1.0 Ω resistor is replaced with a different resistor. The potential difference across the 3.0 Ω resistor is now 1.5 V.

Calculate the resistance of the new resistor.

$$1.5 = \frac{3}{3+x} \times 16 \quad [1]$$

$$x = 29\ \Omega \quad [1]$$

OR

New current through 3.0 Ω , I = V / R = 1.5 / 3.0 = 0.50 A [1]

R of new resistor = V / I = (16 - 1.5) / 0.50 = 29 Ω [1]

9 **(a)** Complete Fig. 9.1 by calculating the amount of energy used by each appliance. [1]

appliance	power rating / W	time switched on / hours	energy used / kWh
TV and computer	1000	2.0	2.0
kettle	2000	0.20	0.40
lights	800	3.0	2.4
water heater	3500	0.20	0.70
air conditioner	1500	6.0	9.0

1 mark for all correct values [1]

(b) The cost of electricity is 31 cents per unit. Calculate the cost of the electricity usage for one day.

$$total\ energy = 2.0 + 0.4 + 2.4 + 0.7 + 9.0 = 14.5\ kWh\ [1]$$

$$cost = 14.5 \times 0.31 = \$4.50\ [1]$$

(c) The wires supplying electric current to the water heater are thicker than those supplying current to the lights.

Explain why this is necessary.

As the power supplied is higher, the current flowing through the wires are higher.

Having wire thick will lower the resistance of the wire to reduce energy / power loss / prevent overheating / melting of the wires.

[2 marks for 3 points, 1 mark for 1-2 points]

10 **(a)** Explain why an e.m.f. is induced in the coil as the turntable rotates.

As the turntable rotates, the magnetic flux in/linking the coil changes [1]

also accept magnetic field/ lines passing through/linking /cutting the coil changes

Due to electromagnetic induction, there is an induced e.m.f.. [1]

(b) As one of the magnets approaches the coil, the magnet experiences an opposing force. Explain why.

The induced current produces a north pole near the magnet. [1]

Like poles repel. [1]

Alt.

The magnetic effect of the induced current opposes the change inducing it [max 1]

(c) The graph below shows how the e.m.f. varies with time when the turntable rotates at a constant speed. On Fig. 10.2, draw the graph for 0 to 30 ms to show how the e.m.f varies with time if the turntable rotates at twice the speed. [2]

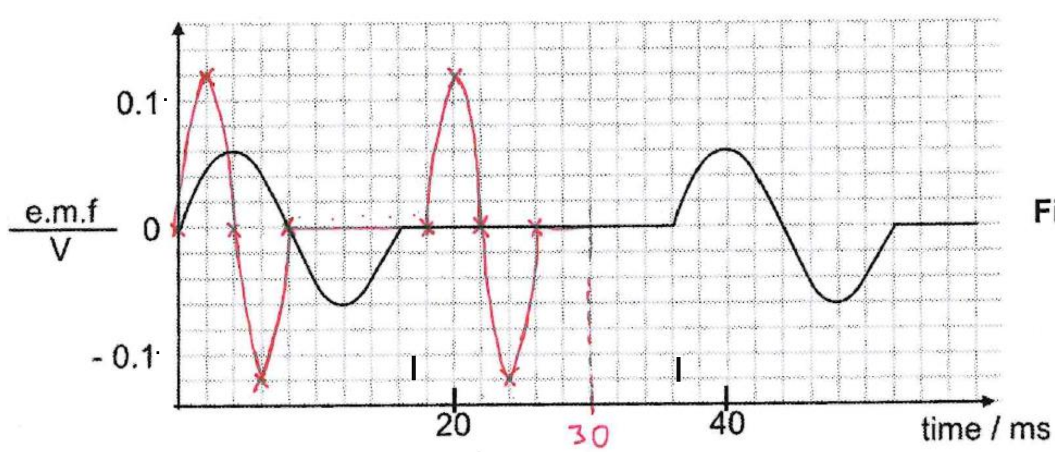


Fig. 10.2

11 **(a)** State one other variable that should be kept constant to ensure a fair test.

Size (dimensions) of bowl; size of ice cubes; surrounding temperature (any 1) [1]

(b) Using the information from Table 11.1, suggest which material is better for insulation and explain your choice.

Polystyrene is a better insulator, due to slower rate of energy transfer to ice

Use data to justify [1];

example – after 25 minutes, only 30 g of water is collected in polystyrene bowl while 79 g of water is collected paper cardboard bowl

(c) Using ideas about thermal processes, suggest one reason for the difference in the mass of water collected with and without lid for both materials.

Air is trapped with lid on, and air is a poor conductor of heat / less energy is transferred to ice by conduction. OR

Less energy is transferred to ice by radiation as the lid helps to absorb or reflect some of the radiation [1]

reject convection or evaporation

If more than 1 thermal process is stated, mark only the first one

(d) State and explain whether the bowl should be light-coloured or dark-coloured.

Light coloured; poorer absorber of (infra-red) radiation [1]

Reject absorber of <u>heat</u> (must be specific since the thermal process is radiation)

(e) **(i)** State what is meant by *specific latent heat of fusion of water is 340 J / g.*

The <u>340 J</u> of energy transferred per <u>1 g</u> of <u>water/ice</u> to change between the <u>solid and liquid states</u>, at <u>constant temperature.</u>

All underlined points: 2 m

2 - 4 underlined points: 1 m

Zero marks if <u>change in temperature</u> is suggested in the answer.

(ii) Explain why the internal energy of water decreases even though the temperature of water remains constant as it solidifies into ice.

Internal energy decreases because potential energy of the water particles decreases during solidification as the average distance between particles decreases / forces of attraction increase / stronger bonds formed, even though the kinetic energy of the particles remains unchanged. [1]

(iii) Calculate the total amount of energy transferred as 500 g of water at 25.0 °C is cooled to form ice at – 3.0 °C.

Stage 1 (cooling water): $Q = m\,c\,\Delta\theta = (500)(4.2)(25.0 - 0) = 52\,500$ J

Stage 2 (solidification): $Q = m\,l_f = 500(340) = 170\,000$ J

Stage 3 (cooling ice): $Q = m\,c\,\Delta\theta = (500)(2.1)(0 - (-3.0)) = 3\,150$ J

Total energy transferred = 226 000 J or 230 000 J

[1] for each of the 2 formulae [1] for final answer

12 (a) State two differences between beta particles and gamma rays.

Beta particles are high energy electrons while gamma rays, are electromagnetic waves

Beta particles have higher ionising power than gamma rays

Beta particles are less penetrative than gamma rays

Beta particles have a charge, but gamma rays are uncharged

Beta particles have mass, but gamma rays do not have mass

Any 2

(b) (i) State the reason why different count rates are obtained from samples 6 to 9.

As nuclear decay is a random and spontaneous process. [1]

(ii) The average value of the last four samples is the average count rate from 2.0 cm^3 of blood. Determine the volume of blood in the patient's body which has a total count rate of 144 000 per second.

$average\ value = \frac{40+38+36+40}{4} = 38.5$ [1]

$volume = \frac{144000}{38.5} \times 2.0 = 7500\ cm^3$ [1]

(iii) Iodine -131 (I) has nucleon number 131 and atomic number 53. It decays into Xenon (Xe) by emitting beta radiation.

Write the nuclear decay equation.

[1] also accept the beta symbol.

(iv) Sample number 9 is kept.

The count rate is measured after 16 days. Estimate the count rate given that the half-life of iodine-131 is 8.0 days.

$$\frac{40}{2^2} = 10\ counts\ per\ second$$

1 mark for recognising 2 half lives

1 mark for final answer

count rate = ………………..[2]

(c) State two factors the doctor must s when selecting the radioactive isotope to be used for this purpose.

It must have a short <u>half life</u>

It must not be poisonous to the human body

*do not accept it must be able to penetrate the skin as the blood samples are removed from the body

*do not accept harmful as it is too general

Section B

13 (a) Calculate the frequency of the sound wave.

$$f = \frac{1}{0.020} = 50\ Hz$$

1mark for recognising correct period or stating formula. 1 mark for final answer.

(b) The speed of sound in air is 330 m / s. Calculate the wavelength of the sound wave.

$$\lambda = \frac{330}{50} = 6.6\ m$$

(c) Describe how the vibration of the paper cone causes sound to travel to the observer.

As the magnet and paper cone oscillates, it collides with the neighbouring <u>air particles.</u> [1]

Transferring kinetic energy [1] or *<u>cause neighbouring particles to vibrate</u>*

<u>Without transferring the medium</u> [1] *consider BOD if mention air particles <u>oscillate</u> / <u>vibrate</u> about fixed positions*

(d) Power supply P is replaced with one with a lower voltage and higher frequency.

State how the sound produced changes.

The sound is softer [1]

The pitch is higher [1]

(e) Explain why no sound is heard when power supply P is replaced with a direct current power supply.

If a direct current is used, the magnetic field will not change, [1]

and the magnet/paper cone will remain stationary. [1] or *the magnet will only move once*.

14 **(a)** Explain why deploying a parachute is not an option to slow down the descending combined lander-ascender modules.

Moon has no atmosphere / very little atmosphere [1]

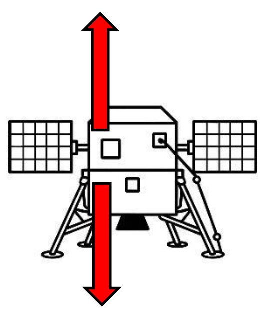
also accept no air on the moon

Cannot create the required (air) resistance / drag to slow down the modules [1]

(b) (i) Draw and label on Fig. 14.2 below, the two forces acting on the lander-ascender modules as it descends at constant speed. Indicate the magnitude of both forces. [2]

Correct labels [1]

Correct magnitude [1]



Lift / upthrust / Upward force = 6240 N or 6200 N

weight = 6240 N or 6200 N

accept w label

(from centre of gravity somewhere in the middle)

Fig. 14.2

(ii) Explain, using Newton's laws of motion, how the forces acting on the lander-ascender modules should change to cause it to decelerate as it approaches the Moon's surface.

Increase the upward force [1]

Using F=ma or Newton's 2nd Law, negative net force will result in negative acceleration / deceleration [1]

* also accept net force must not be zero. However direction of force and acceleration must tally.

(c) (i) Calculate the acceleration of the ascender module as it lifted off the Moon's surface.

mass of ascender = 700 kg

net upward force = 3000 – (700)(1.6) = 1880 N [1]

a = net F / m = 1880 / 700 = 2.7 m / s^2 [A1]

(ii) When orbiting around the Moon, the modules are moving with constant speed. State and explain whether the modules are accelerating or not.

Since direction of motion of modules are continuously changing, [1]

they are accelerating as their velocity is changing. [1]

mention about direction changing

acceleration is a vector quality